ASSESSMENT OF FATTENING AND MARKETING SYSTEM, AND EFFECT OF CONCENTRATE SUPPLEMENTATION WITH LOCALLY AVAILABLE FEEDS ON FATTENING PERFORMANCE OF INDIGENOUS CATTLE IN BONKE WOREDA OF GAMO GOFA ZONE

M.Sc. THESIS

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HAWASSA UNIVERSITY

COLLEGE OF AGRICULTURE

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APPROVAL SHEET - I

DEPARTMENT OF GRADUATE COMMITTEE

HAWASSA UNIVERSITY

This is to certify that the thesis entitled "*Assessment of Fattening and Marketing System, and Effect of Concentrate Supplementation with Locally Available Feeds on Fattening Performance of Indigenous Cattle in Bonke Woreda of Gamo Gofa Zone"* submitted in partial fulfillment of the requirements for the degree of Master of Sciences with the specialization in ANIMAL PRODUCTION of the graduate of the school of Animal and Range sciences, College of Agriculture, Hawassa University, is a record of original research carried out by Guyo Demisse ID. No. SGS/136/06, under my supervision, and no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received during the course of this investigation have been dully acknowledged. Therefore, I recommended that it be accepted as fulfilling the thesis requirements.

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APPROVAL SHEET - II

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As members of the Examining Board of the Final M Sc Open Defense, we certify that we have read and evaluated the thesis prepared by GUYO DEMISSE entitled *Assessment of Fattening and Marketing System, and Effect of Concentrate Supplementation with Locally Available Feeds on Fattening Performance of Indigenous Cattle in Bonke Woreda of Gamo Gofa Zone* and recommend that it be accepted as fulfilling the thesis requirement for the degree of Master's.

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Final approval and acceptance of the thesis is contingent upon the submission of the final copy of the thesis to the Department of Graduate Council (DGC) of the candidate's major department.

I hereby certify that I have read this thesis prepared under my direction and recommend that it accepted as fulfilling the thesis requirement.

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DEDICATION

I dedicate this thesis manuscript to my father DEMISSE ANNO, who sacrificed much to bring me up to this level but I lost him during the study period (July, 2014).

STATEMENT OF THE AUTHOR

I declare that this thesis is my authentic work and all sources of materials used for this thesis have been duly acknowledged. 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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ABBREVIATIONS/ ACRONYMS

BoARD	Bureau of Agriculture and Rural Development
BoFED	Bureau of Finance and Economic Development
CSA	Central Statistical Authority
ESAP	Ethiopian Society of Animal Production
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
HH	Household
LIVES	Livestock and Irrigation Commodities Value Chain for Ethiopian Smallholders
ILRI	International Livestock Research Institute
MOA	Ministry of Agriculture
NGO	Non-governmental Organization
Pas	Peasant Associations
SNNPRS	Southern Nations, Nationalities and Peoples Regional State
SPSS	Software package for social science
UNDP	United Nations Development Programme

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Assessment of fattening and marketing system, and effect of concentrate supplementation with locally available feeds on fattening performance of indigenous cattle in Bonke woreda of Gamo Gofa Zone

