World Journal of Pharmaceutical and Life Sciences
WJPLS
www.wjpls.org
SJIF Impact Factor: 3.347

PASTORALIST PERCEPTIONS ON FACTORS AFFECTING RANGELAND PRODUCTIVITY IN YABELLO WOREDA, SOUTHERN OROMIA, ETHIOPIA

***[1]Galgalo Dika Godana, [2]Abdulkadir Hussein Gemada and Semegnew Tadese Feyisa[3]**

*[1]Department of Soil Resource and Watershed Management, Gambella University.

[2]Department of Geography and Environmental Management, Adama Science and Technology University.

[3]Department of Natural Resource Management, Gambella University.

Article Received on 24/02/2016 Article Revised on 15/03/2016 Article Accepted on 06/04/2016

***Corresponding Author**
Galgalo Dika Godana
Department of Soil Resource and Watershed Management, Gambella University.

ABSTRACT

This study was conducted with the main objective of assessing pastoralist perceptions on factors affecting rangeland productivity. The study would hope to contribute to policy makers, planners and natural resource managers and may serve the district resource managers and anyone who intends to conduct a study in the similar theme. The data for this study were emanated from both primary and secondary sources. Qualitative data is analyzed by discussion of the ideas, opinion and concepts of collected data and quantitative data is analyzed using SPSS software and Microsoft Excel program to present the results in the form of charts, graphs, percentages and tables. Non parametric statistics such as binomial test and chi-square test for goodness of fit were also part of the analysis. This research has showed that the main factors affecting rangeland productivity in study area are bush encroachment, recurrent drought, rangeland degradation, overgrazing, erratic rainfall and expansion of crop cultivation. These factors have considerable impacts on the productivity of rangelands and livelihoods of pastoralist. The problems affecting the productivity of rangeland should explicitly be regarded as community and societal problems and not simply the only concern of pastoralist.

KEYWORD: Indigenous; Knowledge; Indigenous knowledge; Rangeland; Dry lands.

1. INTRODUCTION

1.1. Background and Justification

Around the globe, rangelands represent 24% of the world's land area and important sources of livelihoods for pastoralists. According to the World Bank (2007), 200 million households and 50% of the world's livestock population depend on rangeland (cited in FAO 2011a). Livestock, which greatly depend on rangelands for their growth, are socially, culturally and economically essential for rural livelihoods. It is a fast-growing agricultural sub-sector, accounting for as much as 50% of GDP in countries with significant areas of rangeland. Pastoralism is considered the most appropriate strategy to maintain human well-being in rangelands, as it provides secure livelihoods, conserves ecosystem services, promotes wildlife conservation and honors cultural values and traditions (FAO, 2011a).

Complex pastoral management systems have evolved from the pastoralists' successful adaptation under the harsh conditions of arid and semi-arid rangelands (Kirk, 1999). Similarly Blench (2001) noted that, the existing pastoral systems including their local adaptations are highly diverse, although they share common development trends. Pastoral resource management systems are influenced by natural environments with high variability in rainfall and recurrent extreme climatic conditions, associated with spatial heterogeneity. Again, the pastoralists' knowledge and strategies in rangeland and water management are disturbed by inappropriate development policies, and this leads to environmental degradation and the erosion of important social structures.

Pastoralists in Ethiopia like the other African countries have continuously suffered from a long history of political, economic and socio-cultural marginalization. The pastoralist's problems have been exacerbated by recurrent and complex natural calamities such as drought, flood, disease etc (PFE, 2002). The environment is the basic determinant of the nature and productivity of rangeland ecosystems of pastoralists. Physical environmental factors, like climate, topography and soil determine the potential of rangeland to support certain types and levels of land use (Desta, 2009b).

Since the 1990s, pastoral development approaches in eastern Africa have improved, due partly to increased support for livestock mobility, customary institutions and pastoral livestock strategies and partly to a greater emphasis on human development and rights based approaches. The building blocks for pastoral development, notably empowerment and governance, are now better understood and addressed, but there remains a major gap in

understanding, at a practical level, of how pastoralists manage their natural resource base. Development projects have enabled pastoral communities to strengthen their tenure over rangeland resources, and to restore traditional management practices, but projects often lack the capacity to help pastoralists to benefit from scientific advances in rangeland management (FAO, 2011b).

Indigenous or local knowledge can be defined as skills, practices and technologies that are an integral part of the production system in a specific culture. They are area-specific skills and practices concerning natural resource management, human and animal health, etc. developed by indigenous people over centuries. Therefore, it is important to take advantage of indigenous institutions, environmental knowledge and traditional management practices (Desta, 2009a).

Borana rangelands are one of the southern Ethiopia's lowland grazing units in which pastoralists have been keeping their livestock for living. Cattle, goats, sheep, and camels are the dominant domesticated animals in these rangelands. According to Cossins and Upton (1987), the Borana pastoral production in southern Ethiopia was considered until the early 1980s as one of the few remaining productive pastoral systems in East Africa. Since then, there is evidence that the system is experiencing decline in productivity, associated with periodic losses in cattle populations; changes in land use; and fire ban that have resulted in the proliferation of bush encroachment and a general decline in forage production. The present crisis might be the result of the combined effects of climatic variability and increases in bush cover that may increase the risk of drought-induced herd die-offs (Angasa, 2007).

Traditionally, the vagaries of the natural environment can be overcome through access to and management of communal rangelands, mobility of stock, and institutions for mutual assistance. However, drought induced livestock mortality is often seen as a symptom of inherent flaws in livestock production systems; barren rangelands are taken as evidence of unsustainable grazing pressure and increasing land degradation (Tache, 2008).

Therefore, the rationale for this study was to identify major factors that hamper the potential of rangeland productivity and to assess the role of indigenous knowledge in rangeland management.

2. THE STUDY AREA AND METHODS

2.1. The Study Area

The Borana Rangeland is found in Oromia National Regional State, southern Ethiopia. It lies between $4^{o}0'$-$5^{o}30'$ N latitude and $37^{o}30'$-$39^{o}20'$ E longitude. It covers about 95,000 km^2 which is estimated to be 7.6% of the national area. Yabello *Woreda* is found in this category covering about 5556 km^2.

Woreda is located between latitude $4^{0}30'55.81"$ and $5^{0}24'36.39"$N and longitude $37^{0}44'14.7"$ and $38^{0}36'05.35"$ E (Dessalengn, 2009).

