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CHARACTERIZATION OF CATTLE PRODUCTION SYSTEM AND FEED RESOURCES IN ESSERA DISTRICT, DAWURO ZONE, SOUTHERN ETHIOPIA

MSc THESIS

BY

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DEPARTMENT OF ANIMAL PRODUCTION STUDIES

MSc PROGRAM IN TROPICAL ANIMAL PRODUCTION AND HEALTH

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College of Veterinary Medicine and Agriculture, Bishoftu

CHARACTERIZATION OF CATTLE PRODUCTION SYSTEM AND FEED RESOURCES IN ESSERA DISTRICT, DAWURO ZONE, SOUTHERN ETHIOPIA

A Thesis submitted to the College of Veterinary Medicine and Agriculture of Addis Ababa University in partial fulfillment of the requirements for the degree of Master of Science in Tropical Animal Production and Health

By

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College of Veterinary Medicine and Agriculture, Bishoftu

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As members of the Examining Board of the final MSc open defense, we certify that we have read and evaluated the Thesis prepared by **Andualem Tonamo** titled **"Characterization of Cattle Production System and Feed Resources in *Essera* District, Dawuro Zone, Southern Ethiopia"** and recommend that it be accepted as fulfilling the thesis requirement for the degree of Masters of Science in Tropical Animal Production and Health.

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TABLE OF CONTENTS **PAGE**

LIST OF TABLES **PAGE**

LIST OF FIGURES **PAGE**

LIST OF APPENDICES **PAGE**

DEDICATION

The author dedicates this manuscript to his grandmother ***W/ro Workinesh Dejene****, who passed away in December 2010/11without seeing any of his achievements. "****Emama****" you are always in his heart. May God rest your soul in peace!*

STATEMENT OF AUTHOR

First, I declare that this thesis is my *bonafide* work and that all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for an advanced (MSc) degree at Addis Ababa University, College of Veterinary Medicine and Agriculture and is deposited at the University/College library to be made available to borrowers under rules of the Library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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LIST OF ABBREVIATIONS

ADF	Acid detergent fiber
ADL	Acid detergent lignin
ANOVA	Analysis of Variance
BW	Body weight
CF	Crude fiber
CI	Calving interval
CP	Crude protein
CSA	Central Statistical Agency
DM	Dry matter
EARO	Ethiopian Agricultural Research Organization
EWARDO	*Essera* Woreda Agriculture and Rural Development Office
EWFEDO	*Essera* Woreda Finance and Economy Development Office
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
HHs	Households
IGAD	Inter-Governmental Authority on Development
IPS	International project service
IVDMD	*In vitro* dry matter digestibility
IVOMD	*In vitro* organic matter digestibility
m.a.s.1.	Meters Above Sea Level
MoA	Ministry of Agriculture
NCFR	Non-conventional feed resources
NDF	Neutral detergent fiber
r	Correlation coefficient
SE	Standard error
SNNPR	Southern Nation Nationality and Peoples Region
SPSS	Statistical Packages for Social Sciences
TDN	Total digestible nutrients

ABSTRACT

This study was conducted in *Essera* District, *Dawuro* Zone of South Nations Nationalities and People Region with the objectives of assessing cattle production system, identifying major feed resources and analyzing their chemical composition as well as identifying and prioritizing cattle production constraints of the study area. Ninety households (HHs) owning cattle were selected randomly. A structured questionnaire was prepared and used to collect data on cattle production system, production constraints, feeding systems and available feed resources. Feed samples were collected from crop residues, indigenous grass, legumes and browses to analyze their chemical composition. Collected data were analyzed using descriptive statistics, indices and one-way ANOVA using SPSS software. The average family size was 6.74±0.32 per HH. Crop-livestock mixed farming was the commonly used farming system (95.5%). The mean total land holding was 2.91±0.18 ha per HH and there was no significant ($P>0.05$) difference in total land holding among three agro-ecologies. The average land allocated for crop production, fallow land, others and grazing land was 1.00 ± 0.26, 0.92 ± 0.20, 0.46 ± 0.19 and 0.42 ± 0.19, respectively. The results of this study showed that the average cattle herd size per HH was 11.12 ± 0.69 and significantly ($P<0.05$) varied across agro-ecologies. The purpose of keeping cattle in the district was for milk (46.7%), meat (44.4%), manure (100%), traction (4.4%), and others (37.8%). Natural mating (82.2%) was the most widely used means of breeding system practiced and significantly ($P<0.05$) differed among agro-ecologies. Trypanosomiasis was first ranked disease in the study area. Majority (93.3%) of HHs experience of housing cattle in their living house. The sources of water for cattle were river (75.5%), spring (13.3%) and tape (11.1%). The survey showed the major constraints of cattle production to be shortage of feed, diseases and shortage of water with indices of 0.385, 0.367 and 0.111, respectively. The first three major feed resources were natural pasture (54.4 and 90%), crop residues (63.3 and 100%), and crop aftermath (65.5 and 90%) during dry and wet season, respectively. Grazing on natural pasture was the commonly used feeding system. Maize stover and *teff*

straw were the two major crop residues with indices of 0.407 and 0.245, respectively. According to 48.9 and 51.1% of respondents, feed shortage existed in between January to March and February to April in the District, respectively. The results revealed, only 17.8% of farmers used feed quality improvement techniques in the study area. The results of laboratory analysis of chemical composition showed that the DM content of maize stover, *teff* straw, *Lamuxxa*, *Cayshiyaa*, *Dawuro daama* and *Gasaa* were 92.11, 92.09, 69.63, 57.08, 43.38 and 18.73%, respectively. The ash content of *Lamuxxa*, *teff* straw, maize stover, *Cayshiyaa*, *Dawuro daama* and *Gasaa* were 7.95, 7.89, 6.56, 5.0, 3.71 and 2.75% respectively. The crude protein content of *Dawuro daama*, *Cayshiyaa*, *Gasaa* and *Lamuxxa* was 14.23, 13.39, 12.35 and 10.30%, respectively. The CP content of *teff* straw was 4.26% and that of maize stover, was 3.67%. The NDF content of available major feed resources ranged between 9.43% - 78.23%, whereas that of ADF content ranged between 5.34% - 53.94%. Maize stover, *teff* straw and *Lamuxxa* had high values of ADF and NDF. The IVDMD of indigenous legumes and browses was higher than the grasses and crop residues. The highest value of IVDMD was found in *Gasaa* (95.29%) followed by *Dawuro daama* (85.18%) and *Cayshiyaa* (77.22%). Lowest IVDMD was found in maize stover (40.90%).

Keywords: - C*attle production, characterization, chemical composition, essera, feed resources*

1. INTRODUCTION

In Ethiopia, agriculture is the main economic activity and more than 80% of Ethiopian population is dependent on agriculture in which livestock play a very important role (CSA, 2009). In Ethiopia, agriculture contributes about 50% to the overall GDP, generates 90% of export earnings and provides employment for 80% of the population (CSA, 2009). Livestock is an integral part of the agriculture and the contribution of live animals and their products to the agricultural economy accounts for 47% (IGAD, 2011). Among livestock species, cattle contribute significantly to the livelihoods of farmers. They serve as a source of draught power for the rural farming population, supply farm families with milk, meat, manure, serve as source of cash income, and play significant role in the social and cultural values of the society.

Cattle contribute nearly all the draught power for agricultural production at smallholder level in Ethiopia (Melaku, 2011). Cattle are also used to generate critical cash in times of scarcity, provide collateral for local informal credit and serve other socio-cultural functions in Ethiopia (Ulfina *et al*., 2005). Despite the importance of cattle to the farming community in particular and to the national economy at large, the sector has remained underdeveloped and underutilized. According to CSA (2011), Ethiopia has about 52.13 million heads of cattle. Cattle produce a total of 3.2 billion liters of milk and 0.331 million tons of meat annually (FAO, 2005; CSA, 2008). In addition, 14 million tons of manure are used annually primarily for fuel and 6 million oxen provide the draught power required for the cultivation of crops (Befekadu and Birhanu, 2000).

Ethiopia has an immense potential for increasing livestock production, both for local use and for export purposes. However, expansion and productivity was constrained by quantitatively and qualitatively inadequate and imbalanced nutrition, sporadic disease outbreak, scarcity of water, lack of appropriate livestock extension services, insufficient and unreliable data to plan the services, and inadequate information to improve animal

performance, marketing, processing and integration with crop and natural resources for sustainable productivity and environmental health (Aynalem *et al*., 2011).

Currently, feed is the main constraint limiting livestock productivity in the country and there is seasonal fluctuation in feed supply in both quantity and quality. Feed shortage and nutrient deficiency are common during the dry season in both highlands and lowlands of the country. Various factors contribute to the low feed supply to livestock. Grazing lands are decreasing due to human population increment and increasingly conversion of grazing land into croplands. Poor soil fertility and unreliable and seasonal fluctuation of rainfall limit the amount of feed obtained and crop residues are low in nutritive value. The use of improved forages by smallholder farmers is not common and utilization of agro-industrial by-products is limited to urban and peri-urban areas (EARO, 2001).

Currently, livestock depend on natural pasture and crop residues as their main feed resource in the country (Alemayehu, 2005). The quality and quantity of feed produced from the natural pasture is low (EARO, 2001). According to this source, a mean annual yield of 4.2 ton DM per hectare can be obtained from the natural pasture. In addition, the critical nutrient lacking in natural pasture was noted to be CP during the dry season. The same source reported that in January the CP content of the natural pasture was about 3.2%, which is below maintenance requirement for ruminant animals.

Owing to this, up to 20% body weight (BW) loss has been recorded in cattle kept entirely on natural pasture (EARO, 2001). It is also observed that BW gains made during the rainy season are lost during the dry season. Currently, with increasing human population and demand for crop production, grazing lands are shrinking and livestock are kept in low potential lands that are not suitable for crop production and other purposes (Alemayehu, 2005). This condition is evident in the mixed farming systems of the highlands and mid altitude zones of Ethiopia.

Improvement in cattle productivity can be achieved through identification of production constraints and introduction of new technologies or by refining existing practices in the system. In Ethiopia, the cattle production system in different agro-ecological zones is not studied fully and farmers' needs and production constraints have not been identified (EARO, 2001). Assessment of the cattle production system and identification and prioritization of the constraints of production is a prerequisite to bring improvement in cattle productivity in the country. Prioritization of the production constraints is essential as it helps to use the scarce resources efficiently. Understanding the production system helps to design appropriate technologies, which are compatible with the existing system. In general, assessment of the production system is important to plan development and research activities and bring improvements in productivity.

Although cattle play a very significant role in the livelihood of smallholder farmers in the *Essera* district, cattle production system, constraints of cattle production, feed resources and feeding practices have not been studied yet. Thus, assessment of the cattle production system, identifying and prioritizing the constraints, available cattle feed resources and analyzing chemical composition of major cattle feeds are necessary in the district in order to design appropriate technologies compatible with the existing system and to plan development and research activities aimed at improvements in cattle production.
Therefore, this study was conducted with the following objectives.

- To characterize cattle production system, identify and prioritize the constraints limiting production in the *Essera* District;

- To identify major cattle feed resources and feeding systems;

- To analyze the chemical composition of the major cattle feed resources in the District.

2. LITERATURE REVIEW

2.1. Livestock Production Systems in Ethiopia

2.1.1. The highland crop-livestock mixed farming system

The highland crop-livestock mixed farming system encompasses nearly 40% of the country's land area and is located above 1,500 m.a.s.l (NEPAD-CAAD, 2005). It is featured by a mixed farming system where crop cultivation and livestock production are undertaken side by side and complementing each other. According to the same source, about 80% of cattle, 75% of sheep and 25% of goats from the total national livestock holdings are found in this production system. Despite the contribution of livestock to the economy and to smallholders' livelihood, the production system is not adequately market-oriented (Ayele *et al*., 2003).

There is little evidence of strategic production of livestock for marketing except some sales targeted to traditional Ethiopian festivals. According to the same authors, the primary reason for selling livestock is to generate income to meet unforeseen expenses. Sales of oxen are taken as a last resort and large ruminants are generally sold when they are old, culled, or barren. In the highlands, large numbers of cattle are kept to supply draft power for crop production.

2.1.2. The lowland pastoral and agro-pastoral production system

The lowlands in Ethiopia cover about 60% of the country's land area and are situated below 1,500 m.a.s.l (NEPAD-CAADP, 2005). The lowlands are situated in the Eastern (Afar and Somali), Southern (Borena and South Omo), and Western (some parts of Gambela and Beneshangul) part of the country. According to the same source, the sector is characterized by pastoral and agro-pastoral production systems, whereby about 20% of

cattle, 25% of sheep and 75% of goats of the total national livestock population are found.

The pastoral society, which depends on livestock resources, is able to purchase food grains, cloth and other household items. Their sources of income include sales of animals and animal products and hiring out of drought animals to the highlanders (Bruke and Taffese, 2000). Livestock are the principal source of subsistence providing milk and cash income to cover family expenses for purchase of food grains and other essential household requirements (mostly consumer goods). The pastoral areas have been the traditional source of export animals. Some scholars also indicated that to a certain extent, Middle East importing countries have preference to the local breeds of livestock raised in these areas (Mohammed *et al*., 2007).

2.2. Constraints Limiting Cattle Production

2.2.1. Breed factor

As compared to breeds originated from temperate areas, cattle breeds of the tropics generally have a limited genetic potential for milk production and remain mediocre producers (500-1500 kg per lactation) even when the best possible husbandry conditions are available to them (Pagot, 1992). In a general way, the genetic improvement of local breeds for milk production has essentially been obtained by crossing with breeds, which originate from temperate countries. However, the tropical African indigenous breeds have special adaptive traits for disease resistance, heat tolerance and ability to utilize poor quality feed (Tedonkenk-Pamo and Pieper, 2000).

The livestock genetic resources of Ethiopia have involved largely as a result of natural selection influenced by environmental factors. This has made the stock better conditioned to withstand feed and water shortages, diseases challenges and harsh climates. Nevertheless, the capacity for the high level of production has remained low (IPS, 2000).

2.2.2. Shortage of feed resources

Availability, quality and quantity of feeds vary among varies production systems. Cattle largely depend on rangeland grazing or crop residues that are of poor nutritive value. Feed is not uniformly supplied and the quality is poor (Ibrahim and Ololaku, 2000). Natural pasture, browses and bushes account to the major food sources of livestock owned by pastoralists.

Seasonal fluctuation in the availability and quality of feed has been a common phenomenon, inflecting serious changes in livestock production (Alemayehu, 2005). Dry season feed supply is the paramount problem. The feed shortages and nutrient deficiencies are more acute in dry seasons (Tedonkenk-Pamo and Pieper, 2000). In contrast, under normal circumstances in lowlands when there is sufficient feed for cow, milk tends to be adequate for home consumption as well as for market (Bruke and Tafesse, 2000).

The natural pastures of the tropics have significant seasonal variations of productivity and nutritive value. Pagot (1992) showed that modern agronomic techniques (selection of forage species, fertilization and irrigation) enable the attainment of productivity very much higher than the best obtained in temperate countries. Tropical climates are favorable to the production of abundant food energy notably in the form of starchy root crops, but the level of production of forage proteins is not high.

2.2.3. Shortage of water

Since rainfall rather than livestock, density determines net primary production and vegetation cover, its variability is the most important climatic factors determining the state of the natural resources base. Hence, rainfall variability and productivity of the vegetation correspondingly determines livestock production (Kedija, 2008).

Ruminates require water to maintain the water content of the body, and water availability affects voluntary feed intake; less water leads to inadequate intake of dry matter. For animals kept under pastoral production system, the frequency of watering is very important. During the dry season, water is available only from wells and some lakes and streams (Ibrahim and Olaloku, 2002). This leads to over grazing around watering points. Water intake increases as watering frequency is decreased and feed conversion efficiency becomes lower as watering interval increase (Ibrahim and Olaloku, 2002).

2.2.4. Climatic factors

Numerous experiments have shown that a prolonged period in which temperatures are more than 25^{o}C, particularly in humid air conditions leading to a reduction in dry matter intake by milking cows and, as a consequence, a drop in their production. High ambient temperatures have another depressive action on milk production by reducing the fertility of the cows, thus lengthening the interval between lactations (Pagot, 1992).

Another similar study indicated that dairy cattle, like other warm-blooded animals, function most efficiently in environments where they can maintain their body temperature at around 38°C. Tissue and cellular metabolism and the underlying biochemical reactions that sustain life and productive functions need body temperature to be maintained within very narrow limits. Relatively small increases in body temperature, for example, one degree Celsius or less result in detectable and deleterious effects on

metabolism and tissue integrity, in particular, the breakdown of body protein and a significant depression in production (Vercoe, 1999).

2.2.5. Animal healthcare

Animal healthcare and improved health management is also one of the major constraints of dairy development in Ethiopia, which caused poor performance across the production system. Many of the problems result from the interaction among the technical and non-technical constraints themselves. For instance, poorly fed animals have low disease resistance, fertility problems, partly because the animal healthcare system relays heavily on veterinary measures. Moreover, poor grazing management systems continue to cause high mortality and morbidity (e.g. internal parasites), many of the diseases constraints which effect supply are also a consequence of the non-technical constraints, for example, insufficient money to purchase drugs or vaccines (Ibrahim and Olaloku, 2002).

Contact of livestock brought from various localities through the use of communal pastures and watering as well as marketing places play an important role in the transmission of economically significant infectious and parasite diseases. Such livestock movements could be the cause of direct or indirect transmission of various economically important livestock diseases (Zinash, 2004).

