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Rehabilitation of Rangeland Implication for Rangeland Degradation in Borena Pastoralist Dry Land Area:The Case of Borena Zone Yabello Woreda, Southern Ethiopia

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Abstract

Rangeland degradation is 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 decreased water and soil conservation, recreation values, carbon balance and so on. It also defined as the loss of utility or potential utility or the reduction, loss or change of the features of rangeland ecosystem. In general, rangeland degradation is reduction in the rank or status of natural vegetation, Loss of plant cover. The objective of this research paper was to assess Rehabilitation of rangeland implication for Rangeland Degradation in Borena pastoralist dry land area and specific objects to identify causes of rangeland degradation, and rehabilitation techniques. The study was conducted at colqasa rangelands located 46km south of Yabello district of the Borana rangeland, in southern Ethiopia. While selecting participants for key informant interview and FGD, snow ball sampling was used. Another method used for primary data collection was focus group discussion. Direct Observation is another method of data gathering tool that used in this research. The method of analysis used under this study was a qualitative approach of thematic analysis. Though restoration of degraded rangeland remains a challenge, studies have shown that degraded vegetation is able to recover in a relatively short time when protected. Today rangeland degradation is a decrease in plant species diversity, plant height, natural vegetation cover and plant productivity. Recommendations to combat rangeland degradation that rangeland management systems integrate community perceptions and practices.

Keywords: Rehabilitation; Degraded Rangeland.

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1. Introduction

Rangeland degradation is a worldwide problem which constitutes the largest biome (major ecological system). Its impact has recently been serious problem due to the multiple causes such as climate change (increase in temperature, expansion of tropical cattle disease, loss of biodiversity, and drought), increasing in human and animal number or population which creates pressure on range resource management regimes [12]. In arid and semi-arid African rangelands, pastoralists are blamed for contributing to range degradation, but rarely considered a critical authority on the rangeland [28]. Rangeland degradation, a worldwide problem, is serious in Ethiopia, especially in Southern Ethiopia. In Yabello-Borana Southern Ethiopia, loss of perennial grass cover and increase in annuals, unpalatable forbs and bush cover are the leading cause and also conversion of rangeland to cropland, wood harvesting and over-grazing by livestock are the major causes [27,15]) also pointed out that the reference point of rangeland degradation with respect to ecosystem processes is the ability of ecosystem to cycle nutrients, process energy and to conserve the soil. Change in the pattern and state of vegetation or structure, as defined by patchiness and biodiversity in semi-arid regions, are the main indicators of the state of land degradation [33] and it gives useful information for monitoring.Recurrent drought, expansion of crop cultivation, human population growth, settlement, overgrazing, bush encroachment, and bans on use of fire were the main factors attributed to degradation, which corroborates findings of many other studies [16, 35]. Setting stocking at higher density has commonly resulted in a decline in the most palatable perennial species and an increase in less favorable species [29]. Overgrazing is defined as repeated heavy grazing over several years that result in deterioration of the plant community and a decline in the vigor, production, and biodiversity of rangelands [36]. Climate change is a major contributor to rangeland degradation through its effects on ecological dynamics of these systems [30, 21]. Reference [24] reported that decreased vegetation is associated with growth of pastoral conflict in the Horn of Africa. Climate change is influencing pastoral mobility trends locally and in trans-border areas – as pastoralists transcend Eastern Africa borders in search of better pastures and resources [27]. Agriculture and the associated developmental practices in the rangelands have increasingly contributed to rangeland degradation [18]. Agricultural activities are often associated with rangeland degradation and, as [15]. Suggest, a number of newcomers relocated in such rangelands often pursue agricultural production at the expense of pasture productivity. Bush encroachment is the suppression of palatable grasses and herbs by encroaching woody species often unpalatable to domestic livestock [40]. Bush encroachment and the expansion of invasive plant species represent significant problems as found elsewhere in the rangelands of Ethiopia [30, 3]. Reference [34] suggested that the causal factors for bush encroachment are complex and have been a contentious issue in rangeland ecology. Though restoration of degraded rangeland remains a challenge, studies have shown that degraded vegetation is able to recover in a relatively short time when protected [41]. For rehabilitation to be effective and successful, it should target the underlying causes of degradation and reverse the degradation process [19]. Natural ecosystems have been severely destroyed because of anthropogenic disturbances, UN reasonable utilization, and neglect of protection and restoration [17]. It is also important to establish the relationship between ecosystem structure and functioning, and to assess the potential for ecosystem restoration [10]. Vegetation plays an important role in erosion control; it efficiently mitigates erosion by active and passive protection [32]. Vegetation also has a passive action by trapping and retaining sediments inside the catchment due to its aerial parts [2]. Rangelands in such situations are prone to