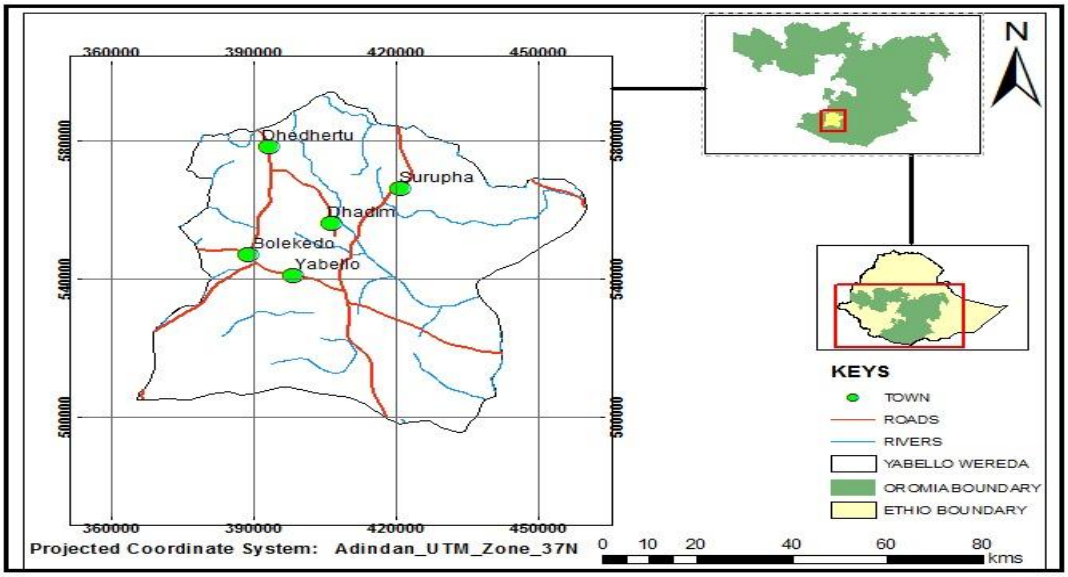

Figure 2.1: Map of study Area.

Source: Developed by the researcher.

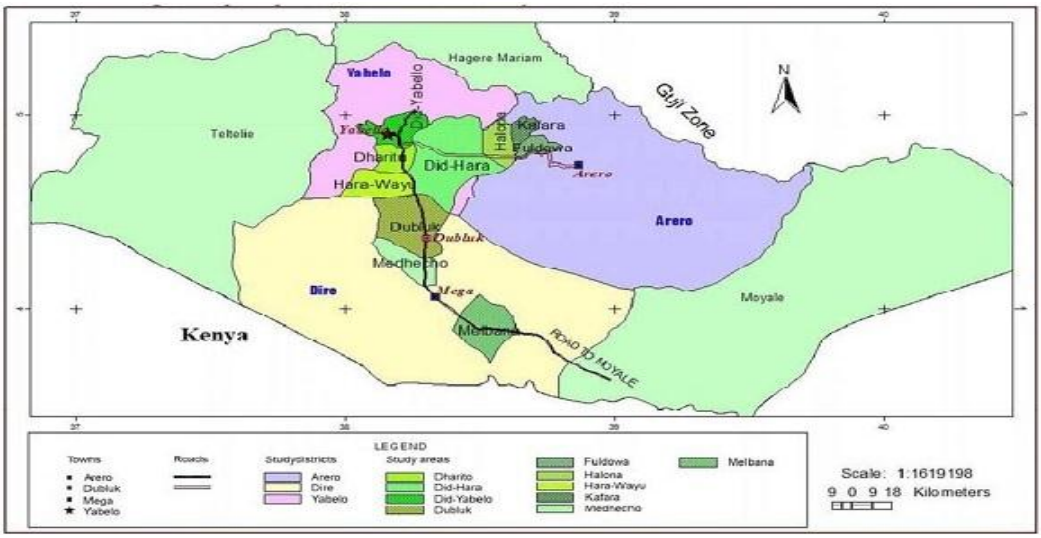

Figure 2.2: Map of specific study sites.

Source: Adapted from Angasa, 2007.

The study area comes under the influence of a bi-modal monsoon rainfall type, where 60% of the 300-900mm annual rainfall occurs during March to May (*Ganna*) and 40% between September and November (*Hagaya*) (BLPDP, 2004 as cited in Zemenu, 2009). Adisu (2009) also cited that, the rainfall of the area is distinctly bimodal pattern.

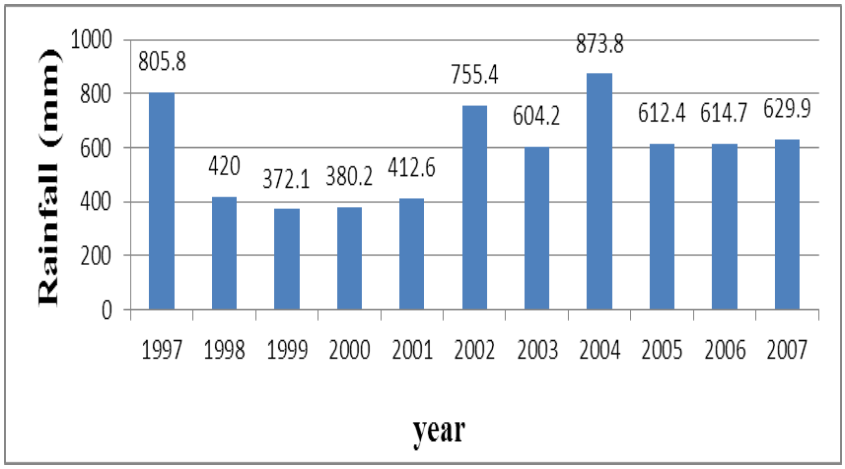

Figure 2.3: Annual Rainfall of Yabello Woreda (1997-2007).

Source: National Meteorological Agency.

2.2. Research Design and Methods

For this study partially mixed concurrent dominant status qualitative decision research design were applied.

Both qualitative and quantitative methods of data analysis were considered. Qualitative data were analyzed by discussion of the ideas, opinion and concepts of collected data. Quantitative data were analyzed by using of SPSS software and Microsoft Excel program. Descriptive statistics and non parametric tests like binomial test and Chi-Square Test for goodness-of-fit were used.

3. RESULTS AND DISCUSSIONS

3.1. Factors Affecting Rangeland Productivity

The primary focus of this chapter is the analysis of major factors affecting the productivity of rangelands, impacts of factors affecting rangeland productivity on pastoralists, role of indigenous knowledge in rangeland management and analysis of major constraints to indigenous knowledge based rangeland management.

From the result presented on (Figure 3.1), almost all of respondents (97%) reported that the productivity of rangeland is declining. In support of this, the results of qualitative data

obtained from respondents indicated that the main factors affecting rangelands productivity in Yabello woreda are rangeland degradation, encroachment of undesired species and trees, overgrazing by livestock, unpredictable and unreliable rainfall, recurrent drought and expansion of crop cultivation. The detail discussion of these factors will be explained in the coming section.

