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Advantage of Water Shade in Both Natural Pasture and Improve Forages, Constraints and Option of Range Plats on Rage Ecology of Pastoral and Agro Postural in the Low Land Areas of Ethiopia. A Systematic Review (July, 2015)

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1. INTRODUCTION

The rangelands of East African countries are almost exclusively found in dry land areas where there is general moisture deficit (Coppock, 1994; Herlocker, 1999). The dry land ecosystem covers areas where rainfall is low, variable, often unreliable, and generally unevenly distributed throughout the year (UNEP, 1992; IUCN, 1999). Dry lands have highly seasonal rainfall regimes with significant inter-annual variability and mean annual precipitation values which vary from about 800 mm in summer rainfall areas to 250 mm in winter regimes (IUCN, 1999). They are the habitat and source of livelihood for about one quarter of the earth's population. It is estimated that these ecosystems cover one third of the earth total land surface and about half of this area is in economically productive use as range or agricultural land (CCD Secretariat, 1997). According to FAO (1996) classification,

Ethiopia is one of the thirty-six dry land developing countries in the world. The dry lands, which includes the arid, semi-arid and dry sub-humid areas The rangelands of Ethiopia cover about 60% of the total area and are the major sources of livestock feed (BLPDP 2004; PFE 2004). These areas are characterized by lowland plains, relatively harsh climate with low, unreliable and erratic rainfall and high temperatures (Ayana, 2007). Of the total livestock population of the country, about 40% cattle, 75% goats, 25% sheep and almost 100% of camels are raised in the rangelands (Alemayehu, 2004). The rangelands are not only known for livestock rearing, but there are also many wildlife, parks, sanctuaries, and reserves (Abule et al 2005). In most developing countries, rangelands have contributed to the major portion of feed consumed by ruminants. In Ethiopia more than 90% of the ruminant livestock feed on natural pastures, which vary in composition depending on the agro-ecology (Alemayehu, 2005). Rangeland is defined as land producing natural forage for animal consumption (Coppock, 1994). Most rangelands are at best only marginally suitable for arable cropping, and in Ethiopia there are extensive areas where livestock raising on the natural vegetation is the only possible types of land use.

The lowlands of the country are found below 1500 meter above sea level (masl) and are estimated to cover about 78 million hectares, which is about 61–65% of the total land area of the country (Friedel et al. 2000). They are home for about 12-15% of the human and 26% of the livestock population (Beruk and Tafesse, 2000). Pastoral communities dominate the lowland areas of the country. Low human population density and highly variable and uncertain rainfall characterize the lowland areas. In the pastoral community, grazing biomass is entirely determined by the amount, pattern and timing of rainfall.The rangelands are presently undergoing extensive deterioration both in quantity and quality (Belaynesh, 2006). The rangelands have limited capabilities in vegetative production and in providing reasonable animal sustenance and production due primarily to adverse environments including low and seasonal rainfall; moisture gathering winds; varying degrees of poor soil; soil erosion; lack of or inadequate forage and grazing management; and overstocking rates (Alemayehu, 2005). Intensity of grazing and browsing and restriction of livestock mobility have more serious consequences on the rangelands than the number of animals owned by the pastoralists. Community structure is vastly altered when improper grazing continues for long periods (Holcheck et al. 1998).

In seasonally dry environments, the main limitations to animal production are the lack of green feed for at least half of the year coupled with the low nutritive quality of forages during most of the active pasture growth period (Alemayehu, 2005). Absence of adequate baseline information about the rangeland resources is considered as one of the bottlenecks for development of rangelands in Ethiopia (Amsalu, 2000). This review was carried out with the following aims

- To review the advantage of water shade in both natural pasture and improve forages in low land areas of Ethiopia.
- To review the constraints of range plats on range ecology of pastoral and agro postural water shade in low land areas of Ethiopia.
- To review the option of range plats on rage ecology of pastoral and agro postural water shade in low land areas of Ethiopia

Review of Literature

Water shade, roles of range plants, constraints and option

Water shade

Watersheds and improved forage productions

A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place. John Wesley Powell, scientist geographer, put it best when he said that a watershed is: "that area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community."(John Wesley Powell, 1864)

Role of indigenous knowledge on watershed management

Land management interventions by research and extension systems have to properly Interface with local or traditional knowledge and practices. For instance, on sloppy Land, the management of water and runoff over many small farms is done through intricate negotiations to get farmers to cooperate in constructing drainage and conservation works. However, some 'modern' approaches do not recognize the potential of using local knowledge in conservation and management of water resources including springs, riverbanks, marshes and swamps. Instead new agricultural programmed in the drier regions often target swamps and marshes for irrigation, leading to loss of dry season grazing, biodiversity and other watershed function These voluntary organizations also constitute a nucleus for the improvement of production, commercial orientation of agriculture, enterprise diversification, high value production and marketing. Adding value to local resources should be promoted using indigenous innovations as well as new external approaches and technologies. A good example is RELMA's work with innovative farmer groups such as the ones established at Armanya and Dejen in Ethiopia that use indigenous technologies Adapted to modern land management at watershed level Azene.etal. (2006).

Role of watershed on forage production

Over the past two decades quite a large number of annual perennial forage and fodder species have been tested in the lowland zones of Ethiopia. Under rain fed and irrigated conditions respectively. As a result many useful improved herbage species have been identified (Alemu tadesse, 2003) In research centers and some dairy state a farm, the first cut which is usually taken in mid-July is used for making silage the re growth which is cut in October is used for making hay. Following hay-making, the pasture fields provide considerable grazing for about two months sometime during the early months of the dry season (November and December). Chloris gayana, Cenchrus ciliaris, Pennisetum purpureum, Panicum spp, Medic ago sativa and Luciana leucocephala are promising species for semi-arid and arid lowland areas below 1000 m usually under irrigation (Alemu tadesse, 2003).

In irrigated areas of the lowlands alfalfa and Rhodes grass are very important and can give 8-10 harvests with herbage yield of 45-55 t/ha DM each year. (Lulseged Gebre-Hiwot, 1985).

