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PROSPECTS AND CHALLENGES OF ECOTOURISM DEVELOPMENT IN LAKE TANA BIOSPHERE RESERVE: THE CASE OF BAHIR DAR CITY ADMINISTRATI

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COLLEGE OF AGRICULTURE AND ENVIRONMENTAL SCIENCES

DEPARTMENT OF RURAL DEVELOPMENT AND AGRICULTURAL EXTENSION

FARMERS' PERCEPTION AND PRACTICE ON THE SHIFT FROM FREE GRAZING TO ZERO GRAZING OF LIVESTOCK: LESSONS FROM SELECTED WATERSHEDS OF WEST GOJJAM ZONE, AMHARA REGION

M.Sc. Thesis

BY

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APPROVAL SHEET

As Thesis research advisor, I hereby certify that I have read and evaluated this Thesis which was prepared, under my guidance, by Molla Haile entitled "**Farmers' Perception and Practice on the Shift from Free Grazing to Zero Grazing of Livestock: Lessons from Selected Watersheds of West Gojjam Zone, Amhara Region"**. I recommend that it to be submitted as fulfilling the thesis requirement.

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As member of the Board of Examiners of the M.Sc. Thesis open defense examination, we certify that we have read, evaluated the Thesis prepared by Molla Haile and examined the candidate. We recommended that the thesis be accepted as fulfilling the requirement for the Degree of Master of Science in Rural Development management.

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DECLARATION

I declare that this Thesis is my own work and that all sources of materials used for this Thesis have been duly cited and acknowledged. This Thesis has been submitted in partial fulfillment of the requirements of MSc Degree at Bahir Dar University. I declare that this Thesis is not submitted to any other institution for award of any academic degree, diploma, or certificate.

Name: Molla Haile

Signature: _____

Bahir Dar University, Bahir Dar

Date of Submission: _____

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DEDICATION

I dedicate this thesis manuscript to my father Mr. **Haile Biru**, my mother **Asmarech Haile,** and **Shaleka Kegne G/Meskel,** for nursing me with affection and love.

ABBREVIATIONS/ACRONYMS

ACSI	Amhara Credit and Saving Institutions
ANRS	Amhara National Regional State
AI	Artificial Insemination
BoARD	Bureau Of Agriculture And Rural Development
CHAWS	Community Based Animal Health Workers
CSA	Central Statistical Authority
EB	Ethiopian Birr
ESAP	Ethiopian Society of Animal Production
FAO	Food And Agriculture Organization
FGD	Focused Group Discussion
GDP	Gross Domestic Product
Ha	Hectare
IGAD	Inter-Governmental Authority on Development
ILRI	International Livestock Research Institute
MASL	Meter Above Sea Level
MoA	Ministry of Agriculture
MoFED	Ministry Of Finance and Economic Development
NGO	Non-Governmental Organizations

NPC	National Plan Commission
SPSS	Statistical Packs for Social Science
SWC	Soil and Water Conservation
SWCS	Soil and Water Conservation Structures
TLU	Tropical Livestock Unit
TV	Television
WLRC	Water and Land Resource Center
WOARD	Woreda Office Of Agriculture And Rural Development

Abstract

The main objective of this study was to assess opportunities and challenges and livestock production practices under zero grazing system of livestock in the selected learning Watersheds of West Gojjam Zone of Amhara Region.. The study was conducted in the learning watersheds of west Gojjam Zone, Amhara Region; namely Debre Yakob and Aba Gerima. The study watersheds were selected based on multistage sampling technique. A total of 200 households were selected based on systematic random sampling technique. The collected data was coded and entered into the computer by using SPSS V.20 program for analysis of descriptive statistics like mean, mode, standard deviation and frequency. Statistical tests like independent sample t-test and chi-squared tests were done to test mean and occurrence comparison among adopter and non-adopter farmers of zero grazing system.Likert scale, with five point measurements scale technique was used to scale and quantify the level of farmer's perception. The analytical result showed that the current implementation approach of zero grazing was through money enforcement mechanism, which ranges from 50 to 200 EB penalties per grazing animal per day. The research result revealed that there is a good understanding and perception on the disadvantages of free grazing and the advantages of zero grazing. There are also challenges of zero grazing implementation which were shortage of land for private grazing and feed production and shortage of animal power source for crop production. On the other hand the watershed development created an opportunities for the production of improved feed at different niches, government focus on the cross breeding, experience of livestock sharing and availability of ground water. Adoption of zero grazing can be successful without any enforcement mechanism, by increasing training and awareness creation works on the zero grazing, increasing forage and water availability, improving local livestock breed and increasing farm mechanization for crop production should be planned and implemented.

Key words: *Zero Grazing, Free Grazing, Learning Watersheds and West Gojjam Zone*

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CHAPTER1. INTRODUCTION

1.1. Back Ground and Justification

Ethiopia has a largest cattle population in Africa with the estimated population size of 57.83 million cattle, 28 million sheep, 28.6 million goat, 1.23 million camel, 60.5 million poultry, 2.1 million horses, 0.4 million mule and 7.88 million donkey (CSA, 2016). While there is abundant livestock population, because of population growth, rising income and urbanization, the demand for livestock products such as milk, meat and egg become increased and not satisfied in Ethiopia (Smith, 2013). On the other hand the production and productivity of livestock is very low due to different reasons. Among various reasons, shortage of feed both in quality and quantity was the major problems that affect the overall livestock product and productivity (Adugna Tolera *et al.,* 2012).

The dominant source of feed is natural pasture, improved forage and browse with its different nutritive values (CSA, 2012). The country's total area of grazing land is estimated about 61 to 65 million ha, of which 12% hectare is found in mixed farming system and the rest is found in pastoral areas (Alemayehu Mengistu, 1998). The feed sources gained from grazing lands are communally owned and administered by the community (Gebremedihin Sintayehu *et al.,* 2013). Even the availability and quality of feed depended up on the agro-ecology, the type of crop produced, accessibility and production system was different across areas (Ahmed Hassen *et al.,* 2009). The use and status of communal and private grazing lands as a livestock feed resources has been declined overtime (Benin *et al.,* 2003).

The main reason for depletion of grazing land is free grazing of animals under the natural condition. Free grazing of animals means free scavenging of livestock without any time and space restriction. In addition to feed shortage, free grazing contributes more for soil erosion and land degradation (Alemayehu Mengistu, 2006).

To solve such problems different methods of feed production and management system has been promoted especially in developed watershed areas of Amhara Region and other parts of the country (Malede Birhan & Takele Adugna, 2014). Zero grazing or stall feeding is one of

the feeding systems that prevent the livestock from free grazing (Wilson, 2014). Zero grazing also helps to address the issues of land degradation, low productivity of livestock, low quality and quantity of fodder, disease expansion and inbreeding between free grazing livestock.

In Amhara Region, zero grazing system mainly implemented through enclosing the communal grazing lands and putting communal enforcement measures/community by-laws on livestock owners in order to enforce them to keep their animals indoor and to practice animal feeding through cut and carry system. However, there is high challenge and cost on the implementation of zero grazing. Because farmers' perception towards free grazing and zero grazing system do not further studied and improved (McCarthy *et al.,* 2001).

Since 2012, the project named "Water and Land Resource Center (WLRC)" launched an integrated learning watershed development project in five selected watershed areas of Amhara Region and other areas of Oromia Region. Promotion and implementation of zero grazing system holds a key part of the watershed development program. Therefore, this study was conducted to assess the issues raised by the farmers' and different development practitioners, related to opportunities and challenges to promote and implement zero grazing systems in the selected learning watershed areas.

1.1. Statement of the Problem

Natural pasture is the major source of feed for livestock, and their productivity almost depending on it (CSA, 2016). However, the communal grazing areas don't fulfill both the quality and quantity requirements of animals particularly in the dry season (Berhanu Gebremedihin *et al.,* 2009). Mostly communal grazing areas were allocated at marginal lands because of the qualitative and quantitative productivity is very low (Samuel & Jon, 2002). Even though the potential grazing areas have been allocated for grazing purpose, which reallocated for crop production purpose especially it's given for rural youths.

According to the study of Adugna Tolera *et al.,* (2012), free grazing and overstocking has a problem of deforestation and environmental degradation, which substantially reduce soil

fertility and productivity of land. Currently free grazing causes a grazing land productivity and livestock productivity decrease and increase in disease transfer among animals. The effects of free grazing become severe on the cropping areas of developed watersheds because the established soil and water conservation structures and plantations become disturbed.

Implementation of zero grazing is a key recommended feeding technique by different scholars (Elias Zerfu *et al.*, 2017). Promotion of zero grazing and producing hay from the grazing lands has been started over past long years in Amhara Region and other parts of the country. But there is high resistance by farmers' to accept it without any enforcement mechanism.

The sustainable use of grazing lands depends on the understanding of the extent of the rangelands deterioration, and how can these grazing areas be restored (Solomon *et al.*, 2006)

Identifying possible challenges, opportunities and farmers' perception and practices on the implementation of zero grazing system was not well documented. This research identified the major positive and negative factors that contribute to the implementation of zero grazing in the selected learning watershed areas of western Amhara Region.

1.2. Objectives of the Study

1.2.1. General Objective

To assess farmers' perceived opportunities and challenges and livestock production practices under zero grazing of livestock, in the selected learning Watersheds of West Gojjam Zone of Amhara Region.

1.2.2. Specific Objectives

Specifically, the study sought to:

I. Identify livestock production and feeding practices under zero grazing in the watersheds
II. Determine the communal grazing land management of the watersheds
III. Assess farmers' perception on the disadvantages of free grazing and advantages of zero grazing in watersheds
IV. Identify major opportunities and challenges towards the implementation of zero grazing in the watersheds

1.3. Research Questions

I. What are the livestock production and feeding practice under zero grazing system in the watersheds?
II. How communal grazing lands becomes used and managed in the watersheds?
III. How farmers' perceived the disadvantages of free grazing and advantages zero grazing?
IV. What kinds of challenges and opportunities do the farmers' face to implement zero grazing?

1.4. Scope of the Study

This study concentrated on assessing farmers' perception towards the implementation of zero grazing in water and land resource center watershed areas of Western Amhara Region. The study was mainly focused on Abagerima and Debreyakob learning watersheds at Bahir dar zuria and Mecha Woredas respectively.

Operational Definition

Adopter farmers- in this study the farmers those who used zero grazing system for their animals by the enforcement mechanism

Non-Adopters - in this study the farmers those who are not using zero grazing system for their animals at the communal grazing areas only

Free grazing:- Free grazing refers to the herd or stock of livestock access to grazing land/range lands for free without any time, space and animal number restriction(Wilson, 2014).

Zero Grazing:- means the opposite of free grazing stall feeding of animals or restricting animals from freely grazing at the grazing areas and cropping areas (Wilson, 2014).

1.5. Significance of the Study

The findings of this study used for livestock producers to understand the positive and negative sides of free grazing and zero grazing respectively. Besides, the study was conducted at micro level, which may contribute to macro level. Similarly, it helps development practitioners to make decisions and to capitalize on watershed development and pasture management. The information generated from this study can help to make an appropriate decision by the farmers', policy makers, researchers and others who need the information for their respective purposes. The document also would serve as reference and stand point for researchers for further work. The research work will be reached at micro level through the regular extension service channel if the high level and mi level government officials accept and included as a livestock and watershed development package.

1.6. Limitation of the Study

The concepts of adoption and perception it is clear that several factors explain the adoption decision. However, the attempt to include all these in the study is generally not viable option due to shortage of research funds and time that may limit the amount of data to be collected. In addition, the relationship generally exists among number of factors, precluding their inclusion in the analysis efforts. Considering this limitation, therefore, those factors was considered and defined to exert the largest influence on technology adoption; given the circumstances in the study area will be investigated in the analyses in the adoption of the selected technology for the study. Due to shortage of budget and logistics, the research work forced to limit the number of watersheds and kebeles.

1.7. Organization of the Thesis

This thesis report is organized in to five chapters, having the introductory section above the remaining chapters structured as follows. Chapter two presents literature review on livestock production system, feed resources and theories and definition of perception, adoption. Methods approached in the study (to select sample kebeles, determine the sample size, select sample households', collect data and specify the econometric model) are presented in chapter three. Chapter four presents results and discussion parts. The last chapter presents conclusions and recommendations derived from empirical findings of the study.

CHAPTER 2. LITERATURE REVIEW

2.1. Theoretical Literature

2.1.1. Concepts of Technology Adoption and Perception

According to the conclusions of Rogers (1971.pp.4), social change characterized into two broad categories, inborn and interaction change. The first is a kind of change where the source of the change is from within social system and the second kind is where the source of the new idea is outside the social system. Direct interaction change or planned change, which is one component of contact change, is caused by outsiders who on their own or as representatives of change agencies, intentionally seek to introduce new ideas in order to achieve goals they have defined.

Diffusion of a new innovation is considered as a deliberate social change of given situation. The father of extension, Rogers, (1983.pp.6), showed that innovation decision process is the process through which an individual or other decision making group passes from first knowledge to starting an attitude towards the new knowledge, a decision to adopt or reject, to implement new idea, for confirmation of this decision.

The behaviour consists of dealing with the uncertainty that is inherently involved in deciding about a new alternative to those previously in existence. It's the perceived novelty of the innovation, and the uncertainty associated with this novelty, that is a unique aspect of innovation decision making as compared to other types of decision making. Communication channels play different roles at various stages in the innovation decision process. The farmer-to-farmer exchange of experiences with the use of innovation seemed to lie at the heart of diffusion. When enough such positive experiences were accumulated by farmers' especially the innovators and early adopters and exchange within the community, the rate of adoption took off (Rogers, 1983.pp.12).

On the other hand, Rogers, (1995.pp.6-7), identified five characteristics, which are important in adoption studies. Farmer's perception with regard to those characteristics will influence their adoption behaviour. These include the relative advantage, compatibility, Complexity,

trial ability and observability of the given technology or recommendation with the local practices.

2.1.2. Definition of Grazing Land, Free Grazing and Zero Grazing of Livestock

According to WOCAT (2008.pp.13), grazing lands defined as a land (natural, partial natural, open wood lands and improved or planted pastures), which refers to the land which is used for livestock purpose either for feeding or scavenging. Therefore grazing lands can include non-grasslands. Grazing lands represent both a source of animal feed and a key element in biodiversity protection.

Most rural people living in Ethiopian rangelands are agro-pastoral, combining small-scale farming with livestock keeping, or specialize in herding (pastoralists) or farming (Homewood, 2004). In much of grazing lands are primarily governed by common property rules, which enable people to pool and reduce the risks associated with variable forage production. The ability of the land to sustain increasing numbers of livestock owners without damaging the environment can be determined in part by the way the users themselves can govern access to and use of this vital resource (McCarthy *et al.,* 1999.pp.8)

Grazing lands include rangelands, croplands and forestlands. Across those land cover types, different livestock production systems can be distinguished. These include pastoralism, agro-pastoralism and mixed crop-livestock systems. Livestock production systems in Ethiopia are determined by rainfall amount and seasonality, population density and cultural predispositions. In very general terms it can be said that historically pastoralism dominates in the drylands of while limited crop-livestock integration and agro-pastoralism dominate in the dryland ecosystems (Ellis & Galvin, 1994.pp.340).