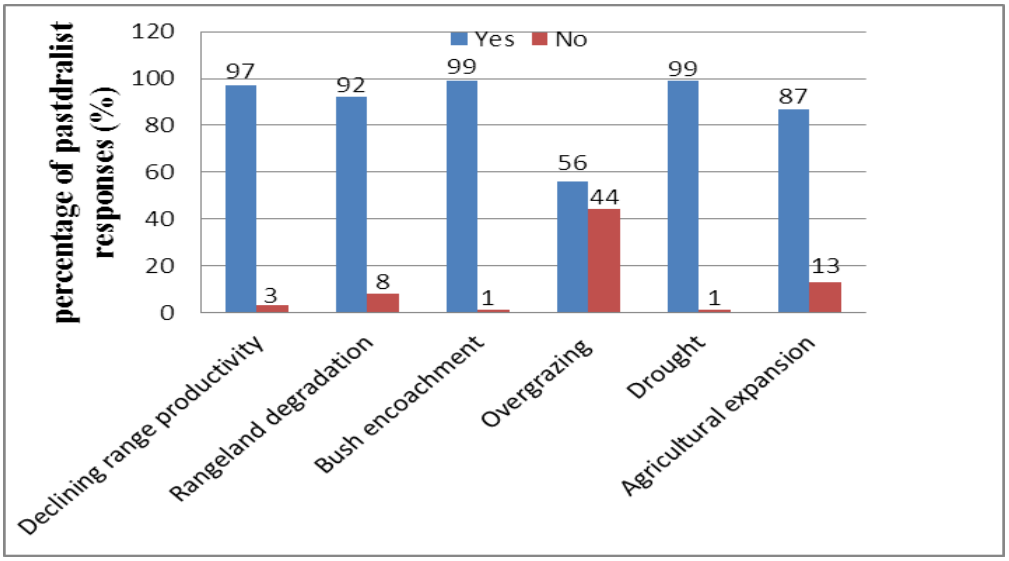

Figure 3.1: Graphs showing responses of pastoralists on factors affecting rangeland productivity.

Source: Own field survey data, April 2013.

Figure 4.1 shows that bush encroachment and recurrent drought are the major factors affecting the productivity of rangeland. For both factors almost all of the respondents replied. The third most important factors affecting the productivity of rangeland is degradation of rangeland in which 92% of respondents replied followed by expansion of crop cultivation (87%). Last but not least, overgrazing (56%) is also raised as one of the factors affecting the productivity of rangeland.

As it is shown in the Chi-Square test for goodness-of-fit, in the first table presented below, the observed frequencies from the current data file are presented, showing that 175 out of 180 (97%) of the respondents reported that there are the decline in rangeland productivity. In the support of this view, Angasa (2007) in the literature stated that, there is evidence that the system is experiencing a decline in productivity. The expected N for this result is 60, while the observed N is 175. The response of the pastoralist is more than expected.

Table 3.2: Summary of Chi-Square Test for goodness-of-fit.

a.

Declining rangeland productivity			
	Observed N	**Expected N**	**Residual**
Yes	175	60.0	115.0
No	5	120.0	-115.0
Total	180		

b. Test Statistics

	Declining rangeland productivity
Chi-Square	330.625[a]
df	1
Asymp. Sig.	.000

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 60.0.

Source: Own field survey data, April 2013.

The test statistics table reports the results of the Chi-Square test, which compares the expected and observed values. In this case, the discrepancy is very high and statistically significant (sig. = 0.000).

A **Chi-Square goodness of fit test** indicates there was significant difference between responses of the pastoralist, reported Yes (97%) for declining rangeland productivity and those reported No (3%) for declining rangeland productivity. This result indicates there is dramatic decline in rangeland productivity. Then $x^2(1,\ n = 180) = 0.000, p < 0.05.$

The result of the descriptive statistics like Minimum, Maximum, Mean, Std. Deviation and Variance of the observed data was presented in the table below.

Table 3.3: The result of descriptive statistics for variables factors affecting rangeland productivity.

	N	**Minimum**	**Maximum**	**Mean**		**Std. Deviation**	**Variance**
	Statistic	**Statistic**	**Statistic**	**Statistic**	**Std. Error**	**Statistic**	**Statistic**
Age	180	17	105	40.69	1.330	17.841	318.292
Sex	180	1	2	1.39	.037	.490	.240
Declining rangeland productivity	180	1	2	1.03	.012	.165	.027

Rangeland degradation	180	1	2	1.08	.020	.269	.072
Bush encroachment	180	1	2	1.01	.008	.105	.011
Overgrazing	180	1	2	1.44	.037	.498	.248
Level of rainfall	180	1	2	1.76	.032	.431	.186
Drought	180	1	2	1.01	.008	.105	.011
Expansion of crop cultivation	180	1	2	1.13	.025	.335	.112
Valid N (list wise)	180						

Source: Own field survey data, April 2013.

The result from (Table 3.3) depicts that, age of respondents with Std. deviation of 17.841 is more dispersed than the other variables followed by sex of the respondents with Std. deviation of .490. Other descriptive information can be seen from the table.

3.1.1. Rangeland Degradation

According to the response of many of the respondents (92%) from study area, rangeland degradation is one of the factors affecting rangeland productivity and its main causes are overgrazing which is caused by increase in number of livestock population and population pressure on rangeland (Figure 4.1.). Grazing pressure is not only factor causing changes in range conditions; other factors include climate and other sorts of human activity. The potential for damage to range conditions from overgrazing is higher when vegetation is stressed and the stocking rate is not significantly reduced.

During analytical discussion with pastoralists of Borana in Yabello woreda many of them repeatedly informed different causes of rangeland degradation. First and for most, livestock number of pastoralists has been increasing than ever everywhere in pastoralist area due to increased veterinary services and values pastoralists have for their livestock. Again increase in population of pastoralists and constant settlement is another cause. From every household of pastoralist of Borana livestock of different groups are released to rangeland every day. Increasing population of pastoralist leads to increase in livestock number which in turn put greater pressure on carrying capacity of rangeland. Because of pressure of livestock on rangeland overgrazing occur. This creates pressure on rangeland.

When we consider the severity of rangeland degradation, according to the responses of the pastoralist, (64 %) of them responded degradation of rangeland is high, (18%) responded as if degradation is severe, while only (17%) and (1%) responded severity of degradation of

rangeland is medium and low respectively (Figure 3.3). Rangeland degradation is said to be severe if adverse impacts on pastoralists in very high and severity is high if impacts of degradation is high.

One of the pastoralists from Dharito kebele tells about rangeland degradation as follows:
Box 3.1: Problems of rangeland as told by an elder

I have been living in Dharito for about five abbaa gadaa regime. I am now 52 years old. When I was a child caring for calve Dharito is one of the best grazing rangelands for livestock. Villages are not too many like today. There are only too few villages in one reera. Number of population is also very small because of sparse nature of settlement. Livestocks not go far from the villages for grazing. There is no expansion of farm land like today and many of today's farm land area are that times grazing head/mata tika. At that time there is no problem. Livestocks have enough forage to graze and their productivities are high and we have a very good product of meat and milks from livestock. Today conditions are not like that. In the gadaa of your time every things has changed. Previously grazing heads are now taken by farm land. Again today due to increase in number of population, livestock number has increased. The productivity of rangeland has decreased due to overgrazing and today the land does not grow grasses like before. Rangelands are degraded everywhere and livestock have few too graze.