The most serious animal disease constraints to livestock productivity are the parasitic and viral diseases mainly vector-transmitted that have a wide geographic distribution and whose severities are strongly influenced by the environment (Tedonkenk-Pamo and Pieper, 2000). The diseases transmitted by ticks (babesiosis, anaplasmosis, heart water) have been the main justification for a long time of the crossing of Zebus with specialized European breeds for milk production. In improved methods of animal production (Zero grazing), the need to favor these practices is considerably reduced (Pagot, 1992).

The low veterinary service performance in the lowlands is the outcome of the government-monopolized services. Government veterinary staffs are few in number and cannot cover such a vast area to adequately address the veterinary needs of livestock keepers. Besides government staffs need adequate mobile facilities for which currently the government does not have the capacity to provide (Tafesse, 2001).

2.3. Feed Resources and Their Nutritive Value

Livestock feed resources in Ethiopia are mainly natural pasture, crop residues, improved pastures, forage crops and agro-industrial by products (Alemayehu, 2004). The feeding systems include communal or private natural grazing and browsing, provision of crop residues and cut-and-carry feeding. At present, stock are fed almost entirely on natural pasture and crop residues. Livestock are grazed on permanent pastures, fallow land and cropland aftermath (Alemayehu, 2004).

The major roughage feed resources for dairy animals across all the different production systems included natural pasture/grasslands, crop residues, non-conventional feed resources (e.g. leaf and stem of *enset*, banana and sugarcane; crop thinning) and crop aftermath (with the exception of urban dairy producers). The contribution of these feed resources, however, depends up on the agro-ecology, the types of crop produced, accessibility and production system (Azage *et al.,* 2013).

2.3.1. Natural pasture

Natural pastures supply the bulk of cattle feed. They are composed of indigenous forage species and are subject to severe overgrazing. Grazing occurs on permanent grazing areas, fallow land and on land following harvest. The availability and quality of native pasture varies with altitude, rainfall, soil type and cropping intensity. Average pasture

yield for the highland areas is estimated to be 4 tons/ha. In many areas, natural pastures are invaded by species of low palatability (Solomon and Alemu, 2009).

2. 3.2. Crop residues

Crop residues are fibrous materials, which are the by-products of cultivated crops. This is a basic limitation in residues such as straw and stover with crude protein contents around the borderline level of 6-7% (Solomon and Alemu, 2009). Most residues are deficient in fermentable energy and minerals. Crop residues have low palatability and digestibility that leads to poor intake, particularly when fed as the sole roughage. The availability of crop residues is closely related to the farming systems, the type of crop produced and the intensity of cultivation. *Teff*, wheat and barley straws are the major residues available in the highlands while maize and sorghum are common in the lowlands. Crop residues are often left in the field or accumulated in places where the crop is threshed. Transportation of crop residues, even over short distances, can become difficult and costly because of their bulk. The production of crop residues is also seasonal, available in very large quantities just after harvest and less available thereafter (Solomon and Alemu, 2009).

The plant species, agronomic practice used, soil, temperature, and the stage of growth influence the chemical composition, and palatability of straws. Solomon (2004) reported that there is a considerable variation in the contents of CP and CF. However, the quality varies significantly from crop to crop. Residues from leguminous crops have better quality than the residues from cereals. Legume straws contain less fiber, high digestible protein than cereal straws (Solomon, 2004).

2.3.3. Fodder trees

Fodder trees and shrubs are important animal feeds in Ethiopia especially in arid, semi arid and mountain zones, where large number of the country's livestock is found (Alemayehu, 2004). Most browse species have the advantage of maintaining their greenness and nutritive value throughout the dry season when grasses dry up and deteriorate in quality and quantity (Rangnekar, 1992).

Tree fodders are generally rich in protein, vitamins and mineral elements and can be used as dry season feed sources and supplements to poor quality grasses and crop residues. However, their utilization is reduced by the presence of tannins and other phenolic compounds in their leaves (Devendra, 1990). Compared to grasses, fodder trees and shrubs have relatively high concentrations of crude protein and minerals. These nutrients are subject to less variation than in grasses and this particularly enhances their value as dry season feeds for livestock (Moog, 1989). However, nutritive value of fodder trees decreases with aging, since they become woody as they mature. Nevertheless, such situation can easily be overcome by regular lopping of the plants.

2.3.4. Improved (cultivated) pasture and forage crops

Improved (cultivated) forages yield is higher than the naturally occurring swards and have higher nutritional value. In addition, the length of the productive season is longer for cultivated pastures than for the native pastures, which provide an opportunity to develop and use pasture and forage at a large scale for dairy production and fattening. Over the past two decades, several forages have been tested under varying ecological zones for their adaptability. As a result, a number of useful forages have been selected for different zones. Improved pasture and forages therefore, have been grown and used in government ranches, state farms, farmers' demonstration plots and dairy and fattening areas (Alemayehu, 2002).

Forage crops are commonly grown for feeding dairy cattle with oats and vetch mixtures, fodder beet, elephant grass mixed with siratro and desmodium species, Rhodes/Lucerne mixture, phalaris/trifolium mixture, hedgerows of sesbania, leucaena and tree-Lucerne being common ones (Alemayehu, 2006). Due to unprecedented population increase, land scarcity and crop dominated farming, there has been limited introduction of improved pasture and forages to smallholder farming communities and the adoption of this technology by smallholder mixed farmers has been generally slow (Abebe *et al*., 2008).

Yield of improved pasture and forage ranges from 6 to 8 tons and 3 to 5 tons of DM per hectare, respectively, while that of tree legumes ranges from 10 to 12 tons of DM per hectare. In suitable areas, yield of oat-vetch mixtures are commonly 8 to 12 tons of DM per hectare. Despite the advantages of improved pasture and forage crops, due to land scarcity and crop-dominated farming, there has been limited spontaneous introduction of improved pasture and forages (Alemayehu, 2002).

In Ethiopia, most improved tropical species can be grown in the altitude ranging from lowland to mid altitude (1,500-2000 m.a.s.l.) except temperate species, which can grow in areas between 2,100 to 3,000 m.a.s.l. (Alemayehu, 2002). Pasture establishment is relatively difficult in the highlands compared to the humid, warmer and lower areas because of the types of soil and climate.

2.3.5. Agro-industrial by-products

Agro-industrial by-products produced in Ethiopia include by-products from flour milling, sugar factory, oil processing factories, abattoir and breweries. These products are mainly used for dairy, fattening and commercial poultry production and the scope for their wider use by smallholder producers is low due to availability and price (Solomon and Alemu, 2009).

Agro-industrial by-products have special value in feeding livestock mainly in urban and peri-urban livestock production system, as well as in situations where the productive potential of the animals is relatively high and require high nutrient supply. The major agro-industrial byproducts commonly used are obtained from flour milling industries, edible oil extracting plants, breweries and sugar factories. The current trends of increasing urban population has a significant effect on the establishment of agro-industries due to the corresponding increasing demand for the edible main products. Agro-industrial by-products are rich in energy and/or protein contents or both. They have low fiber content, high digestibility and energy values compared with the other class of feeds (Zinash and Seyoum, 1991).

Alemu *et al*. (1991) also reported more than 35% CP and 50-70% *in vitro* organic matter digestibility (IVOMD) for oil seed cakes and 18-20% CP and more than 80% IVOMD for flour milling by-products. Supplementing ruminants fed low quality feeds with agro-industrial by-products enables them to perform well due to higher nutrient density to correct the nutrient deficiencies in the basal diet.

2.3.6. Factors affecting feed quality

Forage testing is necessary because forage quality varies considerably due to several factors, including differences in forage genotype, maturity, season, and management. An understanding of factors affecting forage quality will help producers anticipate and plan for changes in forage quality. When forage quality is low, forages alone may not support desired rates of animal performance. In such cases, it is necessary to provide livestock with supplements for protein and energy (Adesogan *et al.*, 2012). Forage nutritive value is primarily determined by concentrations of crude protein (CP) and “available” energy in the forage. For many years total digestible nutrients (TDN) has been used as an overall measure of available energy in forages.

In the past 20 years, however, measurements of digestible forage, metabolizable energy, and net energy of forage have increasingly been used. However, TDN is still an acceptable and easily understood measure of nutritive value, particularly for beef cattle. Forage quality is affected most by variations in forage genotype, maturity, season, and management. Other "anti-quality" factors may be encountered occasionally.

2.3.6.1. *Genotype*

Legumes generally have a higher quality than grasses. Legumes have higher CP concentrations and a higher intake by livestock due to a higher percentage of rapidly digestible leaves. However, TDN concentrations of legumes and cool-season grasses are similar. Generalizations about quality of grasses are risky, but temperate or cool-season grasses, such as rye and ryegrass, often have higher quality than tropical or warm-season grasses, such as Bermuda grass and Bahia grass. However, there is much variation in forage quality within and among grass genera (Adesogan *et al.*, 2012).

2.3.6.2. *Maturity*

Maturity stage at harvest is the most important factor determining forage quality of a given species. Forage quality declines with advancing maturity. For example, cool-season grasses often have dry matter (DM) digestibilities above 80% during the first 2 to 3 weeks after growth initiation in spring. Maturity of legumes and cool-season grasses can be assessed by determining the reproductive stage of growth. For warm-season grasses, however, weeks of regrowth are a better indicator of maturity because flowering may begin shortly after regrowth begins (Adesogan *et al.*, 2012). Thereafter, digestibility declines by 1/3 to1/2 percentage units per day until it reaches a level below 50%. Maturity at harvest also influences forage consumption by animals. As plants mature and become more fibrous, feed intake drops dramatically. Intake potential decreases and NDF concentration increases as plants age. This is because NDF is more difficult to digest than

the non-fiber components of forage. In addition, the rate at which fiber is digested slows as plants mature. Therefore, digestion slows dramatically as forage becomes more mature.

2.3.6.3. *Season and Climate*

Moisture, temperature, and the amount of sunlight influence feed quality. Rain damage is very destructive to feed quality. When bad weather delays harvesting, the forage crop becomes more mature and hence lower in quality. High temperatures may increase lignin accumulation and decrease quality, but drought stress may actually benefit quality by delaying maturity. Gains of grazing cattle were less during the summer than in spring and fall. The less cattle weight gain during the summer is an effect of environment on forages and not due to the effect of the environment on animals. Spring harvests are made generally after short re-growth periods, while summer harvests are made after long re-growth periods because of heavy summer rainfall that delays harvests (Adesogan *et al.*, 2012).

2.3.6.4. *Feed management*

Improper harvest techniques can seriously reduce feed quality, primarily through the loss of leaves. Storing a hay crop at an incorrect moisture content, or improper ensiling of a feed crop, can dramatically lower its quality. The quality of hay or silage will never increase during harvesting and storage, but careful management can minimize post-harvest decreases in quality (Adesogan *et al.*, 2012).

2.3.6.5. Other factors influencing quality

Several lesser factors also can influence forage quality. Weeds can negatively affect quality, especially in the case of noxious weeds. Insect pests can lower forage quality, particularly if they cause significant leaf loss. Plant diseases can affect quality when they result in a shift in the species present in the field and when they promote leaf senescence.

3. MATERIALS AND METHODS

3.1. Description of the Study Area

This study was conducted in *Essera* District of *Dawuro* Zone, Southern Nation Nationalities and People Region (SNNPR). The District is 522, 575, and 584 kms from Addis Ababa through *Hosanna*, *Shashemane*, and *Jimma* roads, respectively and 350 kms from *Hawassa*, the regional capital city. The area is topographically undulating and rugged. The district covers a total area of 1043.1 km^2 and lies between 6.7-7.02^0 latitude and 36.7 to 37.1^0 longitudes, with an elevation ranging from 501 to 2500 m.a.s.l. The District has 29 *kebeles* (27 rural and 2 urban) with a total population of 77,265 (EWFEDO, 2013). The District lies in three agro-ecological regions: *Kolla* region, which is within 500-1500 m.a.s.l; *Woyna-dega* within 1501-2500 m.a.s.l; and *Dega* at above 2500 m.a.s.l. The annual mean temperature varies from 17.6 to 27.5^{o}C. The rainfall is a bimodal type: the short rainy season is between February and March and the long between May and September. The average annual rainfall varies between 1401-1800 mm (EWARDO, 2008). According to the land use plan of the area, 38.4% is cultivated land, 13.39% grazing land 16.81% forest bushes and shrub land, 17.09% cultivable, and 14.31% is covered by others. The livestock resources of the District include 54, 800 cattle, 21, 684 sheep, 7, 171 goats, 2, 360 horses, 932 mules, 317 donkey, 45, 890 chicken and 26, 155 beehives (traditional, transitional and modern hives) (EWARDO, 2013).

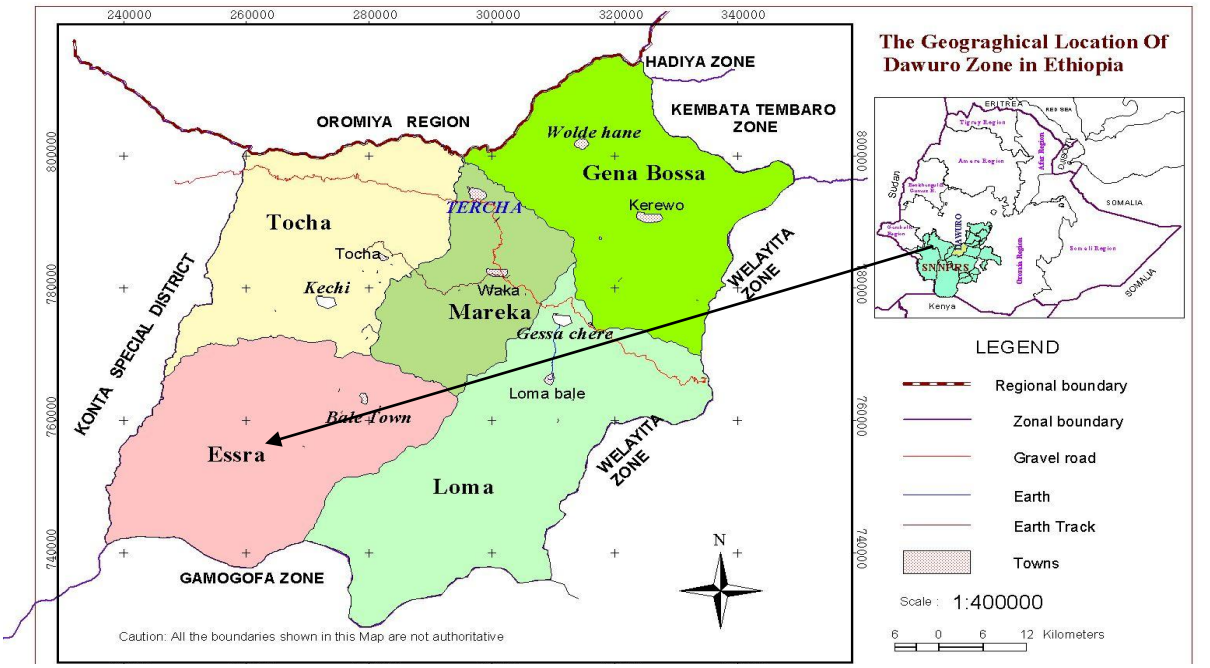

Figure 1: Map of the study area

Source: (EWARDO, 2013)

3.2. Study Population and Study Design

All HHs cattle owning in *Essera* District of *Dawuro* zone were the study population. Cross-sectional study was carried out to assess cattle production system, the constraints and available feed resources for cattle from December 2013 to February 2014.

3.3. Sample Size Determination and Sampling Procedure

Prior to undertaking any sampling procedure the background information on cattle population in *Essera* District was collected through rapid exploratory field visits together with focus group discussions and available secondary information. The study sites were

selected purposively taking into account the agro-ecological conditions and cattle population. Based on the available information, *Essera* District has a total of 29 *kebeles* distributed into *dega* (high altitude), *woyna-dega* (medium altitude) and *kolla* (low altitude). Then the *kebeles* in each agro-ecology were ranked according to their cattle population and the first two kebeles with highest cattle numbers from each agro-ecological zone making totally six *kebeles* were selected purposively to represent the District. The sample size was determined using the formula recommended by Arsham (2007) for survey studies.

$$N=0.25/ (SE)^2$$

Where:

N= sample size

SE= standard error of the proportion

Assuming the standard error of 5.27% at a precision level of 5%, and the confidence interval of 95%, 90 households having cattle were selected by a simple random sampling technique for interview. Thirty from *dega*, thirty from *woyna-dega* and another thirty from *kolla* were selected randomly.

3.4. Chemical Analysis of feeds

The selection of feeds or plant species for laboratory analysis was done based on information provided during group discussion regarding their relative abundance in the area and their consumption by cattle. Samples of feeds were taken during the dry season because this is the period of the year when these feeds may be more important for cattle due to feed shortage. Representative samples of the feeds, which are dominantly grown and used for feeding cattle in the district, were collected from different areas, where available with the help of trained and recruited enumerators. Feed samples were collected on the same day from the shoreline of river and swampy areas and then the collected samples were bulked per feed type. Then samples were dried under shade, and the

amount sufficient for lab analysis was sub-sampled and transported to Hawassa University Animal Nutrition Laboratory. Then samples were oven dried at 65^{o}C for 72 hours and ground in Willey Mill to pass through 1 mm sieve. Feed samples were analyzed for DM, nitrogen (N) and ash contents according to AOAC (2000). Nitrogen was determined using the micro-Kjeldahl method. The CP content was calculated by multiplying nitrogen content by a factor 6.25 (N x 6.25). Neutral detergent fiber (NDF), acid detergent fiber (ADF) was determined using Ankom^{200} Fiber Analyzer and acid detergent lignin (ADL) was determined using Ankom Daisy^{II} incubator. The Ankom^{200} Fiber analyzer and Ankom Daisy^{II} incubator were used to determine *in vitro* DM digestibility (IVDMD).