Free grazing refers to the herd or stock of livestock access to grazing land/range lands for free without any time, space and animal number restriction. On the other hand zero grazing means the opposite of free grazing stall feeding of animals or restricting animals from freely grazing at the grazing areas and cropping areas (Wilson, 2014.pp.1-2).

2.1.3. Concepts and Definitions of Tragedy of Commons

Based on the report of Hardin (1968.pp.4), “The tragedy of the commons” issue has become a universal phrase used by people concerned with natural resource problems. The concept has been raised to explain overgrazing of grazing areas, the depletion of resource and pollution of the environment. The rationalization of Hardin’s article is that rational herdsman will try to keep as many cattle as possible on pasture that will ultimately lead to overgrazing. So he concluded that, common ownership brings deterioration to the grazing area (Stevenson, 1991. Pp.28). In1970’s, the tragedy of the commons was almost conventional wisdom of resource management. Due to the population growth there is a pressure on resources would grow and resources held in common would eventually degrade (Wade, 1986).

Also Hardin (1968.pp.4), explain the common grazing land tragedy as a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, "What is the utility to me of adding one more animal to my herd?" This utility has one negative and one positive component.

1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1.

2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of –1.

Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit--in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

The investigation of the role of common property resources developed mainly from mid-1980. The literature accordingly documented that some traditional social organizations and property right systems were capable of avoiding the dilemma of the "tragedy of commons" (Berkes, 1998). The alternative parallel suggested was state control of the commons. But those advocating privatization or state control didn't recognize the secret behind common resource ownership. Since the 1980's there has been renewed optimism about the prospects for effective community based management (Bruce, 1996.pp.19 & FAO, 1992.pp.12). It was understood that Hardin assumed common property as open access in so far as this conceptualization, an attempt made to change the ownership status of commons has yielded negative results to the resource condition and beneficiaries.

2.2. Empirical Studies on related Issues of Zero grazing Implementation

2.2.1. Economic Contribution of Livestock for Ethiopian Economy

Ethiopia has the largest cattle population in Africa with an estimated population of 57.83 million cattle, 28 million sheep, 28.6 million goats, 1.23 million camels, 60.5 million poultry, 2.1 million horses, 0.4 million mules and 7.88 million donkeys (CSA, 2016). The livestock sector in the country brings about 8.2% of the GDP (NPC, 2015).

Ethiopian livestock perform important role in the livelihoods of small holder farmers', such as used as a source of food (meat and milk), services (transport and traction), cash income, manure for soil fertility and fuel purpose and serve as store of wealth and social security. Livestock also used as a source of livelihood diversification integrated with mixed farming system (Berhanu Gebremedihin *et al*., 2009 & Little *et al.,* 2001).

In Amhara Region the livestock population is estimated to be 15.9 million cattle, 10.7 million sheep, 6.4 million goat, 3.6 million equine and 19.9 million poultry (CSA, 2016).This indicates that the livestock sector is an important part of the local economies at both the national and house hold level, where cattle constitute the main livestock species kept by farm owners (Dehininet Gizie, 2008).

Despite the livestock population in Ethiopia the sector contributes at micro or the macro level is below its potential due to the various reasons, among feed shortage and diseases are the main reasons for low achievements. Those problems are compounded by inefficiencies in the input (feed, genetic material and veterinary services) and output in livestock products marketing including poor market infrastructure, lack of marketing supports in market information (Berhanu Gebremedihin *et al*., 2009).

According to the report of IGAD, (2011), the contribution of livestock for each type of animal and its products listed down (Table 1).

Table 1. Estimated gross value of livestock production

Product or service	MOFED estimate	Revised estimate
Cattle off take	6.302	8.103
Sheep off take	1.643	2.254
Goat off take	1.563	2.255
Camel off take	0.145	0.145
Total estimated off take	9.653	12.757
Sub-total off take	9.653	-
Cattle milk	8.483	10.899
Cattle milk for butter	4.533	5.824
Goat milk	1.352	6.436
Camel milk	1.978	3.346
Butter residue	3.125	4.015
Total estimated milk + products	19.471	30.520
Sub-total	19.634	-
Sheep wool	0.003	0.005
Dung for fuel	1.966	3.429
Change in stocks	1.384	1.384
Total ruminant product output	32.64	48.095
Percentage change	-	47%
Animal draught power	-	21.500
Percentage change	-	113%

(**Source:** IGAD LPI working paper (2011)

2.2.2. Livestock Production System and its Contribution in Amhara Region

In Amhara Region livestock production is an integral part of crop livestock mixed farming system. The main purpose of keeping livestock is for drought power, consumption, sale of livestock products such as milk and meat have secondary importance to the farmers' (FAO, 2006).The common breeds of cattle available in the area are mixed highland zebu types. Some crossbred or improved dairy cattle are also found in the Region. However, the production of improved dairy cattle is very small as compared to the local cattle. Small ruminants are mainly used as an income source as well as for house hold consumption. The livestock production system commonly found in villages with open grazing is the main style of feeding. Local cattle and small ruminants are the main livestock species kept by households in the study watersheds (Adugna Tolera *et al.,* 2012).

2.1.1. Zero Grazing Implementation and feed Management in Ethiopia

Livestock mainly get a feed from natural pasture, weeds of arable land, fallows and crop residues left after harvest. Bottom lands are set aside for hay to be used for severe dry periods. In the highlands farmer's fence small areas of pasture, which are grazed by oxen at the time of ploughing and used to feed young calve. Most stock graze on hilltops, swamps, forest margins, roadsides and stony or unfertile lands (MoA, 2014).

In high potential areas, dairy farmers' grow improved pasture and forages, mainly fed on cut-and-carry, and hay (Amlaku Asres *et al.,* 2012). Dairy associations have started silage making for their milk cows. Farmers' involved in small-scale fattening do cut-and-carry and hay (from natural pasture and crop residues) feeding. Residues of local grain by-products and beverages are mixed with salt and given to milking cows, plough oxen and fattening animals. In the lowlands (pastoral areas) livestock graze and browse (Adugna Tolera *et al.*, 2012).

2.1.2. Opportunities and Challenges of Free Grazing in Amhara Region

The major sources of feed, their relative importance and critical periods in the Region classified according to the particular farming system. The farming systems in the Region can be classified in to three sorghum-teff mixed farming system in the kola agro ecological Zone at altitudes less than 1700 2700 m.a.s.l.; teff-finger millet-maize system in the mid-to-high altitude range and the barley-wheat system at altitudes greater that 2700m.a.s.l**.** (MoA, 2011).

While, cattle ownership is more important in the first two farming systems, ownership per household is higher in teff-finger millet-maize system, where animal traction is more important. The main source of feed is communal free grazing areas, crop residues, stubble grazing on crop land during the dry season and after harvest and hay (cut-and-carry system). Free grazing in the communal grazing areas is the most important source in the first two systems, followed by stubble grazing and cut-and carries of hay. In the barley-wheat system, all three sources are equally important. Generally, availability of feed is critical during the growing seasons of March to May and July to August when croplands are cultivated. During these periods, movements of livestock are restricted and free grazing is limited to designated communal grazing areas and uncultivated hillsides. In addition, crop residues and hay that were stocked from the previous season are depleted (CSA, 2014).

It seems that there has been a significant change in the use of various feed sources since 1997. With the exception of purchased fee and crop residues, use of other sources of fodder (communal grazing lands, woodlots, forests and homestead (e.g. prickly pear) and private pastures) has declined between 1991 and 1999 and the decline was larger in higher rainfall areas. The increase in use of crop residues was greater in higher rainfall areas, while increase in use of purchased feed was greater in drought-prone areas, with the proportion of households buying feed being about three-times larger in drought-prone areas.

Purchased feed includes oil-seed cakes, grain mill by-product, straw and *atela* (residue from local brewery) (Benin *et al.*, 2012).

The free grazing system has contributed significantly to the land degradation problem in the Ethiopian highlands, where grazing on hillsides and other fragile areas is widespread during the rainy season when other sources of feed (stubble grazing and crop residues) are in short supply. Following harvest during the dry season, all cropland become open to free grazing (stubble) until the next growing season (Alemayehu Mengistu*et al.*, 2006).

2.2. Conceptual framework of the study

Based on the objective of the study, the independent variables selected to achieve the ultimate objective of the study are broadly categorized in to economic, institutional, demographic and psychological factor related variables.

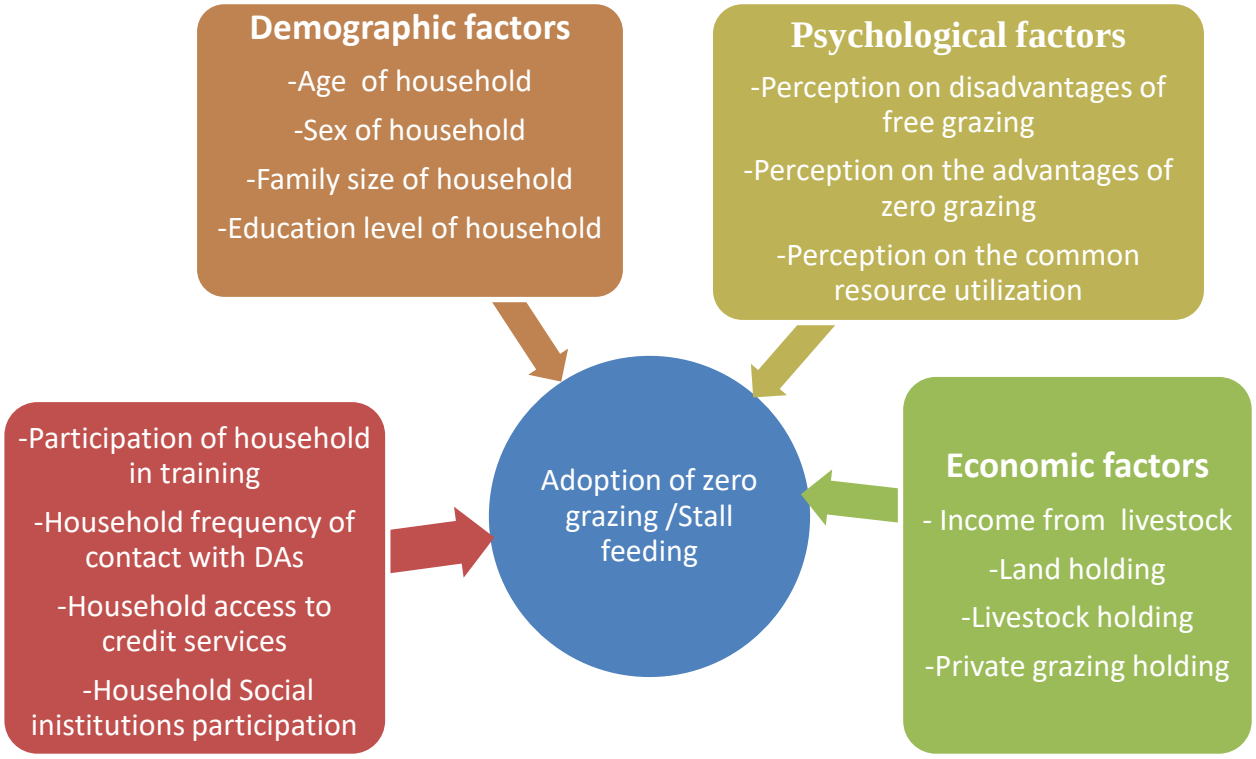

Figure 1. Conceptual framework of the study **(Source:** Own sketch, 2017)

CHAPTER3. RESEARCH METHODOLOGY

3.1. Description of the Study Areas

The study was conducted in the selected two watersheds of Western Amhara Region. The watersheds were namely Aba Gerima and Debreyakob which is located in west Gojjam zone, Amhara region. The Watersheds were established in 2012 G.C by Water and land Resource Center project (WLRC) to undertake research-supported, participatory, integrated watershed development to combat land degradation and achieve sustainable land management (WLRC, 2012).

Aba Gerima watershed

Aba Gerima watershed is found in Amhara Region, West Gojjam Zone, Bahir Dar Zuria Woreda specifically in Aba Gerima and Gonibat Kebele. It is situated about 15km from Bahir Dar city. The watershed is bounded by two kebeles namely, Gonibat to the North and North West and Laguna Abune Hana to the South and South-West. The total area of the watershed covers around 900ha of land. The watershed was part of the Tana sub- basin located nearby Lake Tana. It is a representative landscape of the northern part of Abay basin particularly Lake Tana surroundings

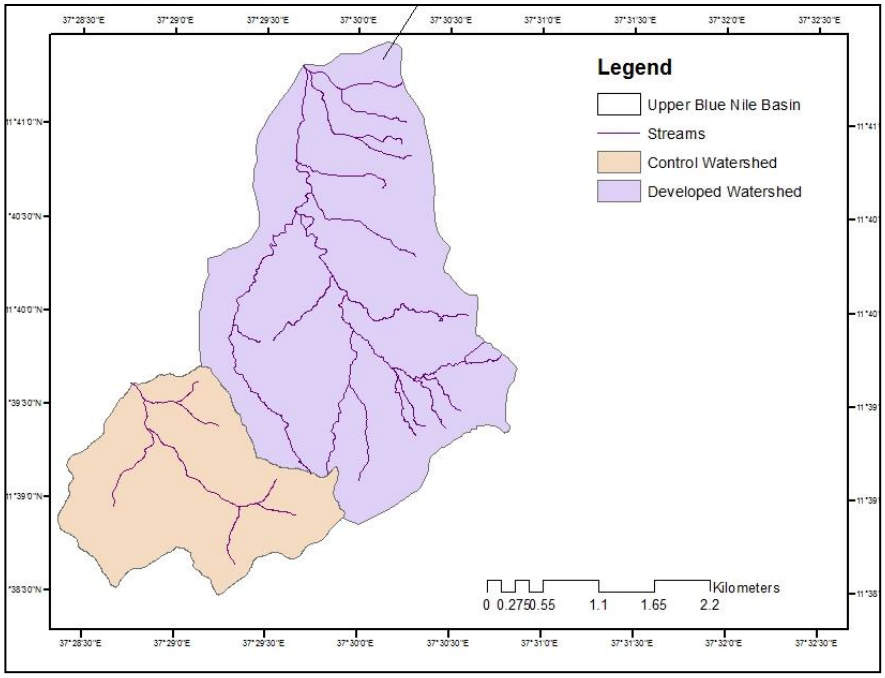

Figure 2. Location map of Abagerima watershed (Source Wlrc, 2012)

Biophysical and Socio economic Background of the Watershed

The topography is dominated by undulating slopes highly influenced by the impact of human and livestock pressure and subsequent land degradation processes. Due to high level of land degradation from intensive cultivation without proper management practices, the soils in the study watershed are poor and of low productivity potential. Cultivated land dominates the land uses in the study watershed comprising 66%. Major crops grown are maize, finger millet and teff. The production system in the study watershed can be described as rain fed mixed farming system with very low level of productivity. The productivity of teff, for instance, is just 1.2tone/ha (WLRC, 2012).