Source: own field survey.

As per the ideas of elder mentioned above in (Box 3.1), there are great changes in rangeland condition of Dharito. The ideas of one of the group discussion with pastoralists from Dharito also support the concept by focusing on the issues of rangeland degradation as the main cause of changes in the rangeland condition. The main cause of rangeland degradations and changes in rangeland conditions in Dambala Saden and Harweyu are also the same. Most of the respondents from these kebeles have also confirmed the same issues as causes of rangeland degradation. Overgrazing, permanent settlement of pastoralist at one area and population pressure are raised as main causes of rangeland degradation.

3.1.1.1. Causes of Rangeland Degradation

The data obtained from the analytical discussion with pastoralist, reveals the following issues as the main causes of rangeland degradation.

a. Overstocking and overgrazing

The total number of animals in the study area has been increased; herds are concentrated in pastures near villages and exceed the safe carrying capacity in study area. This has been exacerbated by an increase in household's livestock holdings and the reduction of pastures areas due to bush encroachment, soil erosion and pasture area allocation for cultivation.

b. Permanent settlement of pastoralist at one area

The creation of constant settlements concentrated stockbreeders around cultural and social centers. This creates great impacts on rangelands.

c. Change in the livestock composition:

The growing number of different herd groups can cause the degradation of rangelands. For instance, increased population of camel can trample on grasses.

4.1.1.2. The Consequences of Rangeland Degradation

The results of analysis of group discussion with pastoralist from the study area indicated rangeland degradation manifest in many ways. One of the manifestations of rangeland degradation is as a reduction in the extent of grass cover. Whenever there is rangeland degradation extent of grass cover decline. The impact of degradation of rangeland not only limits itself to the decline in the extent of grass cover, but also density of grass cover and output of forage has been declining. Again degradation manifests itself as increase in unpalatable grass species.

Reduction in amount of grass cover, grass density, decline in forage output and increase in undesirable grass species have great impacts on livestocks which depends on rangeland and pastoralists as well. Most of the pastoralist has repeatedly raised the following issues as the main consequences of rangeland degradation.

- Loss of palatable grass species and decline in forage base.
- Loss of weight of livestock/poor weight livestock
- Death of livestock/livestock become unable to pass from drought
- Increase in unpalatable grass and bush species
- Decline in livestock productivity (milk and meat)

3.1.2. Bush Encroachment: Increasing of Undesirable Species

Almost all of the respondents from study area 99% (Figure 3.1) confirmed that, the main factors affecting the productivity of rangeland in Yabello *woreda* is encroachment of different bushes, trees and shrubs which are unpalatable for livestock to graze.

In the past Borana Rangeland in general and that of Yabello *woreda* as well was not affected by encroachment. Before Gadaa of Jiloo Aagaa (1976-1984) rangelands are in a good conditions and pastoralist control bushes and undesirable species by burning. The results of qualitative in-depth interviews and discussion with pastoralist groups from Dharito, Dambala Saden and Harweyu of Yabello *woreda* indicates that encroachment of bushes were started during Gadaa of Jiloo Aagaa (1976-1984). Since then the cover, types and density and abundance of bushes have been increased from time to time.

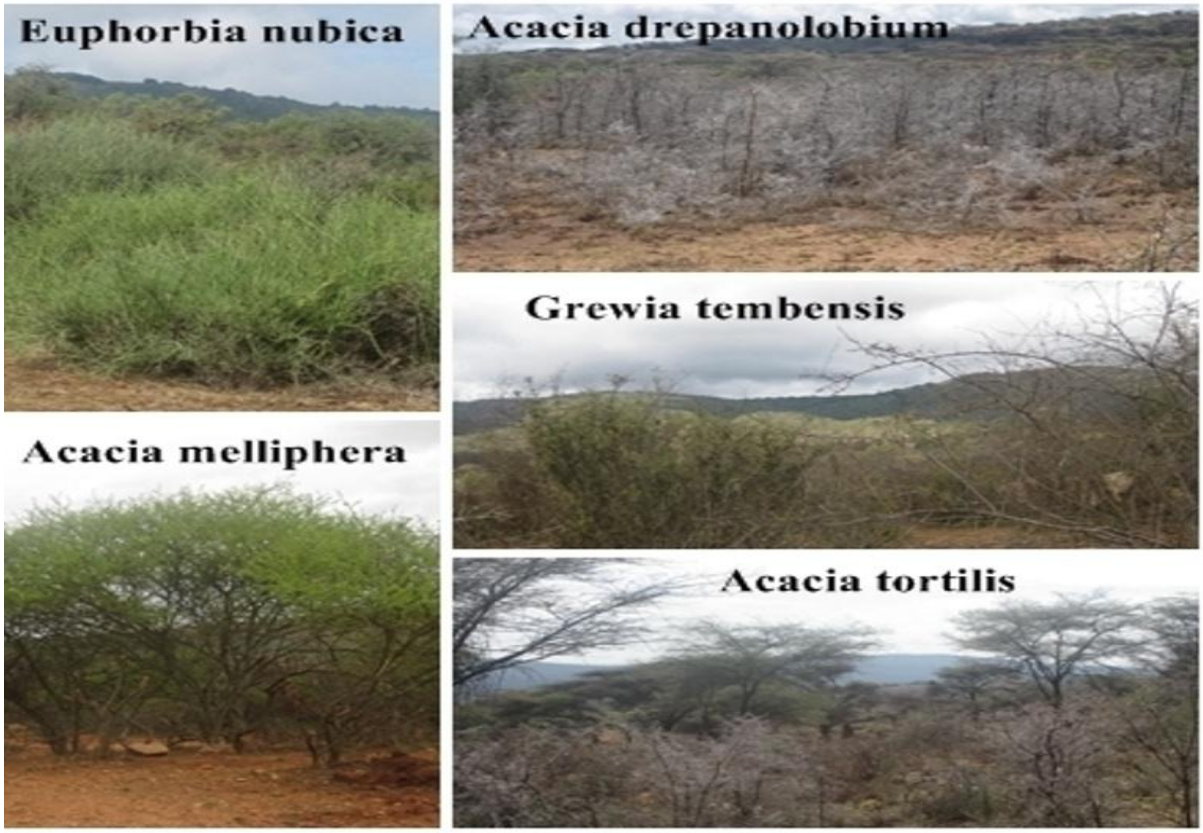

Figure. 3.2: The encroaching condition of different bushes in study area.

Source: Photo by the researcher, March 2013.

Figure 3.2 visualize the encroaching condition of grewia tembensis, Euphorbia nubica, acacia drepanolobium, acacia tortilis and acacia melliphera. Acacia tortilis is not taken the land in every study site. However in some area there is a steady encroaching of its species. In every study sites acacia melliphera has took the area of rangeland. These bushes suppress the grass

species and even hinder the growth of grasses and make the lower ground susceptible to wind and water erosion.