wind and soil erosion, which in turn leads to decline in soil fertility and seed in the soil [38]. Reseeding technology has been used successfully as a means of rehabilitating degraded rangelands in East Africa[26,37]but are not common in a pastoral setting because of their high capital requirements [39,31]. Enclosures in Africa were associated with the expansion processes of European overseas missions and its effect in expanding the productive role of capitalism [20]. Enclosures are "areas surrounded by walls, objects or other structures" and serve to keep objects, usually animals, inside a given area [21]. The connection between land degradation and livestock management is an acknowledged problem in the arid and semi-arid areas, calling for improvements in livestock management strategies and hence enhancing grazing management best practice is important for sustaining the productivity and health of rangelands [4]. Therefore, the objective of this research paper was to assess Rangeland Degradation and Restoration in pastoralist area and specific objects to identify causes of rangeland degradation, and rehabilitation techniques.

2. Materials and methods

The study was conducted at colqasa rangelands located 16km south of Yabello district of the Borana rangeland, in southern Ethiopia (Fig.1). The study was carried out in Yabello district which is located at $3^0 18' 64''$- $10^0 09' 04''$North, and $3^0 18' 03''$ - $43^0 04' 24''$East in Borana zone. It's about 312,202 km^2area. Yabello is the capital town of Borana Zone, which is positioned at 570km in the south from Finfine. Yabello district is bordered in the south by Dillo and Dubuluki district, in the west by Elwaye district, in the east by Arero district, and in the north by Gomole district .Yabello district is divided in to 18 Kebele. The study district covers a total land area of 5550 square kilometers with altitude ranging of 1000 to 1600 meter above sea level (m.a.sl)[22], with peaks 2000 m.a.sl [9] and the average annual rainfall ranges from 400 mm to 600 mm. The mean annual temperature is 24ºC with a mean maximum of 28ºC and mean minimum of 17ºC.The area is characterized by an arid to semi-arid climate and bimodal rainfall pattern in which a long rainy season occurring between March and May (ganna) and the long rainy season are usually from September to November (*hagaya).*The rainfall is erratic and recurrent drought is a common phenomenon in the study area. According to the estimate of the district's Yabello agricultural and natural resources' office (2013), 95,571 ha of the land area are cultivable. The grazing land consists of about 397,028 ha; bushes and shrubs cover 147,000 ha; forest land 39,129 ha and physical constructions, waste lands and others 2,277 ha. The livestock population is estimated to be 467,374 cattle, 378,793 goats, 97,011 sheep, 61,333 camels, 11006 mules, 6,648 donkeys and 833 horses (Yabello Agricultural and Natural Resources, 2013*).*