Rainfall is the basic freshwater resource in the study watersheds on which agricultural production relies. Even though rainfall is appreciably high in the study watersheds, it is highly seasonal and water is scarce during the dry season. The main sources of water for domestic use are shallow hand-dug wells and natural springs. At the study watershed, 3 perennial

streams, 2 natural springs and 1160 operational shallow hand-dug wells serve as sources of water for domestic use and khat growing (WLRC, 2012).

Debre Yakob watershed

Debreyakob watershed was found in Amhara Region West Gojam Zone, Mecha Woreda specifically in Felege-Hiwot and partly in Sira Betigel Kebeles. The watershed shares boundaries with Midre Genet kebelle to the North, Amarakanti hill to the south, Lumamie watershed to the west and Koga River to the North East. The watershed has area coverage of 325 ha.

The topography of Debreyakob watershed is characterized as undulating with some hills and flood plain that form heterogeneity in landscape and considered as representative of the surrounding environment. The aspect of the watershed is aligned from South West to North East, dissected by two small depressions. The heterogeneity in topography mainly containing undulating and hilly terrain makes the watershed vulnerable to soil erosion. As a result rill formation and gully development is prominent in many part of the watershed. In Debreyakob watershed around 4% of the watershed is considered as flat. On the contrary around 6% of the watershed is very steep and totally unfavourable for crop cultivation. The remaining (90%) of the watershed is sloping (gentle to moderate) and makes the watershed unsuitable for crop cultivation without SWC measures (WLRC, 2012).

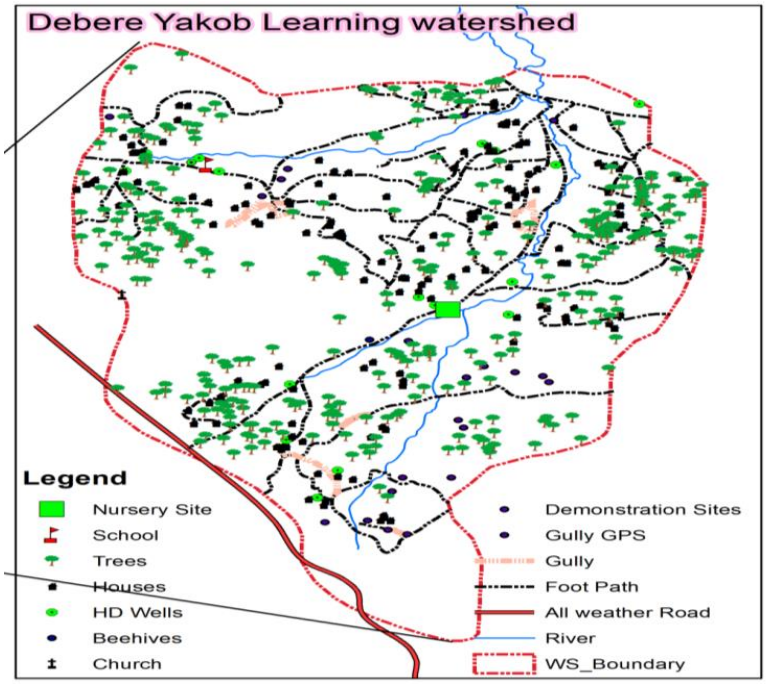

Figure 3. Location map of the Abagerima watershed (Source: Wlrc, 2012)

Biophysical and socio-economic back ground of the watershed

The watershed covers 325ha area of land. The altitude of the watershed ranges from 2074-2262m.a.s.l. the major agro ecology is Woyna Dega with the average 1300mm/Yr rainfall. In the watershed there was a total population: 975, Male: 497, Female: 478. The major source of livelihood is from mixed farming, and the major crops grown are Teff, Maize, Sorghum and Finger millet. The average productivity of the area are 12qu/ha for Teff, 16qu/ha for Millet, and 30qu/ha for Maize (WLRC, 2012).

3.2. Sampling Procedure

Multi-stage sampling technique was used to select representative study sites and respondents. From western Amhara Region, West Gojjam was selected purposively because out of the (Water and Land Resource Center project) watersheds in the Region five of them are found in

these zones which are trying to implement zero grazing system for above five years. From those learning watersheds in the Zone, two watersheds were selected randomly using lottery method, namely Aba Gerima and Debre Yakob. Abagerima watershed covers two kebeles namely Laguna and Gombat kebeles. Whereas, Debreyakob watershed covers relatively small numbers of villages and remain in one kebele.

Then three villages were selected from each kebeles because of considering the communal grazing land holding at village level from two watersheds. The villages were selected purposively based on their experience of involving in watershed development program in learning watershed. Finally, from each village, farmers' were selected using systematic random sampling from the sampling frame. The number of farmers' in the village was determined using the formula of Yamane (1967) to minimize availability of error and bias during sample determination selection for the study. The formula for sample determination was described as follows:-

$$n = \frac{N}{1 + N(e)^2}$$

n=Sample drawn from the total households of the woreda

N=Total households of the two watershed

e=Error tolerated for the study (9)

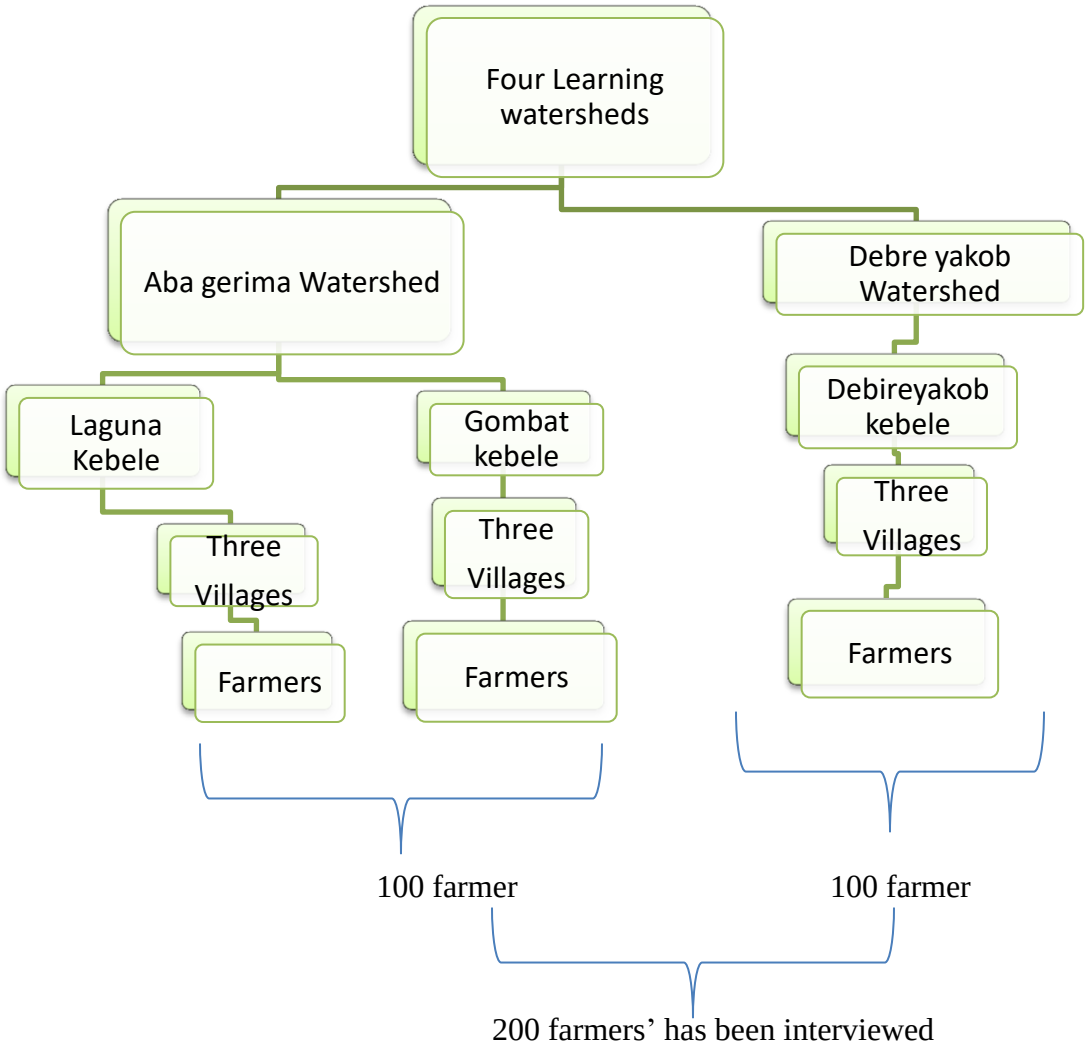

Figure 4. Sampling frame

Watershed	N(total population)	n(sample population)
Aba Gerima(2KA)	890	100
Debre Yakob(1KA)	519	100
Total	2315	200

The sample equality for each watershed was the returned sample from the total interview but Aba Gerima watershed has a larger population than D/Yakob.

3.3. Methods of Data Collection

3.3.1. Type and source of data

Secondary data

Qualitative and quantitative types of data were used. The source of secondary data was from government and NGO reports, different published and unpublished reports, scientific journals, and proceedings from online source and from different office libraries and individuals resources. The nature of collected data was about the trend and number of livestock hold in the study area, source of feed and feeding management, different efforts made through scientific techniques, methods and official decisions to improve livestock and feed management.

Primary data

The nature of primary data source was both qualitative and quantitative type. The primary data sources were from 200 individual house hold survey, 22 key informant interview and two focus group discussions FGD.

Household survey

Based on the prepared schedule all necessary data were collected from randomly and purposively selected livestock producers about the demographic characteristics of the study area, livestock production experience, and other socio-economic characteristics of the households' related to zero grazing and free grazing management. The main focus of primary data was on livestock feed sources, feeding system, grazing land management system and the farmers and development agents perception on it.

Key Informant Interview

A total of 22 key informant interviews were made to dig out issues related to the objective of the study. The key informants were individual farmers' those who have a long experience and information on livestock keeping, kebele administrators, and development agents. Other organizations, which directly or indirectly involve in livestock development sector was also used as a key informant. From sampled key informants in depth interviews using open ended checklist, perception of individuals about zero grazing system and its challenges and opportunities were collected.

Focus group discussion (FGD)

The other qualitative source of data was from different stakeholders those who have a direct and indirect contact and role about livestock and feed free grazing and zero grazing management. Two focus group discussions were conducted based on FGD guide line at each watershed after preliminary analysis of the data (Freitas *et al.*, 1998). The discussion was guided and facilitated by the trained enumerator or researcher. The key notes were captured by the tape recorder and re-referred by the researcher during the write up time.

3.4. Methods of Data Analysis

Descriptive Analysis

The collected data was coded, entered and managed by SPSS (Version 20). Descriptive statistics was also conducted by the software and results were presented through mean, mode, standard deviation and frequency. Statistical tests of independent sample t-test and chi-squared tests were done to test mean and occurrence comparison purpose among adopter and non-adopter farmers of zero grazing system.

Farmers' perception data which was collected by using five point likert scale measurement was analyzed by using frequency and non-parametric test of Chi-square test to know the difference between adopter and non-adopter farmers of zero grazing system. Before running

the Chi-square test, item reliability test (Cronbach's alpha test) was done to know the inter reliability of questions or statements (Harry *et al.*, 2012). Average likert scale value was established after summation of the rates for each statements and it was considered to measure to which individuals are a part. Then the chi-square test was done to know which type of people more perceived the dis-advantage of free grazing and advantages of zero grazing in their farming system.

CHAPTER 4. RESULTS AND DISCUSSIONS

4.1. Household Demographic Characteristics

Age of Household Head

The average age of total sampled household heads was 45.07±12.76 years old. The households those who adopted and non-adopted zero grazing system have an average age of 44.65±12.49 and 47.18±14.07 years old respectively (Table 3).

Sex of Household Head

From the total sampled household heads, 94.5% and 5.5% were male and female respectively. Among zero grazing system adopter farmers 96.4% and 3.59% farmer were male and female, respectively. While with in the non-adopter households (84.85% and 15.5%) were male and female respectively. According to the chi-square result (P-0.008), shows a significant difference by sex of adopter and non-adopter farmers (Table 2).

The proportion of female farmers in non-adopter was a bet higher than adopters of zero grazing system. It is because of female farmers having less information and extension contact than male farmers in the study watershed. On the other hand, female headed household heads have no information about the advantages of zero grazing because of their triple role (the female households have a productive and reproductive role) of the house hold. This result was in line with the results of the study of Nhemachena and Hassen, (2007).

Marital Status of Household Head

The martial status of all sampled (98% and 2%) households were married and divorced respectively and there were no widow/widowers. Among zero grazing adopter households about 99.4% and 0.6% were married and divorced respectively. Among non-adopter households 90.9% and 9.1% households were married and divorced respectively. The Chi-square result with a p-value of (0.003) which is significant difference between zero grazing adopters and non-adopters by their marital status (Table 2).

This implies that most households were married and living with the settled condition which was good for the livestock management. Households can be easily managing livestock if they were married because labor and settling condition was proper for it.

Educational Status of Household Head

Regarding education status of sampled households, majority of households were illiterate (71%). The percentage of households who attend primary education, religious education and adult education were 11.5%, 9% and 6.5%, respectively. Very few households (2%) were completed secondary school. Among zero-grazing adopters, majority of the households were illiterate (70.1%) and followed by primary educated (12%), religious education (8.4%) and adult education (7.2%). Only 2.4% of the households have completed secondary school. In non-adopter households, the education status was (75.8%) illiterate, (9.1%) primary education, (2.1%) religious education and (3%) adult education (Table 2).

The above result shows that, adoption of zero grazing system did not need any sophisticated knowledge and technics. Some scholars argued that on the opposite side of the argument, according to Quddus, (2013) education was believed to improve the readiness of the house hold to accept new ideas and innovations, which in turn enhances producers' willingness to accept zero grazing system.