3.5. Sources and Methods of Data Collection

Both qualitative and quantitative data were collected by employing the following methods.

3.5.1. Formal survey

A formal survey was conducted with the help of structured questionnaire, with open-ended and closed-ended questions using trained enumerators. A structured questionnaire was prepared and pre-tested before administration and some re-arrangements, reframing and corrections were made. The questionnaire was administered to the randomly selected household heads by enumerators recruited and trained for this purpose with close supervision by the researcher. The questionnaire was designed to capture information such as: household demographics including sex, marital status and age of the respondent; cattle production practices, identification of constraints to production, feed resources, management practices including; feeding, watering, breeding and health provision.

3.5.2. Secondary data collection

Previous studies, manuals, literatures and documented data were reviewed to characterize cattle production system, cattle production constraints and feed resources. The secondary data pertaining to the investigation were collected from governmental organizations, non-governmental organizations, various stockholders.

3.5.3. Focus group discussion

In each of the study *kebeles*, discussions have been made with agricultural development agents, elders, village leaders and individuals who have knowledge about the cattle production system, cattle feed resources, cattle production constraints in the area. Group discussions consisting of 9-11 people were made to complement the survey work and the researcher facilitated the discussion at all sites. These households were selected by the help of agricultural extension workers considering their age and experience with cattle production activity, knowledge about the major feed resources, land utilization pattern, crop-residues utilization and major constraints of cattle production.

3.5.4. Field observation

Field observation was made to enrich the data about production practices, feed resources, feeding, watering, housing, and healthcare of cattle, utilization and management of crop residues, and any odd event pertaining to investigations were observed to strengthen the information obtained.

3.5.5. Key informants interview

Primary data were generated by informal interview with extension workers in addition to direct field observations and one informal discussion per *kebele* with village elders, and

farmers groups. The informal interview was conducted with extension workers intended to gather information about the cattle production system, available feed resources and constraints hindering cattle production.

3.6. Data Management and Statistical Analysis

The computer software Excel was used for data management and entry. All the collected data were coded and entered into the computer with Excel. The SPPS software version 20 was used for data analysis. The descriptive statistical analysis was also employed for descriptive data, which included frequencies, percentages, means and standard errors in the process of examining and describing cattle production practices, cattle production constraints and feed resources. Indices were calculated for major diseases and constraints affecting cattle production and sources of crop residues in the study area. The means of quantitative data between study sites were compared by one-way analysis of variance (One-way ANOVA) in SPSS. The differences between means were declared significant at $P<0.05$.

4. RESULTS

4.1. Characteristics of Households

4.1.1. Socio-economic characteristics

Socio-economic characteristics of household in the study area are shown in Table 1. The average family size was 6.74±0.32 heads/household (ranging from 2-13). The statistical analysis revealed that about 70% respondents were males and remaining 30% were females of different age and educational status. Most of the respondents (36.7%) were in the age group over 55 years old, while about 21.1%, 18.9%, 15.6% and 7.8% were in the age group ranging from 35-44, 25-34, 45-54 and 15-24 years old, respectively.

About 77.8% of the respondents were married followed by widowed, single and divorced, 8.9%, 7.8% and 5.6%, respectively. Regardless of their gender, educational level of the surveyed households showed that 15.6%, 7.8% and 4.4% had primary, secondary and junior secondary schools educational status, respectively. About 3.3% of the respondents could read and write whereby 68.9% of the respondents were illiterate. The occupation of the sampled households is displayed in Table 1. About 71.1% of the respondents in the study area were farmers (cattle and crop production) followed by students (15.6 %) and housewives (13.3%).

Table 1: Socio-economic characteristics of sampled households in the study area

Variables	**Category**	**Respondents**	
		N	%
Sex	Male	63	70
	Female	27	30
Age	15-24	7	7.8
	25-34	17	18.9
	35-44	19	21.1
	45-45	14	15.6
	>=55	33	36.7
Occupation	Farmer	64	71.1
	Student	12	15.6
	Housewife	14	13.3
Marital status	Single	7	7.8
	Married	70	77.8
	Widowed	8	8.9
	Divorced	5	5.6
Education	Illiterate	62	68.9
	Read and write	3	3.3
	Primary school	14	15.6
	Junior secondary	4	4.4
	Secondary	7	7.8
Family size	6.74±0.32		

4.1.2. Farming system

Farming system is characterized by mixed crop-livestock production system which was confirmed by 95.5% of HHs. Cattle are the dominant livestock species. The major annual food crops grown in the area included cereals such as maize *(Zea mays)*, sorghum (*Sorghum bicolor*), barley (*Hordeum vulgare*), wheat (*Triticum aestivum*), and teff (*Eragrostis teff*)), and pulses as beans (*Phaseolus vulgare*), peas (*Pisum sativum*)). Maize and teff followed by beans, sorghum and peas were the dominant crops grown in the area.

Perennial crops such as enset (*Ensete ventricosum)*, banana (*Musa paradisiaca*), coffee (*Coffea arabica*), sugar cane (*Saccharum officinarum*), avocado (*Persea americana*), mango (*Mangifera indica*), papaya (pawpaw) (*Carica papaya*), different agro-forestry tree species and eucalyptus plantations and root crops (potatoes (*Solanum tuberosum*), sweet potatoes (*Ipomoea batatas*), cassava (*Manihot cassave*), yam (*Dioscorea*) and taro (*Colocasia esculenta*)) are also grown in considerable amounts. Cash crops, which many farmers grow at back yard, are pumpkins (*Cucurbita spp.*), geeshoo (*Rhamnus prinoides*) for preparation of local alcoholic drinks, garlic (*Allium sativum*), onions (*Allium cepa*), ginger (*Zingibere officinale Rosc.*) and pepper (*Piper nigrum*).

4.1.3. Landholding and land use pattern

The average land holding per household of the overall study sites was 2.91±0.18 ha. The average land allocated for crop production, fallow land, others and grazing land per HH were 1.00±0.26, 0.92±0.20, 0.46±0.19 and 0.42±0.19, respectively (Table 2).

Table 2: Landholding (ha) and land use pattern observed in the *Essera* District.

	Agro-ecology					
	Dega	***Woyna-dega***	***Kolla***	**Overall**	**Test**	
Characteristics	N=30	N=30	N=30	N=90	F-value	P-value
Total land holding	2.93±0.18	3.31±0.17	2.43±0.21	2.91±0.18	6.086	0.003*
Crop land	1.05±0.17	1.13±0.07	0.84±0.20	1.00±0.26	3.549	0.033*
Grazing land	0.42±0.16	0.33±0.15	0.52±0.19	0.42±0.19	1.717	1.186
Fallow land	0.94±0.16	1.20±0.14	0.61±0.19	0.92±0.20	13.070	0.000*
Other land	0.51±0.16	0.40±0.14	0.46±0.18	0.46±0.19	1.954	0.148

**=significance (P<0.05) difference; N= number of households; ha=hectare; Other land includes land for Enset, backyard cash crops cultivation, both human and cattle house construction.*

4.1.4. Cattle holding and herd structure

Cattle holding and the herd structure per household in the study area are given in Table 3. The overall mean cattle holding per household was 11.12±0.69. It was observed that the average number of cows, oxen , calves , bulls, heifers and crossbred were 5.89±0.43, 1.84 ±0.17, 2.00±0.18, 0.62±0.09, 0.69±0.09 and 0.08±0.04, respectively.

Table 3: Means and standard errors of cattle herd structure in the study area.

	Agro-ecology					
	Dega	***Woyna-dega***	***Kolla***	**Over all**	**Test**	
Herd type	N=30	N=30	N=30	N=90	F-value	P-value
Total cows	3.43±0.37	8.90±0.51	5.33±0.88	5.89±0.43	19.619	0.000*
Milking cows	1.33±0.16	2.27±0.22	1.67±0.29	1.76±0.14	4.319	0.016*
Dry cows	1.17±0.18	4.60±0.29	2.27±0.43	2.68±0.24	30.710	0.000*
Pregnant cows	0.93±0.13	2.03±0.21	1.40±0.24	1.46±0.12	7.647	0.001*
Oxen	1.33±0.18	1.60±0.13	2.60±0.43	1.84±0.17	5.788	0.004*
Total calves	1.60± 0.20	2.40± 0.22	2.00± 0.46	2.00± 0.18	1.591	0.209
Male calves	0.47± 0.09	1.27± 0.17	0.73± 0.20	0.82±0.10	6.444	0.002*
Female calves	1.13±0.18	1.13±0.13	1.27±0.28	1.18±0.12	0.137	0.872
Bulls	0.93± 0.08	0.27± 0.08	0.67 ±0.23	0.62±0.09	5.032	0.009*
Heifers	0.87± 0.12	0.67 ±0.11	0.53 ±0.23	0.69±0.09	1.056	0.352
Crossbred	0.07±0.05	0.17±0.10	0	0.08±0.04	1.831	0.166
Mean holding/HH	13.27±1.13	14.00±0.58	11.13±0.40	11.12±0.69	4.591	0.013*

** =shows significant difference (P<0.05); N=Number of households; HH=households*

4.1.5. Purpose of keeping cattle

As shown in Table 4, 95.6% of respondents keep cattle for both milk and traction. About 46.7 and 44.4% of the farmers in the district held cattle for only milk and meat production, respectively. All households keep cattle for manure purposes while 37.8% of farmers keep cattle for other purposes.

Table 4: Purposes of keeping cattle in the study area.

Variables	**Category**	**Respondents**							
		Agro-ecology							
		Dega		***Woyna-dega***		***Kolla***		**Total**	
		N	%	N	%	N	%	N	%
Purpose of keeping cattle	Milk production only	16	53.3	13	43.3	17	56.7	42	46.7
	Traction only	0	0	0	0	4	13.3	4	4.4
	Milk and traction	30	100	30	100	26	86.7	86	95.6
	Meat production only	10	33.3	13	43.3	17	56.7	40	44.4
	Manure	30	100	30	100	30	100	90	100
	Others	22	73.3	14	46.7	20	66.7	34	37.8

N=number of households

4.1.6. Labor division for cattle management

All HHs (100%), in *dega* and *woyna-dega* agro-ecologies indicated that only females were responsible for milking cows (Table 5). About 93.7% of the households in the *kolla* area designated that only female members of the household were responsible for cow milking (Table 5). Only 6.7% of the households in *kolla* indicated that not only females but also males take part in milking of cows. According to respondents, in all agro-ecologies, males were not involved in milk processing, milk and milk products selling. In contrast, traction and bull feeding activities were the task of males. Irrespective of the age of family members, about 33.3 ad 13.3% in *dega,* 60and 6.7% in *woyna-dega,* and 80 and 26.7% in *kolla* of the respondents reported that cattle herding and feed collection activities were the responsibility of both sexes, respectively.

Table 5: Labor division of the family member for cattle management activities.

	Agro-ecology								
	Dega (%)			***Woyna-dega*** (%)			***Kolla*** (%)		
Type of activities	F	M	FM	F	M	FM	F	M	FM
Milking	100	0	0	100	0	0	93.3	0	6.7
Milk processing	100	0	0	100	0	0	100	0	0
Milk and milk products selling	100	0	0	100	0	0	100	0	0
Pregnant cow feeding and caring	73.3	26.7	0	40	60	0	86.7	0	13.3
Cattle herding	13.3	53.3	33.3	13.3	26.7	60	0	20	80
Bull feeding	0	100	0	0	100	0	0	100	0
Traction	0	100	0	0	100	0	0	100	0
Calf rearing	93.3	6.7	0	100	0	0	100	0	0
Heifer rearing	80	20	0	60	40	0	0	100	0
Barn cleaning	93.3	0	6.7	100	0	0	86.7	0	13.3
Herd feeding/watering	26.7	73.3	0	26.7	26.7	46.7	26.7	20	53.3
Feed collection	20	66.7	13.3	30	53.3	16.7	20	53.3	26.7

F= Female, M= Male and FM= Female and Male

4.2. Cattle Husbandry and Management

4.2.1. Cattle breeds and breeding systems

About 99.5% of the respondents owned non-descriptive local breeds of cattle, whereby 0.5% of the respondents had crossbred heifers (Table 6). About 0.3% of crossbred (Holstein Frisian X Zebu) were distributed by MoA and the rest 0.2% of crossbred were obtained through AI. Of total respondents, 82.2% indicated that natural mating is the only

means of breeding system practiced and the rest 17.8% practiced both natural mating and AI. About 84.4% of the respondents selected the best bulls for breeding purpose. Coat, color and body conformation, and behavior of bulls were indicated as parameters of selection by 80% and 37.8% of respondents, respectively and 81.7% of the respondents said that breeding was uncontrolled. About 51.9% of respondents had breeding bull. About 65.2% of HH having bull indicated that bull serves their own and neighbor herd freely and the rest 34.4% HH pointed that for their own herd only. Based on the survey, majority of respondents (77.8%) had no experience of using AI. About 57.8, 16.7, 15.6 and 13.8% of respondents indicated that the reasons for the limited use of AI in the study area were inaccessibility, difficulty of getting inseminator, the fear about the size of local female cows to carry the pregnancy and normal delivery the offspring of improved breeds and lack of awareness, respectively (Table 6).

Table 6: Breed, breeding system of cattle and reasons for not using AI services

	Agro-ecology					
	Dega (%)	***Woyna-dega*** (%)	***Kolla*** (%)	***Overall*** (%)	***Test***	
					F-value	P-value
Breed of cattle						
Local breed	97.3	97.1	100	99.5	1.482	0.233
Crossbred	2.7	2.9	0	0.5		
Breeding systems						
Natural mating	80	66.7	100	82.2	6.407	0.003*
Both natural mating and AI	20	33.3	0	17.8		
Reasons for not using AI						
Lack of awareness	10	23.3	6.7	13.8	0.663	0.321
Inaccessibility to AI services	60	43.3	73.3	57.8	0.075	0.996

Difficulty of getting inseminator	16.7	23.3	10	16.7	1.251	0.293
Small size of indigenous cattle	13.3	10	13.3	15.6	1.01	0.298

**= shows significance difference (p<0.05).*

4.2.2. Cattle health condition and treatments

Trypanosomiasis, mastitis, *Zuluwa (*bloody urine symptom disease) and anthrax were the major diseases that affect cattle production with indices of 0.263, 0.200, 0.166 and 0.160, respectively (Appendix 3). Leech and others such as CBPP and pasteurellosis were the next important diseases with indices of 0.115 and 0.048, respectively. Others such as black leg, ticks and FMD were least ranked diseases (Appendix 3).

Of the respondents, 83.3% in the study area have access to government based para veterinary service. Of the sampled farmers of 68% in the district use an alternative measure of ethno-veterinary treatments and indigenous knowledge. About 72% of respondents in the area perceived ethno-veterinary treatments to have a potential either to reduce pathogenic effects or cure completely.

Table 7: Traditional cattle diseases treatment in the study district from focus group discussion

Diseases	**Method of treatment**
Trypanosomiasis	Branding the area around the swelling with hot iron.
Blackleg	Smoking white *Eucalyptus tree* leaves, drenching cattle with grinded and homogenized with water and incising around the shoulder and depositing butter inside, and branding with a very hot sickle or iron bar.
Leech	Nasal administration of grinded fresh leaves of

	Colocasia esculenta (Taro), Nicotiana tobacum, Citrus aurantiflora, Allium cepa (Tumuwa), Aframomum corrarima (Okashiya), Zingibere officinale, individually homogenized in water. Oral administration of albendazole dissolved in water
Ticks	Painting the area where ticks are present with Vaseline and diesel. Provide cattle with salt added drinking water.
Cough	Oral administration of homogenized inner part of *Solanum incanum (Buluwaa)* fruit.
Diarrhea	Drenching the crushed and homogenized fresh bark of *Syzygium guineense (Ocha)* and feeding of seeds of *Lepidium sativum (Fexo)* mixed with grinded leaves.
Dystocia/ placenta retention	Feeding the cattle red colored *Enset* leaf.

4.2.3. Cattle housing system

Out of total HHs, 97.8% had experience of housing their cattle. Out of total respondents included in the study, 93.3% kept their animals in their living house, which was not separated from the owners living houses and the rest 6.7% kept their cattle in simple crashes within their own compounds. 93.3% of respondents housed their cattle in the dry as well as wet seasons. About 97.8, 80 and 66.7% of respondents who kept cattle in their homes mentioned that cattle are housed together with the family because of need to protect them from extreme weathers and predator wild animals, theft and others, respectively.

Table 8: Importance of cattle housing in the study area

Variables	Responses		
	Yes (%)	No (%)	NC (%)
Protect from extreme climate	97.8	0	2.2
Protect from predators	97.8	0	2.2
Protect from theft	80	17.8	2.2
[1]Others	66.7	31.1	2.2

NC=not concerned: [1]Others=for ease of husbandry practices such as feeding, watering, milking, waste management.

4.2.4. Source of water and its utilization

Source of water and its utilization in the study areas is presented in Table 9. The sources of water for cattle were river (75.5%), spring (13.3%) and tape (11.1%). With regard to the frequency of watering, majority (79.5%) of the respondents watered their cattle twice a day during dry season, while 10.56% of the respondents watered their cattle once a day and 9.9 % of the respondents offered water freely during dry season. Out of the interviewed cattle producers, 49.7% of HH offered water once a day and 41.3% and 8.96% of HH provided water to their animals freely and twice a day during wet season, respectively. About 91.1% of the respondents indicated the existence of water related problem. The major water related problems were scarcity (44%), access to water sources (35.5%) and hygiene problems (20.5%) especially during dry period. The survey revealed that 71.1, 20 and 8.9 % of respondents alleviated water related problems by going long distance to the river, fetching from rivers and digging the ground water, respectively.