Present status of lowland areas of Ethiopia

The natural pastures are poorly managed throughout the country resulting in serious land degradation, reduced biodiversity, gradual decline in nutritive value and replacement by poorly palatable and drought tolerant species. Regardless of the importance of pastoralism in native range lands areas as living system, land degradation has been one of the major threats to the increasing livestock as well as human population. Furthermore, desertification is becoming a constant threat particularly in the arid and semi arid parts of Ethiopia and distribution of natural vegetation is closely linked with climatic conditions, locally modified by altitude, topography and soil factors. Generally the Ethiopia rangeland biodiversity is severely threatened by environmental degradation, particularly in the densely human as well as livestock populated areas. The loss of natural vegetation resulted in soil erosion, land degradation, deceased soil fertility, loss of biodiversity and impoverishment of ecosystems, which in turn affect the human, plant and livestock welfare.The rangelands are presently undergoing extensive deterioration both in quantity and quality (Belaynesh, 2006).

In the past, the Ethiopian government policy towards pastoralists had never been spelt out clearly in any pastoral or arid-land policy documents or strategy. It was only implicit in the kinds of projects that were implemented in pastoral areas (Tafesse, 2001). Currently, the government is taking measures that indicate the concern towards the welfare of the pastoralists, like the establishment of National Pastoral Extension Team, establishment of 8 Pastoral Affairs Standing Committee in the Federal parliament, Pastoral Affairs at National and Regional levels. The government has given emphasis on pastoral and agro-pastoral research programs. The government policy recognized pastoralists right to free land for grazing and cultivation and not to be displaced from their own land and on the basis of their unique situation a different extension support is envisaged (Mohammud, 2003).

Roles of range plants

As animal feed resource

Forage production of rangeland is an important resource to pastoralists and agro pastoralist having an animal-based economy. Forage contains a variety of chemical constituents, which serve as nutrients for livestock/large herbivores. Some nutrients are sources of energy while others satisfy a specific requirement in the animals' bodies. These chemical components can be divided into cell wall constituents (CWC) and cell contents (CC), and into digestible, indigestible or poorly digestible fractions (Van Soest, 1982). Associations of soluble carbohydrates, starch, organic acids, cellulose and hemicelluloses, together with lipids (fats), contribute to the energy content of forages. Proteins, vitamins and minerals provide essential components of the animals' diet and are required in an appropriate balance if animals are to perform adequately. Among the essential components is crude protein, which is the primary measure of quality and is often the main limiting nutrient for livestock in the tropics (Norton, 1982). This is because the protein content of forages imposes a severe physical restriction by limiting intake when total protein content is less than 6-7% (Milford & Haydock, 1965). Norton (1982) reported that more than 50% of all tropical grasses contain less than 9% crude protein and less than 20% of them have crude protein contents above 15%. Generally, it is reported that many tropical grasses have only modest levels of crude protein when green, and this falls to very low values following maturity (Norton, 1982).Apart from protein, minerals could be in short supply in rangeland and this could lead to physiological disorders and suppression of animal performance. The soil minerals of the tropics are highly leached and weathered and are mainly of low base-exchange capacity. In consequence, the mineral content of tropical forages is relatively low in some of the minerals needed by animals, particularly phosphorus, sodium and calcium (Norton, 1982). The essential dietary minerals are classified as either macro or trace element nutrients, depending upon the quantity required by the animal. The macro elements are mainly utilized either for structural purposes (calcium, phosphorus and sulpher) or in the maintenance of acid base balance (sodium, potassium and chlorine). In addition, they make vital contributions to energy transfer, nerve impulse transmission and enzyme activation (potassium, calcium and magnesium).It is known that variations in nutrient content occur between and within plant species and that livestock select forages to obtain a nutritionally balanced diet (Mentis, 1989). The forage species selection by animals has been shown to be positively associated with the Content of protein, potassium and phosphorous but negatively correlated to fiber content (Heady, 1964).

The natural vegetations in the arid and semi-arid lowland of the region form the main natural and traditional sources of livestock feed (IPS, 2002). Grazing and browsing species of the natural vegetation are the only sources of livestock feed in the region. The distribution of such natural vegetation varies from place to place depending on climatic variation and consequently on the ratio of grazing to browsing resources. Depending on the type and ratio of feeding resources, the pastoralists diversify their herd to effectively utilize the available feed resources. The pastoralists also have a well- structured traditional resource management system that involves categorization of the range resource into dry and wet grazing which allow regeneration of natural vegetation during intermittent

As soil fertility, soil and water conservation

The knowledge of soil characteristics and classification is essential for rangeland management because soil is the primary factor determining the potential for forage production of an area within a particular climate (Holecheck et al., 1989). High yields of quality forage and a nutrient-sufficient status of forage crops are attributes of soil productivity. Productivity is a function of natural soil fertility, soil physical properties, climate, management and other non-inherent factors used to produce crops (Follett & Wilkinson, 1995). Barnes et al. (1991) tried to correlate the variations in yield of natural grassland with soil water content, nitrogen (N) supply and the cat ion exchange capacity. The major factors associated with yield variations were soil water content, N supply and cat ion exchange capacity, in order of importance. Next to water, fertility is the second most limiting factor of forage production in arid rangelands. The concept of "soil quality" has recognized soil organic matter as an important attributes that has a great deal of control over many of the key soil functions (Doran & Parkin, 1994). The same concept was conducted by (Ward et al, 1998), who emphasized that soil organic carbon is a good measure of overall soil quality. (Humphreys, 1994) also considered water retention to be the most important physical property. Plant yields were linearly related to stored water and to water usage during the growing season. These characteristics were related to soil structure, organic matter content, macro porosity and rate of infiltration. Organic matter also influences physical and chemical properties of soils. It binds mineral particles into granules and increases the amount of water a soil can hold. It is also a major soil source of P and S and the primary source of N. Ward et al. (1998) showed organic matter frequently to be highly correlated with two of the most important soil nutrients, N and P, in many African soils. Organic matter is also a source of energy for soil organisms - without it biochemical activity would come to a near standstill. Soil N, P and pH are positively related to soil carbon (C) and the level of soil organic matter (OM), which largely determines the fertility and pH of sandy soils (Jones, 1973; Wilding & Hossner, 1989).

In general, the organic contents of soil are important in providing energy, substrates and the biological diversity necessary to sustain numerous soil functions. A sandy soil carries less organic matter than finer textured soil.