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ABSTRACT

The study was carried out in Bonke Woreda of Gamo Gofa Zone, southern Ethiopia, with the objectives of assessment of fattening and marketing system, and effect of concentrate supplementation with locally available feeds on fattening performance of indigenous cattle. The study involved survey to assess cattle fattening and marketing practices, and action research to evaluate the effect of homemade concentrate from locally available feed resources on fattening performance and economic return of indigenous cattle. The survey part involved interviewing 120 households purposively selected from six kebeles in three agro ecologies. Focus group discussions and key informants have been employed to enrich the data. The feeding trial was conducted in Danible Ottora Kebele,with 18 (9 castrate and 9 non – castrate) indigenous cattle for 70 days excluding adaptation period of 15 days. Treatments included farmer's practices alone (T1); T1 + concentrate supplementation at 1% of body weight (T2); and T1 + concentrate supplementation at 1.5% of body weight (T3). Maize stover and stubble grazing was provided as a basic ration which was the farmers feeding practice. Experimental animals were blocked by farms/households and randomly assigned to three feeding treatments separately. Heart girth and body condition score were recorded while body weight was estimated from heart girth using regression equation developed for zebu cattle. The data were analyzed using the General Linear Model Procedure of statistical package for Social Science (SPSS 16). The result showed that the most dominant cattle breed used for fattening in the study area was indigenous. The major source of cattle for fattening was through purchasing from market (69.1%) followed by raising at home (24.2%). Almost all fatteners in highland (95%) and mid-altitude (100%) were engaged in fattening castrate. Concerning physiological stage of the fattening animals, most of the producers (83%) use matured & old oxen. In highland, majority of the farmers fatten cattle once within a year (60%), while it was three times per year for mid-altitude (42.5%) and two times per year for lowland (70%) agro-ecologies. The majority (90%) of the respondents indicated that the most common criteria used to decide fattening period was body condition of the animals. Majority of the respondents in the highland, mid altitude and lowland fatten cattle for six months, three months and five months, respectively. The major types of feed resources for the fattening animal were natural pasture, crop residues, stubble grazing, grass hay and feed supplements. The major criteria used while purchasing fattening cattle included frame size, heath, body condition, coat color and price of animals. The experience in cattle fattening, large cattle population, diverse & suitable agro-ecology, availability of crop residues, high irrigation potential, initiation of the introduction of improved forage species and cheap labor force reveals the potential of the area for improved cattle fattening. However, feed shortage, shortage of land, prevalence of disease, poor access for credit service and marketing information, and underdeveloped cattle marketing were the major constraints that hinder the performance of cattle fattening. The feeding trial showed that

average daily gain were highest (p<0.05) for animals supplemented with T3 followed by T2 and T1. Similarly, the net return was higher (P<0.05) for the supplemented group (T2 & T3) compared to non-supplemented group kept under farmers management (T1). Among the supplemented groups, marginal rate of return was higher for animals supplemented with T2 compared to T3. Thus, it can be concluded that when resources are not meager smallholders producers could use supplementation at 1.5% of body weight for higher return. However, when resources are limited producers are advised to supplement at 1% of body weight for higher marginal rate of return. Detail research work on availability, nutrient composition and digestibility of the major feed resource are recommended for further work.

Key words: Cattle fattening, Concentrate supplementation, marketing system, Weight gain

1. INTRODUCTION

Ethiopia holds the largest livestock population in Africa, estimated at 56.7 million heads of cattle, 29.3 million sheep, 29.1 million goats, 1.16 million camels, 56.8 million chicken, 2.03 million horses, 7.3 million donkey and 0.4 million mules (CSA, 2015). Livestock play vital role in Ethiopian economy where it is a source of livelihood for many smallholder farmers, pastoralists and agro pastoralists. It also serves as a source of cash income, household security, accumulating capital and fulfilling various socio-cultural obligations (Ayele *et al.,* 2003; Sere *et al.,* 2008). Livestock contributes to about 12-18 % of the total GDP, 35 - 49% of agricultural GDP and 23.8% of export earnings (Beruk, 2014; FAOSTAT, 2010; IGAD, 2011, 2013).

However, in spite of the huge livestock population, the contribution of livestock sub-sector to the agricultural sector in the country is very low (Jabbar *et al.,* 2007; Negassa *et al.,* 2011). This is due to inadequate year-round feed supply, both in terms of quantity and quality, and poor nutrition, low genetic potential of indigenous animals for functional traits, prevalence of diseases and parasites, traditional animal husbandry practices, inadequate veterinary service delivery, undeveloped livestock market and linkage, poor capacity by value chain actors and service providers, and lack of marketed oriented extension (Belete *et al.*, 2010; Legese *et al.*, 2008). Consequently, the production and productivity of livestock in general and meat production in particular is extremely low (Azage and Alemu, 1998). Thus, many Ethiopians, like other developing countries, do not consume adequate amount of meat. According to Abbey (2004) the per capita meat consumption of developed countries was 77 kg, which is by far higher than 25 kg for developing countries and only 9 kg for Ethiopia.

Bonke district of Gamo gofa zone is known for its high livestock population and diverse agro – ecological zones suitable for cattle fattening. The dominant farming system in the area is crop-livestock where cereal crops such as maize and sorghum and pulses such as haricot beans are widely cultivated in the area. Cattle production in general and cattle fattening in particular is an important component of the farming system. There is also cheap labor, better experience in cattle fattening, and increasing demand for fattened cattle in the local market. Despite the potential, cattle fattening system in the area is traditional low-input-low-output, and the performance of cattle fattening is generally very low. Lack of commercial concentrate feed supply, poor quality and quantity of feed resources, poor nutrition, undeveloped cattle market, poor access for credit and market information, poor extension and veterinary service delivery, poor capacity by value chain actors and service providers are among the bottlenecks that contributed to poor fattening performance in the area.