Table 2 Summary of Categorical Variables

Attribute		Adopter		Non-adopter		Overall Total		Difference b/n A&NA
		F	%	F	%	F	%	x^2
Sex	Male	161	96.4	28	84.85	189	94.5	
	Female	6	3.59	5	5.15	11	5.5	7.08***
	Total	167	100	33	100	200	100	
Marital status	Married	166	99.4	30	90.9	196	98	
	Divorced	1	0.6	3	9.1	4	2	11.95***
	Total	167	100	33	100	200	100	
Education	Illiterate	117	70.1	25	75.8	142	71	
	Religious education	14	8.4	41	2.1	18	9	
	Primary education	20	12	3	9.1	23	11.5	2.27^{ns}
	Adult education	12	7.2	1	3	13	6.5	
	Secondary school	4	2.4	0	0	4	2	
	Total	167	100	33	100	200	100	

Note: ***, 1% probability level, Ns, not significant & (**Source**: own survey 2017)

4.1.1. Family Size and labour Condition of the Household

The average family sizes of households were 5.31±2 and the most frequent value of family size was four. The average family size for zero grazing adopters and non-adopters was 5.37

and 5 respectively. Adopter households have a greater family size than the non-adopters but there is no significant difference between (Table 3).

This result shows that family size don't affect adoption of zero grazing because stall feeding uses minimum number of labor than free grazing. When a farmer those who adopted zero grazing, animals can be managed by the children and women who were staying at home integrated with the home works.

Table 3. Family size of the household

Attribute	Adopter		Non adopter		Over all		The difference between A/NA
	Mean	SD	Mean	SD	Mean	SD	T-test
Age	44.65	12.49	47.18	14.07	45.07	12.76	-1.04^{ns}
Family size	5.37	2	5	2.16	5.04	2.04	0.95^{ns}

Most of the households (99%) were managing their livestock by family member only and only 1% households used a hired labor. Among adopter households about 98.8% were used family labor and only 1.2% used hired labor. Among non-adopter households (100%) use their family labor to keep their animals. From the total sampled households 86.5 % reported that, there is no labor shortage problem to manage livestock and the rest 13.5 have a labor shortage for livestock managing.

There was no shortage of labor for 85.6% adopter and 90.9% non-adopter households to manage their animals. There was also a labor shortage for 14.4% adopter and for 9.1% non-adopter to manage their animals. This is because of some households children not reached for livestock managing (Table 4). Hired labor was used for free grazing animals but for zero grazing adopter households did not need hired labor (FGD).

> *"When our children become engaged in the cattle keeping they drop out from school or they have more absent dates from school and finally have low educational performance"*

Table 4. Labor demand for livestock management

Attribute		Adopter		Non-adopter		Overall Total	
		F	%	F	%	F	%
Who manages your livestock	Family member	165	98.8	33	100	198	99
	Hired labor	2	1.2	0	0	2	1
	Total	167	100	33	100	200	100
Is there any labor shortage to manage livestock	Yes	24	14.4	3	9.1	27	13.5
	No	143	85.6	30	90.9	173	86.5
	Total	167	100	33	100	200	100

4.2. Farming Characteristics of Household

4.2.1. Land Holding and Land Allocation

The average land holding size of sampled household was 0.93 ±0.53ha. The most frequent land holding value was one hectare. The maximum land holding was 3 ha and some sampled household have no any land holding. Zero grazing adopter households have an average land size of 0.88 ha, on the other hand non-adopter households have 1.16 ha (Table 5). The independent sample t-test result showed that there is a significant ($P<0.001$) difference between adopters and non-adopters in land holding. The average land holding sizes in the study area was lower than the Regional average land holding size of 1.7 ha (CSA, 2014).

The overall average rented in land by the individual household was 0.19 ha. Adopter and non-adopter households rented in on average 0.21ha and 1.25ha land respectively. The overall average rented and/or shared out land size was 0.02 ha. The adopter households rented and/or shared out about 0.02 ha of land (Table 5). Non-adopter households have more rented in land

than adopter household for crop production. This shows that households those who were not-adopting zero grazing were expertizing more on crop production.

On the other hand the adopter households were trying to maximize their effort on livestock production through because livestock needs minimum land size than crop production. The study result of **Negatu, (2005**) also agreed that, large size farm holders were found to be significant users of fertilizer, improved seeds and manure.

The major crops grown in the study area was finger millet, maize and *Teff* in the main rainy season. *khat*, *Gesho*, Mango, Avocado and Banana also the major crops used as a backyard development. *Khat* was the dominant cash crops in Aba Gerima watershed. Land allocation of the study watersheds were for crop, forest (eucalyptus), and backyard fruits (*khat* and mango) and private grazing respectively based on their importance areas.

The average amount of allocated land for crop, forest, backyard and private grazing purposes were 0.83, 0.06, 0.11, 0.14 hectare respectively. Households those who adopted zero grazing system allocated a land for crop, backyard fruit, forest and private grazing purposes were 0.80, 0.07, 0.10, 0.10 hectare on average respectively. On the other hand non-adopter households allocated land for crop production, forest, backyard fruit and private grazing purposes were 1.005, 0.02, 0.13, 0.09 hectare on average respectively.

There was a significant mean difference between adopter and non-adopter households in forest and private grazing land allocation with ($P<0.05$ and $P<0.01$) respectively (Table 5). This shows that allocation of land for private grazing land was very important factor for the adoption of the zero grazing system.

Table 5. Land holding size and land allocation in ha per house hold

Attributes		A			NA			Overall			d/ce A/NA
		F	Mean	SD	F	Mean	SD	F	Mean	SD	t-value
Land holding size	Owned	167	0.88	0.55	33	1.16	0.54	200	0.93	0.53	-2.66**
	Rented in	167	0.21	0.29	33	1.25	0.29	200	0.19	0.29	1.73*
	Rented out	167	0.03	0.13	33	0	0	200	0.02	0.12	1.39^{ns}
Land allocation type	Crop land	167	0.80	0.74	33	1.005	0.40	200	0.83	0.70	-1.51^{ns}
	Forest land	167	0.07	0.13	33	0.02	0.06	200	0.06	0.12	2.39**
	Back yard	167	0.10	0.10	33	0.13	0.11	200	0.11	0.11	-1.57^{ns}
	Grazing land	167	0.10	0.14	33	0.09	0.10	200	0.10	0.10	2.38***

4.3. Livestock Production and Feeding Practice under Zero Grazing System

4.3.1. Livestock Holding and Production Practice of Household

From a total sampled household, one farmer owns on average 3.45±1.93 cattle, 0.17±0.21 small ruminant, 2.22±3.46 local chicken, 1.7±3.95 exotic chicken, 0.48±2.07 hive with colony and 0.26±0.26 equine with TLU converted value (ILRI, 2013). Zero grazing system adopter households have an average of 3.33±1.77 cattle, 0.46±0.25 small ruminant, 2.24±3.59 local chicken, 1.78±4.12 exotic chicken, 0.56±2.24 hive with colony and 0.24±0.25 equine. Also non-adopter households have an average of 4.07±2.55 cattle, 0.24±0.45 small ruminant, 2±2.64 local chicken, 1.7±2.83 exotic chicken, 0.09±0.38 hive with colony and 0.33±0.28 equine. There is a significant mean difference between the adopter and non-adopter farmers in cattle and hive holdings with ($p<0.05$ and $P<0.01$) respectively (Table 6).

Cattle holding of adopter households were less than non-adopters which have a good contribution for crop production. It's because about 91% adopter households minimized their livestock number. This is used to fit the number of livestock with the available feed resource.

The result of Agraw Amanie *et al.,* (2016), which was studied in the same watershed shows feed gap between the available livestock number and available feed.

Table 6. Size and structure of livestock holding

Attribute	Adopter		Non-adopter		Overall		Difference between A/NA
	Mean	SD	Mean	SD	Mean	SD	t-value
Cattle	3.33	1.77	4.07	2.55	3.45	1.93	-2.009**
Small ruminant	0.46	0.25	0.24	0.45	0.17	0.21	-0.888^{ns}
Chicken local	2.24	3.59	2	2.64	2.22	3.46	0.398^{ns}
Chicken exotic	1.78	4.12	1.7	2.83	1.77	3.95	0.068^{ns}
Hive with colony	0.56	2.24	0.09	0.38	0.48	2.07	-1.80*
Donkey	0.24	0.25	0.33	0.28	0.264	0.26	1.197^{ns}

4.3.2. Livestock keeping Experience and Income from Livestock

On average a household have 25.7 years of livestock keeping experience. Adopter and non-adopter households also have 25.16 and 28.69 years of livestock keeping experience respectively. The overall average income from livestock activity was 9123.05 EB per individual farmer. The adopter and non-adopter households gained 9929.04 and 5044.24 EB average income from livestock respectively. The t-test result shows a significant ($P<0.01$) income difference between adopter and non-adopter households (Table 7).

This result shows that zero grazing adopter household gained a better income than non-adopters. The purpose of livestock keeping in the study area was in line with the study of different scholars (Agraw Amanie *et al.*, 2016 and Berhanu Gebremedihin *et al*., 2009).

The adopter households gained a better income from zero grazing system because mainly they engaged in fattening. During the FGD the farmers agreed as:

> *"The body condition of stall feeding animal gives a better selling price because of long resting and feed and water taking increment"*

Table 7. Livestock experience and income from livestock

Attribute	Adopter			Non-adopter			Overall			Difference between A/NA
	F	Mean	SD	F	Mean	SD	F	Mean	SD	T-value
Experience	167	25.16	12.15	33	28.69	14.85	200	25.74	12.66	-1.47NS
Income	167	9929.04	9233.23	33	5044.24	5579.63	200	9123.05	8912.10	2.93***

4.3.3. Livestock Housing Practice in the Study Watersheds

In the study watersheds there are two major types of livestock housing. The first which was used by 83.5% households were adjacent house to the main human house. The second type of house which was used by 16.5% households was a partitioned house from the main human house. The house was constructed by grass, wood and corrugated iron roofed. All Cattles except calves and equines share the same class, sheep and goats also have small class or semi partition in the livestock house. This result was in line with the result of (**Shigdaf Mekuriaw** *et al*, 2012) that was studied in the South Gonder Zone.

4.3.4. Animal Breeding Practice of the Household

In the study area there are two types of breeding system used for cattle reproduction. One is natural mating system by using non-improved bull. The other was by using artificial insemination (AI) system for exotic breeds of cattle. The major source of animal breeding used by 97% households was natural mating system by using non-improved bull. The rest 2.5% and 0.5% households have an improved bull and both improved and local bull sources respectively.

From a total zero grazing system adopters 97%, 2.4% and 0.6% of them were using the local oxen, improved oxen and both improved and local oxen sources respectively. About 97% and 3% non-adopters households were using local oxen and improved oxen sources respectively. Among all sampled households (79% and 21%) have access to AI service and have no access AI service respectively. About 79% and 21% of zero grazing adopter households have access to AI service and have no access to AI service respectively. On the other hand 78.8% and 21.2% non-adopter households have access to AI service and have no access to AI service respectively (Table 8).

According to the FGD result the AI system was not more successful at the local cows during the synchronization campion. In selected local cows with the consultation of AI technician was successful. According to the annual report of Amhara livestock and fishery promotion agency, (2016), a synchronization campion was not successful.

Table 8. Source of animal breeding of the household

Attribute		Adopter		Non-adopter		Overall		χ^2
		F	%	F	%	F	%	
Major source of bull	Local	161	97	32	97	193	97	
	Improved	4	2.4	1	3	5	2.5	0.241^{ns}
	Local and IP	1	0.6	0	0	1	0.5	
	Total	166	83.4	33	16.6	199	100	
Do you get AI service	Yes	132	79	26	78.8	158	79	-
	No	35	21	7	21.2	42	21	-
	Total	167	83.5	33	16.5	200	100	-

4.3.5. Major Livestock Feed Sources and Utilization

The major feed sources in the mixed farming system of two watersheds were communal and private grazing lands, crop residues, grass hay, alcohol residues (*brint* and *atela*), and improved forages (Napier grass, saspania and Rhodes). Due to shortage of land, improved forage species were not more expanded by farmers.

Access and source of feeds to livestock were 99.5% crop residue, 46% grass hay, local brewery byproduct (90% *brint* and 36.5% *atela*), 11% Napier grass, 18.5% Saspania and 2% Rhodes for all sampled households. Access and source of livestock feed as a feed sources for adopter households were 99.4% crop residue, 54.5% grass hay, local brewery byproduct (42.5% *brint* and 91.6% *atela*), 12% Napier grass, 18% Saspania, and 2.4% Rhodes. Also Access and source of livestock feed as a feed sources for non-adopter households were 100% crop residue, 45.5% grass hay, local brewery byproduct (6.1% *brint* and 81.8% *atela*), 6.1% Napier grass and 21.2% Saspania (Fig. 5).

Crop residues and roughages were the major feeds in the dry season, but it has a poor quality. Improving of this feed source to increase its palatability and nutritive value was essential to increase the productivity of livestock. But majority households (98%) have no experience of improving the palatability and quality of crop residues.

Feed sources and types were in line with the identified feed sources and types by study of Agraw Amanie *et al*., (2016) in the same watersheds. Also the feed types and feed sources of the Region was agreed with this result (ALA, 2017; CSA, 2016; Adugna Tolera *et al.*, 2012)

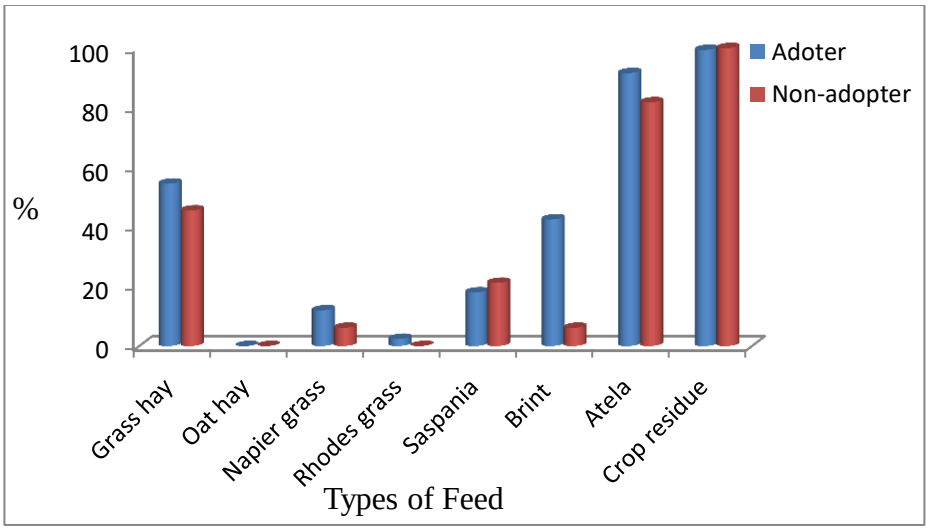

Figure 5. Major feed sources used by the study households (%)

4.3.6. Livestock Feed Scarcity Management Practices

To solve feed shortage problem during wet and rainy seasons, about 92.5% households purchased additional feed for their livestock. The most frequent type of purchased feeds was alcohol residues (*brint* and *atela*), concentrate (salt,wheat bran and *nuag* seed cake/*Fagulo*), grass hay and crop residue respectively. The average expense for feed purchasing was

1752.33 EB ranging from 50 to 11460 EB. The most frequent expense was 800 EB. The average costs for each purchased feed type was 1584.8, 1119.52, and 1113.67 EB for concentrate (*Nough* cake), crop residue, and grass hay, respectively (Fig 6).