The effect of soil pH on nutrient availability is important. The availability of nutrients such as N and P and the solubility of nutrients such as K, P and other essential elements are strongly influenced by soil pHs A pH of 6 to 7 is best for P availability and for most nutrients needed for plant growth (Follett & Wilkinson, 1995). In soil of arid and semi-arid regions, lack of extensive leaching leaves the level of base-forming cat ions quite high. As a result the pH is commonly 7 or above (Brady, 1990). Grasses tend to use more of the bases present in soil and prevent the soil pH from dropping by depositing plant parts on the soil surface (Thompson & Troeh, 1978).

Water transmission or infiltration is the process by which water enters the soil. Infiltration rate is the quantity of water absorbed in the soil per unit of time. The infiltration rate influences the soil water content, which satisfies the evapotranspiration requirements of growing plants and also acts as solvent to dissolve nutrients. Infiltration rates are controlled by vegetative, edaphic, climatic and topographic influences. The kind of vegetation and amount of cover modify the soil water relationship of a site. Grazing systems are often used to improve both vegetation cover and infiltration rates (Wood & Blackburn, 1981). Many researchers have studied the influence of

As human consumption

Rural people of Ethiopia are endowed with a deep knowledge concerning the use of wild plants. This is particularly true for the use of medicinal plants (Abebe and Ayehu, 1993) but also for wild plants some of which are consumed at times of drought, war and other hardship. Elders and other knowledgeable community members are the key sources or ‘reservoirs’ of plant lore. Wild-food consumption is still very common in rural areas of Ethiopia, particularly with children. Among the most common wild plant fruits consumed by children are, for example, fruits from Ficus spp, Carissa edulis and Rosa abyssinica plant species.

The consumption of wild plants seems more common and widespread in food insecure areas where a wide range of species is consumed. The linkage has given rise to the notion of ‘famine-foods’, plants consumed only at times of food stress and therefore an indicator of famine conditions. Local people know about the importance and the contribution of wild plants to their daily diet as well as being aware of possible health hazards such as stomach irritation occasionally occurring after consumption of certain wild plants

The term ‘wild-food’, though commonly used, is misleading because it implies the absence of human influence and management. In reality, there is a continuum resulting from the development of co-evolutionary relationships between humans and their environment (Bell, 1995). People have indirectly shaped many of the plants and some have been largely domesticated in home gardens and in the fields together with farmers’ cultivated food and cash crops. Nevertheless, the term ‘wild-food’ is used in this article to describe all plant resources, which are harvested or collected for the purpose of human consumption outside agricultural areas in forests, savannah and other bush land areas. Wild-foods are incorporated into the normal livelihood strategies of many rural people, be they pastoralists, shifting cultivators, continuous croppers or hunter-gatherers (Bell, 1995). Wild-food is usually considered as an additional diet to farmers’ daily food consumption pattern, generally based on their crop harvest, domestic livestock products and food purchases on local markets. Fruits and berries from a wide range of wild growing plants are typically referred to as ‘wild-food’. Wild fruits and berries add crucial vitamins to the normally vitamin deficient Ethiopian cereal diet,particularly for children.For instance, Konso people and Kamba Wereda of North Omo Zone people eat the fruits of Balanites rotunda during food shortage. Piliostigma thonningii (‘olofo’ in Hamer language) trees are another example. In Alduba village (South Omo Zone) the Hamer people collect pods of the tree and eat the fleshy part around the small seeds like biscuits,(Dr. Yves Guinand and Dechassa Lemessa, 1999).

As local drought indicator plant

Farmers and pastoralists in southern Ethiopia recognize a number of indigenous so-called drought indicator plants. In the lowlands of Konso special wereda, along the Segen River, Dobera glabra (‘karsata’ in Konso language), is one such typical drought indicator. It is a much-branched evergreen shrub or tree of up to 10 meters in height. New shoots always grow during the dry season. If rains are delayed or fail, the tree typically shows an enhanced production of new shoots, fruits and seeds. Local Konso people observed a significant Dobera glabra fruit production increase during the last four years (1996-1999) coinciding with the climatic dry spell. Farmers revealed that in normal times, when rains are on time or abundant, Dobera glabra does not produce much fruit and seed. When the tree is blooming abundantly, Konso people fear that a drought may very well be under way and hence, food may become scarce. Besides its drought indicator qualities, Dobera glabra produces eatable fruits and the seed is considered a typical ‘famine-foods UNICEF, (1999).

As Firewood

Fuel from shrubs has been minimally discussed in the literature. Nevertheless, cutting or grubbing out shrubs to be burned as a fuel for cooking and heating constitutes an important use. More important, this use seriously depletes the vegetation resource. Desperation or ignorance may lead to the removal of all shrub and tree species regardless of their values if left in place (Kabagambe, 1976).

Woody fuel gathering and transport back to villages is a common sight in developing countries where petroleum-based fuel sources are unavailable or too expensive. Unfortunately, as pressure mounts for an increase in production of charcoal (Kabagambe, 1976) greater emphasis shifts from woodlots to the use of trees and shrubs of rangeland areas. In some areas where the shrub resource is already depleted by removal for fuel or by overgrazing such additional pressure is disastrous. Changing long-standing cutting practices such as restricting cutting to top growth so that the plants can re grow may be difficult. Sanchez and Jama (2000) estimated that on average a family consumes about 0.4 tonnes of fuel wood per year.

Since there is severe fuelwood shortage in Ethiopia, promotion of this practice is very important. It involves inter-planting the tree species on or around agricultural lands with a main production objective, to produce fuel wood. Species that can be used for this purpose include:A. abyssinica, F. albida, A. seyal, A. tortilis, A. etbaica, A. sieberiana, A. bussei, and B. aegyptiaca (Kindeya, 2004).

The tree species listed above have been indicated to have high calorific value and meet most of the requirements of a fuelwood species. Combined and unrestricted use of shrubs for both grazing and cutting for fuel is a destructive practice. Thalen (1979) pointed out that grazing alone will not destroy shrubs because livestock will move on before all vegetation has disappeared leaving the woody stems to regrow. Fuel gathering, although more restrictive in area, destroys the remaining crown at the surface level.