Table 9: Water source and frequency of watering in the study area

Sources of water		***Dega*** (%)	***Woyna-dega*** (%)	***Kolla*** (%)	**Total** (%)
River		100	66.7	60	75.6
Spring water		0	20	20	13.3
Tape water		0	13.3	20	11.1
Frequency of watering					
Once a day	Dry	20.3	4.7	6.7	10.56
Twice a day	season	73.2	80	85.3	79.5
Ad libtum		6.5	10	13.3	9.9
Once a day	Wet	61.3	24.5	63.3	49.7
Twice a day	season	5.1	5.1	16.7	8.96
Ad libtum		33.6	70.4	20	41.3

4.2.5. Manure disposal and utilization

Hundred percent of cattle producers in the study *kebeles* used animal dung as fertilizer. In addition, according to 58.3 and 30.2% of respondents, it is also used for other purposes and household fuel, respectively. All of HH had no practice of marketing animal dung (dung cake) for fuel or fertilizer purposes in the studied area. The majority of the respondents (65.4%) indicated that they dispose manure from the barn once a day.

Table 10: Cattle manure utilization in the study area

	Dega		***Woyna-dega***		***Kolla***		**Over all**	
Utilization	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Fertilizer	100	0	100	0	100	0	100	0
Fuel	43.6	56.4	27	73	20	80	30.2	69.8
[1]Other purposes	67.2	32.8	54.9	45.1	52.7	47.3	58.3	41.7

[1]*Other purposes (mud house construction, pottery and wastage)*

4.2.6. Major constraints of cattle production/improvement

According to respondents, feed shortage, diseases, water shortage and poor genotype were the major constraints that affect cattle production with indices of 0.385, 0.367, 0.111 and 0.100, respectively (Appendix 4). Shortage of initial capital and lack of knowhow were other constraints.

4.3. Feed Resources and Feeding System

Natural pasture, crop residue, crop aftermath and others were ranked 1st, 2nd, 3rd and 4th by 54.4, 63.3, 66.5 and 95.6% of HH during dry season in overall agro-ecology, respectively (Table 11). In contrast, during wet season natural pasture, crop aftermath/stubble grazing, crop residues and others were the first, second, third and fourth ranked sources of cattle feed by 90, 90, 100 and 93.3% of HHs, respectively. Free grazing on natural pastureland was the most dominating feeding system for their cattle in the study area.

Table 11: Respondents ranking using different feed resources based on season in the study area.

Agro-Ecology	TFR	Dry season				Wet season			
		1st	2nd	3rd	4th	1st	2nd	3rd	4th
Dega	NP	66.7	20	13.3	0	100	0	0	0
	CR	6.7	66.7	26.7	0	0	0	100	0
	CAm	26.7	13.3	60	0	0	100	0	0
	Others	0	0	0	100	0	0	0	100
W. Dega	NP	46.7	20	33.3	---	80	20	0	0
	CR	40	60	0	0	0	0	100	0
	CAm	6.7	13.3	66.7	13.3	0	80	0	20
	Others	6.7	6.7	0	86.7	20	0	0	80
Kolla	NP	50	23.3	26.7	0	90	10	0	0
	CR	33.3	63.3	3.3	0	0	0	100	0
	CAm		13.3	16.7	70	10	90	0	0
	Others	0	0	0	100	0	0	0	100
Overall	NP	54.4	21.1	24.4	0	90	10	0	0
	CR	26.7	63.3	10	0	0	0	100	0
	CAm	15.6	14.4	65.6	4.4	3.3	90	0	6.7
	Others	2.2	2.2	0	95.6	6.7	0	0	93.3

TFR= Type of Feed Resource NP= Natural Pasture CR= Crop Residue CAm= Crop Aftermath

4.3.1. Crop residues sources and utilization

Maize stover, *teff* straw and bean and pea haulms were the major sources of residue in the study area with indices of 0.407, 0.245 and 0.126, respectively (Appendix 5). Barley straw, sorghum stover, and others such as *Enset*, banana, coffee and root crops were other

important sources of crop residue for their animals with indices of 0.111, 0.052 and 0.037, respectively (Appendix 5).

As indicated in the Table 12, all of households stated that the residues from *teff* straw and maize stover are used primarily for feed. In addition, 93.3% of the respondents indicated that teff straw is used for construction of local houses by mixing it with mud, which is then used to plaster the wall. The highest proportion of households (88.9% for maize and 77.8% for sorghum) stated that the residues from these crops are used as a source of firewood. The only crop residue sold was *teff* straw in the study area.

Table 12: Utilization of crop residues in the study area

	Percentage of responses					
Type of crop residues	Feed	Construction	Fuel	Compost	Sold	Other purpose
Teff straw	100	93.3	53.3	55.6	33.3	22.2
Bean and pea haulms	68.8	0	61.1	0	0	0
Sorghum stover	93.3	88.9	77.8	62.2	0	64.4
Maize stover	100	10	88.9	82.2	0	53.3
Wheat straw	66.7	44.4	35.6	51.1	0	26.7
Barley straw	66.7	58.9	30	65.6	0	44.4

4.3.2. Crop aftermath

Farmers in the District use aftermath grazing as one means to sustain their cattle for duration of about 3-4 months starting from November until almost the second short rains cultivation.

4.3.3. Hay

All HHs (100%) in the study area, were not practicing hay making. This was mainly due to letting cattle graze standing dried grass (Fig. 2), lack of awareness and large number of cattle as indicated by 60, 33.3 and 6.7 % of respondents, respectively.

Figure 2: Cattle grazing on standing hay in one of the study *kebele*.

4.3.4. Indigenous plant feed resources

The common woody species used as cattle feed included plants such as *Cordia african, Bambusa vulgaris* (Bamboo tree), *Ficus sur (Shola), Zaagiya (Dawuregna), Ilala and waasha (Dawuregna)* leaves. *Dawuro daama, Gasaa, Cayshiyaa* and *Lamuxxa (Dawuregna)* were the most important, widely used and preferred by farmers. The first two are classified under legume and the second two were under legume browse and grass, respectively.

A, *Dawuro daama*

B, *Cayshiyaa*

C, *Lamuxxa*

Figure 3: Indigenous legume (a), legume tree (b) and grass (c)

4.3.5. Non-conventional feed resources (NCFR) and mineral licks

Out of interviewed households, 95.6% practiced feeding of non-conventional feed resources. The proportions of farmers using "*Axuriyaa*" (salty soil) (Fig 4) and "*Aduwaa*" (natural salty water) as animal feed resources in the district is 55.3% and only 9% of the total respondents did not use these as feeds for their animals and the remaining 35.7 % respondents do not have the access to it.

Figure 4: "*Axuriyaa" (*salty soil) in one of study *kebeles* market

4.3.6. Seasonality of feed availability

In the study area, all respondents have mentioned that they have come across cattle feed shortage. According to 48.9 and 51.1% of respondents, feed shortage existed in between January to March and February to April in the district, respectively. As the survey results revealed, 100, 97.8 and 53.3% of responses indicated that feed shortage resulted in weight loss, weakness and reduction in milk yield of cattle, respectively. However, this was alleviated by use of destocking, fodder bank and feed purchases as indicated by 24.4, 20 and 15.6% of HHs, respectively. Of the 15.6%, 9.3% purchased green grass and 6.3 crop residues from neighbored settlers.

4.3.7. Feed quality improvement

As the results revealed, only 17.8% of farmers used feed quality improvement techniques in the study area. Of these respondents, 34.4, 23.3, 15.6, 13.3, 8.9 and 4.4% treat crop

residues by soaking with water, chopping, grinding, alkali (salt), crushing and others, respectively.

4.3.8. Improved forage production

All of interviewed respondents witnessed that there was no improved forages cultivation for their cattle at farmer's level in the study area. Most important constraints regarding improved forage cultivation were scarcity of seed/raw material (55.6%), lack of information (28.9%) and both scarcity of seed and awareness (15.6%) (Table 13).

Table 13: Alleviating feed shortage, feed quality improvement and reasons of not practicing forage development in the study area.

	Agro-ecology			
Variables	***Dega***	***Woyna-dea***	***Kolla***	**Over all**
Ways of alleviating feed shortage				
Fodder bank	13.3	33.3	13.3	20
Destocking	20	0	53.3	24.4
Purchasing feed	20	20	6.7	15.6
None	6.7	0	0	2.2
Others	40	46.7	26.7	37.8
Means of feed quality improvement				
Soaking with water	60	6.7	36.7	34.4
Chopping	13.3	33.3	23.3	23.3
Grinding	26.7	20	0	15.6
Alkali treatment	0	26.7	13.3	13.3
Crashing	0	0	26.7	8.9
Others	0	13.3	0	4.4
Reasons why forage development is not practiced				

Scarcity of seed	26.7	60	80	55.6
Lack of awareness	53.3	13.3	20	28.9
Both	20	26.7	0	15.6

4.4. Chemical Composition and IVDMD of Major Feed Resources

Regardless of the effect of season and agro-ecology, chemical composition of major feeds in the study district is shown in Table 14. The results of laboratory analysis of chemical compositions showed that the DM content of maize stover, *teff* straw, *Lamuxxa*, *Cayshiyaa*, *Dawuro daama* and *Gasaa* were 92.11, 92.09, 69.63, 57.08, 43.38 and 18.73%, respectively. The ash contents of *Lamuxxa*, *teff* straw, maize stover, *Cayshiyaa*, *Dawuro daama* and *Gasaa* were 7.95, 7.89, 6.56, 5.0, 3.71 and 2.75% respectively.

The CP contents of *Dawuro daama*, *Cayshiyaa*, *Gasaa* and *Lamuxxa* were 14.23, 13.39, 12.35 and 10.30%, respectively. Crop residues had CP content of 4.26 and 3.67% in *teff* straw and maize stover, respectively. The NDF and ADF contents of all available major feed resources were in the range of 9.43% to 78.23% and 5.34% to 53.94%, respectively. Maize stover, teff straw and *Lamuxxa* had higher values of ADF and NDF. The ADL content of crop residue, *Dawuro daama* and *Cayshiyaa* were comparable and in the range of 4.66 -5.66%. The lowest value of ADL was found in *Gasaa* (1.02%) followed by *Lamuxxa* (2.53%). The IVDMD contents of indigenous legume types and browse type were higher than the grass type and crop residues. The highest content of IVDMD was found in *Gasaa* (95.29%) followed by *Dawuro daama* and *Cayshiyaa*. Lowest level of IVDMD was found in maize stover (40.90%).

Table 14: Chemical composition of major cattle feeds in the study district

	Chemical composition (% DM)						
Types of feed	DM %	Ash	CP	NDF	ADF	ADL	IVDMD
Crop resides							
Teff straw	92.09	7.89	4.26	76.10	46.25	5.24	50.68
Maize stover	92.11	6.56	3.67	78.23	53.94	5.66	40.90
Indigenous grass sp.							
'*Lamuxxaa*'	69.63	7.95	10.30	41.92	23.43	2.53	76.19
Indigenous legume sp.							
'Dawuro daama'	43.38	3.71	14.23	16.57	10.53	5.63	85.18
'Gasaa'	18.73	2.75	12.35	9.43	5.34	1.02	95.29
Indigenous browse							
'Cayshiyaa'	57.08	5.00	13.39	25.37	15.55	4.69	77.22

5. DISCUSSION

5.1. Characteristics of Sampled Households

5.1.1. Socio-economic characteristics

The average family size in this study was 6.74±0.32 head/household and this figure seemed to be less than the Ethiopian national average (7.4) and greater than Sub-Saharan average (5.6) as reported by USAID (2009). The higher HH size could be attributed due to practices of polygamous marriage as well as meager family planning in the district. The results of this study agreed with findings of Dhaba Urgessa (2011) in *Ilubabore* zone.

There were a comparatively larger number of children per household in the *Dega* and *Woyna-dega* kebeles of the study area. Having many children is thought as an asset for farming activities and being large in number in a household has social prestige showing the strength of that family or clan. Similarly, study by Agajie *et al*. (2005) indicated that having many wives is one of wealth indicators and commonly practiced type of marriage in the Central Rift Valley.

There were more male headed HHs than female headed HHs of different age and educational status. The results of the current work differed from the report of Ayza *et al*. (2013) who reported that 48.3% female-headed households and 51.7% male headed household dairy farmers in *Boditti*. About 36.7% of respondents were in the age group of over 55 years old. This was in congruence with the report of Ayza *et al*. (2013), where 38% of households were over 40 years in *Boditti*.

Regardless of their gender, educational level of the surveyed households showed that majority of the respondents (68.9%) had no formal education, which agreed with the

findings of Kechero *et al*. (2013), where 70% of the respondents in *Dedo* district of *Jimma* zone were illiterate. This indicates that farmers need to get basic education for the reasons of adopting new technologies. Education is an important factor if lacking can negatively influence features of enhanced cattle production. Farmers with high education levels adopt usually new technologies more rapidly than lower educated farmers (Ofukou *et al*., 2009).

The results of the study showed that the occupation of the majority of respondents (71.1%) in the study area was farming (crop-livestock). This figure is less than the findings of Tesfaye (2007) in *Metema* district, where 82.9% of interviewed HH practicing mixed farming agriculture. This clearly indicated that both crop and cattle farming is the main income sources for the households in the district. More or less, there is no participation in off-farm activities such as blacksmith, local tannery, cloth weaving and pottery as highlighted in one of group discussion due to those who involve in cloth weaving, pottery, tannery, blacksmithing and labor works are considered by the community as low class people. Families from those who involve in such activities are also not allowed to integrate in marriage with families of others who do not carry out such activities.

5.1.2. Farming system

Farming system is characterized by mixed crop-livestock production system and is similar to most parts of the central southern region. Cattle are the dominant species, mainly used for milk and draught power followed by meat production, income and manure for maintaining soil fertility. This is in line with the report of Belay *et al*. (2012) in *Dandi,* where cattle were the main species reared by the respondents and were used primarily for draught power, traction, milk, and meat as secondary interest.

Cattle also have an important socio-cultural role in the study area. This was consistent with the findings of Belay *et al*. (2012) in *Dandi* district. Crop farming in this area was mainly practiced using oxen/draught power and oxen are given due attention next to lactating cows particularly with regard to better feeding.

Farmers practice growing of a wide range of cereals, pulses, root and tubers and cash crops for household consumption and marketing. Maize and teff followed by beans, sorghum and peas were grown in the highest proportion in the area. Perennial crops such as enset (*Ensete ventricosum)*, banana (*Musa paradisiaca*), coffee (*Coffea arabica*), sugar cane (*Saccharum officinarum*), avocado (*Persea americana*), mango (*Mangifera indica*), papaya (*Carica papaya*) and root crops such as potatoes (*Solanum tuberosum*), sweet potatoes (*Ipomoea batatas*), cassava (*Manihot cassave*), yam (*Dioscorea*) and taro (*Colocasia esculenta*) are also grown in considerable amounts. This was in line with the report of Ayza *et al*. (2013) in *Boditti, Wolaita* zone of southern Ethiopia.

5.1.3. Landholding and land use pattern

Respondents explained about land use pattern mainly for crop production, grazing and *enset* production. The average landholding of the overall study sites per household was 2.91±0.18 ha. The land holding reported in this study was higher than that of reported by Belay *et al*. (2012), who observed 2.5 ha average landholding per household in *Dandi* district of Oromia Regional State, which call for intensification of cattle production in the area. In the Southern Regional State and the country studies indicated that the minimum landholding is 2.01 ha and the maximum is 5 ha for 32.6% smallholder farmers in the country and 16.2% of the stallholder farmers in SNNPR, respectively and landholding ranged from 1.01 to 2.00 ha for about 30.8% of farmers in the SNNPR and for 33.3% of farmers at the national level (CACC, 2003). The results revealed significant variation ($P<0.05$) in landholding between agro-ecologies.

The average size of total landholding was significantly (P<0.05) higher in *woyna-dega* (3.31±0.17 ha) than *dega* and *kolla*, 2.93±0.18 and 2.43±0.21 ha, respectively. Likewise, land allocated to crop cultivation and fallow land varied in the three agro-ecologies. Grazing land and others, (e*nset* and backyard cash crop cultivation and house construction) were not varied in the study district. Larger proportion of land was allocated for crop cultivation in the district. This was in agreement with the report of Belay *et al*. (2012), who indicated that majority of the land owned per household was used for crop production in *Dandi* district. In the study district, less land was allocated for cattle grazing. This indirectly may indicates that there is less attention paid for grazing land, which results in shortage of grazing land in all study *kebeles*. The findings of this study agreed with the work of Zewdie (2010) which illustrated shortage of grazing land as the major contributor to critical feed shortages in the Highland areas.

5.1.4. Cattle holding and herd structure

The overall mean cattle's holding per household was 11.12±0.69. This figure was less than that of Tesfaye (2007) with 12.25±0.6.23 cattle per household in Northwestern Ethiopia and greater than that of Belay *et al*. (2012) with 4.53±0.4 cattle per HH in *Dandi* district. There were differences in cattle holding within the study area. The average size of cattle was significantly (P<0.05) higher in *woyna-dega* (14.00±0.58) than *dega* and *kolla*, 13.27±1.13 and 11.13±0.40, respectively. It was observed that cows, calves and oxen were the three first higher numbered cattle with 5.89±0.43, 2.00±0.18 and 1.84±0.17, respectively. This was in agreement with the findings of Belay *et al*. (2012), where oxen and milking cows accounted for 37 and 16%, respectively of the total cattle holding in *Dandi*.