This implies that intensification in livestock sector was still minimal with respect to the crop sector therefore the households was overhead money for feed which was costly and there is no formal feed market in the study watersheds.

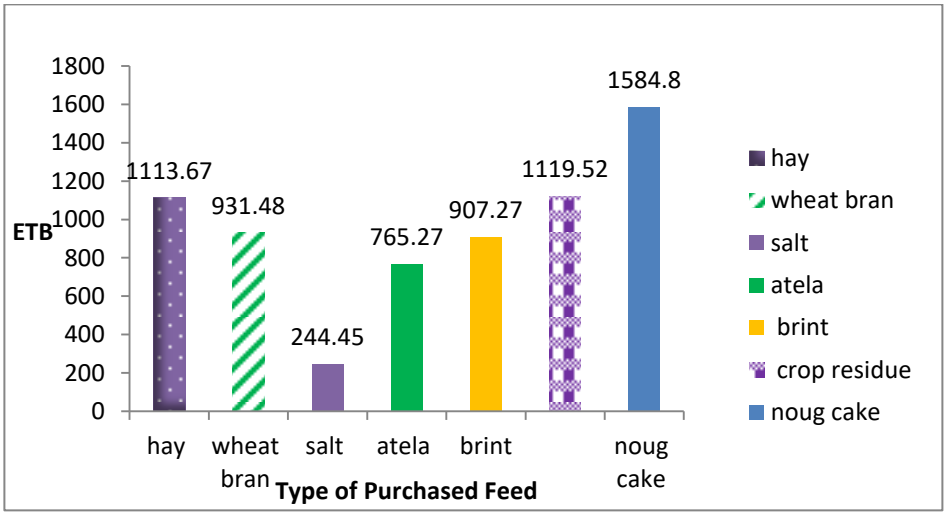

Figure 6. Costs expended for additional feed purchasing

4.3.7. Major Livestock Water Sources

In the study watersheds there are three sources of water used for human, livestock and irrigation development purposes. River, spring, hand dug well and pipe water sources were the major water sources. All sampled households get water on average 8.5 and 1.12 minutes far from their residence for river and hand dug water sources respectively. River, hand dug well and both sources were a major water sources for 41.5%, 32% and 26.5% households respectively.

River, hand dug well and both sources were a major water sources for 46.7%, 33.5% and 19.8% of adopter households respectively. About 15.2%, 24.2% and 60.6% non-adopter

households used a river, hand dug and river and hand dug water sources respectively for their livestock (Table 9).

More adopter households used hand dug well water source than the non- adopter households. This result revealed that utilization of river water for livestock leads for free grazing because of the need to travel to river. Water is the major determining factor for the livestock productivity in the mixed farming system (Sewmehon Demissie, 2012).

Table 9. Major water sources in the watersheds

Land holding type	Adopter		Non-adopter		Overall total	
	F	%	F	%	F	%
River	78	46.7	5	15.2	83	41.5
Hand dug well	56	33.5	8	24.2	64	32
River and hand	33	19.8	20	60.6	53	26.5

4.3.8. Feed Storage and Feeding Materials

All (100%) sampled households have feed storing experience through making hay. Silage making and treating crop residue by using ammonia or urea was not experienced by all interviewed households. In order to adopt zero grazing system with enough feed availability at the feed scarce time, there is a need to preserve green forages in the form of silage.

In the study watersheds, there are two types of feed storage houses (corrugated and grass roofed) used by 40.5%, 47.3%, and 6.06% of total sampled, adopter and non-adopter households respectively. On the other hand about 59.5%, 52.7% and 93.9% of total sampled, adopter and non-adopter households have no any feed storage house respectively. From a total sampled households about 77.8%, 21% and 1.2% have a grass roofed, corrugated roofed and plastic sheltered feed storage houses respectively. Among adopter households about 79.7%, 19% and 1.3% have a grass roofed, corrugated roofed and plastic sheltered feed storage

houses respectively. Among non-adopter household about 19% and 1.3% households have a grass roofed; corrugated roofed and plastic sheltered feed storage houses respectively (Table 10).

From the total sampled households only 2.5% households have inside house feeding material and about 97.5% have no experience of constructing of feeding material. Among zero grazing system adopter households about 2.4% and 97.6% households have and have no inside feeding material for their livestock respectively. Out of zero grazing system non-adopter households about 3% and 97% have and have no inside feeding material for their livestock respectively.

Of the total households about 69% and 31% have outside feeding material respectively. Among adopter households about 71.3% have outside feeding material and 28.7% have no any outside feeding material for their livestock. Also among non-adopter households, 57.6% of them have outside feeding material and 42.4% of them have no any outside feeding material for their livestock (Table 10).

Different researches showed that constructing of feed house has an advantage to save the nutritive value of the feed for the long period of time and protect from the sun and rain. Also access to of feeding trough used to save feed and to know the amount of feed taken by livestock (Zewdie Wondatir *et al.,* 2015).

Table 10. Feed storage and feeding material condition

Attribute		Adopter		Non-adopter		Overall Total	
		F	%	F	%	F	%
Feed storage types used	Grass roofed	63	79.7	0	0	63	77.8
	Iron sheet roofed	15	19	2	100	17	21
	Plastic shed	1	1.3	0	0	1	1.2
	Total	79	100	2	100	81	100
Is there any feeding material inside the livestock house	Yes	4	2.4	1	3	5	2.5
	No	163	97.6	32	97	195	97.5
	Total	167	100	33	100	200	100
Is there any feeding material outside the house	Yes	119	71.3	19	57.6	138	69
	No	48	28.7	14	42.4	62	31
	Total	167	100	33	100	200	100

4.3.9. Feed Availability across Seasons

Llivestock feed was enough for 85.6% and 74.4% households from September to half March respectively. But for 14.4% and 25.6% households have a feed scarcity from September to March respectively. Then from April to first June there was a peak feed scarcity time for (14.4% and 53.5%) households. During the feed scarcity time the farmers purchased additional feed for their livestock both at formal and informal feed markets (Fig. 6).

According to the *FGD,* its due to the rainy season is not started in this month's fully. When the rainy season started the green grass and weeds reached (Fig. 6). According to the results of Adugna Tolera *et al.*, (2012), Berhanu Gebremedihin *et al.*, (2009) and Dehininet gizie, (2008), to get full livestock production potential of the animals, from livestock get enough

feed at every time when needed was the key issue. Food security for animals should be assured at least all year round.

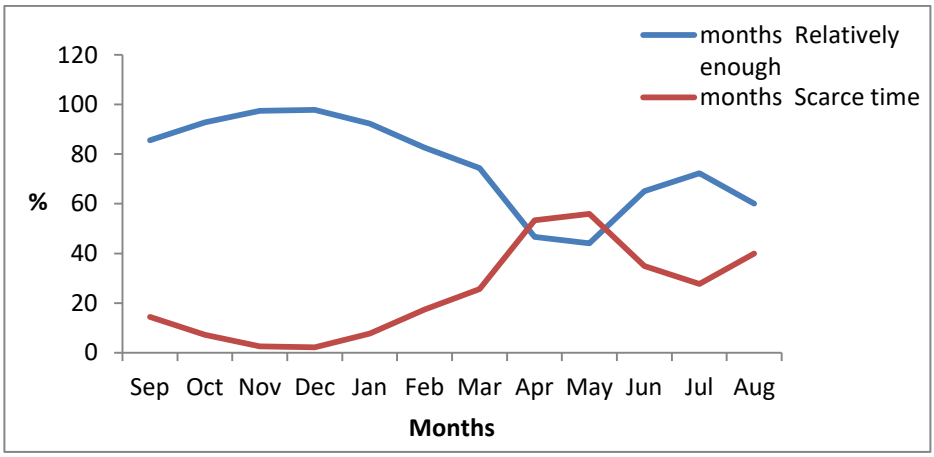

Figure 7. Feed availability across seasons

4.4. Communal Grazing Land Management System in the Developed Watershed

4.4.1. Major Livestock Grazing Sources

In the study watersheds there are two types of grazing sources, communal and private grazing sources. From the total sampled households only 16.41% have free grazing access and use of communal grazing lands for their livestock. The rest 42.05%, 22.05% and 19.48% households have a private grazing land, restricted communal and private grazing land and zero grazing/stall feeding source respectively (Fig. 8). The average distance of the communal grazing land was 17.5 minute on foot from household's resident.

During FGD, farmers and experts understood that, freely grazed communal grazing areas have no enough feed sources and it's not balanced with the number of animals or stock. Because of it animals unable get enough feed. According to the conclusion of (MoA, 2011, Benin *et al.*, 2012 and Abera Adie, 2006), grazing areas unable to fulfil feed requirements of animals all year round.

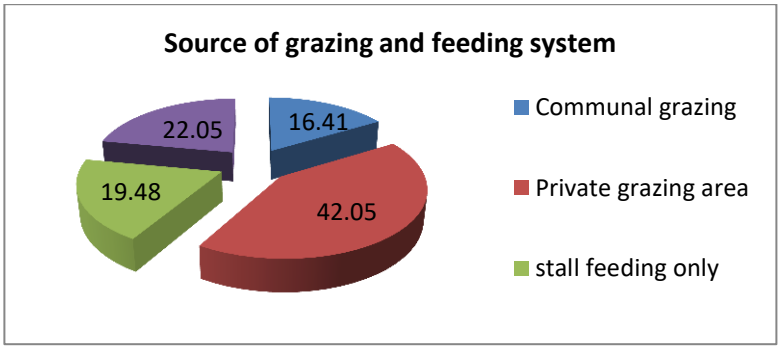

Figure 8. Major grazing source in the study watershed

4.4.2. Grazing System and Grazing hour /Grazing Intensity

About 83.5% households method of feeding were stall feeding/zero grazing and private grazing system. The grazing hour by grazing animals at the communal grazing areas ranges on average from zero to 11 hours per day. About 41.02% households accepted zero grazing system and stay their livestock at home and about 41.71% livestock graze from 0.5 to 5 hour at the communal and private grazing lands. The remaining 17.27% household's animal grazed from 6 to 11 hour at the grazing area freely per day (Fig. 9).

The above result shows when animals spent more time at communal grazing areas reduces plantations, shrubs and grasses. The result gained in the developed country shows that the grazing time increase affects the productivity of dairy cows (Kathrin *et al.*, 2017).

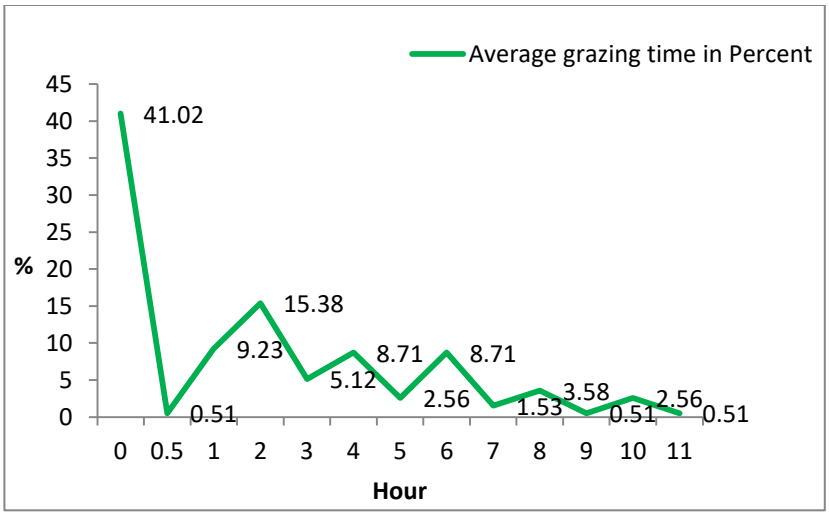

Figure 9. Grazing hour for free grazing animals

4.4.3. Farmers' Perception on the Status of Communal Grazing Areas

According to farmers' observation since 1997 G.C, grazing areas have been decreased in its size. The decrease in size was because of the communal grazing areas were given for youths' and for construction of infrastructure development (schools, offices and other institutions).

From a total sampled households 49.7%, 1.53% and 3.5% households observed that communal grazing areas decreased in its size only, forage productivities only and decreased both in its size and forage productivities respectively. On the other side about 3.5% and 27.69% households have an observation and perception of grazing areas become increasing in its size and forage productivity respectively. The other households' (4.1%) understands that our communal grazing areas become decreased in its size but increased in its forage productivity. The rest interviewed households did not see any change on the status of communal grazing areas since 1997 G.C (Table 11). The main reason for decrease in the communal land size was provision of the communal lands for youths. The reason for increasing forage productivity was because of watershed development the communal grazing areas are closed from free grazing.

The households' looks the decreasing status of free grazing areas in its size and nutritive value pushes individuals to adopt zero grazing and restrict their livestock from free grazing. According to the reports of (Teshome Abate *et al.*, 2010, Elias Zerfu *et al.*, 2017 and Amaha Kassahun *et al.*, 2007), the status of grazing areas in Amhara Region as well as the country Ethiopia have been similarly decreasing.

Table 11. Farmers' perception on the status of communal grazing lands

Attribute	F	%
Increasing in size	7	3.5
Decreasing in size	97	49.7
Increasing in forage productivity	54	27.6
Decreasing in forage productivity	3	1.53
Deceasing in its size but increasing in its forage productivity	8	4.1
Decreasing in size as well as forage productivity	7	3.5
No change	19	9.7
Total	195	100

4.4.4. Farmers' Participation on Communal Grazing Land Management

According to KI interview result, utilization of communal grazing lands was through *Gote* level common community ownership. Community members were participated in the decisions of land provision for youths and infrastructure development. Also farmers were participated in the decisions on type and amount of punishment to stop free grazing at the communal grazing areas and cropping areas.

From the total sampled households 91.8% and 8.2% have participated and not participated in the decisions of land provision for youths and infrastructure development from communal

lands respectively. About 53.8% and 45.6% households' also participated and not participated in the decision of the type and amount of punishment to stop free grazing. Also about 99.5% and 0.5% households have participated and not participated in the decision (Table 12).

This is a best practice to stop free grazing because if farmers participated in a decision implementation can be easy. Farmers' participation plays a good role to incorporate farmers' indigenous knowledge and experience. In the study of Mastewal Yami *et al.*, (2011) and Quddus, (2013) shows, indigenous knowledge have a great role for communal grazing areas management.