A more expensive alternative is to plant desirable species that may satisfy fuel as well as other needs such as browse or soil fertility maintenance. Where dense shrub growth exists removal of the less desirable species for making charcoal would at the same time release good browse and forage grass species from competition and stimulate their growth.

Energy from woody biomass is being investigated as an alternative fuel for industrial use through pyrolysis or bioconversion to a liquid or gas fuel. Van Epps et al (1980) have found that selected shrub populations growing in favourable sites of the Great Basin can produce as much as 458,000,000 Kcal/ha of energy. Shrubs are generally equal in heat value to low quality bituminous coal (7500 BTU/lb) Van Epps et al (1980).

As Construction

Although not generally considered as a suitable building material for large structures, shrubs and fodder trees are used considerably by people in rural areas for houses, shelters, animal pens, and fences. Without shrubs mud-plastered walls of many structures would lack the strength provided by woody stems woven among the supporting poles. Many useful implements and household tools are made from sticks and stems from trees and shrubs. Bark and fiber taken from woody plants also find use in construction as a framework and matrix for baskets, shelters and chinking material in walls made from poles or boards (FAO, 2000).

Major constraints of range plat production system

The pastoral and agro pastoral forage production systems experience many challenges caused by the vagaries of nature and the interferences of man (kidane, 2005).

Natural causes

The pastoral areas of Ethiopia are dominated by arid and semi-arid climates and these areas are characterized by lowland plain and have a relatively harsh climate with low, unreliable and erratic rainfall and regularly high temperature. As a result, moisture stress becomes a fore leading constraint for all plants, human and livestock in the pastoral areas of the country (Alemayehu, 2004).

Rain full and temperature

Moisture stress caused by inadequate and erratic rainfall makes water the most important limiting factor to meet both plant and animal requirements. Moisture shortages are further aggravated by high temperatures, leading to high evapotranspiration. The permanent water supply systems existing watering points are unevenly distributed that leads for dying of Micro organisms, plants and Animals (Alemayehu, 1998).

Drought and diseases

Another natural disaster in the lowlands is the frequent recurrence of drought. Livestock mortality during droughts is largely attributed to severe feed shortages and outbreak of diseases. The erratic and inadequate rainfall in the rangeland leads to forage biomass that is poor in quantity and quality of forage productions

(Kidane, 2005). Example1 The drought that took place in the year 1973/74 in the Afar region resulted in livestock mortalities of 90%, 30%, 50%, and 30% for cattle, camels, sheep, and goats respectively due to shortage of forage production and water (Ali Said, 1994). Example2 during the 1991/1992 droughts in the Borana area, the average individual household lost about 79% of its cattle, 95% of its camels, 83% of its equines and 60% of its sheep and goats due to shortage of forage production and water (Alemayehu, 1998).

Human Factor

The human factor also plays a major role in rangeland degradation. It is important to note that rangeland degradation not only decreases biological productivity, but also negatively affects the general environment. Rangeland degradation is generally caused by poor management of rangeland resources. Such management practices relate to the expansion of sedentary agriculture, the expansion of agricultural projects, the expansion of natural parks and game reserves and the conflict among the interethnic and interethnic groups. This leads to higher livestock pressure on the rangelands and ultimately causes overgrazing and resource degradation that may have irreversible consequences for the environment (Coppice, 1994).

Example Among the vast lowlands of the country, the northeastern lowland of the Afar region is one of the most important. In Afar the arid ecological zone, which lies at an altitude below 500 m, covers more than 80% of the region. The semi-arid ecological zone, at an altitude of 500-1500 m, covers 20% of the area of the region (Dawit, 2000). The area sustains over 90% of its inhabitants as pastoralists, with considerable numbers and distribution of livestock (CSA, 1994). Based on the land-use and land-cover study of the Afar National Regional State, the potential vegetation area, which is 24.49% of the region, is classified into grasslands, shrub land, bush land and reverie woodland vegetation types (MCE, 2000).

The northeastern lowland is also affected by climatic factors and poor management of the rangelands. Both these factors put a great deal of pressure on the feed resources of the region, causing overgrazing and degradation of the range (Beruk, 2000). Among the rangelands affected by this phenomenon is the Zone 3 rangeland of the Afar region, with a land cover of 1,184,817 ha (CEDEP, 1998, as cited by Beruk, 2000). This area was once deemed to have an excess feed balance of 354 915 tons relative to the other zones that had negative feed balances (Beruk, 2000). The main animal feed source of the region is entirely based on natural vegetation, dominated by deciduous acacia bush land growing mostly along the flood plains of the Awash River. The higher areas, up the bottomlands, which are relatively dry, vary from closed thicket to open shrub lands with occasional scattered trees, to open grass plains. The open grasslands are the predominant feed source of the grazing animals.

Among the prominent, extensive grasslands of the region is the Alaidege rangeland which covers an area of 200 000 ha (Halcrow, 1989). The rangeland is characterized as open grassland, dominated by tufted perennial grass with periodic growth of annual grasses and forbs in the rainy season. This is the grazing area where the Afar tribesmen keep animals to graze for extended periods throughout different seasons. This grazing system has resulted in overgrazing of the area, causing an eventual decline in the vegetation cover.

According to the pastoralists' perception, this was due to the disruption of the traditional rules and regulations they practiced on grazing areas for decades, as well as to the recent intervention and expansion of agriculture, which shrinks the alternative dry season grazing area used in the system (personal communication, clan leaders, 2003).

Expansion of sedentary agriculture and large scale agricultural projects

The continued growth of the human population is believed to have increased competition for natural resources, particularly land, in recent decades (Helland, 1980). Population growth in the agricultural areas forced people to migrate into marginal lands, which are often key grazing areas for nomadic herds. As a result, large areas of natural grasslands have been converted into arable lands and settlements. Throughout the dry land Africa, herders have lost prime grazing lands, particularly in low-lying areas, to make room for flood recession and irrigated agriculture. Population pressure and over-utilization of cropland in the adjacent high land areas put much pressure on pastoral areas. In turn, this has resulted in encroachment of pastoral rangelands by sedentary crop cultivators. This situation is more serious in pastoral areas of Afar, Somali, and low lands of Oromoia and southern Omo .As a result, large part of prime grazing lands are converted into sedentary farming (Beruk, 2000). Constant expansion of large-scale agricultural projects has threatened the traditional pastoral territory. Since the last 50 years, the Afar Region has lost close to 50-60,000 hectares of dry-season grazing area along the Awash River to various plantation projects. Similarly, the Keryu lost about 22,000 hectares for the Methara sugar estate. Specific examples that can be cited in Somali region include the Gode irrigation project with a potential of 27,000 hectares, and the Chinagsen, Serge, Elbaye and Biye dams with a potential of irrigating about 1000 hectares (Beruk, 2003).