The reason for large proportion of cows was that they are maintained for producing replacement oxen, very important for draught power. The higher proportion of cows

obtained in this study was in agreement with the report of Tesfaye (2007) in *Metema*. Next to calves, the higher number of oxen per HH indicated their importance for draught power. This was in agreement with the reports of CACC (2003), where cows and oxen represented 42 and 40% respectively of the total cattle in mixed farming system.

The results revealed that there was a significant ($P<0.005$) difference in total cows, milking, pregnant and dry cows, oxen, male calves and bulls holding within the study agro-ecologies. In *woyna-dega,* there was significantly large number of total cows (8.90 ± 0.51), milking (2.27±0.22), dry (4.60±0.29) pregnant cows (2.03±0.21) and male calves (1.27±0.17) than other agro-ecologies and there was significantly large number of bulls in *dega* (1.47±0.13) followed by *kolla* and *woyna-dega*.

5.1.5. Purpose of keeping cattle

The results of current study revealed that cattle in the district are kept for different purposes. Knowledge of reasons for keeping cattle is prerequisite for devising breeding goals (Rewe *et al*., 2006). Based on the results of this study, cattle were mainly kept to satisfy both milk and traction (95.6%) needs. Etafa *et al.* (2013) reported that the primary purpose of keeping oxen in *Hararghe* was for draft power accounting for 99.4 % of the responses, whereby cows were kept for sell of milk and for other purposes accounting for 86.6% and 12.5% of responses, respectively.

5.1.6. Labor division for cattle management

Majority of the respondents in all agro-ecologies indicated that only female members of the household were responsible for milking. The results were in agreement with the findings of Alganesh (2002) in eastern *Wollega*, Kedija, (2008) in *Mieso* district and Lemma (2004) in East Shoa zone where female members of the HH entirely undertook

milking. However, Asaminew and Eyassu (2009) reported that for Bahir Dar Zuria and Mecha districts mainly males did milking. According to respondents, dairy products processing and marketing was the activity of females. This was in line with results reported for northwestern Ethiopia where female members of the HH (Asaminew and Eyassu, 2009) performed marketing of dairy products. In contrast, plowing and bull feeding activities were tasks of males. Irrespective of age of family members, in over all agro-ecologies cattle herding and feed collection activities were responsibility of both sexes, which agreed with reports of Ayalew *et al*. (2013) in *Ilu Aba Bora* Zone of South Western Ethiopia.

5.2. Cattle Husbandry and Management

5.2.1. Cattle breed and breeding systems

Almost all cattle owned by the respondents (99.5%) were non-descriptive indigenous cattle breed. Also, Ayalew *et al.* (2013) reported that the cattle breed kept in *Ilu Aba bora* Zone were 100% non-descriptive indigenous cattle. Correspondingly, in Ethiopia according to CSA (2003), 99.4 % of the total cattle populations in the country are local breeds and the remaining are the hybrids and the exotic breeds that accounted for about 0.5 % and 0.1 %, respectively.

Majority of respondents (82.2%) indicated that natural mating was a means of mating/breeding system practiced, which agreed with findings of Ayalew *et al*. (2013). Thus, the study suggested the need to introduce artificial insemination service to increase the genetic merit of the herd to improve milk production.

In the current study during the breeding season, some farmers mated their cows and heifers by superior bulls owned by themselves or the neighbors, whereas most farmers bred their cows by any bull available in the herd when their cows are in heat. Some

farmers who have superior bulls were not volunteer to give their bulls to their neighbor for breeding service because of the lack of understanding that their bull might lose its genetic superiority due the interbreeding process.

About 84.4% of the respondents select the best bulls for breeding purpose. Respondents indicated coat color and body conformation, and behavior of bulls as parameters of selection. This result was in line with the result reported by Mekonnen *et al*. (2012) in which traits like body size, physical appearance, coat color and hump size were considered by farmers for bull selection.

5.2.2. Cattle health and treatments

Different disease types were found in the study area, indicating the need to establishing and extending veterinary service in the future to increase production of cattle in the area through reducing disease incidence and severity. Therefore, it is essential to give attention through establishing different sites of veterinary service and veterinary technician in different sites at large. In current study, major animal diseases and parasites were identified through group discussion involving key informant farmers, development agents and veterinary technicians. As reported by Tajebe *et al.* (2011) economic losses due to disease and parasites have quadruplet their effect further when factors such as feed shortage, poor management practices and environmental factors are prevalent.

The result showed that trypanosomiasis was first most important disease followed by mastitis, *Zuluwa*, anthrax and leech. The reason for the existence of different diseases among the study areas was probably due to the variation in agro-ecology. *Zuluwa* was the most economically important disease in the *Dega* agro-ecology of the study area. This might be due to major feed resources at *Essera* District were almost natural pasture in the form of grazing and which is seasonally water logged and the district lacks clean tape water to animals increasing the chance of exposure to fluke infection. Nonetheless,

farmers perceived that the source for blood urinating was related with cattle urinate directing their genital organ towards rainbow or '*Keste-damena',* which works for human being also. Moreover, epidemiologically the area is favorable for the development and multiplication of intermediate hosts like snail. Accordingly, strategic application of fluckicide and provision of worm safe pasture and water provide better considerable success in the prevention/control of fluke infection in the study area.

Ticks were major ectoparasites of cattle in the study area and results in milk yield reduction and weight gain of cattle. Belay *et al*. (2012) reported that mastitis and external parasites are the major diseases of importance in *Dandi* district. Ectoparasite infestations impose economic losses because of reduction in leather quality, reduction in body weight gain and milk yield, occasional mortality, reduction in performance in draught animals and losses associated with treatment and prevention of diseases (Regasa *et al*., 2006).

According to group discussion, farmers indicated that feed shortage was acute during the months of January to April. Cattle in the area get sick during these periods. This might be due to feed deficiency, which predisposes the animals to low disease resistance. The shortage of feed and inadequate supplementary feeding were reported to be major causes of livestock mortality and poor performances in highland agro-ecologies of southern and central Ethiopia (Desta and Oba, 2004; Hassen *et al.,* 2010).

In the study area, there was one animal health technician for two *kebeles* commonly but the service delivery was not to the required extent owing to inadequate veterinarians and veterinary supplies, cost of veterinary drugs and inadequate transport facilities. Lack of veterinary services, un-affordability of veterinary drugs and shortage skilled technician were some of the major constraints limiting cattle production. There was no even a single private veterinary clinic in the district. The present findings were in agreement with that reported by Mekete (2008) and Belete *et al*. (2010).

Thus, more than 50% sample farmers in the district used an alternative measure of ethno-veterinary treatments and indigenous knowledge. Extracts from leaves and roots local vegetation and other ingredients were applied against various diseases and parasites. Majority of the respondents in the area perceived ethno-veterinary treatments either reduce pathogenic effects or cure completely. This was in consistent with Kocho and Geta (2011).

Farmers are using their indigenous knowledge to treat their sick animals using different mechanisms but the dosage of the treatments and the impact of the drugs are not known and burning of cattle body to treat their sick animal may have mechanical damage on their body. On the other hand, the efficacy and dosage of medicinal herbaceous plants should be studied for possible large-scale production and uses.

5.2.3. Cattle housing system and its management

The current results revealed that majority of the respondents (93.3%) kept their animals in their own homes at night. Similar results were reported by Jiregna (2007) and Oumer (2011). The results of present study also agreed with reports of Abrha (2007), who reported similar finding in Tigray National Regional State where livestock housing is very primitive even compared to sub-Saharan African standard. Respondents mentioned that cattle are housed together with the family in order to protect from climate and wild animals, theft and others. Ayza *et al*. (2013) reported similar reasons, where Boditti cattle were housed together with the family because of theft, extreme environmental hazards and ease of husbandry practices such as feeding, watering, milking, waste management.

5.2.4. Source of water and way of utilization

The result revealed that the main sources of water for cattle were river, spring and tape. This general trend of water sourcing is in agreement with Zewdie (2010) who reported

similar results in *Debre-Birhan* area. The quality of water and the distance traveled to reach are major concerns. According to key informants in the studied area, watering frequency in the study area varied between seasons. In dry season, even though animal's need for frequent watering increases, it is not possible to get more than once per day since rivers are far from the grazing points. As a result, the seasonal availability and distance of water sources have implications on watering frequency of cattle.

During the dry months, watering points dry up and cattle must track long distance. Current study indicated that there are water related problems in the study area. The major water related problems were scarcity, access to water sources and hygiene problems especially during dry period. The poor quality of water leads to pathogens and helminthes infestation among the animals thereby to disease outbreaks, higher morbidity and mortality, and lower productivity As the results revealed that farmers alleviated water related problems by going long distance to the river, fetching and digging the ground water. The quality of water and the distance traveled to reach are major concerns. Descheemaeker *et al*. (2009) in the Blue Nile basin made similar observations.

5.2.5. Manure disposal and utilization

All the interviewed cattle producers in the study area used animal dung primarily as fertilizer. Similarly, Zewdie (2010) reported that animal dung around *Ziway* was used to fertilize croplands and few farmers used it for their grazing lands. In addition, according to 58.3 and 30.2% of respondents it is also used as other purposes and household fuel, respectively. Belete *et al*. (2010) reported in *Fogera woreda* that the majority of the respondents (98.1%) use the dung as source of fuel. There was no practice of marketing animal dung (dung cake) for fuel or fertilizer purpose in the studied area, which is in agreement with findings of Ayza *et al*. (2013) in B*oditti* as there was no practice of marketing animal dung (dung cake) for fuel or fertilizer purpose. Contrastingly, Zewdie (2010) reported dairy farmers from *Debre- Birhan* and *Sebeta* used dung mostly to make

dung cake to sale at the local market or for satisfying family's own energy needs. The majority of the respondents (65.4%) indicated that they dispose manure from the barn once a day. Ayalew *et al*. (2013) reported also from *Ilu aba bora* zone that 43.3% of the respondents disposed manure from the barn once per day.

5.2.6. Major constraints of cattle production/improvement

Generally, cattle production was affected by several factors. The survey results on one hand as reported by cattle keepers revealed that feed shortage is the major constraint of cattle production ranking first followed by animal health and water scarcity. However, poor genotype, initial capital shortage and lack of awareness were among listed constraints of cattle production in the study area. The first and second constraints of this study were in consonance with the study of Belay *et al*. (2012); it is also similar with the result of Ulfina *et al. (*2005), in which he reported feed shortage, diseases and parasites, labor scarcity and lack of capital and credit were the major constraints limiting livestock production. In the meantime, the third and fourth constraints were different for this study. However, all listed problems in the finding of Ulfina *et al*. (2005) and Belay *et al*. (2012) were also similar problems for this study. Results of the present study were in line with the observations of Asaminew (2007) who reported the major constraints for livestock production in *Bahir Dar Zuira* and *Mecha* districts.

5.3. Feed Resources and Feeding System

Different feed types were used in the study area. The major sources of feed for cattle in the study area were natural pasture grazing, crop residue, aftermath grazing and nonconventional feeds, which were in line with the report of Belay *et al*. (2012) in *Dandi* district. All respondents remembered that free grazing on natural pastureland is the most dominating feeding system for their cattle in the study area. Results indicated that the major constraint for cattle production in the area was feed shortage. Feed shortage is

prevalent throughout the year both in dry and wet seasons (Kechero *et al*., 2013). Results showed that there were no effects of the agro-ecology on cattle feeds, but season had effect on cattle feeds in the study area. Inadequate supply of feed in both quantity and quality was reported to be the single most important problem responsible for low productivity of livestock (Ulfina *et al.,* 2005).

5.3.1. Natural pastureland

Farmers in the study area indicated that natural pasture was first most important source of feed for their cattle in both dry and wet season in the study area. Grazing on natural pasture was the most dominant feeding practice for cattle. Cattle are reared on natural pasture under continues grazing systems. Natural pasture in the high altitudes was rich in pasture species, particularly indigenous legumes (Kechero *et al*., 2010). According to field observation and survey results, there was grazing of cattle on communal and private pastureland, roadside, swampy area and around homestead either free or tethered in the study area.

Leaves from multipurpose trees (Aynalem *et al*., 2008), bushes and shrubs were provided during the end of the dry season. Due to continuous stocking and over grazing of pastures and roadsides, soil erosion has developed into major phenomenon. Encroachment of the less palatable and preferred plants like *Asracantha longifolia* locally known as *okaa* in the major grazing areas become a major problem of cattle production. Tethering and cut-and carry were mainly practiced in major cropping seasons.

5.3.2. Crop residues sources and utilization

Crop residue was the second most feed resource followed by crop aftermath during dry season. In the study area, maize crop was the most important source of crop residue followed by *teff*. The last ranked crop residue source was wheat. In current study, the

major feed resource available among crop residues were maize stover and *teff* straw with indices of 0.407 and 0.245, respectively followed by barley straw (0.126). The results were in agreement with the study of Azage *et al*. (2011), for *Mieso* woreda. Crop residues are abundantly produced throughout the world.

In this study, no crop residue is completely consumed by animals without leaving some behind. All of households stated that the residues from *teff* and maize are used primarily for feed. *Teff (Eragrostis teff)* is one of the major cereals straws produced in Ethiopia. The major uses of crop residues in the district is of course as a feed but considerable households surveyed alternatively use crop residues for fuel, roof shatter, fences and any of their combinations as the need arises. Crop residue as fuel source is one, which highly competes more since the practice is a daily consumption and an alternative way has to be found to minimize this competition through awareness creation of the farmers.

5.3.3. Crop aftermath

As the result revealed, during wet season, crop aftermath/stubble grazing was the second most important source of cattle feed followed by crop residues. After harvesting the crops, cattle are allowed to graze stubbles of maize, sorghum, teff, wheat, barley and pulses between October and December. The stubbles are not accessible to other neighbor cattle owners in the community for first two months as agreed to the report of Sisay (2006) where stubbles are accessible to livestock owned by individual farmers in central highlands of Ethiopia. For the first two months, the stubble is grazed by the animals of the farm owner and later it becomes accessible to all animals in the community. Farmers in the district use aftermath grazing as one means to sustain their cattle until almost the second short rains cultivation.

5.3.4. Hay

The practice of feed conservation in the form of hay was non-existent (100%) in the entire production year. This was due to letting cattle to graze standing dried grass, lack of awareness and large number of cattle. The most common practice used in conservation of feed resources was grazing in the form of standing hay. However, during this study, the researcher observed that, model farmers from each *kebeles* of the district selected and trained on hay and silage-making using less sophisticated procedures and locally available materials by the Woreda Agriculture and Rural Development office in collaboration with Agricultural Growth Program, which was not applied at least up to the time of the survey work. This may indicates that there was a weak extension service.

5.3.5. Indigenous plant feed resources

To date, there has not been any scientific study of vegetation in the study area. Farmers climb up forage trees to lop down leaves and branches of various trees and shrubs and feed them to their cattle during the dry season except when they face critical problems. They also collect herbaceous wild plants, legumes and grasses as feed for cattle. Similarly, Adugna and Said (1992) reported in *wolaita Soddo*. *Cordia africana (Wanza) ,Bambusa vulgaris* (Bamboo tree), *Ficus sur (Shola), Zaagiya (Dawuregna), Ilala* and *washaa (Dawuregna), 'Dawuro daama', 'Gasaa', 'Cayshiyaa'* and *'Lamuxxa'* were mostly used as cattle feed during dry season of the year/ feed shortage season in the district.

From the group discussion, it was heard that providing the leaf/fruit of *Ficus sur* for milking cow is locally not recommended due to it is considered that it cans the teat hole of milking cow and difficulty may face during milking. This is probably thought to be because of its sticky whitish colored fluid effect, which needs scientific investigation. '*Dawuro daama'* leaf and stem were chopped, grinded and mixed with salt and water and given to drink mainly for milking cows. This disagreed with Adugna (2007) who reported

that other feeds used for fattening include leaf of wild plant *Dambursa (Wolaytigna)* synonym with *Dawuro daama (Dawuregna).* All farmers in the study area believed that it improves the quality of butter and they use it as mending medicine for broken cattle as well as human being.

Gasaa and *Cayshiyaa (Dawuregna*) were the other indigenous legume and legume browse feed types, respectively. During group discussion with extension workers, local elders and locally experienced cattle owners in *Dega* and *Woyna dega* agro-ecology, it was mentioned that these two indigenous feed resources were used mainly during dry season for the sake of survival and milk production of cattle. These plants keep green through the year even during dry season.

'Lamuxxa' was one more feed resource in the study area. It was naturally cultivated grass species in *Kolla* agro-ecology particularly on the mounted area of the district and used as feed by cut- carry system for principally milking cow. These more promising wild plants should be further investigated for their voluntary intake and digestibility by animals, content of anti-nutritional factors, biomass production and ease of propagation.

5.3.6. Non-conventional feed resources

The most commonly used non-conventional supplementary feed is residues of local brewery (*atella*). Although the nutritional value this is feed is rated as good (Zewdie, 2010), the availability is very limited and therefore does not satisfy the demand owing to religious factor that totally forbid production of local alcoholic drinks (*tela* and *caticala*). Very exceptionally sampled farms in the study, responded that they provide boiled grains like beans, maize grain to oxen, fattening and weak cattle. Although farmers selective feeding of productive animal is a good indication of their understanding of the role of supplementation in enhanced productivity, the question as to whether farmers supplement their cattle sufficiently or not is a question for further investigation. A residue from local

drinks of coffee mainly from leaf was added with salt and water to be sprayed on standing hay grass and supplemented on crop residues of cattle feed.