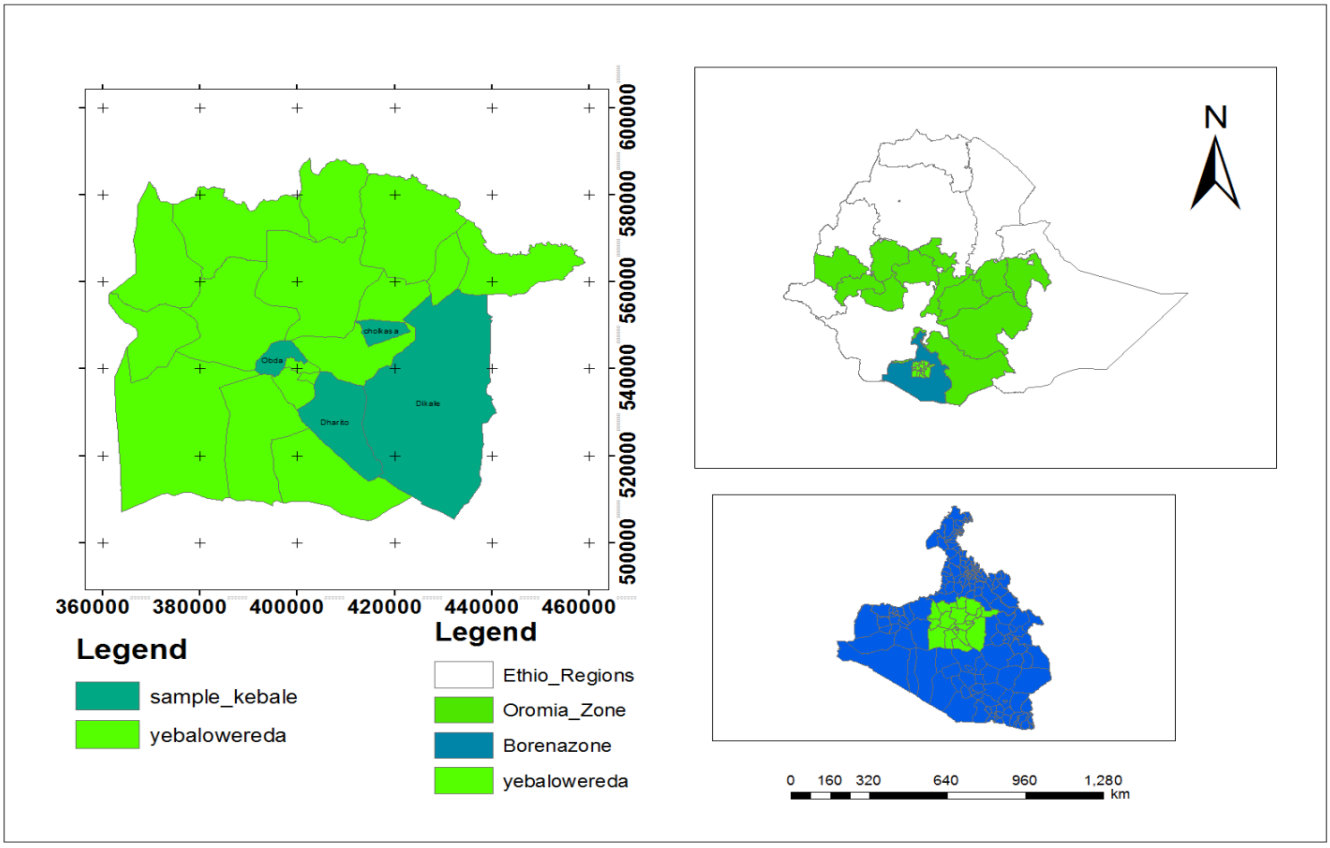

Figure 1: Map of the study

2.1. Methods of data collection

Amalgamations of methods were used to collect relevant information from respondents. Qualitative methods of data collection such as key informant interview, focus group discussion (FGD) and direct observation were used to explore the IEK of Borana pastoralists to build a complex holistic picture, to analyze narratives and reports, and to conduct the study in the natural setting of the participants. While selecting participants for key informant interview and FGD, snow ball sampling was used. Snowball is a sampling technique used to identify cases of interests reported by people who know other people involved in analogous cases and have insights into the IEK of the Borana pastoralists [7].

2.1.1. Key Informant Interviews

The key informants were selected purposively; because it depends on the knowledgeable people who know about the study area and the relationship of rangeland resource with pastoralist community. In addition, all key informants from the community were selected based on their role within the community, experience and knowledge bases. Thus, eight key informants for each four Kebeles were interviewed for my study from local elders' four persons, two local leaders and two government officials' of developmental agents who know about the trends of rangeland degradation and also impacts of rangeland degradation.