According to the respondents of this study and observation by the researcher through transect walk, different types of encroaching bushes, trees and shrubs were identified. Different types of bushes take the grazing area and suppress the growing of grasses (Figure 3.2).

Table 3.4: Encroaching plant species in study area.

No.	Scientific name	Local name	Growth form	Type
1	Acacia drepanolobium	Fulleensa	S	I
2	Commiphora Africana	Hammeessa	S	I
3	Dodonea angustifolia	Dhittacha	S	I
4	Acacia seyal	Waaccuu	T	NI
5	Euphorbia nubica	Aannoo	GC	I
6	Abutilon hirtum	Gurbii daalattii	S	I
7	Helichrysum glumaceum	Darguu	F	I
8	Acacia melliphera	Saphansa gurracha	T/S	I
9	Acacia brevispica	Hammarreesa	S	I
10	Euclea divinorum	Mi'eessaa	T/S	NI
11	Pyrostrica phyllantheoidea	Ladhana	S	NI
12	Solanum incanum	Hiddii waatoo	F	I
13	Acacia oerfota	Waanga	S	I
14	Acacia bussei	Halloo	T	I
15	Oea europaea subsp. cuspidat	Egersa	T	NI
16	Pappea capensis	Biiqqaa	T	NI
17	Acacia etabaica	Halqabeessa	T	NI
18	Balanites aegyptiana	Badana lu'oo	T/S	NI
19	Solanum somalense	Hiddii gaagee	F	I
20	Sansevieria ehrenbergii	Cakkee	S	I
21	Lippia carviodora	Urgoo	F	I
22	Aloe species	Hargeessa	S	I
23	Grewia bicolor	Harooressa	S	I
24	Barleria spinisepala	Qilxiphee	F	I
25	Acacia reficiens	Sigirso	T	I
26	Acacia Senegal	Hidhaadho	T	NI
27	Delonix baccal	Baallanjii	T	NI
28	Dombeya aethiopica	Siltaachoo	T	NI
29	Cissus rotundifolio	Cophii koora	GS	NI
30	Cordia siriensis Lam.	Madheera raphachoo	S	I
31	Acacia tortilis	Dhadacha	T	I
32	Boscia mossambicensis	Qalqalcha	T	NI
33	Rhus species	Daboobessa	S	NI
34	Acacia goetzei	Burraa	T	NI
35	Carissa edulis	Dhagamsa	S	I
36	Acacia nilotica	Burquqqee	T	NI

37	Lannea rivae	Handaraka	T/S	NI
38	Grewia villosa	Ogondii	S	NI
39	Ormocarpum trichocarpum	Buutiyee	S	NI
40	Psydrax schimperiana	Gaallee	T	NI
41	Grewia tembensis	Dheekkaa	S	I
42	Phyllanthus sepialis	Dhirrii warseesoo	S	I
43	Barleria argentea	Agaggaroo harree	F	I

Note: Growth form: Tree (T), Shrubs (S), Tree or Shrubs (T/S), Forbs (F), Ground cover (GC) and Grown with shrubs (GS). Type: Invasive (I) and Non-invasive (NI).

Source: Own field survey data, April 2013.

Table 3.4 clearly indicates the growth forms and type of encroaching species. Growth form of the encroachers are tree, shrubs, that can be both tree and shrubs, forbs, those grown on the ground and those that grow wish shrubs. Almost all of the encroachers are different types of shrubs followed by trees. Regarding type of the bushes most of them are invasive species except few non-invasive species. For instance, Acacia drepanolobium, Commiphora Africana, Dodonea angustifolia, Acacia melliphera and others are the most invasive species. Other than this some non-invasive species are Acacia seyal, Acacia nilotica and many others.

3.1.2.1. Characteristics of Woody Species

The result from the qualitative interviews, discussions and observations through transect walk in study area indicated different characteristics of bushes in study area. Some of the bushes grown close to one another and hinders movement of peoples and livestocks as well. Other groups of bushes grown on the ground cover the grounds and suppresses the growing of grasses. Again some of them are invasive and take the grazing area quickly. The invasive species were critically identified from that of non-invasive species. Invasive species are area specific and respondents reported that one species was invasive at one site while not at other site. In each of the study sites invasive species has identified. For instance, from all of three study sites Acacia melliphera (saphansa), Acacia drepanolobium (Fulleensa), euphorbia nubica (Aannoo waraabessaa), dodonea angustifolia (Dhitacha), Acacia oerfota (waangaa), Acacia bussei (halloo), commiphora Africana (hammeessa), and etc. are the most invasive species (Table 4.4).

3.1.2.2. Causes of Bush Encroachment

As it was said in the introduction parts of this chapter, bush encroachment is one of the main factors affecting rangeland productivity in Yabello woreda. Before Gadaa of Jiloo Aagaa (1976-1984), there is no problem of bush encroachment in Borana. But today according to the

response of many of the respondents, it seems one of the consequences that happened following the misunderstanding of indigenous bush management system. There are many factors, which are raised as causes of bush encroachment in the study area. These factors all together, resulted in wide bush coverage, which expands through time and takes rangeland area. As the results from personal interview and group discussion with pastoralists and herders showed the major causes of bush encroachment are the following:

A) Ban of Prescribed Fire

According to the result of discussion with Borana pastoralist, traditionally they used controlled burning as a bush management techniques. During early growth, the encroachers were burned with fire and killed by repetitive burning. Fire limits tree recruitment and makes different bushes to disappear. Burning also helps to stimulate the growth of new grass shoots, and destroys unpalatable dried and very mature grasses and undesired bushes. The grasses that grow following controlled burning are very palatable for livestocks to graze and usually called *guba* (pastures grown after burning) in local naming.

However, the continuity of this traditional indigenous range management system were disturbed by implementation of the law that prevented rangeland burning. Since 1970, Dergue regime banned the burning of rangeland. This time is during Gadaa of Gobba Bule (1968 – 1976). This period is perceived to have promoted the rapid expansion of bush encroachment. Since then, unpalatable grass/herb/shrub/bush species got the chance to grow. Most of them are not palatable for most livestock, and they suppressed palatable grass species, and began to dominate.

B) Overgrazing

Overgrazing is the utilization of rangelands beyond their carrying capacity and optimum grazing frequency. It is one of the factors affecting rangeland productivity and cause of bush encroachment as well. It is associated with the increasing number of both human and livestock population. The degree of grazing strongly affects the structure, composition and quality and productivity of rangeland vegetation. High degree of grazing in study area makes degradation of rangeland and allows growth of undesirable bushes.

C) Environmental Stress

Some of the pastoralists indicated that, recurrent drought occurring in the study area as part and Borana in general gives rise to conducive environment for the encroachers. Most of the

time in the study area there is insufficient rainfall due to its failure during *ganna* and *hagaya*. Hence, grasses do not have a deep root, which traps water from the deep soil, shortage of rainfall limits the growth of grasses there will be the chance for encroachers and exotic species to grow.