In Bonke district, cattle fattening heavily relies on grazing natural pasture and crop residues. However, these feed resources are poor in crude protein and soluble carbohydrate, rich in fiber, and their availability is seasonal (Gebre-Egziabher and Mullugeta, 1995; Yoseph *et al.*, 2011). Moreover, under traditional grazing system, fattening cattle are expected to walk long distance for grazing, which results in energy loss. Thus, it is common to see body weight and body condition loss as well as reduced carcass composition in grazing animals (Lamond, 1970). Supplementation of low quality feed resources with nutritious ones is among the strategies followed to prevent weight loss, improve carcass composition and animal performance in general.

Although supplementation with agro-industrial by-products such as wheat bran and oil seed cakes has been reported to have improved body weight gain and carcass characteristics of cattle

fed on crop residues or grazing natural pasture (Azage and Mukassa-Mugerewa, 1995; Osuji and Capper, 1992; Tesfaye *et al.*, 2002), its availability is limited to urban areas, and access for these resources is marginal for rural areas such as the ones where this study was conducted. On the other hand, there are different types of crops with better nutritional quality grown in the study area. However, the use of these feed resources for value addition such as cattle fattening is at its infancy. There is no specific feeding strategy developed for cattle fattening from locally available feed resources in the study area. Thus, it is imperative to formulate home-based concentrate for smallholder cattle fattening according to requirements from locally available feed resources specific to the study area. This is believed to reduce extended fattening duration and improve fattening performance of indigenous cattle. The use of homemade concentrate could also help overcome periods of feed shortage and ensure constant supply of livestock products throughout the year.

Therefore, understanding the existing cattle fattening & marketing practices, and introducing improved feeding from locally available feed resources is very imperative to improve the performance of fattening cattle in the study area. Thus, the current study was undertaken with the following objectives.

General Objective

- To assess smallholder cattle fattening and marketing system, and effect of supplementation with locally available feeds on fattening performance of indigenous cattle in Bonke woreda of Gamo Gofa zone of Southern Ethiopia.

Specific objectives

- To assess smallholder cattle fattening and marketing practices in the woreda
- To assess the major constraints and opportunities for cattle fattening in the area.
- To evaluate the effect of concentrate supplementation from locally available feeds on fattening performance of indigenous cattle under farmers management
- To assess economic return of concentrate supplementation

2. LITERATURE REVIEW

2.1. Livestock Production Systems in Ethiopia

Based on integration of livestock with crop production, level of input and intensity of production, agro-ecology and market orientation, livestock production systems in Ethiopia is categorized as pastoral, agro-pastoral, mixed crop-livestock farming, urban and peri-urban farming and specialized intensive farming systems (Mohammed *et al.*, 2004; Yitay 2007). However, the livestock production systems are predominantly categorized as agro-pastoral system in the lowlands, and the mixed crop-livestock system in the highlands. Traditionally, fattening of animals in both systems concentrates on male animals and on females which are either infertile or have finished their reproductive cycle (Kefyalew, 2011).

In both rural and urban areas, smallholder cattle fattening is emerging as an important source of income. In rural Ethiopia cattle fattening is based on locally available feed resources. In the lowland agro-pastoral system, grazing is the most common source of feed, with limited use of crop residues, whereas in the high land system, crop residues are the most important source of animal feed. During the wet season, when crop residues are scarce in the highlands, male animals are taken to the lowland areas for grazing (Elias *et al.*, 2007). Ethiopia with having large number of animals the potential for beef fattening are high and the demand for meat is increasing both in domestic and export markets. Fattening of beef cattle as a business is not very common in Ethiopia. Rather than grazing, no different feeding systems are used by many rural farmers to fatten animals.

2.2. Cattle Fattening Systems in Ethiopia

In Ethiopia, smallholder cattle fattening is emerging as an important source of income. In rural area, cattle fattening is based on locally available feed resources (Takele and Habtamu, 2009). According to MOA (1997), Cattle fattening practice in Ethiopia is categorized in to three major fattening systems: traditional system, by-product based system and the Hararghe fattening system.