Expansion of wildlife parks and sanctuaries

The reduction of the traditional pastoral territories and establishment of national parks and sanctuaries without the full consent of pastoralists has greatly affected the people and the resource base. The rangelands converted to wildlife parks and sanctuaries are estimated to occupy about 353,730 ha (Afar Region); 62,300 ha (Southern Nations and Nationalities Peoples Region); 50,610 ha (Gambella region) (Beruk, 2003).

Encroachment of invancive plant species

Bush encroachment and other alien plant species are causing degradation to the rangelands. Coppock (1994) indicated that about 15 woody species were considered to be encroachers in the Borana rangeland. Mejor especies include Commiphora africana, Acacia brevisca, Acacia nilotica and Acacia drepanolobium. Similarly, rapid expansion of Acacia seyal, Acacia mellifera and Acacia Senegal in Tigray and south national nationalities of Ethiopia as well as Prosopis juliflora are major concern to the Afar region. The rapid expansion of an alien species, Prosopis juliflora, in particular to prime irrigable and rangelands is considered as a menace. Consequently, there is a strong objection against the spread of this noxious plant in the area (MCE, 2000). In Somali region, the rapid expansion of parthenium commonly known as congress grass is encroaching both the rangelands and crop farms (Beruk, 2000). Many factors may be involved in bush encroachment, however, overgrazing including high stocking rate is claimed to be the major problem (Coppock, 1994).In all the above cases, change in vegetation composition from grassland to woody and unpalatable plant species has forced pastoralists to alter their livestock composition from grazing to browsing species (Alemayehu, 1998).

Conflict over the rangeland resources

Intra and inter clan conflicts over rangeland resources mainly grazing land and water points especially during the dry season has contributed to the decline of the resources. This is a common feature among the pastoral areas of Afar, Somali, Boran, Gambela and South Omo. Conflict not only denies resource usage, but also cost human and livestock losses (Beruk and Tafesse, 2000).The changes in natural resource use in Afar territory have had negative implications for the pastoral mode of production and culminated in resource use conflict (Ali, 1994). The Afar pastoral groups have lost prime grazing lands, particularly in low-lying areas, to make room for flood recession and irrigated agriculture. Somali pastoralists surveyed in 1996, strongly disapproved of the privatization of land. Among other reasons, they mentioned inter- and intra-clan conflicts, as a result of land enclosure and boundary disputes (including killing between close relatives) (Hashi, 1996).

Inappropriate pastoral development interventions

Pastoral development projects were implemented in major pastoral areas (Borana, Afar and Somali) with the aim of raising the standard of living of the pastoralists through restructuring their traditional system of extensive livestock production (Tafesse, 2001). In all the past projects, common emphasis was given to herd productivity and range management through range improvement, water development, veterinary service, and infrastructure development (Tafesse, 2001).The major achievements of these projects, however, have been confined to short-term objectives of raising productivity.

Population pressure

In arid and semi-arid rangelands the fundamental driving force on natural resources is population pressure especially that applied from outside the arid rangelands. This strong growth of other groups results in an increasing encroachment by arable farmers on to the pastoralists “key resources” sites. Flood plains, which have been traditionally used for wet season grazing, are being converted into crop land. Furthermore, flexibility of animals’ movement is progressively hampered by increased population pressure and loss of corridors between wet and dry season grazing areas. Stock is increasingly concentrated the entire year on the same lands, breaking the ecologically sound cycle of alternating use of wet and dry season grazing areas, leading to over use of dry season grazing land and, inevitably, to human suffering (Haan et al., 1997). Generally, crop encroachment, fuel wood collection and overgrazing are the interlocking factors causing land degradation in these areas. Crop encroachment exposes the soil directly to the erosive effects of winds and downpours and it progressively hampers the flexibility of animals movement because it obliterates passages between wet and dry season grazing areas. In the past 60 years, the pastoral communities have lost about 2.6 million hectares of prime grazing territories to different agricultural development interventions (Beruk, 2003). This includes 613,730 ha in Afar 417,000 ha in Somalia, 1.3 million ha in Borana Zone, 121,000 in South Omo, and 100,000 ha in Gambela region (Hurni, 1992). Getachew (2006), suggested that the change in land use from rangeland to other forms of agriculture without due consideration to the benefit of the local pastoralists is considered a threat to the pastoral production system.

Policy

past development efforts in the pastoral areas of Ethiopia

In the 1960's and 1970's, attempts have been made to alleviate shortage of feed in the pastoral areas of Ethiopia through the implementation of different rangeland development projects: Borena Rangeland Pilot Project, Second Livestock Development Project (SLDP), Third Livestock Development Project (TLDP), Fourth Livestock Development (FLDP/SORDU Pilot Project) and South Eastern Rangeland Projects (SERP). However, the outcome of the projects was not satisfactory to the extent of improving the standard of living of the people, productivity of the rangelands, the livestock resources as well as the ecosystems in sustainable manner. Reasons for these massive failures of the technological interventions of the earlier projects could be many, out of which, top down government driven approach which led to negligence to consider the cultural, social and economic system resulted in lack of sound community participation and implementation were considered the major factor (Beruk and Tafesse, 2000; MOA, 2000).

Current government attitude and support

The political change in Ethiopia in 1991 has resulted in policy changes from centralized and regulated socialist economy to decentralized and free market capitalist economy. In the past government's policy documents did not normally include pastoral issues. At present, the federal government of Ethiopia has taken some important measures towards the interests of the pastoral community. Of these measures, a change from resource based approach to a human-centered approach is the major ones to be mentioned. The decentralization of public administration has also paved the way for quick decision making at regional, zonal and district levels with an increase of direct involvement of the community in various development programs. Only the most general policy matters will be decided by the central government. This opportunity would make pastoralists to utilize the enormous potential for development activities autonomously without any interference (MOA, 2000). Furthermore, nowadays, the government is taking an encouraging measure that indicate the concern towards the welfare of pastoralists like the establishment of national pastoral extension team, establishment of Pastoral Standing Affair Committee in the Federal Parliament and Pastoral Affairs Committees at national and regional levels (Mohammed, 2003).