2.1.2. Focus Group Discussion

Another method used for primary data collection was focus group discussion. Focus group discussion was one of the most important research methods for gathering qualitative data from different sections of the community. : has been employed in data gathering process during the time of data collection. Participants were divided into three groups and discussions will be conducted. Each of the groups consists of ten individuals from each Kebeles. In groups' Abba dheeda, influential traditional leaders and councilor (hayyuu) must be participated in FGD. According to [25] the optimum size for FGD should be six to eight participants per session. For this study, sample size for FGD was conditioned by two factors: the group must be small enough for everyone to participate and more manageable in contrast to larger group usually harder for moderator to control.

2.1.3. Direct Observation

Direct Observation is another method of data gathering tool that used in this research. During the data collection period, the researcher was made observations at different sites and practices of rangeland management. Direct personal observations; for instance, was made to various grazing sites, utilization and management system. Direct observation was conducted throughout the whole courses of the research in order to ensure the validity of information obtained. Additionally, it was done for the purpose of informal discussions with community, observing values of local people especially the norms of the society and different activities practiced by the community to the management of the rangeland resources. For instances this method helps to assimilate the setting from both insider and outsider perspectives. Hence, the purpose of observation was mainly to understand the general condition of the study area (to witness how Borana pastoralists manage their livestock, rangeland resources and water resources) and to re-track back the missing information from detailed interview questions.

2.1.4. Data Analysis

The data gathered from different sources by employing key informant interviews, FGDs, direct observations and primary data which was obtained by direct personal observation from the fieldwork was supplemented with data obtained from secondary sources (reading different book, different journal) in order to fill information gap from primary sources and were compiled in the ways that was easy to manage. Following the completion of data collection, the results of the analysis were interpreted and discussed by using qualitative approach. The method of analysis used under this study was a qualitative approach of thematic analysis. Thematic analysis is a method used for "identifying, analyzing, and reporting themes within the data" [8]

2.3. Results

2.3.1. Rangeland degradation

Rangeland degradation is amalgamation terms: it has no single effortlessly characteristics, but instead describes, how one or more of the rangeland resources, soil, water, vegetation, rock and so on, has change detoreiated. Totally decline of productivity potential of the lands, including: major use, forest, deforestation/ changes farming system, detoreiated, soil physicals and values of economic resources .General, rangeland degradation is

reduction in rank or status, which includes a loss of topsoil, soil erosions, land cover change, loss of vegetation, increasing expansion gully, losses of palatable grasses, and perpetual abatement of productivity. With the raise in the number of pastoral livestock and the over use of pastures and grazing, vegetation cover reduction and degradation of the rangeland has occurred and well-grounded degradation of grazing for pastoralists in Borana. The major pointer of rangelands degradation is shift in species composition, loss of range biodiversity, diminishment in biomass production, low productivity and soil erosion. Rangeland degradation is occurring as a result of in appropriate management grazing plans, removal of vegetation, fertility soil, and increase soil erosion. With the increasing in the number of livestock and the over use of pastures and grazing, vegetation cover diminution and degradation of the rangeland has occurred and well ground degradation of grazing for pastoralists in Borana pastoralist area. In addition, an increasing human population in some parts of the Borana rangelands has led to the exploitation of these lands with Agricultural land to meet the needs of the population that has in turn led to decreasing areas of rangeland. Due to this reason rangeland become is deteriorated and degraded is increase from time to time in Borana pastoral area.

Figure 2: Borana pastoral area Rangeland degradation

2.3.1.1. Causes of Rangeland Degradation

The causes of rangeland degradation are elaborate in time and space and associated with interactions between pastoralists, governance and policy, and environmental factors. The extent is often suspected, as are the causes and potential solutions for improvement. The imminent causes of rangeland degradation include overgrazing, bush encroachment, population pressure, drought, climate, overstocking, government policy desertification, deforestation and Agricultural expansion or rangeland converted in to crop land. The ultimate drivers, however, are typically associated with policies, as well as changes in land use system, socio-economic changes, or interactions of socio-economic and governance factors with climatic stressors such as drought that means anthropogenic factors and natural factors.