2.2.1. Traditional type of fattening system

This system generally depends on grazing natural or planted pastures with variable degrees of supplementation. Cattle are kept mainly for draft power, milk, and manure production and are usually only sold when they are too old for these purposes, or drought or cash shortages force people to sell. Animals require a long period of time to attain market weight and condition. Oxen are usually sold after the plowing season when they are in poor condition. Meat yield are low, the beef is of poor quality and farmer returns are often inadequate to buy a replacement oxen (MoA, 2002).

2.2.2. Agro-industrial by-product-based fattening system

This is a type of fattening in which the agro-industrial by-product such as molasses, cereal milling by-product and oilseed meals is the main sources of feed. In this system grazing land is completely unavailable and crop-residues are only significant roughage source.

2.2.3. Hararghe type of fattening system

This type of fattening system involves intensive feeding of the available feed supply to young oxen they are using for draught power could best describe the Hararghe fattening practice. The feed types used for the fattening are entirely obtained from crop production especially from maize and sorghum. Pagot (1992) substantiated that in Ethiopia the farmers fatten young

bullocks at the edge of the fields with lower leaves taken from the stems of sorghum. Among the most common feed types, cereal straw such as maize and sorghum are major feeds offered to fattening animal during the main and early dry seasons (Abdi *et al*., 2013). This tradition is seasonal undertaking to utilize seasonally available feed. During abundant feed supply, the animals are offered in *ad-libitum*. Farmers extend animal's daytime feeding up to nighttime and supplement the animal with common salt or locally available mineral licks twice a week. The nighttime feed offering is used to supplement the amount of daytime dry matter consumption and to compensate under supply of feed during daytime as in the case when the farmer is away from his house. During short rainy season, they allow their oxen to graze at the edge of farm plots or roadsides for 1.5 to 2 hours every morning before sunrise. In the cases where the farmers have more than one ox, they transfer the second one to their relative or person in the same village to feed for him after using for traction (Fekadu and Alemu, 2000).

2.3. Feed Resources & Feeding Systems

2.3.1. Feed resources

In Ethiopia the major source of animal feed are natural pasture, crop residues and agro-industrial by products.

2.3.1.1. Natural pasture

Natural grazing land is a predominant feed source for livestock in Ethiopia. There are very limited areas of land planted with improved pasture or forage crops in Ethiopia. However, natural grazing areas are usually communally owned (Alemu, 2009) and do not fulfill the nutritional requirements of animals particularly during the dry season due to poor management and low productivity (Malede and Takele, 2014). Thus, the production and productivity of cattle that relied on natural grazing was reduced and could not attain market weight within a

short duration of fattening. Therefore, farmers continue keeping fattening animals for a long sometimes for more than a year. This would not enable smallholder producers to ensure the economic feasibility.

2.3.1.2. Crop residue

Crop residue is the main feed resource for livestock in Ethiopia. However, it has low quality, high fiber content, and low digestibility which reduce productivity of livestock, weaken disease resistance potential of animals (Malede and Takele, 2014). Thus, fattening animals could not attain market weight within short period of time.

2.3.1.3. Agro-industrial – by products

Agro-industrial by-products are rich in crude protein and energy, and could serve as a supplement for livestock kept on poor basal diet. These feed resources are mainly by - products of flour and oil seed mills. However, these feed resources are commonly available in urban and peri-urban areas and poorly accessed by small holder cattle fatteners in rural areas. However, due to availability, access and high cost of industrial – by products, supplementing for fattening cattle is existed at its infancy.

2.3.2. Feeding systems of fattening cattle

According to Kefyalew (2011), grazing is the most common form of feeding system. On the other hand, fattening system of Hararghe smallholder farmers involve intensive feeding of the available feed supply to young oxen they are using for draught power. In areas such as Hararghe, farmers practice cut-and-carry feeding systems for cattle fattening. They use high seed rate to enhance maize and sorghum biomass production and then thin excess seedlings are feed to animals. Moreover, Tsigereda, (2010) revealed that Hararghe farmers feed common baking yeast such as *Saccharomyces cerevisiae*, Abish flour (*fenugreek*) and fermented dough

or their combination to fattening cattle mixed with additional fresh flour of maize or wheat bran or alone. On the other hand, according to Takele and Habtamu (2009), Cattle fattening in Wolaita is largely based on non-conventional feed resources and uses locally - innovated feeding strategies. Addisu *et al.* (2012) indicated that farmers in Arsi Negele fatten animals using attela (local brewing by-product) which they purchase from local brewers. In central southern region of Ethiopia, Shewangizaw *et al.* (2014) reported that most of the smallholder cattle fatteners use stall feeding while few of them use both stall feeding and grazing jointly.