3.1.2.3. Effects of Bush Encroachment

Most of the respondents for this study pointed out that, bush encroachment has an adverse effects on the ecosystem and the environment. The expansion of unpalatable woody species significantly reduced the rangeland size and availability of grasses. Specially, as indicated by most of the respondents from Harweyu, rangeland has fragment into many parcel because of encroachment of bushes. The same thing applies for both Dharito and Dambala Saden. The movement of peoples and livestock in bushes is difficult. In addition, the bush prohibits access of livestock to the underlying grasses and as the canopy closes the grasses and herbs disappear letting the ground susceptible to water erosion.

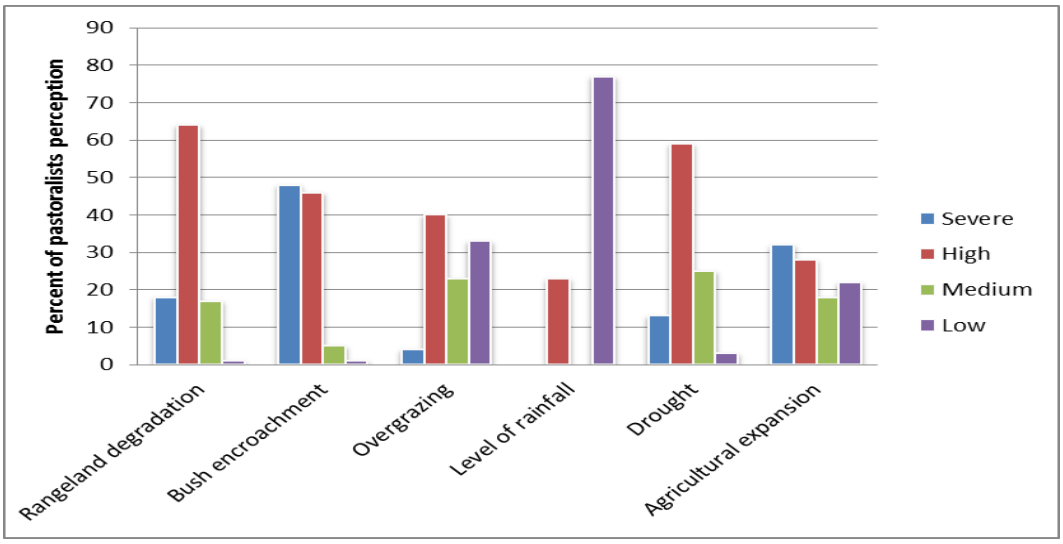

Figure 3.3: Graph showing perception of pastoralists on severity of factors affecting rangeland productivity

Source: Computed based on own survey data.

As it can be seen from the (Figure 3.3), the severity of encroachment of the bushes, according to the responses of the pastoralist (48 %) is severe. Some of the respondents (46%) responded as if encroachment is high, while only (5%) and (1%) responded severity of encroachment is medium and low respectively.

3.1.2.4. Control Method of Bush Encroachment

Pastoralists from all of study sites repeatedly rose as bush encroachment is common problem in their area. The causes and effects of bush encroachment were discussed earlier in the above section. Their indigenous system of burning range has banned during dergue. Even though controlled burning is taken to be against the government policy, the perception of pastoralists on control method of bush encroachment has inclined towards rangeland burning and bush clearing. Borana pastoralists further asserted as there are no other techniques to overcome encroachers other than burning and clearing.

Different government and non-governmental organizations have been trying to reduce bush expansion in the study area. The main control mechanism, which has been tried by almost all organizations is clearing through cutting. This is executed through food for work and cash for work programmes. After the bush is cleared, it is piled for burning. So far little attention was given to bush encroachment. Currently, its adverse effect on the performance of the pastoral economy is being acknowledged. Local and international non-governmental organizations and some governmental departments are conducting range rehabilitation, involving burning and hand clearing of woody species along highways and near settlements, on an experimental basis.

3.1.3. Overgrazing

Majority of respondents of this study 56% (Figure 3.1) reported that, there is problem of overgrazing in the study area. According to their responses, most of areas of rangeland in study sites were taken by bush encroachment and expansion of farm lands. When we consider its severity, overgrazing in the study area is said to be high (Figure 3.3). Due to this the area of rangelands has been declining from time to time. Again human population and livestock population has been increased at an alarming rate. Almost all of the households send livestock to grazing area. From one village a minimum of more than one ***karra*** livestock was send to grazing head of each site. Livestock number increase from time to time and become beyond the capacity that grazing areas can handle. Overgrazing implies that the stocking rate on a given pasture is too high.

3.1.3.1. Effects of Over Grazing

Overgrazing is considered to be the major cause of soil degradation worldwide. In the study area over grazing by livestock has removed grass cover from many grazing area. This has made the soil susceptible to the effects of water and wind erosion. Again overgrazing results

in reduced infiltration and accelerated runoff and soil erosion. Grazing animals also have an effect on the botanical composition by trampling and selective grazing. Furthermore, animal faeces and urine change the element content of soil and plants. High grazing pressure also decreases plant density, grass cover and often accelerates the invasion of unpalatable species.

Figure 3.4: Overgrazing and degradation condition.

Source: Photo by the researcher, March 2013.

From (Figure 3.4) it can be visualized that the problem of rangeland degradation and overgrazing is severe. This photo is taken from one of traditional enclosure. The roots of grasses were uprooted by overgrazing. During the time of rain the top soil became susceptible to water erosion. This is because of reduced infiltration capacity of soil which leads to surface run-off.

Overgrazing may be controlled when pastoralists move out their livestock from grazing areas to allow re-growth of pastures. During the periods of fast growth, overgrazing will occur if livestock are kept in permanent grazing areas for many days.

According to response of many pastoralists from study area, overgrazing may be controlled by minimizing number of livestock, moving by livestock to the areas where forage is available and diverting direction of livestock daily grazing/*bobbaa jijiiruu*

3.1.4. Insufficient Amount of Rain: Unreliable and Erratic Rainfall

According to results of response of household survey for level of rain fall 77% of them responded that amount of rain in their area is low (Figure 3.3). Again in the results obtained from key person interviews with elders and group discussions with elders and herders,