Overgrazing

Overgrazing a situation in which rangeland is damaged, and detoreiated because livestock or others in it have been allowed to eat too much of grass around the rangeland area or have been allowed to feed on it for a long periods of time in grassing area. In addition improper use management for stakeholders consists of all the unsustainable practices that pastoralists and herders use for rangeland and livestock management that lead to overgrazing. Overstocking refers to grazing excessive number of animals that leads to overgrazing. Overstocking can be part of improper use management. Generally according to borana pastoralist overgrazed

grazing lands as 'Barbadaa', which means few or no grass available and degraded areas as 'Adaala'. Indicators of deterioration of the rangeland included: Shortage of grass, Decreasing desirable palatable grasses, Low milk production, reduced conceiving frequency of cows.

Figure 3: Overgrazing lands (by researcher 2021)

Climate Change and Variability

Changes in climate include increased temperatures and evapotranspiration, changes in rainfall patterns and amounts and in the available water resources. Additional in Borana pastoral community area Climate change put on rangeland degradation through changes in vegetation species, and deterioration soils structure, physicals and through changes to the water points(like community pond, Ella(deep well). Degradation of soil and water resources, rangeland resources is likely to be intensified by adverse changes in temperature and precipitation, although adaptive behavior has the potential to mitigate these impacts as land use and management have been shown to have greater impact on soil conditions than the indirect effect of climate change. On others hands the bare pastoralist's areas between grasses become larger as the grass species are exhausted, causing a decline in the effective use of rainfall in the area and also the stage of rangeland deterioration in grassland is characterized by increased rates of runoff. The traditional institutional systems do not use alternative of adaptation and mitigation, it pursued collective action of both, which are the major contributors in economical and human welfare in pastoral and agro-pastoral setting. The most people understand that herd mobility is mostly for adaptation of climate change, it is true some form of context, it also the same important in climate change mitigation, during the mobility resting the place/areas that we mobile from , the place is getting rest and ecological becoming resilience, the resting rangeland improved vegetation cover, which increase carbon sink, so the herd mobility is also the most mechanism for climate change mitigation role in pastoral areas of Borana rangelands

Agriculture and Associated Developmental Practices

Agricultural farming was still hap in such drought limited area to improve food security for their subsistence farming however, their crop productivity, was diminish. Therefore, in combination with other factors, agricultural addendum foremost to rangeland degradation cause and land use cover change of the study area.

Table 2: Agricultural expansion during the Years with local name in each Borana pastoralists Gada period

Years	Local name of the drought(Gada period)	agricultural expansion
1936	"" Gada "Bule Dabasa	No cultivation
1976	"Gada" Goba Bule	No cultivation, during this period Borana pastoralist life is depends only on livestock production that means pure pastoralist.
1984/85	"Gada" Jilo Aga	Starting time but very few ,home garden
1992	"Gada" Boru Guyo	Few ,home garden
1996	"Gada" Boru Madha	Good, during this period slow Borana pastoralist life change pastoral to agro pastoralist.
2003/7	Gada" Liban Jaldesa .	More agricultural expansion, to start rangeland convert into agricultural land, during this period also increase agro pastoral area.
2011	"Ola Gada" Guyo Goba (very severe drought	Similarity

Source: (pastoralists Historian interview, 2013)

During 1997 to 2003 Borana pastoralists 75% was Agro pastoralist,25% was pure pastoralist due to this reason human need more demand to change his life's, and expansion of agriculture is rising and rangeland covert into croplands, deforestation, soil erosion occur at this period and more rangeland is degraded due anthrogen factocts or increase human induce and natural factors. In addition, respondents further indicated that during dry season, water was very far from home and thus, they buy water for weak cows, and calves from nearby urban areas. Some of respondents indicated that during long drought year there could be a probability of losing all livestock and falling into poverty. As the interviewees further confirmed that they are living "Jiruu Muka Ibiddaa" which if translated, we are living life of fuel wood. This study similar with different results that, the major constraints on livestock production were recurrent drought, feed and water scarcity occurrence and that have resulted severe mortality and greater reduction in herd growth potential [14, 5, 35] and the removal of forest cover had seriously affected the capability of the Afar people to sustain livestock and livestock holding sizes had been steadily being declined [42].