Papaya peels, banana (stem, leaf and peel) chopped and fed cattle, taro (*Colocasia esculenta*) stem and root, cassava, potato, sweet potato (vines and occasionally tubers), sugarcane tops, leaves and whole cane (chopped) and fed mostly to fattening animals, pumpkins and fruits and vegetables left over in the study area. This is in line with the report of (Adugna, 2007) in Soddo Zuria Woreda. Enset (*Ensete venticosum*) (stem, leaf and root), cabbage wastes, kitchen wastes and edible leaves of other plants such as '*Korch*' are also fed to animals in the study area and this is in agreement with Ayza *et al*. (2013) in *Boditti.*

5.3.7. Mineral or salt lick

Naturally obtained "*Axuriyaa*" (salty soil) and "*Aduwaa*" (natural salty water) were abundantly available as cattle feed resources in the district and used by 55.3% of farmers. This figure was lower than the report of Yeshitila (2008) in *Alaba* district as the 72.3% of farmers using mineral or salt lick as animal feed resources. During the group discussion, it was mentioned that both mineral rich soil and natural salty water, locally known as *Axuriyaa* and *Aduwaa*, respectively, increase the quantity and quality of milk. This is probably due to high content of sodium in mineral soil.

Nutritionally, study in *Soddo* previously showed that mineral-rich soil, locally known as *Bole,* which is synonym with *Axuriyaa,* is used as mineral supplement for ruminants. These soils are rich in sodium but low in phosphorous and hence attempts should be made to correct phosphrous levels of these feeds when they are used as dry-season supplements to diets based on crop residues and dry pastures (Adugna and Said, 1992).

Mineral salt was commonly given for cattle in wet season. However, as suggested by the farmers, because of the hot climate and the scarcity of forage resources, animals were not given salts during the dry season. As gathered from key informants, salt is given to enhance feed consumption, initiate cows to be in heat and increase milk production. Tesfaye (2007) reported the same finding in *Metema* district of *Gonder* zone.

5.3.8. Seasonality of feed availability

In the study areas, all respondents have mentioned that they came across cattle feed shortage. According to respondents, feed shortage existed between January and March and February and April in the District. Seasons are two in the district, the main crop season *meher* that extends from July through September where long cycle crops are grown and the second season is *belg*, period of only short cycle crops predominantly grown. The same finding was reported by Yeshitila (2008) in *Alaba* the main crop season *Meher*, which extends from July through September and the second season is *belg* a period.

As the survey results revealed that feed shortage results in weight loss, weakness and reduction in milk yield of cattle. Similar observation was reported by Zewdie (2010) in the Highlands and central rift valley of Ethiopia the consequences of feed shortage for livestock include weight loss, lower milk yield, mortality and absence of heat. However, according to respondents this was alleviated by use of fodder bank, destocking and feed purchase. Of the total respondents, only 15.6% purchased green grass (9.3%) and crop residues (6.3%) from neighbored settlers. This agrees with Adugna (2007) in Damot Gale Woreda report as green grass and *teff* straw are sold depending upon the season and the size of the load.

5.3.9. Feed quality improvement

There are different techniques by which the quality of a feed could be improved to cite some of these physical treatments from a simple soaking with water, chopping, grinding and pelleting up to the high chemical treatment, especially the latter improves the nutritive value of crop residues. However, in this study only 17.8% of farmers treated crop residues by soaking with water, chopping, grinding, alkali (salt), crushing and others. This result is slightly similar with the report of Yeshitila (2008) in *Alaba* crop residues are not exposed to such treatments in the survey areas. Most of the time a feed coping mechanism of like this is the interventions recommended in cereal based high crop residue areas like that of *Essera*.

5.3.10. Improved forage production

In view of increasing feed shortage, improved forage production is important in many of the mixed farming systems in the Blue Nile basin (WBISPP, 2002). In terms of quality, also many scholars underline that the present crude protein content is not even sufficient for maintenance. Therefore, improved forage production practices both for enhanced productivity and for higher feed quality are paramount importances in mixed crop livestock systems of the Blue Nile basin.

Contrastingly, the results of this study demonstrated that improved forages production was not practiced in all study area at farmer's level. The study of Zewdie (2010) in central Highlands of Ethiopia also indicated that the proportion of farmers practicing improved forage production is only 13%. Farmer's reason for not practicing improved forage production varies across the study agro-ecologies. For example in *Kolla* the main reasons for not practicing improved forage production were lack of seeds followed by lack of awareness. For HH in *dega* and *woyna-dega* agro-ecologies, the main reason for not practicing improved forage production was lack of awareness. Although lack of

awareness is a common denominator for whole of the study area. Problems identified in this study agree with report of Zewdie (2010).

According to Alemayehu (2005), for last two decades, forage adaptability and production trials were made across the different agro ecosystems in the country and some promising forages were selected. It was observed that around homesteads of some HHs, there was *sesbania* tree as life fence, but farmers did not feed their animals because of lack of awareness. To date adoptions of technologies are generally limited to per-urban and urban area. Relevant question here is probably as to why policy measures that enhances improved forage production could not be implemented and as to whether policy recommendations, if it exists, are system specific or generalized.

5.4. Chemical Composition and IVDMD of Dominant Feed Resources

Chemical composition and IVDMD values of crop residues varied hardly among species. The dry matter (DM) content of crop residues was above 90%, which corresponds with Sisay (2006). The CP content of crop residues ranged from 3.67% DM in *teff* straw to 4.26% DM in maize stover. This result is lower than the range of FAO's (1984) recommendation, that the threshold value of feedstuffs for CP is between 7% and 8%, which is adequate for maintenance of livestock and above the minimum requirement for optimum rumen function (7.5%) suggested by Van Soest (1982). The results of the current work agree with the report of Seyoum and Fekede (2008) that cereal crop residues are normally characterized by low digestibility and energy value, which are both inherent in their chemical composition. The former contained lower CP compared to the later.

Indigenous legume browse has higher CP content compared to indigenous grass and crop residues sampled in this study. This confirms previous reports that indicated higher CP contents of indigenous browses in Ethiopia (Getnet, 2003; Solomon *et al*., 2004; Mekonnen *et al*., 2009 and Solomon *et al*., 2010) and other tropical countries (Njidda and

Akhimioya, 2010 and Boufennara *et al*., 2012). The CP content of indigenous legumes and grass species in the current study is higher than the minimum threshold level of between 7% and 8 % CP required for optimum rumen function and feed intake in ruminant livestock (FAO, 1984).

The neutral detergent fiber (NDF) content of crop residues was above 65%. Sisay (2006) reported higher (>70%) NDF contents for cereal crop residues. NDF above 55% can limit the DM intake (Van Soest, 1967). The NDF contents of crop residues in this study are beyond the limit of 55% and hence could hinder DM intake (Van Soest, 1967). Roughage feeds with NDF content of less than 45% are categorized as high quality, 45-65% as medium quality and those with more than 65% as low quality roughages (Singh and Oosting, 1992). Therefore, crop residues in this study might be categorized as low quality roughages that may inflict limitations on animal performance. The higher NDF content could be a limiting factor on feed intake, since voluntary feed intake and NDF content are negatively correlated (Ensminger *et al*., 1990). Opposite to crop residues, indigenous grass, legumes and browse could be classified as high quality feeds, which could not impose limitations on feed intake and animal production.

ADF is widely used for measuring the fiber in feeds, often substituting for crude fiber, which is used in the proximate analysis of feeds. The acid soluble fraction included primarily hemicelluloses and cell wall proteins, while the residue recovers cellulose and the list digestible non-carbohydrate fractions. Acid detergent has the advantage of removing substances that interfere with the estimation of refractory components so that ADF residue is useful for the sequential estimation of lignin, cut in, cellulose, indigestible Nitrogen and Silica (Van Soest, 1982). The ADF content of crop residues varied from 46.25% in *teff* straw to 53.94% in maize stover (Table 14). High ADF content in crop residues might be associated with lower digestibility since digestibility of feed and its ADF are negatively correlated (McDonald *et al*., 2002). Generally, Kellems and Church

(1998) categorized roughages with less than 40% ADF as high quality and above 40% as low quality. So, crop residues could be categorized as low quality roughages.

The ADL content was high for both crop residues and indigenous grass (Table 15), which limits DM intake. Lignin is completely indigestible and forms lignin-cellulose/hemicelluloses complexes (Kellems and Church, 1998) due to physical encrustation of the plant fiber and making it unavailable to microbial enzymes (McDonald *et al*., 1995). However, the lignin contents of feeds in this study were lower than the maximum level of 7% that limits DM intake and livestock production (Reed *et al*., 1986).

The mean *in vitro* digestible dry matter in the dry matter (IVDMD) for crop residues was about 45.79%, which is lower than the minimum level required for quality roughages (Seyoum and Fekede, 2008). Due to long lag times and slow fermentation, straws and stovers limit intake and utilization (Van Soest, 1982). The IVDMD values of major feeds concur with reports of Solomon *et al*. (2010).

6. CONCLUSIONS AND RECOMMENDATIONS

The study assessed cattle husbandry practices, like breeding system, watering, housing, healthcare and major feed resources. Results of the study showed that mixed crop-livestock production system was the dominant farming system in the study area. Cattle served as a source of draught power, food, manure and others like source of income. The current study showed that natural mating was the most mating system practiced. Trypanosomiasis is the first most important cattle disease followed by mastitis and anthrax in the study area.

Feed shortage, diseases and parasites, water scarcity and poor genetic makeup of cattle were the major constraints limiting cattle production. Feed availability in quantity and quality was ranked the first most important problem limiting cattle production. Natural pasture and crop residues were the main sources of feed for cattle. In the study area, the higher proportion of feed was derived from natural pasture and crop-residues, and natural pasture and stubble grazing during dry and wet season, respectively. Although there was cattle feed shortage in the study area, the farmers did not conserve feed as hay and silage and also did not plant improved forages due to lack of awareness, lack of forage seed and combinations of other related factors.

CP content in feed samples from crop residues was below the critical level for optimum rumen function and feed intake. On the other hand, indigenous grasses, legumes and browses contain higher CP values with higher digestibility, indicating their suitability and potential for strategic supplementation, particularly during the dry season. Based on the results and conclusions of this study, the following recommendations are forwarded for improving cattle development in the study area. These are:

- Provision of strong extension services and training on improved forage cultivation, cattle production and management practices is needed.

- The cattle breeds in the study area were not known which calling for characterization of existing breeds for different traits of performance would help to develop the future intervention areas. The potential of existing breed for dairy, beef, etc. need be identified, so that specialization based improvement will be done for each breed.

- Sustainable conservation, proper storage and utilization of hay and crop residues and proper supplementations with forage legumes, interventions in the improvements of pastures and fodders, over-sowing pastures with forage legumes and using multi-purpose forages can also be potential alternatives in order to tackle the serious feed shortage in the area.

- Considering the great potential and experience with irrigation utilization, farmers have to be advised to produce suitable multi-purpose nitrogen-fixing fodder trees like *Sesbania sesban* to be fed by mixing with dry forages at the same time producing of high energy feeds like sugarcane tops and sweat-potato residues to be supplemented for cattle.

- Further studies aimed at animal's responses and anti-nutritional factors that might be associated with the use of indigenous feeds like *Dawuro daama*, *gasaa*, *cayshiyaa* and *lamuxxa* in future and efficient utilization of these indigenous and adaptable feed resources for optimal cattle production.

- Studies should be conducted on identification and contribution of important local tree browse species for cattle feeding during different seasons in the area.

- Detailed monitoring study is imperative to investigate the productive and reproductive performance of cattle to further substantiate the results of the present study.

7. REFERENCES

Abebe, M., Oosting, J., Fernandez-Rivera, S., Van der Zijpp, J., 2008. Multipurpose fodder trees in the Ethiopian highlands: Farmers' preference and relationship of indigenous knowledge of feed value with laboratory indicators. *Agri. Syst.* **96**: 184-194.

Abrha, G., 2007. Major animal health problems of market oriented livestock development in Atsibiwomberta Woreda, Tigray Regional State. M.Sc. Thesis, Faculty of Veterinary Medicine, Addis Ababa University, Debrezeit, Ethiopia.

Adesogan, T., Sollenberger, E., Newman, C. and Vendramini, B., 2012. Factors Affecting Forage Quality.

Adugna T. and Said A., 1992. Prospects for integrating food and feed production in Wolaita Soddo, Ethiopia. The complementarily of feed resource for animal production in Africa. Proceedings of the joint feed resources networks workshop held in Gaborone, Botswana, 4-8 march 1991. African Feeds Research Work. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia. pp. 309-318.

Adugna T., 2007. Feed resources for producing export quality meat and livestock in Ethiopia (Examples from selected Woredas in Oromia and SNNP regional states).

Agajie, T., Ebrahim, J., Sitotaw, F. and David, G. Smith, 2005. Technology Transfer Pathways and Livelihood Impact Indicators in Central Ethiopia. *Journal of Tropical Animal Health and Production.* **37** (1): 101-122.

Alemayehu, M., 2002. Forage Production in Ethiopia: A case study with implications for livestock production, Ethiopian Society of Animal Production (ESAP), Addis Ababa, Ethiopia, p106.

Alemayehu, M., 2004. Rangelands Biodiversity: Concepts, Approaches, and the Way Forward. Addis Ababa, Ethiopia.

Alemayehu, M., 2005. Feed resources base of Ethiopia: Status and opportunities for integrated development. Pp: 377 -386. Proceedings of the 12th Annual Conference

of the Ethiopian Society of Animal Production (ESAP). Addis Ababa, Ethiopia, August 12 -14, 2004, ESAP (Ethiopian Society of Animal Production).

Alemayehu, M., 2006. Country Pasture/Forage Resource Profiles: Ethiopia. Accessed on 05/01/2009 from *http://www.fao.org/ag/AGp/agpc/doc/Counprof/Ethiopia/Ethiopia.htm*.

Alemu, Y., Zinash, S. and Seyoum, B., 1991. *The Potential of Crop Residues and Agro-Industrial By-Products as Animal feed.* In: proceedings of ESAP, 3rd National Improvement Conference. 24-26 May 1989. IAR, Addis Ababa, Ethiopia. Pp: 57-63.

Alganesh, T., 2002. Traditional milk and milk products handling practices and raw milk quality in eastern Wollega, MSc Thesis, Alemaya University, Ethiopia.

AOAC (Association of Official Analytical Chemists), 2000. Official Methods of Analysis. 15th edition, Washington DC.

Arsham, H., 2007. Questionnaire design and survey sampling. http//www.mirror service. Org/site/hom.ubaltedu/ntsbarsh/Business-stat.

Asaminew Tassew, 2007. Production, handling, traditional processing practices and quality of milk in Bahir-Dar milk shed area, Ethiopia. M.Sc. Thesis. Alemaya University, Alemaya. 130p.

Asaminew, T. and S. Eyassu, 2009. Smallholder dairy production system and emergence of dairy cooperatives in Bahir Dar Zuria and MechaWoredas, Northwestern Ethiopia. World Journal of Dairy & Food Sciences, **4**: 185-192.

Ayalew, T., Duguma, B., & Tolemariam, T., 2013. Smallholder Cattle Production Systems in Three Districts of Ilu Aba Bora Zone of Oromia Regional State, South Western Ethiopia, **8**(1), 38-46.

Ayele, S., Assegid, W., Belachew, H., Jabbar, A. and Ahmed, M., 2003. Livestock marketing in Ethiopia: A review of structure, performance and development initiatives. Socio-economic and Policy Research Working Paper 52. ILRI (International Livestock Research Institute), Nairobi, Kenya. p35.

Aynalem, Hayle and Taye Tolemariam, 2008. The feed values of indigenous multipurpose trees for sheep in Ethiopia: the case of *Vernonia amygdalina, Buddleja polystachya* and *Maesa lanceolata.* Livestock Research for Rural Development, **20**(3).

Aynalem, H., Workneh, A., Noah, K., Tadele, D., and Azage, T., 2011. Breeding strategy to improve Ethiopian Boran cattle for meat and milk production. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project. Working Paper No. 26. ILRI (International Livestock Research Institute), Nairobi, Kenya.

Ayza A, Yilma Z and Nurfeta A., 2013. Characterization of milk production systems in and around Boditti, South Ethiopia. *Livestock Research for Rural Development. Volume 25, Article #183.* Retrieved November 17, 2013, from http://www.lrrd.org/lrrd25/10/ayza25183.htm

Azage, T., Berhanu, G., Dirk, H., Berhanu, B. and Yoseph, M., 2013. Smallholder dairy production and marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development, Improving Productivity and Market Success of Ethiopian Farmers Project (IPMS) International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia Pp: 14-15, 17 and 22.

Azage Tegegne, Zewdu Ayele and Dirk Hoekstra, 2011. Farmer innovations in livestock feeding and management in semi-arid areas of Ethiopia, Tropentag, October 5-7, Bonn, Development on the margin.

Befekadu, D. and Birhanu, N., 2000. Annual report on the Ethiopian economy. Volume 1. The Ethiopian Economics Association, Addis Ababa, Ethiopia, Pp: 429. Bureau of African Affairs, 2006. *http://www.state.gov/r/pa/bgn/2859.htm.*

Belay Duguma, Azage Tegegne and B.P. Hegde, 2012. Smallholder Livestock Production System in Dandi District, Oromia Regional State, Central Ethiopia. Global Veterinarian **8** (5): 472-479, 2012 ISSN 1992-6197. IDOSI Publications, 2012.

Belete Anteneh, Azage Tegene, Fekadu Beyene and Berhanu Gebremedhin, 2010. Cattle milk & meat production and marketing systems & opportunities for market-orientation in Fogera Woreda, Amhara region, Ethiopia. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 19. ILRI (International Livestock Research Institute), Nairobi, Kenya. 65 pp.

Boufennara, S., S. Lopez, H. Bousseboua, R. Bodas and L. Bouazza, 2012. Chemical composition and digestibility of some browse plant species collected from Algerian arid rangelands. Spanish Journal of Agricultural Research, **10**(1): 88-98.