Table 12. Farmers' participation in communal grazing management

Attribute		F	%
Do you participated on the decisions of land provision for youths and infrastructure development from communal lands	Yes	179	91.8
	No	16	8.2
Do you participated on a decision on a level of punishment for free grazed animal at a communal grazing area	Yes	105	53.8
	No	89	45.6
Do you participated on a decision on a level of punishment for free grazed animal at a cropping areas	Yes	194	99.5
	No	1	0.5

4.5. Enforcement and Controlling Mechanism of Free Grazing of Livestock

Enforcements mechanism was used to stop free grazing at the community grazing and cropping lands. The major enforcement mechanism was money punishment per grazing animal. The enforcement was not applied at all *Gots* of Aba Gerima watershed communal grazing lands. But in Debre Yakob watershed it's applied both at the communal grazing areas and cropping areas.

The amount of punishment to enforce households to adopt zero grazing or stop free grazing of animals were ranges from 50 to 200 ETB per animal per day. From the total of sampled households 96% believes that, punishment can stop free grazing both at the communal grazing areas and cropping areas. During FGD, some farmers reflected that;-

> *"Animals should be refreshed either at communal or private grazing areas for some time. Even some households leave their livestock to graze in the evening time to be free from any punishment because there is no control at the night time."*

4.5.1. The Role of Social Capital for Communal Grazing Land Management

In the study area there are different informal institutions organized by farmers for different purposes. The institutions were *Edir, Equib, Mahiber* and *senbetie*. *Edir* is one of the major institutions which play a great role of facilitating funereal ceremony. In addition to funereal ceremony, it plays a role of controlling deforestation and free grazing at the communal lands.

Among adopter households about 95.2%, 41.5%, 79% and 95.2% households participated in *Edir, Equib, Mahiber* and *Senbetie* respectively. But the rest 4.8%, 58.5%, 21% and 4.8% adopter households were not participated in *Edir, Equib, Mahiber and Senbetie* respectively. From non-adopter households about 87.9%, 69.7%, 75.8% and 90.9% households have participated in Edir, Equib, Mahiber and senbetie respectively. But the rest 12.1%, 30.3%, 24.2%, % and 9.1% non-adopters were not participated in *Edir, Equib, Mahiber and senbetie* social institutions respectively (Table 13).

Edir, equib, Mahiber and Senbetie contributes for free grazing controlling through discussions and punishments for 31.8%, 3%, 7.5% and 5.6% adopter households respectively. The rest 68.2%, 97%, 92.5% and 94.4% adopter households not using *Edir, equib, Mahiber and Senbetie* institutions for free grazing controlling respectively. Among non-adopters, 13.3%, 8%, 11.5% and 3.3% households used *Edir, equib, Mahiber and Senbetie* for free grazing controlling respectively. But the rest 86.7%, 92%, 88.5% and 96.7% households did not used *Edir, equib, Mahiber and Senbetie* for free grazing controlling respectively (Table 13). The

power of controlling a communal grazing land was from their internal bylaws of social institutions. The farmers described the power of their institutions as:-

> *"If the farmer cuts any forest at the communal areas for private purpose he will be punished money and if he doesn't stop from it the action will be up graded up to dismissing of edir membership"*

The above result shows that the adopter households used the social capital for the control of their decision in the communal grazing areas. The result of Mastewal Yami *et al.*, (2011), agreed on role of traditional farmers social institutions on the level of adopting of communal resource management.

Table 13. Informal institution participation and its role in free grazing control (**%**)

Type of informal institutions	Level of **ZG** adoption	Do you participate		Is there contribution to **FGC**	
		Yes	No	Yes	No
Edir	Adopter	95.2	4.8	31.8	68.2
	Non-adopter	87.9	12.1	13.3	86.7
Equib	Adopter	41.5	58.5	3	97
	Non-adopter	69.7	30.3	8	92
Mahiber	Adopter	79	21	7.5	92.5
	Non-adopter	75.8	24.2	11.5	88.5
Senbetie	Adopter	95.2	4.8	5.6	94.4
	Non-adopter	90.9	9.1	3.3	96.7

Note: **ZG**= zero grazing, **FGC**=free grazing control

4.6. Farmers' Perception on the Disadvantages and Advantages of Free and Zero Grazing

4.6.1. Farmers' Perception on the Disadvantages of Free Grazing

The following statements were targeted to measure farmers' perception on free grazing. The item type statements was about the effects free grazing on soil fertility, livestock productivity, soil and water structures and plantation survival. Cronbach's alpha test has been used to measure the reliability and consistency of questions. Cronbach's alpha result showed that, the questioner was reached above acceptable reliability level above (α=0.7) which is α=0.94 (appendix table 5.4).

4.6.2. Farmers' Perception on Soil and Water Structures and Plantations

Farmers were asked to be either, strongly agreed, agreed, disagreed and strongly disagreed on the statements of "Free grazing cause's soil erosion". From the total interviewed households about 84.5%, 14%, 0.5% and 1% households were strongly agreed, agreed, disagreed and strongly disagreed respectively on the above statement. The overall mean scale value of the above statement was 4.8, which is above neutral response and approaches to strongly agree. The chi-square test result showed that there is a significant ($P<0.01$) difference between adopters and non-adopters towards the effect of free grazing on soil stability (Table 14).

During FGD, livestock producers responded that free grazing of animals in the cropping area aggravates soil erosion through their foot and horn. This result revealed that, farmers' perception and understanding towards the negative side of free grazing leads' was important to adopt the zero grazing system. Different research results agreed on the above statement or the effects of free grazing animal on the soil erosion and land degradation (Adugna Tolera *et al.*, 2012, Alemayehu Mengistu, 2006).

From the total sampled households, 80%, 17.5%, 1.5% and 1% households were strongly agreed, agreed, disagreed and strongly disagreed respectively on the effect of free grazing on the survival of planation. The average likert scale value for the above statement was 4.74, which is above the negative perception of the likert scale value. The chi-square test result shows a significant ($P<0.01$) difference between adopter and non-adopter households perception level on the effects of free grazing on plantation survival (Table 14).

During FGD session there was a big dialog "if the farmers accept about effects of the free grazing on the planation why they don't adopt zero grazing". These showed that the reasons for not responding free grazing fully was lack of realization and follow up. Also result of (Adugna Tolera *et al.*, 2012, Alemayehu Mengistu, 2006) agreed on the above statement and farmers' view on the effects of free grazing on survival of plantations.

From the total sampled households about 78.5%, 19.5%, 0.5%, 0.5% and 1% households were strongly agreed, agreed, neutral, disagreed and strongly disagreed respectively on the effects of free grazing on stability of soil and water structures. The average likert scale value for the above statement was 4.74, which is above the negative value or (above three). There was a significant chi-square score ($P<0.01$) difference between the adopter and non-adopter households on the above statement (Table 14).

During *FGD,* farmers elaborated more about the negative effect of free grazing on constructed soil and water conservation structures. This effect becomes high during external parasite incidence because, animals have more contact and friction with earth. It is more destructive during rainy season when other sources of feed (e.g., growing grazing and crop residues) were finishing (Samuel & John, 2002).

4.6.3. Farmers' Perception on the Effects of Free Grazing on Grass and Shrubs

From the total sampled households about 74.5%, 23%, 1.5%, and 1% adopter households were strongly agreed, agreed, disagreed and strongly disagreed respectively on the effects of free grazing on shrubs and grasses. The chi-square result shows a significant ($P<0.01$) difference between adopters and non-adopters (Table 14). The average likert scale value for the above statement was 4.68; this means the perception tends to be strongly agreed. Free grazing and over stocking destructs communal grazing areas (Elias Zerfu *et al.,* 2017).

4.6.4. Farmers' Perception on the Role of Free Grazing on Animal Disease Spread

About 69%, 26%, 0.5%, 3.5% and 1% households were strongly agreed, agreed, neutral, disagreed and strongly disagreed respectively on the role of free grazing for disease transmission from one animal to other. The average likert scale value of the above statement was 4.5 which is above negative perception value of disagree and strongly dis-agree. There is a chi-square statistical difference between adopter and non-adopter households with the p-value of ($P<0.01$) (Table 14).

These show that animal diseases can be increased at the grazing areas. The result of (Tadesse Birhanu, 2015) shows that the disease transfer was high between grazing animal.

4.6.5. Farmers' Perception on Role of Free Grazing on Weed Expansion

Of the total sampled households about 63.5%, 30%, 0.5%, 5% and 1% households were strongly agreed, agreed, neutral, disagreed and strongly disagreed respectively on the role of free grazing to expand weed from one area to other. The average likert scale value for the above statement was 4.5 which were above the negative perception. There is a statistical

difference between adopter and non-adopter households of zero grazing system with the p-value of ($P<0.01$) (Table 14).

This result shows that adopter households have a better perception and understanding on the negative side of free grazing on weed transfer. The result of the Alemayehu Mengistu *et al.*, (2006), agreed on these result weeds are transferred through different ways among which the major one is through animal journey and dung.

4.6.6. Farmers' Perception on the Effects of Free Grazing on Livestock Productivity

From the total households about 70%, 24%, 1%, 7% and 1% households were strongly agreed, agreed, neutral, disagreed and strongly disagreed respectively on the negative effects of free grazing on the productivity of livestock. The average perception likert scale value was 4.59 for the above statement of "Free grazing decreases the productivity of livestock''. The non-parametric chi-square test result shows a significant ($P<0.01$) difference between adopter and non-adopters for the above argument (Table 14).

The result implies that free grazing of animals did not give good production by itself. It's because they don't get enough feed at grazing areas, lost their energy through long journey and other integral environmental destructions may happen. This shows that if people fail to manage livestock well we fail to get effective product from animals. Productivity of livestock was mainly affected by feed requirement, in addition to the health and breed potentials.

Table 14. Farmers' perceived disadvantages of free grazing (%)

Attributes	Likert scale mean	SD		D		N		A		SA		Difference between A/N
		F	%	F	%	F	%	F	%	F	%	x^2
Free grazing causes a soil erosion	4.8	2	1	1	0.5	0	0	28	14	169	84.5	40.68***
Free grazing damages plantation survival	4.74	2	1	3	1.5	0	0	35	17.5	160	80	41.38***
Free grazing has an effect on soil and water structure stability	4.74	2	1	1	0.5	1	0.5	39	19.5	157	78.5	51.4***
Free grazing has an effect on productivity of grass and shrubs.	4.68	2	1	3	1.5	0	0	46	23	149	74.5	52.94***
Free grazing causes animal disease expansion	4.58	2	1	7	3.5	1	0.5	52	26	138	69	37.44***
Free grazing plays an abundant role for weed expansion	4.5	2	1	10	5	1	0.5	60	30	127	63.5	14.77***
Free grazing decreases the productivity of livestock	4.59	2	1	7	3.5	2	1	48	24	141	70	27.1***

Note: SD=strongly disagree, D=disagree, N=neutral, A=agree and SA=strongly agree

4.6.7. Farmers' Perception on Advantages of Zero Grazing of Livestock

4.6.8. Farmers' Perception on the Advantages of Zero Grazing of Livestock Productivity than Free Grazing

Among zero grazing adopter households about 72%, 19.5%, 2%, 5.5% and 1% households were strongly agreed, agreed, neutral, disagreed and strongly disagreed respectively on advantages of zero grazing system for livestock productivity. The average likert scale value for the above statement was 4.56 which were above the neutral scale value. The chi-squire result ($P<0.01$) confirmed that there is a significant difference between adopters and non-adopters (Table 15).

The above result sows that, adopter households tend to strongly accept the above statement than non-adopter households, because adopter households have good access to training and information than non-adopter households.

4.6.9. Farmers' Perception on the Advantages of Zero Grazing to Minimize Labour Cost

From the total interviewed households about 64.5%, 25%, 1%, 7.5% and 2% households were strongly agreed, agreed, in neutral, disagreed and strongly disagreed respectively on the statement of "Zero grazing did not need more labor ". The average perception scale value for the above statement was 4.42 (Table 15). The chi-square result ($P<0.01$) shows a significant difference between adopter and non-adopter households on zero grazing minimizes labor for livestock management. Adopter households show a positive perception than non-adopters on the above statement. During the FGD the farmers said that:-

> *"Because of implementing zero grazing our animals can eat breakfast, lunch and dinar with us because we see animals nearest to us. When we need to eat our food we think about animals feed because they are in front of us"*

4.6.10. Farmers' Perception on Means of Zero Grazing Implementation

Since the farmers were enforced to stop free grazing both at the communal and cropping lands, they started to design and implement different strategies. Among different strategies minimizing number of animals was used by farmers to solve feed shortage.

From a total sampled household about 62.5%, 26.5%, 26.5%, 6.5% and 1.5% households were strongly agreed, agreed, in neutral, disagreed and strongly disagreed respectively on above means of zero grazing implementation. The mean likert scale value for the statement of ''Zero grazing can be implemented through minimizing number of animals" was 4.44. Based on the chi-square result ($P<0.01$) shows a significant difference between adopters and non-adopter households on the above statement (Table 15).

The above result implies that households were minimizing their animals, those who have no option to produce more feed for their desired amount of livestock. The result of Agraw Amanie *et al.,* (2016) which was in agreement with this result, which was conducted in four learning watersheds to assess feed gaps between livestock number and available feeds.

Table 15. Farmers perceived advantages of zero grazing system

Attributes	Likert scale mean	SD		D		NA/D		A		SA		Difference between A/N
		F	%	F	%	F	%	F	%	F	%	x^2
Zero grazing has a better livestock productivity than free grazing	4.56	2	1	11	5.5	4	2	39	19.5	144	72	40.19***
Zero grazing did not need more labor at home	4.42	4	2	15	7.5	2	1	50	25	129	64.5	44.13***
Zero grazing can be implemented through minimizing number of animals	4.42	3	1.5	13	6.5	6	26.5	53	26.5	125	62.5	44.99***

4.7. Opportunities and Challenges of Zero Grazing in the Watersheds

4.7.1. Challenges of Zero Grazing Implementation in the Watersheds

Shortage of Land for Feed Production

From the total sampled households shortage of feed both in quality and quantity was the major problem for 78% of livestock producers. Due to feed shortage about 85.5% households minimized their livestock number. In the learning watersheds farmers were enforced to stop free grazing at the communal and cropping lands. To solve feed shortage some households allocated their land for feed production and private grazing purposes. But about 46.5% households unable allocate land for private grazing and feed production purpose. Therefore in the study area shortage land for private grazing area and feed production was a key challenge.

Shortage of Animal Power for Crop Production

The main source of farm power was livestock for ploughing, compacting, trashing and transporting. In the learning watersheds the main crops finger millet, teff and maize which need a critical compaction and trashing power. Due to shortage of feed 85% households minimizes their livestock. Because of livestock minimization households were facing animal power source shortage for their crop management. The result of soil researchers showed that compaction has no any advantage for crop production in teff and finger millet production **(Tadele Amare, 2012).** But for transportation and harvesting still there was a shortage of livestock for it.