Bush Encroachment

FGD participants especially those elderly ones in the society clan witnessed that, at the Period of Adi Doyo Gada (1899-1906) invasion of bush encroach is increase during this period, due to this reason in Borana rangeland productivity is diminished from time to time, loss of palatable grass, browsers species, and increases soil erosion, gully expansion and detoreiated soil structure. Bush encroachment is the suppression of palatable grasses and reducing carry capacity of grassing, reducing land productive and increase soil compaction.

2.4. Rangeland Restoration

Range rehabilitation/restoration measures take various forms, which include Reseeding or allowing the onrush of natural regeneration, biological soil and water conservation (fodder tree, vetvar grass, susibania susibana, Alfa grass, elephant grasses mult cropping, allay cropping), physical soil and Water conservation measures (terrace, soil bund, check dam construction, gabion construction, gully rehabilitation), and water harvesting, or soil retention Structures and dry land forestry.

Rangeland restoration techniques

Rangeland restoration techniques according to study area includes livestock management (herd mobility, herd splitting, area enclosure, bush encroachment control, Re-vegetation of degraded rangeland is one of the best method to reduce the degradation, and land is easily recover. Reseeding involves collecting seeds from existing grasses and then sowing them on bare ground plant has ability to resist e.g. “Alchiiso and Mata-gudeesa”. Bush control methods shift the rangeland vegetation from dominance by woody vegetation to dominance by herbaceous vegetation, cultural values of trees like cordiana Africana and for multipurpose tree, and agroforestry. Area closure- is a protection system to improve land with degraded vegetation and/or soil through natural regeneration, giving land complete rest and allow soil stabilization and vegetation regeneration. The aim of enclosing communal lands is to improve sustainable natural resource management, ensure access to dry season grazing, reduces competition for resources, encroachment of conservation areas and to combating rangeland degradation. Herd diversity and splitting are techniques that can be used;-to maintain the long term productivity of the rangeland and in some cases to improve degraded rangelands. Herd diversification is the practice of keeping a variety of livestock species to use efficiently the poor rangeland and water resources, and to with stand the impacts of drought that may distress the productivity of livestock.

Figure 4: Area enclosure in borana pastoral area (sources by researcher 2021)**.**

2.5. Discussion

Rangeland degradation is defined by [18] as the reduction or loss of the biological or economic productivity of rangelands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitat patterns; such as soil erosion, deterioration of the physical, chemical and biological properties of soil, and long-term loss of natural vegetation. The findings of this study confirm that