Bruke Yemane and Tafesse Mesfin, 2000. Pastoralism and Agro-pastoralism: past and present. In Pastoralism and Agro-pastoralism which way forward? Proceeding eighth annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia. August 24-26.

Central Agricultural Census Commission (CACC), 2003. Ethiopian Agricultural Sample Enumeration, 2001/02. Results for Southern Nations, Nationalities and peoples Region. Statistical Report on Livestock and Farm implements. Part IV. (July 2003), Addis Ababa, Ethiopia.

CSA (Central Statistical Agency), 2003. Ethiopian Agricultural sample enumeration. 2001/02 results for Amhara region, statistical report on livestock and farm implements, part 4, Addis Ababa, Ethiopia.

CSA, 2008. Livestock and Livestock Characteristics, Agri cultural sample Survey. Volume II, Statistical Bulletin, **446**: 188.

CSA, 2009. Federal Democratic Republic of Ethiopia, Agricultural Sample Survey. Addis Ababa, Ethiopia.

CSA, 2011. Agricultural sample survey. Volume II report on livestock and livestock characteristics.

Descheemaeker, k., Tilahun Amede, Amare Haileslassie, 2009. Livestock and Water Interactions in Mixed Crop-Livestock Farming Systems of Sub-Saharan Africa: Interventions for Improved Productivity. Colombo, Sir Lanka: International Water

Management Institute. 44p. (IWMI Working Paper 133).

Desta Z. and Oba G., 2004. Feed scarcity and livestock mortality in enset farming sytems in the Bale highlands of Southern Ethiopia. Outlook on Agriculture. **33**: 277-280.

Dhaba Urgessa, 2011. Characterization of small ruminant production systems in three coffee producing districts of Ilubabore zone, southwest Ethiopia. MSc thesis submitted to school of graduate studies of Jimma University, College of Agri culture and Veterinary Medicine, pp: 98.

EARO (Ethiopian Agricultural Research Organization), 2001. Feeds and nutrition research strategy. EARO (Ethiopian Agricultural Research Organization), Addis Ababa. P40.

Ensminger. R.E., J.E. Oldfield, W.W. Heineman, 1990. Feed and Nutrition. (Second edition). The Ensminger publishing company. 1151p.

Essera Woreda Agriculture and Rural Development Office (EWARDO), 2008. Official Document on Agro-climatic Condition of the Woreda, Unpublished. Balle, SNNPR, Ethiopia.

Essera Woreda Agriculture and Rural Development Office (EWARDO), 2013. Official Document on Livestock resources and land condition of the Woreda, Un pub lished. Balle, SNNPR, Ethiopia.

Essera Woreda Finance and Economy Development Office (EWFEDO), 2013. Official Document on Livestock resources and land condition of the Woreda, Un pub lished. Balle, SNNPR, Ethiopia.

Etafa, A., Esmael, Y., kasim, K. & Debela, M., 2013. Cattle Production in West Hararghe : An Opportunity and Constraints Assessments in Darolabu, Odabultum , Gemechis and Chiro, **1**(1), 1–15.

FAO (Food and Agriculture Organization of the United Nations), 1984. Assistance to Land Use Planning of Ethiopia, Livestock and Feed Resources.UNDP/FAO Technical Report 6, FAO, Rome, Italy.

FAO, 2005. *Production YearBook*. FAO, Rome, Italy.

Getnet, A., 2003. Feed Resource Development and Utilization: Possible Options and Recommendations under Ethiopian Condition. Training Handout Prepared For Agricultural Subject Matter Specialists (SMS), Holeta Agricultural Research Centre, Addis Ababa, Ethiopia, pp: 1-37.

Hassen Ahmed, Ebro Abule, Kurtu Mohammed and Treydte A C., 2010. Livestock feed resources utilization and management as influenced by altitude in the Central Highlands of Ethiopia. Livestock Research for Rural Development. Volume, 22, 229. Retrieved March 14, 2012, from http://www.lrrd.org/lrrd22/12/hass22229.htm.

Ibrahim, H. and Olaloku, E., 2002. Improving cattle for milk, meat and traction. ILRI, manual 4. International Livestock Research Institute, Nairobi, Kenya. p135.

IGAD-LPI, 2011. (Inter-Governmental Authority on Development-Livestock policy initiative). The Contribution of Livestock to the Ethiopian Economy - Part I.

IPS, 2000. (International Project Service). Resource potential assessment and project identification study of the Somalia Region: Socio-economic assessment. In vestment office of the Somalia regional state. Research Report. Vol.III. Soma lia, Ethiopia. p351.

Jiregna D., 2007. Characterization of cattle genetic resources in their production systems context in danno district, west shoa, Oromia, Ethiopia, M.S. thesis, School of Graduate Studies, Alemaya Univ. of Agriculture.

Kechero, Y., Tolemariam, T., & Haile, A., 2013. Characteristics and Determinants of Livestock Production in Jimma Zone / Southwestern Ethiopia, **5**(2), 69–81.

Kedija Husien, 2008. Characterization of milk production system and opportunity for market orientation: A Case Study of Mieso District, Oromia Region, Ethiopia. M.Sc. Thesis. Haramaya University, Ethiopia.

Kellems, Richard O. and Church D.C., 1998. Livestock Feeds & Feeding. (Fourth edi tion). Prentice-Hall, Inc., New Jersey, USA. 573p.

Kocho T and Geta E., 2011. Agro-ecologic mapping of livestock system in smallholder crop-livestock mixed farming of Wolaita and Dawuro districts, Southern Ethiopia.

Livestock Research for Rural Development. Volume 23, Article #51. Retrieved November 17, 2013, from http://www.lrrd.org/lrrd23/3/koch23051.htm.

Lemma, F., 2004. Assessment of butter quality and butter making efficiency of new churns compared to smallholders' butter making techniques in east Shoa of zone of Oromia, Ethiopia, M.S. Thesis, Alemaya Univ., Ethiopia.

McDonald, P., Edwards, R.A., Greenhalgh, J.F.D. and Morgan, C.A., 1995. Animal Nutrition. (Fifth Edition). Longman Group, Harlow, United Kingdom. 607p.

McDonald, P., R. A. Edwards, J. F. D. Greenhalgh, C. A. Morgan, 2002. Animal Nutri tion (sixth edition). Pearson Educational Limited. Edinburgh, Harlow, Great Britain. 544p.

Mekete Bekele, 2008. Integrating Livestock in to Water Resources Development: Assessment on Livelihood Resilience and Livestock Water Productivity at Golina and Alewuha Rivers. (MSc thesis). Hawassa University. Ethiopia. 144pp.

Mekonnen A, Haile A, Dessie T and Mekasha Y., 2012. On farm characterization of Horro cattle breed production systems in western Oromia, Ethiopia. Livestock Research for Rural Development. Volume 24, Article #100. Retrieved March 30, 2013, from http://www.lrrd.org/lrrd24/6/meko24100.htm

Mekonnen, K., G. Gerhard and S. Monika, 2009. Assessments of Fodder Values of three Indigenous and three Exotic Woody plant species in the Highlands of Central Ethiopia, International Mountain Society (IMS), Addis Ababa, Ethiopia, pp: 135-142.

Melaku, T, 2011. Oxenization versus Tractorization: Options and Constraints for Ethio pian Framing System. *Intern. J. Sustainable. Agri.* 3 (1): 11-20.

Mohammed, H., Mengistu, N., Getachew, H., Kemal, H. and Reta, H., 2007. Livestock Marketing System Study in Pastoral and Agro-pastoral Communities of the Borena and Guji zones. Yabello Pastoral and Dry land Agricultural Research Center. Socioeconomic and Extension Research Division. Unpublished.

New Partnership for Africa's Development -Comprehensive Africa Agriculture Devel opment Programme (NEPAD-CAADP), 2005. Ethiopia: Investment Project Pro file "Live Animal and Meat Export" -Preliminary Options Outline. P3.

Njidda, A.A. and I. Ikhimioya, 2010. Correlation between chemical composition and in-vitro dry matter digestibility of leaves of semi-arid browses of Northeastern Nigeria. American-Eurasian J. Agri. And Environ. Sci., **9**(2): 169-175.

Ofuoku, A.U., Egho, E. O.and Enujeke, E.C., 2009. Integrated Pest Management (IPM) adoption among farmers in Central Agro-ecological Zone of Delta State, Nigeria. *Advances in Biological Research.* **3** (1-2): 29-33.

Oumer, S., 2011. On - farm phenotypic characterization of cattle in Jimma zone, south western Ethiopia, M.S. thesis, Jimma Univ., Ethiopia.

Pagot, J., 1992. Animal Production in the Tropics and Subtropics. CTA. Hong Kong. p517.

Reed, J.D., Yilma, K. and L.K. Fossel, 1986. Factors affecting the Nutritive value of sorghum and millet crop residues. Plant breeding and the nutritive value of crop residues. Proceedings of ILCA, workshop held at Addis Ababa, Ethiopia. pp. 233-251.

Regasa, C., B. Shelima, A. Abalti, F. Dawo and H. Dinka, 2006. Survey of farmers' perception on major health constraints of cattle under smallholder management systems in eastern shoa zone of Oromia Region. Ethiopia.

Rewe T O, Indetie D, Ojango J M K and Kahi A K., 2006. Breeding objectives for the Boran breed in Kenya: Model development and application to pasture-based production systems. Animal Science Journal **77**:63-177.

Samuel, M, 2005. Characterization of livestock production system of Yerer watershed, Ada'a liben Woreda of east showa, Ethiopia, A Thesis Submitted to Alemaya University, June, 2005, Dire Dawa, Ethiopia.

Seyoum, B. and Fekede, F., 2008. The status of animal feeds and nutrition in the West Shewa Zone of Oromiya, Ethiopia. PP. 27-49. In: Proceedings of the Workshop 'Indigenous Tree and Shrub Species for Environmental Protection and Agri

cultural Productivity', November 7-9, 2006, Holetta Agricultural Research Centre , Ethiopia. Series on Conference and Workshop Proceedings of Commission for Development Studies at the Austrian Academy of Sciences: 2008/1.

Singh, G.P. and Oosting, S. J., 1992. A Model for Describing the Energy Value of Straws. Indian Dairyman XLIV. pp. 322-327.

Sisay A., 2006. Qualitative and Quantitative Aspects of Animal Feed in Different Agro ecological Areas of North Gonder. MSc. Thesis. Alemaya University, Dire Dawa.

Solomon, A. and Alemu, Y., 2009. Shelters and housing for sheep and goats. R.C. Merkel (Eds). In 32th technical bulletin. August, Addis Ababa, Ethiopia. Pp: 1-2.

Solomon Bogale, 2004. Assessment of livestock production system and feed resource base in Sinana Dinsho District of Bale highlands, South East Oromiya. M.Sc. Thesis presented to the school of graduate studies of Alemaya University of Agriculture. p141.

Solomon, B., M. Solomon and Yami Alemu, 2004. Influence of rainfall pattern on grass/legume composition and nutritive value of natural pasture in Bale High lands of Ethiopia, pp: 1-11.

Solomon, M. and A. Teferi, 2010. Chemical composition, in vitro dry matter digestibility and in Sacco degradability of selected browse species used as animal feeds under semi-arid conditions in Northern Ethiopia, Agro forest Syst., **80**: 173-184.

Tadesse D, Ayalew W and Hegde B P., 2005. Survey of traditional cattle production systems and preferred cattle functions in North and south Wollo zones, Ethiopia. Ethiopian Veterinary Journal **9**(1):91-108.

Tafesse Mesfin, 2001. What should a pastoralist development strategy continue towards poverty reduction among pastoral communities in Ethiopia. In: Proceeding of second Annual Conference on Pastoral development in Ethiopia. Pastoral Forum in Ethiopia, May 22-23, Addis Ababa, Ethiopia. p136.

Tajebe Seare, Gangwar S K & Kefelegn Kebede, 2011. Performance and physical body measurement of Abergell sheep breed under traditional management system of

Tigray Regional state, Northern Ethiopia. International Journal of Science and Nature, Volume. **2**(2): 225-230.

Tedonkeng Pamo, E. and Pieper, D., 2000. Introduction to range Management in free and open access environments of Sub-Saharan Africa.

Tesfaye, M., 2007. Characterization of cattle milk and meat production, processing and marketing system in Metema district, Ethiopia, M.S. thesis, Hawassa Univ., Awassa, Ethiopia.

Tola A, Belissa M and Kebede G., 2004. Survey on traditional livestock production system in Manasibu District of West Wollega, Ethiopia. In: Farm animal biodi versity in Ethiopia: status and prospects. Proceedings of the 11th annual confer ence of the Ethiopian society of animal production (ESAP) held in Addis Ababa, Ethiopia, 28-30 August 2003. ESAP, Addis Ababa, Ethiopia. Pp.141-145.

Ulfina, G., Zelalem, B., Jemal, D., Gemeda, D., Chala, M., Jiregna, D., Diriba, G., Lemma, G., Workneh, A. and Adam, D., 2005. Survey of cattle production and marketing practices in Danno District, western Ethiopia, using PRA tools. PRA Report.

USAID (United States Agency for International Development), 2009. USAID Country Health Statistical Report. USAID, Addis Ababa, Ethiopia.

Van Dorland H A, Ayalew W, Tolessa A, Ronalds G J and Rege J E O., 2004. Understanding the purposes for keeping cattle and their perceived traits by farmers in Oromia Regional state, Ethiopia. In: Asfaw Y and Tamrat D (Eds), Farm animal biodiversity in Ethiopia: Status and prospects. Proceedings of the 11th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, 28-30 August 2003. ESAP, Addis Ababa, Ethiopia. pp. 191-201.

Van Soest, P. J., 1967. Development of a comprehensive system of feed analysis and its application to forage. Journal of Dairy Science, **48**:818.

Van Soest, P. J., 1982. Nutritional Ecology of the Ruminants: Ruminant metabolism, Nutritional strategies, the cellulolytic Fermentation and the Chemistry of Forages and Plant Fibers. Ithaca, New York. 373p.

Vercoe, E. 1999. Climatic and environmental factors affecting dairy productivity. In: Falvey, L. and C. Chantalakhana (Eds.). Smallholder Dairying in the Tropics. ILRI (International Livestock Research Institute), Nairobi, Kenya.

WBISPP (Woody Biomass Inventory and Strategic Planning Project), 2002. A Strategic Plan for the Sustainable Development, Conservation, and Management of the Woody Biomass Resources. Amhara Regional State. Final Draft. Addis Ababa, Ethiopia.

Yeshitila, A., 2008. Efficiency of livestock feed resources utilization and forage devel opment in Alaba Woreda, Southern Ethiopia. MSc. Thesis, Haramaya University, Dire Dawa Ethiopia. 128p.

Yigrem S, Beyene F, Tegegne A and Gebremedhin B., 2008. Dairy production, processing and marketing systems of Shashemene-Dilla area, South Ethiopia.

Kechero Y., D. Belay and G.P.J. Janssens, 2010. Indigenous fodder trees and shrubs: Nutritional and ecological approaches. Proceedings of 14th ESVCN Congress, Zurich, Switzerland, pp: 121-121.

Zewdie Wondatir, 2010. Livestock production systems in relation with feed availability in the Highlands and central rift valley of Ethiopia, MSc Thesis presented to Haramaya University .

Zinash Sileshi, 2004. Livestock Production System. Short-term course in Awassa Uni versity. Awassa, Ethiopia. p47.

Zinash Sileshi and Seyoum Bediye, 1991. Utilization of feed resources and feeding systems in the central zone of Ethiopia. Proceedings of the Third National live stock improvement Conference, Addis Ababa, Ethiopia. Pp: 129-132.

8. APPENDIX

Appendix 1: Household questionnaire

Household Questionnaire to characterize cattle production systems and feed resources in Esera district, Dawuro Zone, Southern Ethiopia.

Questionnaire Number_____

Introduction and informed consent

Good morning/ Good afternoon!

My name is _____ I came from Addis Ababa University, to conduct MSc thesis on characterization cattle production systems and feed resources in your district, *Essera*, *Dawuro* Zone, Southern Ethiopia. Hence without your participation it is impossible to achieve the goals. You are randomly selected to provide information for this research. The information you provide will help the researcher for characterizing cattle production, cattle feeds available and constraints limiting cattle production. The interview may take between 30 minutes - 1 hour to complete. Any information you provide will be strictly confidential and will not be used for any purpose outside this research. Information provided in this survey will not be attributed directly to you and will be used only for descriptive and analytical purposes in a form that will not reveal your identity or the identity of your organization.