variability in rainfall is raised as one of the factors affecting rangeland productivity. In all of the study sites rain fall occur at about two times in a year. Thus, study area fall under the bimodal rainfall. According to the woreda pastoral development office amount of rain in study area is between 500-600mm. The short rainy season is *Hagaya* that rain between September and November and *Ganna* is long rainy seasons that fall from March to May. Pastoralists further explained that, land use is influenced by landscape types, water and grazing resources. Strategies of grazing are flexible. Grazing management depends on cumulative knowledge of the range resources and distribution of rainfall. The Borana year is divided into two rainy seasons and two dry seasons. Large amount of annual rainfall is expected during the *ganna* and less amount during the *hagaya*. The interim cool season between the *ganna* and the *hagaya* is *hadolesa*. The hagaya is followed by long dry season (*bona hagaya*). The short *hagaya* rains were failed. The long *ganna* rains were insufficient and poorly distributed. The grazing seasons to be grazed are different for all of the study sites. For instance in Dharito site, *Gombo Mountain* is taken to be as dry season grazing and *Kara Hammeessa* is wet season grazing. The dry season grazing is controlled by customary institution and kebele leaders. They are found in the mountainous area and control of livestock grazing make it to be reserved for grazing. Movements to the dry season involve both *warra* (milk herds) and *foora* (mobile herds) livestock. At that time the intensity of grazing become high and overgrazing occurs. As availability of forage resources decline *foora* livestock began to move to other grazing zones. During rainy season in Dharito livestock was taken to *Kaara Hammeessa* for grazing. Livestock that graze in *Kaara Hammeessa* are *loon warra*. Again for Harweyu the wet season grazing are *Gooro hara jiloo* and *aarra* and dry season grazing are *Didibissa* and *Diroona* Mountain. Dambala Saden has also its own wet and dry season grazing land. The main dry season grazing areas are *Siiqu, Hara hawaxxuu, Kooticha hawaayyee* and *rukkeessa.* However the main wet season grazing for Dambala Saden are *Hara Sora, Kuphii (*one part of *siiqu), Gaddaa* and *Dambalaa.*

Sometimes failure of *Hagaya* rain and insufficient amount of *ganna* rain may lead to recurrent drought which has adverse impacts on the livelihoods of pastoralist and productivity of rangeland.

3.1.5. Drought

During analytical discussions with different groups of herders and elders pastoralists were repeatedly raised the issues of recurrent drought as it is another factors affecting the productivity of rangelands. Almost all of surveyed households 99% (Graph 3.1) responded

that recurrent drought is the main problem in their area. Everywhere in the study sites it is the common phenomenon. When we consider its severity, drought in the study area is said to be high (Figure 3.3). They have faced the drought for the last six month. Borana year is divided into two rainy seasons and two dry seasons. Large amount of annual rainfall is expected during the *ganna* and less amount during the *hagaya*. The interim cool season between the *ganna* and the *hagaya* is *hadolesa*. The *hagaya* is followed by long dry season (*bona hagaya*). The *Hagaya* rain was failed and followed by *bona hagaya.*

Pastoralist knows that drought is coming by depending on their calendar of year. There are two dry seasons in Borana in general and Yabello woreda in particular. The long dry season (*bona hagaya*) and the interim cool season (*hadolesa*) are the two dry seasons. Drought occurs when the normal pattern of rainfall is disrupted and the expected wet season extends into the dry season. If the ganna and the hagaya rains fail, combined dry seasons create severe stress. The forage fails to grow, livestock is deprived of food and their productivity becomes reduced, while mortality rises.

3.1.5.1. Indigenous Drought Coping Strategies

The Borana have comprehensive knowledge of drought. They call drought *oola* that means failure of rain when expected. The pastoralist uses different methods to cope with drought. Some of the indigenous drought coping mechanism will be discussed hereinafter.

A) Drought Grazing Reserves

According to the perception of many of the pastoralists from study area, drought coping mechanisms depend on the security of the resource and on adherence to the traditional values. The community at the *Ardaa* and the *Dheeda* levels co-operate to improve drought survival. Majority of the livestock are sent to the *foora* herd management system. Access to drought grazing reserves is crucial. For example, the Dharito community has grazing reserves at mountainous rangelands. The community takes livestock to the Dharito wells during periodic droughts. In the Dambala Saden, drought was also a major threat. Borana in Dambala Saden, Harweyu and Dharito as well escape from past drought in *Dirree* grazing zone. The preservation of drought reserve was by a community wide grazing control.

B) Household food security networks

The result from qualitative discussion with pastoralists indicates that, at household level, families of different wealth ranks depend on each others' resources for survival in order to

escape from drought impacts. Poor households depend on wealthy households. The dependency is mutual, with each household in the network reciprocating. This type of network is exclusive to women. The household reciprocal relationship is called *marro* or simply "giving in turn". Pastoralists further explains that, sharing of *marro* involves exchange of minor food items and services. The giving and taking establishes networks. Sustenance of the relationship depends on continuous exchange of goods and services. When this fails for one or another reason, the relationship becomes dormant. *Marro* sharing between people who are related by birth or through marriage become an occasional affair. This type of sharing can be extended to all relatives.

C) Bulking grains

Pastoralist from study area repeatedly rose that, a common practice for the pastoralists during the drought is to sell livestock and buy grains from the market during the dry season when food from livestock (i.e. milk and meat) is inadequate. During the dry season, the price of grains would rise against livestock prices. Due to this many of the pastoralists responded that, when hard drought is expected, they sell their livestock during the time when their price is high.

For the security of their livestock pastoralist responded that it is better when they reserve the straw of grains like that of maize, wheat and teff during harvest.

D) Collecting *okaa*

According to the responses of many of the pastoralists from the study area, in order to escape by their livestock from the drought the first option is mobility by livestock to other areas in Borana which has not stroked by drought. Other than this for weak cows (*dullacha laafa*) and calves (*waatiyyee*) pastoralist's women and men collects the grasses. They collect the grasses and leaf of trees that livestock can eat, from the area where the livestock cannot graze. The collected grasses were piled and given at the village in the night.

3.1.6. Expansion of crop cultivation

Among sample households, 87% of them involved in crop cultivation. Pastoral communities throughout the study area are turning to crop cultivation in addition to livestock management. Although the participation of pastoral households in crop cultivation is generally accepted as livelihood diversification in response to economic stress, the rapid expansions of cultivated land have been taking the area of rangeland. According to the Yabello *Woreda* Pastoral

Development Office, 2013 about 11, 971 he of the land of woreda was cultivated land. According to the ideas of some of the respondents from the study area agricultural expansion is said to be severe (Figure 3.3).

Almost all of respondents from Dharito and Dambala Saden have been cultivating the land. The expansion of farm land has been taking the area of rangeland in their area. The communities in Harweyu engaged predominantly in pastoral production, with evidence of recent adaptations of crop cultivation while maintaining livestock mobility. The measures that have been taken in order to minimize expansion of cultivation to rangeland are not this much. The only measures taken is the decision made by *Raba gadaa* to arrange settlement and demarcate settlement area and grazing area.

Generally, the binomial test was conducted for the factors affecting rangeland productivity. The result was presented in the table below.

Table 3.5: Table showing binomial test for factors affecting rangeland productivity.

Variables	Category	N	Observed Prop.	Test Prop.	Asymp. Sig. (2-tailed)
Sex	Male	109	.61	.50	.006[a]
	Female	71	.39		
Declining rangeland productivity	Yes	175	.97	.50	.000[a]
	No	5	.03		
Rangeland degradation	Yes	166	.92	.50	.000[a]
	No	14	.08		
Bush encroachment	Yes	178	.99	.50	.000[a]
	No	2	.01		
Overgrazing	Yes	100	.56	.50	.157[a]
	No	80	.44		
Level of rainfall	Low	136	.76	.50	.000[a]
	High	44	.24		
Drought	Yes	178	.99	.50	.000[a]
	No	2	.01		
Agricultural intensification	Yes	157	.87	.50	.000[a]
	No	23	.13		

a. Based on Z Approximation.