An control grazing management on rangeland vegetation

Grazing is one of the major factors influencing vegetation types and distribution. Although grazing animals certainly exerted some influence, rangeland vegetation co-evolved with foraging wild life in to a dynamic equilibrium between consumers and producers (Stoddard et al., 1975). With introduction of domestic livestock, a new force has been exerted on rangeland vegetation and the equilibrium of the past has changed. According to Blench and Sommer (1999) some rangelands that have co-evolved with grazing species include: the savannas of East Africa (antelopes and zebras), and the prairies of North America (deer and bison). Many studies that have been conducted to explore the relationship between grazing and dynamics of rangeland vegetation have not always come to a consensus. Disagreements have always existed between scientists. Even though, there are a number of studies showing the negative impact of grazing, there are also researchers who have documented positive contribution of grazing on species diversity in the rangelands (Lamprey, 1979, Zerihun, 1985; Oba et al., 2001). However, it is clear that grazing and browsing animals have some influence on vegetation composition, biomass production and biodiversity distribution. According to (Oba et al., 2001), based on his grazing model, grazing can either increase or decrease species richness depending on intensity of the grazing. Naturally, livestock are able to graze selectively the palatable herbage. Moderate grazing of natural pasture can increase production of green biomass, while higher grazing pressure of livestock is associated with a decline in perennial and increase of annual cover, reduced pasture quality and productivity, increased soil erosion, changes in the concentration of soil nutrients, degradation of soil surface structure, reduced soil water infiltration rates and changes in near ground and soil micro climate (Cossins and Upton, 1985; Yates et al., 2000). Moderate grazing by removal of excess grazers and browsers stabilizes the rangeland eco-system, and therefore recommended (West, 1993). On the other hand, total absence of grazing also reduces biodiversity because a thick canopy of shrubs and trees develops which intercepts light and moisture and results in over-protected plant communities, which are susceptible to natural disasters (Cloudsley, 1990).

Options

Natural or artificial re-vegetation

The potential of rangeland improvement by natural or artificial re-vegetation depends upon the kinds and amounts of vegetation remaining, climatic conditions, the feasibility of using grazing management practices or range improvement practices to accelerate succession processes, the expected recovery rate and the cost of alternative approaches (Valentine, 1980). These restoration procedures include active (browsing, burning, clearing, reseeding and cultivation) (Vander Merwe, 1997) and passive methods (withdrawal of livestock/game)

(Milton & Dean, 1995)

Natural re-vegetation implies improved management, particularly of grazing, to restore vigor and accelerate the spread of the remaining desirable plants (Valentine, 1980). Although vegetation responses to improved management vary from site to site, a minimum of 15% of desirable perennial species in the vegetal cover is often used as an index to indicate the potential for successful natural improvement on semi-arid range areas (Valentine, 1980). In certain instances rangeland deterioration is so far advanced that not even the use of sound management practices can restore it to its original grazing potential (Hassanyar, 1977; West et al., 1989; Jordan, 1997). Consequently, manipulation of competing vegetation and artificial re-vegetation may be the only recourse if rapid range improvement is desired.

On the other hand, artificial re-vegetation involves the establishment of adapted species by planting harvested seed or by transplanting seedlings or vegetal segments. This is practiced when insufficient desirable forage plants remain (Valentine, 1989). This method of revegetation works against normal succession processes by attempting to hold the plant community in some artificial stage (Box, 1984, as cited by Valentine, 1989). Under other circumstances, with less intensive land preparation (over seeding) the development of desired plant communities depends upon the integration of artificial re-vegetation (establishment of seeded species) with natural re-vegetation (Valentine, 1980).

In addition to these perceived theories of re-vegetation of rangelands, seed bed preparation practices are also utilized to ameliorate harsh environmental conditions in the surface soil of arid and semi-arid rangelands. Preparation is done by ploughing and furrowing or other mechanical methods for the purpose of creating micro sites/ microclimates suitable for seed germination, plant establishment and persistence. Harper, Williams and Sagar (1965), Grubb (1977) and Harper (1977) reported the need for suitable micro-environmental factors of the seedbed for successful seed germination, seedling establishment and subsequent plant growth. This is attributed to better water infiltration (Griffith et al., 1984).

Mulch, Fertilizer and Manure

The importance of mulch, fertilizer and manure IS to create a favorable microenvironment in the seedbed for successful plant establishment.

In dry land areas, the high evaporation rate, due to the hot, dry climate under reduced rainfall and short rainy seasons, is the major cause of water deficits. This is a continuous process and a very high amount of water is lost through evaporation. One way of reducing evaporation is to use mulches (Rickert, 1973; Jordaan & Rautenbach, 1996). Soil temperatures are influenced by soil cover and especially by organic residues or other types of mulch placed on the soil surface. In warm regions, mulching may provide the double benefit of increased rooting in the more fertile topsoil plus decreased evaporation of water from the soil surface (brady,1990).

In the semi-arid tropics, surface mulching with crop residues has proven effective in conserving soil moisture, decreasing soil temperature and maintaining favorable soil structure through enhanced biological activity (Lal, 1979, as cited by Mathieu & Gorges, 1991). Mulching also increases the soil OM and improves soil physical conditions as well as nutrient content and moisture retention capacity

The use of fertilizers to increase seedling establishment and growth on extensive revegetated areas in arid and semi-arid regions is a questionable practice (Heady, 1975). However, for rapid restoration of degraded rangeland Edwards (1981) emphasized the need for fertilizers. Roundy and Call (1988) also showed the importance of fertilization to promote plant establishment and growth on drastically disturbed areas. This was found to modify the fertility of the soil, thereby creating a favorable microenvironment for seeds to germinate

Improvement of grazing management on both quality and quality of pasture and forage

In Ethiopia improvement of feed quantity and quality is good opportunity for livestock production; there is great potential of improving both the quantity and quality of pasture and forage. For the lowland pastoral areas there are various opportunities for improvement of grazing management. (Alemayehu mengstu, 2004).