4.7.2. Opportunities of Zero Grazing Implementation in the Watersheds

Feed Production Capacity of the Developed Watershed

In the learning watersheds, soil and water conservation practices created an alternative niches for forage development. Those niches for forage development were spaces at soil bunds,

drainages, micro moisture conservation structures and at enclosed grazing lands. The major feeds developed in the learning watersheds were saspania, Napier grass, pigeon pea, Rhodes, cow pea (Agraw Amanie *et.al*, 2017). All sampled households have an experience of collecting forages in the above niches. The above feed source let the farmer to widen their source of feeds adopt zero grazing (FGD).

Farmers Experience of Exchanging Livestock for Trashing, Compacting and harvesting

Due to shortage of feed, about 85% households were minimized their livestock number to fit available feed with animals. During sowing time of finger millet and teff there is a need for more animal for compaction, trashing and transportation. To solve this problem farmers have good trend or best practice of sharing of oxen it.

These shows that farmers created solution which was sharing of animal labor used as an alternative opportunity to adopt zero grazing. Minimizing their animal and changing to modern dairy, fattening, and poultry sectors was also another alternative way for adoption of zero grazing and crop production.

Water Availability for Forage Development and Livestock Drinking

At the study watersheds there was a surface and ground water potential for feed and crop production. Ground water was used at Aba Gerima watershed households through hand dug well for *khat* production and other purposes. But in Debre Yakob watershed about 65% households were not exercising hand dug water. At Abagerima watershed small scale backyard development was common and *khat* production takes a larger area as a cash crop.

This shows that if the farmers able to use surface and ground water for forage and crop development they can adopt zero grazing easily. According the result of Sisay Damtie *et al*., (2017), in Debre mewi learning watershed it was impossible to get ground water in less than 10 m deep before soil and water conservation but after soil and water conservation works, it can be found within 8 m depth, even it is possible to get ground water nearby each village.

CHAPTER 5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusion

a) Livestock Production and Feeding Practice Under Zero Grazing System

Cattle holding of adopter household was less than non-adopters which have a contribution for crop production than other livestock specious. This is because of that the farmers minimized their animal number to fit the number of livestock with the available feed resource. There are two types of livestock housing. The first house was constructed adjacent with the main human house. The second type of house was partitioned from the main human house.

In the study watersheds a major sources of feed were communal and private grazing lands, crop residue, grass hay, local brewery by product (*brint* and *atela*), and improved forages (Napier grass, Saspania and Rhodes). The contribution of those feed resources were crop residue, grass hay, local brewery byproducts (*brint* and *atela*) and improved forages (Napier grass, Saspania and Rhodes) respectively. Crop residues and roughages were the major feeds in the dry season, but it has a poor quality.

In the study area there were enough feed from September to half March and then from April to first June there was a peak feed scarcity. During feed shortage time farmers purchase additional feed for their livestock such as grass hay, crop residue, and local brewery by product (i.e *brint* and *atela*), concentrate (wheat bran and *nuag* seed cake/*Fagulo*) and salt with its importance order. From the above results it shall be concluded that there was a feed shortage and low level of nutritive value. Therefore improving of this feed source was essential to advance its palatability to increase the productivity of livestock.

b) Communal Grazing Land Management System in the Developed Watershed

In the study watersheds there are two types of grazing sources (communal and private grazing sources). The farmers have good perception on the decreasing status of communal grazing areas in its size and forage content. Farmers were participated in the decision of the level of punishment and to give land for youths and infrastructure development. *Edir, equib, Mahiber and Senbetie* contributes for free grazing controlling through discussions and punishments

Enforcement mechanism was used to stop free grazing both at the communal and cropping lands. The major enforcement mechanism was through setting money punishment per grazing animal. The enforcement was not applied at all *Gotes* of Aba Gerima watershed of communal grazing areas but in Debre Yakob watershed it's applied both at the communal grazing areas and cropping areas. The level of punishment was high at the cropping areas and low in the communal grazing areas. In Abagerima watershed some communal grazing lands were freely accessed and grazed by animal without any restriction, punishment and regulation.

Generally from the above objective can be concluded that free grazing was stopped at the cropping areas and communal grazing areas in Debre Yakob watershed but still in Aba Gerima watershed some communal grazing areas free grazing don't stopped. This implies that participating of farmers in a decision increases the level of implementation of the decision.

C) Farmers' Perception on the Disadvantages of Free Grazing and Advantages of zero Grazing

Before the enforcement, farmers have a negative attitude to stop free grazing both at the cropping areas and communal grazing areas. The farmers understands well on the negative effects of free grazing of livestock on soil fertility, livestock productivity, soil and water structures and plantation survival. This perception of farmers was gained after many efforts of watershed committees and other expert's punishment and training; farmers developed a positive a perception on the disadvantages of free grazing.

On the other hand farmers generally strongly agreed on the advantages of zero grazing system. The major advantage of zero grazing which was perceived by farmers were about livestock productivity, minimizes labor demand and easily implemented through minimizing the number of livestock. Generally from this objective it can be concluded that, adopter farmers have better understanding and perception about dis-advantages of free grazing and advantages of zero grazing.

D) Opportunities and Challenges of Zero Grazing in the Watersheds

The major challenges which were perceived by the livestock producer to adopt zero grazing system were shortage of land for private grazing and feed production and shortage of livestock for as power source. On the other hand due to watershed development opportunities were created for production of improved feeds at different niches, government focus on the cross breeding, experience of livestock sharing and availability of ground water.

Generally from the above results it can be concluded that the implementation of zero grazing was mainly through enforcement. It's because of the farmers challenged to accept it. The main reason for challenging to accept zero grazing was feed shortage and lack of awareness by the farmers. On the other hand there are good things that make implementation of zero grazing easy that is watershed development increases the access to feed and feed developing niches. The overall conclusion of the study is free grazing have more disadvantages both at environment and livestock productivity than zero grazing.

5.2. Recommendations

To adopt zero grazing easily, the following recommendations should be implemented by government and non-government organizations. The recommendations are training and awareness creation on the disadvantages and advantages of free grazing and zero grazing, increasing forage and water availability, improving local breed, increasing farm mechanization for crop production.

Increasing training and awareness creation:- the result of these study shows that there is a good understanding and perception on the dis-advantages of free grazing. But there was resistance to adopt zero grazing. Because the farmers have a traditional believe, "if the livestock lives inside the house and does not refresh, there will be incidences of animal disease". Therefore, efforts should be made to enhance the level of awareness of smallholder farmers, especially on those who do not adopt zero grazing system, through intensive

trainings and follow ups about the advantages and disadvantages of free grazing. Besides, experience sharing should also be arranged to the areas where zero-grazing practice is more successful in order to dissatisfy with their current free grazing practices and to more inspire to reach that success full practice.

Increasing forage and water availability: - the main determining factor of zero grazing was availability of feed. Increasing quality feed throughout the year should be encouraged. In the learning watersheds there was a different started forage development works at different niches of land; at the gullies, soil bunds, and at the communal grazing areas integrated with water and soil conservation structures and forest development. The farmers should increase access to forage at their private grazing areas and cropping areas.

Allocating private grazing land nearest to the farmers resident is a key issues raised by the farmers during key informant interviews and FGD. Therefore individual farmers shall be encouraged to allocate their land for private grazing/refreshing areas for their livestock. Perennial forage should also be developed to nearest their residence to increase access to green forages such as saspania, tree Lucerne, pigeon pea etc.to meet their multiple needs.

In addition, water shortage is the other constraining factor to promote zero-grazing in the study areas. Farmers traveled a long distance for searching drinking water for their animals. As the result, they could not supply adequate amount of drinking water for their animals by human labor difficult to keep. Therefore, farmers should be encouraged to dig borehole to produce water for their animals and household consumption at a possible nearest place of their resident.

Improving local breed:- the dominant livestock breed was local breed which low productive in both milk and meat production. Even though; the farmers adopted zero grazing system in some part of the study areas. They were not still receiving the full potential benefits from their livestock activities. Therefore, to maximize the benefits of zero grazing in the study watersheds, improved animal breed should be introduced and promoted. To do so, the already

synchronization technique should be keep continued with organized and effective way to solve a shortage of crossbred milking cows in the study watersheds.

Increasing farm mechanization for crop production: -the farmers are expected to minimize and hold productive livestock breeds which is fitted with their feed amount. However, farmers faced shortage of animal power in land cultivation, draught power and transportation. As the result, farmers in the study watersheds kept different species of animals with large number. These make difficult to reduce in number and types of animals by smallholder farmers in the study watershed. Therefore, technologies should be brought by government and non-government organizations to replace this labor demand so as to promote zero grazing practices in study watersheds.

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7. APPENDIXES

Appendixe 1. Household Questioner

BAHIR DAR UNIVERSITY AND ANDASA LIVESTOCK RESEARCH CENTER

The Questioner prepared to do the Thesis research on the topic of **Farmers' Perceived Opportunities and Challenges towards the Implementation of Zero grazing in Watershed areas of West Gojjam Zone**

I. General information

Woreda ----------Name of watershed ----------Kebele ----------Got ----------

Agro ecology ---------- phone no of the respondent ----------

1. HH Characteristics of the respondent

Name of hh head ---------Family size male -------female -------hired labor size male------female-

2. Land holding and use pattern of the HH

2.1.Total land holding in ***timad*** **----------**

2.2. Total number of parcel hold **----------**

3. Livestock holding of the HH

3.1. How much **year** do you have **experience in livestock** husbandry---------

3.2. Who manages your livestock 1= family member 2= hired labor 3=others ----------

Livestock species	Breed type	Number owned	Purpose of keeping animal (**Code A**)
Ox	Local		
	Cross		
Cow	Local		
	Cross		
Bull	Local		
	Cross		
Heifer	Local		
	Cross		
Calves	Local		
	Cross		
Sheep	Local		
Goat	Local		
Horse	Local		
Donkey	Local		
Poultry	Local		

	Exotic		
Hive with bee colony	Local		

4. Feed source, feeding system and management

4.1. **Main feed sources for your cattle?**

No.	Feed source	**1**=Yes **2**=No	Area in **m^2**	Quantity used in last 12 months	
				Unit	Amount
1	Grass hay				
2	Oat hay				
4	Green grass				
5	Napier				
6	Rhodes hay				
7	Saspania				
8	Beer preparation residues (***Atela***)		--		
9	Areki(Katikala) residue (***Brint***)		--		
10	Silage		--		
11	Treated straw /crop residue		--		
12	Crop residue (straw)		--		
13	If others specify				

4.2.**Animal feed purchased/borrowed in last 12 months**

Type of feed purchased	Amount purchased in last **12** months in **Qt**		Total *estimated*/actual cost in **EB**	At what month you mostly purchased it	From whom &where did you purchased it	How did you measure its quality
	Unit	Amount				
If Grass hay						
Wheat bran						
Grass pea bran						
Salt						
*"**Atela**"*						
*"**Brint**"*						
Crop residue						
Oil seed cake***(Fagulo)***						
If others specify						

4.3.Please rank their major feed resources based on their availability and benefit to animals

4.4. **Water source for your livestock**

Source of water	Types of animal used the water source	How do you give the water to the animals	Distance to get each water source from your residence in ***minute***	Quality of water (**1**=very good**, 2=**Good, **3=**poor and **4=**very poor)	Frequency of watering per day during in ***no.***		Is there scarcity of water **1=Yes 2=No**	
					Dry season	**Rainy season**	**Dry season**	**Rainy season**
River								
Pipe /well								
Spring								
Pond								
Rain coll								

4.5. **Housing and feeding material/trough for the animals**

Type of animal	Type of animal housings	Types of feeding material/trough	
		Inside house	**Out side**
Local cow			
Crossed cow			
Oxen			
Calves			
Small ruminant			
Equines			

4.6. **What are your major feeding systems?**

Livestock species	Breed type Local/cross/exotic	Feeding system in (Code A)		If free grazing is practical for how much time	
		Dry	**Rainy**	**Per day**	**Annually**
Ox	Local				
Ox	Cross				
Cow	Local				

(Code A) 1=Free grazing **2=**Rotational grazing **3=**Zero grazing/stall feeding **4**=Free grazing and stall feeding **5**=grazing in a private area **6**=Others specify

4.7. **Gross feed availability across seasons**

Feed availability rate across months	Feed utilization across months(Put **X**)											
	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Enough availability												
scarce time												

4.8. During excess feed availability time do you practice feed storage? **1**= Yes **2**=No

4.9. If yes what feed storing techniques do you experienced?

1=Silage making for ----------source of feeds **2**=hay making for ----------source of feeds

3= urea treating to increase its palatability for ----------source of feeds

4=others specify ----------

4.10. Do you have any feed storage house or shed? 1=Yes 2=No

4.11. If yes what type of the house/shed----------

4.12. If no a feed storage house/shed why and where do you store----------

4.13. If you don't practice feed storage why? **1**= lack of awareness and training **2**=other-----

4.14. If you don't practiced feed storing during excess feed availability time what happened? **1**= soled to others **2**=given to others as a gift **3**= discarded out **4**= others -------

4.15. **Breeding system**

Where Do you get bull service **1=**private/my own **2=**from neighbors **3=**at grazing areas	what type of bull **1**=local **2**=improved/cross	Do you pay for bull service if yes how much per cow	
		1=local	**2**=improved/cross

II. Free grazing areas and its management

4.16. Do you have access to communal grazing area? **1**=Yes **2**=No

4.17. If yes what is the current status of grazing area? 1= fertile 2= marginal and non-fertile 3=others ----------

4.18. Also how much area in ***Got*** level ----------in ***Timad***

4.19. How much house hold have a right to use the grazing areas----------

4.20. What is the trend of grazing area since 1989? 1= increasing in size 2= decreasing in size 3=increasing in forage productivity 2= decreasing in forage productivity

4.21. If it's decreasing in size why? 1=given to the youths 2=given to HH 2=used for infrastructure development 3=used for land compensation 4=others ----------

4.22. How did the community own/use the grazing land?

1=through distributing by ***niuse*** kebele/ ***Got*** **2**= others specify ----------

4.23. Who manage and distribute the grazing area? **1**= kebele land administrators officers **2**=keble land use committees **3**= community member committee 4= if other specify -------

4.24. Is there any free grazing practice in the grazing areas? 1=Yes 2=No

4.25. If yes from when? 1= During dry season after collecting hay 2= all year round 3=if other Specify ----------

4.26. If yes for 4.24 how did you use it?

1=freely grazing of animals **2**= rotational grazing system **4**= If others Specify ------

4.27. What is your source animal grazing?

1= Communal grazing **2**=Private grazing area **3**= both of 1&2

4.28. Do you think that the grazing area is enough to feed all animals? **1**=Yes **2**=No

4.29. If no what solutions did you take?

1= Giving supplement after grazing **2**= Giving supplement before grazing **3**= No supplement

4.30. If you give a supplement feed before or after grazing what are the major feeds used as a supplement based on its importance?----------

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4.31. If your animals do not freely graze in the grazing area why? Specify down here

4.32. Is there any community by law to stop free grazing on that you agreed up on it? 1=Yes 2=No

4.33. Is there any organized watershed committee and a decision to stop free grazing ? 1=Yes 2=No

4.34. Is there any free grazing stopping trend because of grazing area can't full fill the nutritional and quantitative demand of animals?1=Yes 2=No

4.35. Do you stop free grazing in a communal grazing areas because of your number of animals are too small 1=Yes 2=No

4.36. Do you stop free grazing in a communal grazing areas because of labor shortage to keep animals?1=Yes 2=No

4.37. Do you stop free grazing in a communal grazing area because of having enough source of feed at home and private grazing area? 1=Yes 2=No

4.38. If do you have any others reason for stopping free grazing specify in details ----------

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4.39. Is there any free grazing practice in the developed watershed crop land? **1**=Yes **2**=No

4.40. Do you think that free grazing has a negative effect on your agriculture production system? **1**=Yes **2**=No

4.40.1. Do you face any natural resource degradation (soil erosion, land slide, plant deforestation, low rate of plantation survival? **1**=Yes **2**=No

4.40.2. Do you face any Low access to feed both in quantity and quality? **1**=Yes **2**=No

4.40.3. Do you face any problem of disease transfer between grazing animals? **1**=Yes **2**=No

4.40.4. Do you face any inbreeding problem and less control on the animal history? **1**=Yes **2**=No

4.40.5. Do you face any problem of unsustainability on the developed soil and water structure? **1**=Yes **2**=No

4.40.6. Do you face any other problem specify ----------

4.41. Is there any conflict which is because of grazing area ownership ?1=yes 2=no

4.42. If yes how much it happened and how it happened----------

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4.43. If the community controls free grazing at grazing and watershed cropping lands how they control?