Source: Computed based on own survey data, April 2013.

The Binomial test was conducted to compares the observed frequencies of the two categories of a dichotomous variable to the frequencies that are expected under a binomial distribution with a specified probability parameter. By default, the probability parameter or test proportion for all variables and categories has become 0.50. The probability of observed proportion varies for the categories of each variable. For instance, the observed proportion for decline in rangeland productivity as responded by the pastoralist for the first and second category is 0.97 and 0.03 respectively. Similarly the observed proportion for bush encroachment for the first and second category is 0.99 and 0.01 respectively. The observed proportion for all variables can be observed from the table. The result of observed frequencies for all variables supports the ideas of the pastoralists, says all factors affects the productivity of rangeland in study area. For this test (Binomial test), the observed proportion is more than test proportion. This is statistically significant for 0.05 level of precision and 95% confidence level.

3.2. Impacts of Factors Affecting Rangeland Productivity

According to interviews and group discussions made with elders and pastoralists from study area, the factors affecting the productivity of rangelands discussed above has several impacts. Almost all respondents (94%), of sample household confirmed the issue. First and for most, livestock sectors of pastoralist are affected. Livestock become physically poor due to drought and unreliable rainfall in which forage fail to grow. During drought water is far from the village. For instance, in Dharito livestock from Dharito and other nearby area was taken to *Eellan* Dharito (Dharito shallow wells). The well has steep stony slopes on which week livestock made it difficult to move on and fail sometimes. When livestock weight decline as a result of drought and erratic rain fall, pastoralist fail in tension of from where they can find forage for their livestock. Again the price of livestock decline due to their being physically poor as a result of drought. Many of respondents from study area responded that, during drought physically poor livestock do not buy even water (*bishaan hin bitu*). Water is life and priceless. Pastoralists compare the price of livestock during drought with water as if livestock sold when they are physically poor are like they are given free. Pastoralists further explained that, decline in rangeland productivity brings about death to livestock and decline in the livelihoods of pastoralist. During the time when drought is stress, physically poor livestock dies. During drought and decline in rangeland productivity crops fails to grow because of insufficient and variable rainfall. The only choice of pastoralist is to sell their physically poor

livestock at minimum price. During drought the price of grains raise against the price of livestock and it become difficult for pastoralists to survive.

Decline in rangeland productivity has impacts not only on the livestocks and pastoralist's livelihoods. During analytical discussions with elders many of them repeatedly raised that, many of factors like encroachment of bushes, overgrazing, rangeland degradation, erratic rainfall and drought has great impacts on forages of livestock. For instance, bush encroachment suppresses the palatable grasses and allows the growth of undesirable species. As a result of overgrazing which brings about the degradation of rangeland palatable grasses fail to grow and encroachment of bushes follows. Factors live bush encroachment and expansion of cultivated land brings about rangeland fragmentation.

Fragmentation of the rangeland into spatially isolated units results from actions that are intended to enhance human livelihoods and well-being some times. As of respondents from Dambala Saden and Dharito causes fragmentation of rangelands in their area are expansion of farm land and encroachment of the bushes. Pastoralists from Harweyu raised bush encroachment as main causes of rangeland fragmentation. Pastoralist further raised that, the main cause of fragmentation of rangeland are breakdown of pastoral system (Ik) due to state marginalization, large scale bush encroachment, expansion of cultivated land, population pressure and increase in number of villages.

Rangeland fragmentation has several impacts. Degradation of rangeland is one of the impacts of fragmentation of rangeland. Again the potential of rangeland to grow forages as a result of factors affecting rangeland productivity has declined. Many of pastoralists informed that, today rangeland is not giving forage when compared to before. This is mainly due to decline in rangeland productivity.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1. Conclusions

The study showed different factors affecting rangeland productivity, impacts of these factors on the livelihoods of the pastoralist, role of pastoralist's indigenous knowledge in managing rangeland and major constraints to IK-based rangeland management. This study showed that, the main factors affecting productivity of rangeland in the study area are degradation of rangeland, Encroachment of bushes, overgrazing, and erratic and unreliable rain fall, recurrent drought and expansion of crop cultivation into the areas of rangeland. Rangeland

degradation can be manifested as a decline in the primary productive capacity of rangeland resources. Decline in productive capacity and degradation of range condition has considerable impacts on the productivity of rangelands. The severe problem to the productivity of rangeland is the encroachment of undesirable bushes into rangeland area and recurrent drought. Bush encroachment leads to reduction in the size of rangeland and availability of grasses. Again bushes suppress grass species and even hinder the movement of peoples through it. The major encroaching species were Acacia melliphera, Acacia drepanolobium, euphorbia nubica, dodonea angustifolia, Acacia oerfota, Acacia bussei and commiphora Africana. Another problem to the productivity of rangeland is overgrazing. The pressure of livestock on the rangeland reduces the availability of forage. Failure of *hagaya* rain and insufficient of amount of *ganna* rain leads to the decline in forage bases. Recurrent drought is another bottleneck to the rangeland productivity in which forages fail to grow and livestock become physically poor. Encroachments of crop cultivation into former rangeland area reduce the areas of rangelands to parcels. Decline in rangeland productivity, failure of the grasses to grow, physically poor livestock, and decline in pastoralist livelihoods are the main impacts of factors affecting rangeland productivity.

4.2. Recommendations

The productivity of rangeland in the study area is declining. This is because of many interrelated factors like bush encroachment, rangeland degradation, overgrazing, recurrent drought, erratic rainfall and expansion of crop cultivation. This has also considerable impacts on the livelihoods of pastoralist and rangeland productivity. The unique knowledge of community in rangeland management is also not functioning well. Therefore, the following recommendations are made for the future interventions by the researcher.

- The problems affecting the productivity of rangeland should explicitly be regarded as community and societal problems and not simply the only concern of pastoralist. This mean it should be the concern of all stakeholders: government, private sectors, any local and international NGOs, pastoralists, public and etc.
- Bush encroachment and recurrent drought are the major factors affecting the productivity of rangeland. Bush encroachments should be prevented by clearing of undesirable species and prescribed burning in a way that has no adverse effects on rangeland ecology and community at large. Different bush encroachment control methods should be tested by

rangeland expert of the *Woreda* in accordance with environmental and social acceptability.

- In order to reduce the impacts of recurrent drought on pastoralists NGOs and *Woreda* Administration should take responsibility of helping pastoralist in time of difficulty. Pastoralist's indigenous drought coping mechanisms should be strengthened and supported by policy at regional and national level.
- Impacts rangeland problems induce on pastoralist livelihood should be taken as whole community problems. Government and NGOs should give considerable attentions to pastoralist during the time in which the productivity of rangeland and pastoralist decline.

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