These include:• Encouraging the establishment of a regular monitoring network which is gender-sensitive; in order to study and observe pasture conditions and trends;• Encouraging the implementation of regular monitoring of productivity and management problems for livestock and grazing land Recognizing and strengthening the traditional knowledge of the pastoralists, both men and women, and forms of grazing management practices by: Encouraging and strengthening the traditional rules of grazing management, demarcation of settlement areas and herd mobility; Strengthening the traditionally widespread practice of feed conservation in the form of 'Kalo' (traditional hay). Encouraging fodder banks through hay and other forms of feed conservation, Investigating and encouraging selection and supplementation with leguminous trees like Acacia and other forage legumes for dry season feeding; Setting up a regulated scheme for using fire to control bush and improve animal production and health through reducing tick infestations and improving forage quality. This requires policy development and community participation; Making a detailed analysis of pasture

deterioration to ascertain its extent; and• Investigating more appropriate grazing management systems.

Conservation of Biodiversity

Conservation ensures survival of wildlife, forests, other habitats, species, bio resources, genetic forms and cultures Main purposes of biodiversity conservation are Biodiversity has contributed in many ways to the development of human culture, and human communities have played major roles in shaping the diversity of nature at genetic, species and ecological levels. Biodiversity has to be conserved in order to live in harmony with the immediate environment and Mother Earth while getting the important benefits (ecological, economic, ethical and scientific) Biodiversity conservation needs to be taken as an integral part of life Biodiversity is useful for the health of humans and domestic animals (vitamins, minerals, medicinal plants, fungi, etc. are sourced from BD) Biodiversity is useful for the health of the soil (fertility maintenance, erosion prevention, detoxification of wastes) Biodiversity is useful for regulation of the hydrological cycles, the composition of the atmosphere and protecting the well-being of ecosystem functions Biodiversity has big economic (and monetary) values A unit of biodiversity (species, variety, gene) may be useful in future, though may not seem useful today BD conservation helps to secure valuable resources for future generations The present generation has seen disastrous consequences of biodiversity loss which could only be remedied by conservation For sure we live in the era biodiversity crisis The greatest cause of biodiversity loss is associated with human activity Principal goal of BD conservation is to ensure long-term survival of as many species as possible and allow evolution to continue

Way of for wards

Vegetation Assessment

Vegetations are the most obvious physical representation of ecosystems (Kent and Cocker, 1992). Natural vegetation integrates, and therefore reflects, the whole of natural environment. If natural vegetation is sufficiently conserved it would be used as a broad guide to ensure more natural, more complex and more stable flora and fauna. As stated by Tewoldeberhan Gebre Egziabher (1991) the dry lands of Ethiopia are reportedly biodiversity rich and any vegetation change may result in species decline or loss. For these and other reasons, dry land monitoring and assessment is essential in order to plan and implement conservation measures.

Floristic data are relevant for establishing the present situation for environmental impact assessment and monitoring changes in ecosystem quality in terms of changing species composition (Groems et al., 1994). Information on vegetation may be required to solve an ecological problem such as inputs to environmental impact assessments to monitor management practices or to provide the basis for prediction of possible future change. Vegetation study also aid in the selection and implementation of appropriate conservation and management plans for suitable use of eco-systems (Kershaw, 1973).

Range Condition Assessment

Range condition is the current productivity of a rangeland relative to what it is naturally capable of producing. Range condition is a vital tool used by the range managers to determine whether the exiting management activities in operation are adequate and proper or some modifications are needed to avoid rangeland degradation but optimize its productivity. Range condition classification provides an indication of management inputs necessary. Regardless of the approach used, range condition is called low when desirable species are replaced by poor species, there is reduced ground cover, erosion accelerates, reduced litter cover or a combination of all the factors and vice versa (ILCA,1975). If Range condition is poor we should have improved by different techniques such as Encouraging the establishment of a regular monitoring network which is gender-sensitive; in order to study and observe pasture conditions and trends;• Encouraging the implementation of regular monitoring of productivity and management problems for livestock and grazing land Recognizing and strengthening the traditional knowledge of the pastoralists, both men and women, and forms of grazing management practices by: Encouraging and strengthening the traditional rules of grazing management, demarcation of settlement areas and herd mobility; Strengthening the traditionally widespread practice of feed conservation in the form of 'Kalo' (traditional hay). Encouraging fodder banks through hay and other forms of feed conservation, Investigating and encouraging selection and supplementation with leguminous trees like Acacia and other forage legumes for dry season feeding; Setting up a regulated scheme for using fire to control bush and improve animal production and health through reducing tick infestations and improving forage quality. This requires policy development and community participation; Making a detailed analysis of pasture deterioration to ascertain its extent; and investigating more appropriate grazing management systems.

Governmental organizations and pastoral associations

As in many other parts of the country, diffusion of research results has been slow in the lowland areas mainly due to non-availability of well-organized extension systems and local pastoral associations. if there is Poor co-ordination among research institutions, development organizations and local pastoral associations the channel

communication between pastoralist and governmental organization including research and extension services will be poor. so in order to solve both the natural and manmade constraints we should have to reduce the gap of communication between these organizations.

Reference

Abebe D and Ayehu A (1993) Medicinal Plants and Enigmatic Health Practices of Northern Ethiopia. Monograph, Addis Ababa

Abule E, Snyman H A and Smit G N 2005 Comparisons of pastoralists' perceptions about rangeland resource utilization in the Middle Awash Valley of Ethiopia. Journal of Environmental Management 75: 21-35

Alemayehu Menigistu, 1998. The Borana and the 1991-1992 droughts. A rangeland and livestock resource study. Addis Ababa, Ethiopia, 15-42.

Alemayehu Menigistu, 2004. Rangeland: Biodiversity Concepts, Approaches and the way forward. Addis Ababa University, Faculty of Science, Addis Ababa, Ethiopia, 80pp.

Alemu tadesse, 2003 the unexploited potential of improved forages in the mid-altitude and lowland areas of Ethiopia

Ali S 1994**.** Resource use conflict in the middle Awash Valley of Ethiopia: The crisis of Afar Pastoralist. In: R. Hogg (ed.). Pastoralists, Ethnicity and the state of Ethiopia. London, HAAN Publishing.