How ----------

4.44. If there is a punishment for free grazed animal how much ----------

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4.45. Who guard the freely grazing animals? ----------

4.46. Do you believe that punishment can stop free grazing in developed watershed croplands and grazing areas? **1**=Yes **2**=No

4.47. If you don't believe it why ----------

4.48. What is your recommendation to stop free grazing easily ----------

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III. Zero grazing and its management

4.49. Are you practicing zero grazing system for your animals? **1=** Yes **2=** No

4.50. If you don't adopt zero grazing why? ----------

4.51. If yes when did you start? ----------

4.52. Why did you start or adopt zero grazing?

1= because there is strong watershed committee control and punishment on free grazing

2= because the grazing area can't fulfill the feed requirement of the animals
3=because my animals are too small and no need to go to grazing areas
4= because I have labor shortage to keep herds in the grazing area
5=because I have enough forage and private grazing area
6=if others specify ----------

4.53. If you practiced zero grazing, did you minimize your animal number? **1**=Yes **2**= No

4.54. If yes list the type and number of animals you minimized? ----------

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4.55. Why you minimized the number of animals----------

4.56. Do you believe that the number of animals should be minimized to adopt zero grazing? **1**=Yes **2**=No

4.57. If you don't believe why ----------

4.58. If you practice zero grazing what are the major feeds do you feed at home?----------

---

4.59. Do you think that the feed given for zero grazing/stall feeding is enough? **1**=Yes **2**=No

4.60. If not enough what solutions do you take?

1= Purchasing additional feed **2**=minimizing the animals by selling **3**= no solution

4= if other specify ----------

4.61. If the community stops free grazing at the grazing area is there any practice of plantation of improved forages on it please specify it----------

4.62. If you adopt zero grazing do you collect hay from grazing areas 1=Yes 2=No

4.63. If yes how do you distribute the developed grass from the communal grazing areas?---

---

4.64. Is there any conflict between the community members when you are distributing the hay collected from the grazing areas?1=Yes 2=No

4.65. If yes why ----------

4.66. Do you think that zero grazing or stall feeding has a negative effect on the productivity of livestock? **1**= Yes **2**= No

4.67. If zero grazing has no negative effect, what benefits do you get in zero razing system -

---

4.68. If yes how the effects of zero grazing happened?

1=Shortage of bull for reproduction purpose **2**= labor cost for managing animals at home

3= if other specify----------

4.69. Do you see any improvement from free grazing to zero grazing feeding system in livestock productivity? 1=Yes 2=No

4.70. What preconditions should be fulfilled to adopt zero grazing----------

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IV. **Farmers perception (**Thick on each**)**

Attributes	**Strongly agree**	**Agree**	**Neither**	**Disagree**	**Strongly Disagreed**	**Why to say this**
1. Perception on free grazing						
Free grazing has an effect on soil erosion						
Free grazing has an effect on plantation survival						
Free grazing has an effect on soil and water structure destruction						
Free grazing has an effect on productivity of grass and shrubs on grazing area						
Free grazing decreases the productivity of livestock						
Free grazing has an effect of inbreeding						
Free grazing causes a disease transfer between grazing animals						
Free grazing has play a great role of weed transfer						
2.Perception on Zero grazing						
Zero grazing system has a better livestock productivity than free grazing system						
Zero grazing has no effect on the breeding/ productivity of animals						
Zero grazing can be adopted through changing the breed type from local to cross breeds						
Zero grazing can be adopted through						

minimizing the number of animals						
Zero grazing doesn't need more labor to at home						

V. **Institutional participation**

5. State your level of social participation in last 12 months

Attributes	**1=Yes 2=No**	Level of participation **1**=member **2**=leader/ committee	What contribution or role play to stop free grazing and adopt zero grazing ***please note in detail***
Do you participate in ***Edir***			
Do you participate in ***Equb***			
Do you participate in ***Mahiber***			
Do you participate in ***Senbetie***			
Do you participate in ***Limat buden***			
Do you participate in one to five			
Free grazing controlling committee			
If Others			

5.1. State your level of **training, extension and credit** service participation in last 12 months

Attributes	**1=Yes 2=No**	If yes who give the service (**1**=WBoA **2**=WLRC 3=Research centers)	Frequency of training in year	Level of satisfaction (**1**=V.good, **2**=good and**3**=satisfactory, **4**=not good)	If you need any training in future pleas list it
Do you get livestock production training					
Do you get livestock production advisory service					
Do you get crop production training					
Do you get credit service for livestock production					
Do you get improved seed and seedling service for free					
Do you get veterinary service					
Do you get AI service					

Do you get training about feed storage preparation(silage making, hay production etc)					
Do you have mass media service (Radio,TV and newspaper)					
Do you have agriculture market information (input and output market)					

VI. Income and expenditure of the HH in in last 12 months

6. Income from Livestock and crop

Type of livestock products	Total amount sold	Unit price	Total income gained	Item	Total amount sold	Unit price	Total income gained
Oxen				Teff			
Cow				Maize			
Net Profit from fattening				Wheat			
Sheep				Barley			
Goat				Vetch /Guaya			
Poultry				Chick pea /shimbra			
Donkey				Finger millet /dagusa			
Raw Milk				Eucalyptus			
Butter				Others			
Egg							
Honey							
Skin							
Total income							

6.1. Is there any income change in last five years? **1**=Yes **2**=No

6.2. If no change why ----------

6.3. If yes what changes do you got/observe? **1**= increasing **2**= decreasing

6.4. If increased how and why it increased ----------

6.5. If decreased how and why it decreased----------

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7. Other non-farm and off-farm activities

Source of income	**Unit**	**Total income i**n ETB
Income from labor service on non-farm activities		
Income from labor service on off-farm activities		
Income from Trading		
Income from Remittance		
Income from Donatation from **NGOs**		
Total income		

8. House hold expenditure of the last 12 months

List of costs	Total expended in **EB**
Food related expenditures	
For Teff purchase	
For Pepare /***berebere*** purchase	
For ***Shiro*** purchase	
For Salt purchase	
For Oil purchase	
For Milling cost	
For Sugar purchase	
Non-food expenses	
For transport cost	
For medical cost	
For land tax fee(land +guarding of schools +others paied with tax)	
Medical **insurance** cost	
Annual Church fee (***Sebeka Gubaea***)	
Annual family close purchase	
Alcohol cost for (holiday purchased only)	
Total cost	

8.1.Please state your perception on the major challenges to stop free grazing and to implementation of zero grazing?

8.2.Please state your perception on the major opportunities to stop free grazing and to implementation of zero grazing?

8.3. What pre conditions should be full filed to adopt zero grazing ----------

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Thank you!!

Appendixe 2. Key Informant and FGD Questioner/Check List

GENERAL INFORMATION AT REGIONAL LEVEL

1. Total land size of ANRS ---------- km^2 /ha
2. Total grazing area of ANRS ----------ha
3. Trend of the size of grazing area since 1989-------- ha 1990--------- ha 1991----- ha 1992---- ha 1993--- ha 1994--- ha 1995---- ha 1996--- ha 1997--- ha 1998--- ha 1999— ha 2000— ha 2001--- ha 2002--- ha 2003--- ha 2004--- ha 2005--- ha 2006--- ha 2007--- ha 2008--- ha 2009---- ha 2010------- ha
4. Who administer the grazing areas at the kebele level ----------
5. Total beneficiary for the regional grazing area household head ----------female headed ----------male headed ----------
6. If the grazing area becomes decreased why ----------
   ----
7. If there is a trend of giving common grazing areas for different purpose please state below 1- for youths development ----------ha since ----------to ----------year
   2- for infrastructure development ---------- ha since ----------to ---------- year
   3 for compensation---------- ha since ----------to ---------- year
8. **Number of livestock in the region trend since 1989 can be find in literature**
9. Major water sources for animals **ANRS** ----------
10. How the region try to provide pure water for livestock nearest to the resident areas ---
    ----
11. What are the major formal organizations actively involved/participate in the livestock sector in **ANRS** ----------
12. Major source of animal feeds in the region ----------
13. What is the practice of zero grazing in the region ----------
14. Amount of grazing areas free from free grazing of animals up to 2010 ----------
15. Introduced and adopted improved animal feeds in the region ----------
16. Number of participants who are using the /adopting zero grazing male------female------ total ------

17. How the region trying to stop free grazing in the developed structures and cropping areas ----------

18. What are the major challenges to stop free grazing and to implementation of zero grazing?----------

19. What are the major opportunities to stop free grazing and to implementation of zero grazing?----------

20. What pre conditions should be full filled to stop free grazing in the grazing areas and cropping areas ----------

21. Is there any law in the region to stop free grazing used as a law1=yes 2=No

Appendixe 3**. Cronbach's test table**

Table 16. Reliability Statistics of Cronbach's alpha

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.939	.944	12

8.

Table 12. Item-Total Statistics

Items	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Free grazing has an effect on soil erosion at cropping area	50.0600	50.921	.708	.653	.935
Free grazing has an effect on plantation survival at cropping area	50.1250	49.959	.721	.773	.934
Free grazing has an effect on soil and water structure destruction	50.1250	50.432	.716	.779	.935
Free grazing has an effect on productivity of grass and shrubs on grazing area	50.1800	48.751	.839	.822	.931

Free grazing decreases the productivity of livestock	50.2700	48.892	.682	.649	.935
Free grazing causes a disease transfer between grazing animals	50.2800	48.735	.704	.676	.934
Free grazing has play a great role of weed transfer	50.3650	48.725	.644	.677	.936
Zero grazing system has a better livestock productivity than free grazing system	50.3050	47.590	.717	.634	.934
Zero grazing has no effect on the breeding/ productivity of animals	50.5000	44.975	.758	.708	.933
Zero grazing can be adopted through changing the breed type from local to cross breeds	50.4200	46.235	.762	.769	.932
Zero grazing can be adopted through minimizing the number of animals	50.4450	45.595	.819	.888	.930
Zero grazing doesn't	50.4400	45.534	.783	.864	.932

need more labor to at home					

Table 17. Perception of farmers on the dis-advantages of free grazing

Attributes	Adopter										Non Adopter									
	SD		D		NA/D		A		SA		SD		D		NA/D		A		SA	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Free grazing has an effect on soil erosion	1	0.6	0	0	0	0	13	7.8	153	91.6	1	3	1	3	0	0	15	45.5	16	48.5
Free grazing has an effect on plantation survival	1	0.6	1	0.6	0	0	18	10.8	147	88	1	3	2	6.1	0	0	17	51.5	13	39.4
Free grazing has an effect on soil and water structure destruction	1	0.6	0	0	1	0.6	19	11.4	146	87.4	1	3	1	3	0	0	20	60	11	33.3
Free grazing has an effect on productivity of grass and shrubs on grazing area	1	0.6	0	0	0	0	26	15.6	140	83.8	1	3	3	9.1	0	0	20	60.6	9	27.3
Free grazing decreases the productivity	1	0.6	5	3	1	0.6	30	18	130	77.8	1	3	2	6.1	1	3	18	54.5	11	33.3

of livestock																				
Free grazing causes a disease transfer between grazing animals	1	0.6	3	1.8	0	0	34	20.4	129	77.2	1	3	4	12.1	1	3	18	54.5	9	27.3
Free grazing has play a great role of weed transfer	1	0.6	7	4.2	0	0	45	26.9	114	68.3	1	3	3	9.1	1	3	15	45.5	13	39.4

Table 18. Farmers perception on zero grazing

Attributes	Adopter										Non Adopter									
	SD		D		NA/D		A		SA		SD		D		NA/D		A		SA	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Zero grazing system has a better livestock productivity than free grazing system	1	0.6	4	2.4	2	1.2	26	15.6	134	80.2	1	3	7	21.2	2	6.1	13	39.4	10	30.3
Zero grazing has no effect on the	2	1.2	14	8.4	2	1.2	25	15	124	74.3	1	3	8	24.2	2	6.1	16	48.5	6	18.2

breeding/ productivity of animals																				
Zero grazing can be adopted through changing the breed type from local to cross breeds	2	1.2	2	1.2	13	7.8	26	15.6	124	74.3	1	3	8	24.2	2	6.1	13	39.4	9	27.3
Zero grazing can be adopted through minimizing the number of animals	2	1.2	4	2.4	3	1.8	40	24	118	70.7	1	3	9	27.3	3	9.1	13	39.4	7	21.2
Zero grazing doesn’t need more labor to at home	3	1.8	6	3.6	0	0	37	22.2	121	72.5	1	3	9	27.3	2	6.1	13	39.4	8	24.2

Appendixe 4 . BIOGRAPHICAL SKETCH

The author, Molla Haile, was born in 1985G.C in Andassa, Bahir Dar Zuria Woreda, West Gojjam Administrative Zone, Amhara National Regional State. He had attended and completed his Elementary, Secondary and High school education in in Andassa Primary, Fasilo Junior secondary and Tana Haik Preparatory School, respectively. He joined Bahir Dar University College of Agriculture and Environmental Sciences and graduated with BSc degree in Rural development in2008 G.C. He was employed and worked for four year in Dembecha office of Agriculture, since 2001 E.c. In 2005, then he joined Amhara Regiona Agricultural research Institute, Andasa livestock research center and working as assistant researcher until joining of Bahir Dar University for graduate study of rural development management in 2016.