General, rangeland degradation is reduction in rank or status, which includes a loss of topsoil, soil erosions, loss of land cover change, loss of vegetation, increasing expansion gully, losses of palatable grasses, and perpetual abatement of productivity. With the raise in the number of pastoral livestock and the over use of pastures and grazing, vegetation cover reduction and degradation of the rangeland has occurred and well-grounded degradation of grazing for pastoralists in Borana. Many drivers of range land degradation are anthropogenic factors and natural factors. It is in consistence with the findings [16,35] This study indicates Recurrent drought, expansion of crop cultivation, human population growth, settlement, overgrazing, bush encroachment, and bans on use of fire were the main factors attributed to degradation, which corroborates findings of many other studies. To affirm these main drivers of rangeland degradation comprise anthropogenic and natural factors [27]. Natural variables responsible for rangeland degradation include climate change, aridity and desertification, drought [30, 23, and 27]. Previous studies [6, 27, 1] have shown that shrinking of grazing reserves; high population density, frequent drought, shortage of forage resources, bush encroachment, weakening of traditional resource management practice; climate change and bans on traditional fire management, etc. are the main challenges for the rangeland degradation in Borana pastoralist area. Though restoration of degraded rangeland remains a challenge, studies have shown that degraded vegetation is able to recover in a relatively short time when protected (Yayneshet and his colleagues 2009). For rehabilitation to be effective and successful, it should target the underlying causes of degradation and reverse the degradation process[19] .The objective of enclosing communal lands is to improve sustainable natural resource management, ensure access to dry season grazing, and reduces competition for resources and encroachment of conservation areas. This is achieved through the enclosures ability in supporting the regeneration of grasses through controlled livestock access into the land [20]. The findings of this study confirm that Area closure- is a protection system to improve land with degraded vegetation and/or soil through natural regeneration, giving land complete rest and allow soil stabilization and vegetation regeneration. The aim of enclosing communal lands is to improve sustainable natural resource management, ensure access to dry season grazing, reduces competition for resources, encroachment of conservation areas and to combating rangeland degradation. . Herd diversity and splitting are techniques that can be used to maintain the long term productivity of the range, and in some cases to improve degraded rangelands [11]. The findings of this study similarity Herd diversity and splitting are approaches that can be used;-to maintain the productivity of the rangelands and in some cases to combatting rangeland degradation or to improve degraded rangelands.in addition Herd diversification is the practice of repair a variety of livestock species to use efficiently the poor rangeland and water resources, and to with stand the impacts of drought that may affliction the productivity of livestock. For instance, Rangeland development and extension services of the government should be built capacity on pastoral indigenous rangelands knowledge. Most of the development interventions have lack pre-research and assessment, which is a reimplementation of similar range land projects of highlanders oriented to lowlanders as modeling from each other. This was highly threatening the sustainable rangeland management.

2.6. Conclusion

Today rangeland degradation is a decrease in plant species diversity, plant height, natural vegetation cover and plant productivity. The rangelands productivity is shortage through various factors including population growth, agricultural expansion, and rangeland degradation, amongst others by scarce water and pasture. Kallo mean that

the Borana pastoralists from time to time slowly have to abandon the customary, ecologically balanced management system which reduced risk by operating over a large area, use of Area enclosure enables pastoralist reserve the forage for the time of difficult and gave grasslands time to recover. Fenote selem (2005) also pointed out that the reference point of rangeland degradation with respect to ecosystem processes is the ability of ecosystem to cycle nutrients, process energy and to conserve the soil. Rangeland degradation is reduction or loss, of the biological or economic productivity and pasture, forest and resulting from land uses including: processes increasing from anthropogenic factors and natural factor such as: soil erosion caused by wind and/or water; deterioration of the physical, chemical and biological or economic properties of soil; and long-term loss of natural vegetation. Rangelands degradation release from a number of sources: both natural and anthropogenic. Range rehabilitation/restoration measures take various forms. Rangeland restoration techniques according to study area includes livestock management (herd mobility, herd splitting, area enclosure, bush encroachment control, Re-vegetation of degraded rangeland is one of the best method to reduce the degradation, and land is easily recover. Therefore to conclude this study Preventing rangeland degradation without considering the community participation that's their livelihoods depends on them will lead to unsustainable development results. Therefore, matching the scientific rangeland degradation indicators with the ones pastoralists believe in and understand can lead to the successfully control of range land degradation. We believe that such plans based on indigenous knowledge can be easily accepted and sense of ownership by community.

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2.7. Recommendation

- Community and other stockholders should give attention in the rehabilitation and possible reestablishment of degraded rangelands through watershed developments so this would result in the development of sound sustainable natural resource management and utilization systems that would improve the communities' livelihood diversification and at the same time combat rangeland degradations.
- Pastoralists' active participation in plan and implementing different actives aimed at improving rangeland productivity should be promoted. . To combat rangeland degradation that rangeland management systems integrate community perceptions and practices.

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