Azene, Bekele-Tesemma and Gathiru Kimaru. 2006. Participatory watershed management: Lessons

Coppock, D.L., 1994. The Borana plateau of southern Ethiopia: synthesis of pastoral research, development and change, 1980-1991. ILCA (International livestock Center for Africa), Addis Ababa.

CSA (Central Statistical Authority) 1994. National population and housing census. CSA. Addis Ababa, Ethiopia.

Dawit, A., 2000. Pastoralist and pastoral production system. In: ESAP (Ethiopian Society of Animal Production), Pastoralist and Agropastoralism: which way forward. Proceedings of the 8th annual conference of the Ethiopian Society of Animal Production. 24-26 August 2000, Addis Ababa, Ethiopia.

Doran, J.W. & Parkin, T.B., 1994. Defining and assessing soil quality. In: J.W. Doran, D.C. Coleman, D.F. Bezdicek & B.A. Stewart (eds). Defining soil quality for a sustainable environment. Soil Sci. Soc. Am. 3-21.

Kidane Gebremeskel,(2005) Rangeland potential, quality and restoration strategies in north- eastern ethiopia: a case study conducted in the southern afar region

FAO (1996). The range lands of arid and semi-arid areas. Challenges and hopes for 2000s. 0nline : WWW. National geographic,com.

Follett, R.F. & WILKINSON, S.R., 1995. Nutrient management of forages. In: R.F. Barnes, D.A. Miller & C.J. Nelson (eds). Forages: the science of Grassland Agriculture. Vol II. 5 th ed. Ames: Iowa State Universe. Press. 55-79. from RELMA's work with farmers in eastern Africa. ICRAF Working Paper no 22

Getachew Haile, 2006. Impact of land use/land cover dynamics on the ecology of Borena rangelands, Ethiopia,. M.Sc. Thesis Presented to the School of Graduate Studies of Haramaya University, Ethiopia.122pp.

Groem. K., Vander Meijden R., and Runhaar, H. (1994). The use offloristic data to stablish theoccurence and quality of ecosystems. 2: 35-55. IN: Ecosystem Classification of Environmental Management (Klijin, F. ed.) Kluwer Acadamic Publishers. Netherlands.

Haan, C.d., H.Steinfeld, and C. H. Hoste., (1997). Rangeland production and annual rainfall relations in the Mediterranean Basin and in the Africo Sahlo-Sudanian Zone.J. Range manage. 30: 181-189

Halcrow, W., 1989. Master plan for the development of surface water resources in the awash basin. Final report. Volume 7. Livestock potential, pp 3-21. Ethiopian Valleys Development Studies Authority.

Heady, H.F., 1964. Palatability of herbage and animal preference. J. Range Manage. 17, 76-82.

Helland, J., 1980.Social organization and water control among the Borana of Southern Ethiopia, Working document ILCA. Nairobi, Kenya.

Holecheck, J.L., Pieper R.D. & Herbel, C.H., 1989. Range management: principles and practices. 1st Ed. Prentice- Hall, Inc., Englewood Cliffs, New Jersey.

Humphreys, L.R., 1994. The maintenance of soil fertility: II. Soil structure and erosion. In: L.R. Humphreys (Ed.) Tropical forages: Their role in sustainable agriculture. Longman Group Limited. Essex, England. 73-110.

ILCA (International livestock Center for Africa), 1981. Introduction to the east African range livestock systems study. ILCA-Kenya working document, Nairobi, Kenya.

Jones, M.J., 1973. The organic matter content of the savanna soils of West Africa. J. Soil Sci. 24, John Wesley Powell, 1864) Water shade management and development study

Kabagambe, Dennis M. (1976). 'Spects of resource conservation and utilization. The role of charcoal industry in the Kenya economy.' Working paper No. 271. Nairobi, Kenya. Institute for Development Studies. University of Nairobi.

Kershaw, K.A., 1973. Qualitative and Dynamic plant ecology. Second Ed. The English book Society and Edward Amold (publishers) Ltd.London, UK.

Kidane Gebremeskel, 2005 .Rangeland potential, quality and restoration strategies in north- eastern ethiopia: a case study conducted in the southern afar region

MCE (Metafaria C consultant Engineering), 2000. Rangelands and water development study. Draft final report. Vol. 111. Rangelands/livestock & fodder, Afar National Regional State, Addis Ababa, Ethiopia.

Milford, R. & Haydock, K.P., 1965. The nutritive value of protein in sub-tropical pasture species grown in South-east Queen land. Aust. J. Exp. Agric. Anim. Husb. 5, 13-17.

MOA (Ministry of Agriculture), 2000. Agro-ecological zonation of Ethiopia. Department of Land use and Natural Resources. Addis Ababa, Ethiopia.

Mohammud Abdulahi, 2003. Pastoral development strategies policies in Ethiopia. Acritical analysis and evaluation. pp. 63-74. Proceedings of Pastoralism and Sustainable Pastoral Development. Addis Ababa, Ethiopia, 23-24 December 2003. Pastoral Forum of Ethiopia.

Norton, B.W., 1982. Differences between species in forage quality. In: J.B. Hacker (ed.). Nutritional limits to animal production from pastures. CAB, Farnham Royal, U.K, 89-110.

Oba, G., Veetas, O.R. and Stenseth, N. C. (2001).Relationships between biomass and plant species richness in arid zone grazing lands. Journal of Applied Ecology. 38: 836-845.

Reflections on the role of 'wild-foods' and ‘famine-foods’ at a time of drought

Tewoldeberhan Gebre Egziabher, 1991. Diversity of Ethiopian flora. In : Engles, J. M. M., Hawkes, J. G. and Melaku Worede (eds.), Plant Genetic Resources of Ethiopia . Cambridge University Press, Cambridge.

Thompson, L.M. & Troeh, F.R., 1978. Soils and soil fertility. McGraw-Hill Book Company, New York, USA.

UNICEF, (1999): An Interagency Mission on non-food needs of the drought affected people in North Omo Zone and Konso Special Wereda. UNICEF Internal Field Mission Report, 17 to 24 June, 1999, Addis Ababa.

Van soest, P.J., 1982. Nutritional ecology of the ruminant. O & B. Books, Inc., Corvallis, Oregon. http://www

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