Consent given Yes _____ No_____

(*If the answer is "No" to this question, end the interview now*)

Identification

1. Date of interview _____ 6. Kebele name_____
2. Region_____ 7. Sex_____
3. Zone_____ 8. Age_____
4. Woreda_____ 9. Date Entered: DD/MM/Year _____/_____/_____
5. Enumerator's Name: _____10.Time of interview started and end _____**&**_____

I. Socio-economic characteristics

1. Marital status: 1 = Single 2 = Married 3 =Widowed 4 = divorced
2. How many family members do you have? _____
3. Educational status

    1. Illiterate _____ 4. Junior Secondary School_____
    2. Read and write only_____ 5. Secondary School_____
    3. Primary school_____ 6. Above Secondary School_____

4. Occupation: 1 = Farmer 2 = House wife 3 = Student 4 = Herder 5 = Trader 6 = Handicraft maker 7 = Unemployed 8 = Government employed 9 = Employed non-government 10= House maid 11= retired 12= Other
5. Land holding and land use systems

    1. What is the size of your total land holding? (*Exactly as indicated on land holding Certificate*) ____ha

    2. How much is your land allocated for the followings?

    1. Crop land _____*timad* 3. Fallow land _____*timad*
    2. Grazing/pasture land _____*timad* 4. Others _____*timad*

II. Cattle herd structure

#	Herd type	Cattle type		
		Local	Crossbred	Others
1	Total cows			
2	Milking cows			
3	Dry cows			
4	Pregnant cows			
5	Oxen			
6	Total calves			
7	Male calves			
8	Female calves			
9	Bulls			
10	Heifers			

III. Purpose of keeping cattle

a. Traction, yes_____ no____ d. Meat, yes _____no_____

b. Milk, yes_____, no_____ e. Transport, yes _____no_____

c. Both traction and milk, yes___no_____ f. Manure, yes _____no_____

g. Savings, yes_____, no, _____ h. Other (specify) _____

IV. Labor division of the family member in cattle management activities

Type of Activities	Sex of individuals
Milking	
Pregnant cow feeding and caring	
Cattle herding	
Bull feeding	
Traction activities	
Calf rearing	
Heifer rearing	
Barn cleaning	
Herd feeding/watering	
Milk processing	
Milk and milk products selling	
Feed collection	

V. Breed and Breeding

1. Do you have any crossbred cattle? Yes No

2. If yes, how did you get your crossbred cows?

    1. Purchased from neighbors

    2. Purchased pregnant cow from any project

    3. Purchased from market 4. Through A.I. 5. Supplied by the MoA.

3. When you start having cross bred cows?

    1. Six months ago 2. One years ago 3. Two years ago 4. Three years ago 5. Others

4. Why you start with Cross breed cows/heifers?

1. Better milk production 2. Higher growth rate 3. Higher weaning weight

4. Better body conformation.

5. If no, why you only stick with Local cows?

1. Better disease resistance quality 2. Better resistance on heat stress.

3. Better fat content 4. I don't get cross breed cows/heifers

5. Better body conformation 6. They can fit for Drought purpose

6. What is your breeding system?

1. Natural breeding 2. Artificial breeding 3. Both

7. Do you have an experience of selection the best cattle type for breeding purpose?

1. Yes 2. No

8. If yes what are your parameters used to select the best cattle for breeding purpose?

1. Color coat 2. Behavior of the animals 3. Body conformation

4. Milk production potential 5. Drought power potential 6. Others ----------

9. Do you have an experience of using AI? 1. Yes 2. No

10. If no, why did not use it?

1. We did not know its advantages 2. We did not have any option to get AI service

3. We did not have interest for Crossbreeding 4. Environment will disfavor them.

5. Others ----------

11. What are the major problems in getting artificial insemination services?

1. Places are too far 2. It is often difficult to get the inseminator

3. Payment for crossbreeding service is too much high 4. I don't hear about crossbreeding

12. Do you have your own breeding bull? 1. Yes 2. No

13. If yes, breed type_____

14. If yes, how does it give service?

1. Own herd only 2. Own and neighbor herd freely 3. Others (specify) _____

15. If no, where is your source for the bull?

1. Neighbor 2. Rent from neighbor 3. Bull services (Rent) 4. Others (specify)

VI. Animal health condition and Treatments

1. Do you have any animal health problems? 1 = Yes 2 = No
2. If yes, what are the major animal health problems? Please rank in order of importance.

    1. Foot and mouth 2. Mastitis 3. Trypanosomiasis

    4. Black leg 5. Anthrax 6. Pneumonia

    7. Ticks 8. Blood urinate 9. Mitch 10. Other specify

    Rank: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____ 7 _____ 8 _____

3. How did you overcome the problem? Explain? ----------
4. What are the local plants used for medication to cattle?

    1._____

    2._____

5. What do you do when your animal is sick?

    1. Keep of waiting 2. Culling 3. Consult veterinarian 4. Others (specify)

6. Do you have access to veterinary services? 1. Yes 2. No
7. If yes, from where do you get this service?

Type of service	Sources of service			
	Government	Private	NGOs	Others
Vet				
Paravet				
Others (specify)				

8. If yes, what is the distance of the animal health center/post?
9. Is there a problem with animal health services? 1. Yes 2. No
10. If yes, please mention_____
11. Do you use any control measures for ecto-parasites of cattle? 1. Yes 2. No
12. If yes, specify:

    Method Frequency Cost per treatment/ head

1. _____ _____ _____

2. _____ _____ _____

3. _____ _____ _____

13. If traditional method, specify: _____

14. How do you control internal parasites?

Method Frequency Cost per treatment/ head

1. _____ _____ _____

2. _____ _____ _____

3. _____ _____ _____

15. If traditional method, specify: _____

VII. Housing system

1. Do you have an experience of housing your cattle? 1. Yes 2. No

2. What is the importance of housing?

1. To protect from hot climate 2. To protect from cold weather

3. To protect animals from wild animals 4. To protect the animals from theft

4. It has no importance especially for cattle 5. Others ----------

3. If yes, what type of housing system?

1. Simply crashes 2. Open with roof on the top only

3. I keep the animals with the people residence 4. I tethered at the yard

4. If no, why you don't use house for the cattle?

1. They are great in number 2. We don't have stationary place

3. If they acclimatize the outside environment, they became strong enough.

5. At what time the house is needed?

1. During summer 2. During winter 3. No specific time. 4. Others -------

6. Do you have a selection of species for housing? 1. Yes 2. No

7. If yes, what are the species privileged for housing?

1. Cattle 2. Sheep 3. Goat. Camel 4. Equines 5. Others

Rank them with priority: 1. ---- 2. ---- 3. ----- 4. ---- 5. -----

8. Do you have an experience of age of cattle selecting in housing? 1. Yes 2. No

9. If yes, for what age group you give priority?

1. Small calf 2. Milking cows 3. Oxen 4. Dry Cows 5. Fattened animals

6. Heifers and Rank them with the priority given: 1. ---- 2. ---- 3. ---- 4. --- 5. --6. -

VIII. Watering the animals

1. What is the water source of cattle? 1. Pond water 2. River water 3. Tap water 4. Spring water

2. What is the frequency of watering your animals?

#	Species	Frequency	
		Dry season	Wet season
1	Locals		
2	Crossbred		

Codes:

Frequency: 1 = Once in a day 2 = Twice in a day 3 = Three times in a day

4 = Other (specify)

3. How far the water points from your home? _____ Kms round trip.

4. Do you think unavailability of water is a major constraint during the dry period?

1 = Yes 2 = No

5. If yes, what are the problems?

1. Water scarcity during dry season 2. Less accessibility 3. Hygienic problem

6. If the answer is yes, how did you alleviate the problem?

1. By digging the ground water 2. By going long distance to the river. 3. By fetching 4. Other means

IX. Manure disposal and utilization.

1. How many times you dispose manure per day?

. If yes, what looks like its utilization?

#	Utilization	Percent (%)
1	Fertilizer	
2	Fuel	
3	Feed	
4	Other purposes	

X. Major constraints of cattle development/improvement?

Major cattle production constraints (Direct ranking): 1= major problem…

Problems	Rank constraints
Feed shortage	
Disease	
Drinking water scarcity	
Labor shortage	
Poor genotype	
Lack of market access	
Shortage of initial capital	
Predator	
Lack of knowhow	

XI. Feeds and feeding

1. What are the major feed resources in the area? (Rank 1-5 in the order of importance).

Feed resources

	Natural pasture	Crop residues	Crop aftermath	Concentrate	Others
Dry period					

Wet period

---

2. What are the crop residue sources?

1. Teff 2. Millet 3. Sorghum 4. Barley 5. Maize 6. Wheat 7. Beans and peas 8. Others

Rank them: 1. ----- 2. ----- 3. ----- 4. ----- 5. ----- 6. ----- 8. -------

3. What about the crop residue utilization.

#	Utilization (%)	Types of crop residues					
		Teff	Millet	Sorghum	Maize	Wheat	Others
1	Feed						
2	Housing material						
3	Compost						
4	Fuel						
5	Sold						
6	Other purposes						

4. Did you come across shortage of animal feed? 1. Yes 2. No

5. If yes, Can you mention at what months feed shortages exist.

1._____

2._____

3._____

6. What are the consequences of the feed shortage?

(1) Weight loss (2) Milk yield reduction

(3) Increased mortality (4) Abortion frequency

(5) Weakness (6) Anoestrus

(7)Others, specify----------

7. If yes, what was your solution to alleviate your problem?

(1) Feed preservation as hay. (2) Use of improved forage production.

(3) Fodder bank. (4) Forage purchase.

(5) Destocking. (6) None (7) If others, specify----------

8. Do you produce cultivable forages?

1 = Yes 2 = No

9. If yes, what type of forages do you produce?

1 = Sesbania 2 = Oats & vetch 3 = Alfalfa 4 = Lacuna 5. Other (specify)

10. If no, what was your reason?

1. I did not hear anything about it. 2. Even though I heard, I don't get the seed.

3. I don't have any shortage of feeds 4. I don't have any extra land to cultivate

11. Do you purchased feed for your animals?

1 = Yes 2 = No

12. If yes, from where you purchased?

1 = From neighbor of settlers. 2 = From farmers in other PA

3 = From market 4 = 1 and 2 5 = 1, 2 and 3 6 = From nearby town

13. If yes, what type of feed purchased?

1. Hay 2. green grass 3. Wheat and corn bran and middling 4. crop resides 5. Others Rank them: 1. --- 2. ----- 3. ------ 4. ------ 5. -------

14. If yes, how much feed was purchased?

#	Types of feed purchased	Price per unit
1	Hay	
2	Crop residues	
3	Green grass	

15. Do you have an experience of making hay? 1 = Yes 2 = No

16. If yes, from which land?

1 = Individual Pasture land 2 = Crop land (after math) 3. Cultivated grass

4 = Roadside grass 5 = Community pasture land 6. Other (specify)

17. If no, what was your major reason?

1. We did not know about its importance. 2. We don't have any feed shortage.

3. We can let our animals simply to the dried grass.

4. Since we do have large number of cattle, we cannot accommodate all.

5. It has no importance.

XI a. Non-conventional feed resources given to cattle in the area.

1. Do you use any non-conventional feed resources? (1) Yes (2) No

2. If yes what is the name and amount given? ----------

VI b. Nutritive quality improvement

1. Do you use any feed quality improvement techniques in your household? 1. No 2. Yes

2. If yes, what type? A. Soaking with water B. Grinding C. Using alkalia D. Crushing E. Pelletting F. Other

Appendix 2: Check lists for key informants and extension workers

1. What are the indicators for wealth ranking according to the local community standards?

2. What are the common/major disease and parasites that affect the cattle in the dry/wet seasons? Rank them, Disease type, occurring month, possible causes.

3. Which feed resources are mainly used by farmers as cattle feed and in which season?

4. Do farmers in your area use cattle for dual purposes?

5. How do cattle management system and your production objectives help maintain your cattle in the occurrence of disaster such as drought, disease, shortage of land and water etc?

6. What are the major constraints of cattle production in your area

Appendix 3: Indices of prevalence of cattle disease in the study area

Agro-ecology																
	Dega				***Woyna-dega***				***Kolla***				**Total**			
Diseases	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index
Trips	0	0	0	0.000	26.7	33.3	26.7	0.289	100	0	0	0.500	42.2	11.1	8.9	0.263
FMD	0	0	0	0.000	0	0	6.7	0.011	0	0	0	0.000	0	0	2.2	0.004
Anthrax	0	60	40	0.267	26.7	0	20	0.167	0	0	26.7	0.044	8.9	20	28.9	0.160
BL	0	0	0	0.000	6.7	6.7	0	0.056	0	0	26.7	0.044	2.2	2.2	8.9	0.033
Mastitis	0	40	60	0.233	40	20	6.7	0.278	0	26.7	0	0.089	13.3	28.9	22.2	0.200
BU	100	0	0	0.500	0	0	0	0.000	0	0	0	0.000	33.3	0	0	0.166
Leech	0	0	0	0.000	0	40	13.3	0.156	0	40	33.3	0.189	0	26.7	15.6	0.115
Ticks	0	0	0	0.000	0	0	13.3	0.022	0	0	6.7	0.011	0	0	6.7	0.011
Others	0	0	0	0.000	0	0	13.3	0.022	0	33.3	6.7	0.122	0	11.1	6.7	0.048
Total	100	100	100	1.00	100	100	100	1.00	100	100	100	1.00	100	100	100	1.00

Index = [3 for rank 1) + (2 for rank 2) + (1 for rank 3)] for each of the factor divided by sum of all of the factors, Trips= Trpanosomiasis FMD= Foot and Mouth Disease BL= Blackleg BU=Blood urinate

Appendix 4: Major cattle production constraints in the study areas

Agro-ecology																
	Dega				***Woyna-dega***				***Kolla***				**Over all**			
Constraints	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index
Feed shortage	53.3	0	33.3	0.322	60	40	0	0.433	66.7	13.3	13.3	0.400	60	17.8	15.6	0.385
Disease	20	73.3	6.7	0.356	40	60	0	0.400	20	66.7	13.3	0.344	26.7	66.7	6.7	0.367
Water scarcity	0	0	40	0.067	0	0	60	0.100	13.3	6.7	46.7	0.167	4.4	2.2	48.9	0.111
Poor genotype	26.7	26.7	6.7	0.234	0	0	0	0.000	0	13.3	13.3	0.066	8.9	13.3	6.7	0.100
Shortage of initial capital	0	0	0	0.000	0	0	40	0.067	0	0	0	0.000	0	0	13.3	0.022
Lack of knowhow	0	0	13.3	0.022	0	0	0	0.000	0	0	0	0.000	0	0	8.9	0.015
Total	100	100	100	1.00	100	100	100	1.00	100	100	100	1.00	100	100	100	1.00

Index = [3 for rank 1) + (2 for rank 2) + (1 for rank 3)] for each of the factor divided by sum of all of the factors

Appendix 5: Sources of crop residues in the study area

Agro-ecology																
	Dega				***Woyna-dega***				***Kolla***				**Total**			
Crop residues	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index	R1	R2	R3	Index
Teff straw	0	0	6.7	0.011	0	66.7	33.3	0.278	53.3	46.7	13.4	0.444	17.8	37.8	17.8	0.245
Maize stover	33.3	33.3	26.7	0.322	80	20	0	0.467	46.7	53.3	13.3	0.433	53.3	35.6	13.3	0.407
Sorghum stover	6.7	6.7	6.7	0.067	0	0	0	0.000	0	0	53.3	0.089	2.2	2.2	20	0.052
Wheat straw	0	6.7	20	0.056	0	0	0	0.000	0	0	0	0.000	0	2.2	6.7	0.018
Barley straw	33.3	46.7	6.7	0.333	0	0	0	0.000	0	0	0	0.000	11.1	15.6	2.2	0.111
Bean and pea haulms	26.7	6.7	33.3	0.211	20	0	46.7	0.178	0	0	0	0.000	15.6	2.2	26.7	0.126
Others	0	0	0	0.000	0	13.3	20	0.078	0	0	20	0.033	0	4.4	13.3	0.037
Total	100	100	100	1.00	100	100	100	1.00	100	100	100	1.00	100	100	100	1.00

Index = [3 for rank 1) + (2 for rank 2) + (1 for rank 3)] for each of the factor divided by sum of all of the factor

Appendix 6: ANOVA test resulting for landholding and land use system/patterns

		Sum of Squares	df	Mean Square	F	Sig.
Size of total land	Between Groups	21.089	2	10.544	6.086	.003
	Within Groups	150.733	87	1.733		
	Total	171.822	89			
Crop land	Between Groups	2.867	2	1.433	3.549	.033
	Within Groups	35.133	87	.404		
	Total	38.000	89			
Grazing land	Between Groups	.822	2	.411	1.717	.186
	Within Groups	20.833	87	.239		
	Total	21.656	89			
Fallow land	Between Groups	10.156	2	5.078	13.070	.000
	Within Groups	33.800	87	.389		
	Total	43.956	89			
Others	Between Groups	.822	2	.411	1.954	.148
	Within Groups	18.300	87	.210		
	Total	19.122	89			

Appendix 7: ANOVA test resulting for cattle herd structure in the study area

		Sum of Squares	df	Mean Square	F	Sig.
Total cows	Between Groups	462.156	2	231.078	19.619	.000
	Within Groups	1024.733	87	11.779		
	Total	1486.889	89			
Milking cows	Between Groups	13.422	2	6.711	4.319	.016
	Within Groups	135.200	87	1.554		
	Total	148.622	89			
Dry cow	Between Groups	184.422	2	92.211	30.710	.000
	Within Groups	261.233	87	3.003		
	Total	445.656	89			
Pregnant cow	Between Groups	18.289	2	9.144	7.647	.001
	Within Groups	104.033	87	1.196		
	Total	122.322	89			
Oxen	Between Groups	26.756	2	13.378	5.788	.004
	Within Groups	201.067	87	2.311		
	Total	227.822	89			
Total calve	Between Groups	9.600	2	4.800	1.591	.209
	Within Groups	262.400	87	3.016		
	Total	272.000	89			

Male calve	Between Groups	9.956	2	4.978	6.444	.002
	Within Groups	67.200	87	.772		
	Total	77.156	89			
Female calve	Between Groups	.356	2	.178	.137	.872
	Within Groups	112.800	87	1.297		
	Total	113.156	89			
Bulls	Between Groups	6.756	2	3.378	5.032	.009
	Within Groups	58.400	87	.671		
	Total	65.156	89			
Heifers	Between Groups	1.689	2	.844	1.056	.352
	Within Groups	69.600	87	.800		
	Total	71.289	89			
Crossbred	Between Groups	.422	2	.211	1.831	.166
	Within Groups	10.033	87	.115		
	Total	10.456	89			