2.4. Nutrient Requirements of Fattening Cattle

Livestock feeds are expected to provide basic nutrients required for animal production, including energy, proteins, minerals, vitamins and other micro-nutrients. Livestock feeds may be broadly classified as concentrates and roughages, depending on their composition. Concentrates are feeds that contain a high density of nutrients, usually low in crude fibre content and high in total digestible nutrients while roughages are feeds with a low density of nutrients, with a high crude fibre content including most fresh and dried forages and fodders (FAO, 1983).

According to Leng (1990) ruminant feeding in the tropics and subtropics considerably depended on low quality materials (i.e. grazing pastures and crop residues). Despite the adaptation of most indigenous animals to the nutrient stress, it can be argued that these adaptation mechanisms are only often sufficient to balance nutrient requirements for maintenance. However, beef cattle require nutrients to support body maintenance, reproduction, and growth/production. The nutritional needs of fattening cattle vary by age, class, stage of production, performance level, and weight. Physiological and environmental stressors such as animal health and weather can also impact nutritional requirements.

According to NRC (2000), the daily dry matter requirement for finishing fattening cattle with 250 kg body weight is 7.23 kg DM at 3% body weight based DM intake. Roughage is required for the satisfactory functioning of the digestive system whereas higher percentage of grain is required in the ration for higher body weight gain. However, the risk of digestive upset is greatly increased when more than 80% grain is included in the feed (NSW, 2004).

Protein is a key nutrient in beef cattle diet formulations. Protein in beef cattle diets is commonly expressed as crude protein. It is a major component of muscles, the nervous system and connective tissue. Muscle growth requires protein. Muscle development and protein requirements decrease as animals approach maturity. Depending on dry matter intake a 3 to 4 year old requires 10 to 11% dry matter protein diet. If there is adequate energy for a gain of 1.4 kg per day the protein need will be 12% of the dry matter (David, 2006). Besides, when all fattening cattle provided supplementary feed, they do not respond equally in terms of feed intake and weight gain. However, young cattle require higher energy levels and proteins than older cattle. Depending on age and weight, animals require CP of 11% to 15% (NSW, 2004) for production. Similarly, fattening cattle requires energy for maintenance, production/weight gain. If the fattening cattle diet contains energy that meets only maintenance, the animals will loss body weight. Thus, high energy rations should be fed for maximum weight gains. Therefore, it is important to plan feed management for the road ahead and know the weights of cattle and the growth rate one would like to achieve (Victoria, 2010).

2.4. Cattle Marketing System in Ethiopia

In Ethiopia, the marketing process in general follows a three-step system with primary, intermediate and terminal markets through which marketable animal and animal products pass from producers to small traders and on to large traders and/or butchers. However, most

producers sale their stock and livestock products at local markets directly to consumers or small traders at relatively low prices. Without exception markets are open places in villages and towns. Distance from the market, poor trekking routes and lack of holding grounds create unfavorable conditions for producers forcing them to sell their stock at low prices (Yacob, 2002). Livestock are generally traded by 'eye-ball' pricing, and weighing livestock is uncommon. Prices are usually fixed by individual bargaining and depend mainly on supply and demand, which is heavily influenced by the season of the year and the occurrence of religious and cultural festivals. Ethiopia's livestock supply is heavily influenced by the severity of the dry season. Due to these unfavorable marketing systems and the discouraging price on the producers' side they are not encouraged to improve the quality and the off-take of their animals (Alemayehu, 2003).

The livestock marketing structure follows a four-tier system, of which different actors involve in buying and selling of beef cattle in the market system (Ayele *et al.* 2003). The main actors of the 1st tier are local farmers and rural traders who transact at farm level with very minimal volume, 1-2 animals per transaction irrespective of species involved. Some traders may specialize in either small or large animals. Those small traders from different corners bring their livestock to the local market (2nd tire). Traders purchase a few large animals or a fairly large number of small animals for selling to the secondary markets. In the secondary market (3rd tier), both smaller and larger traders operate and traders and butchers from terminal markets come to buy animals. In the terminal market (4th tire), big traders and butchers transact larger number of mainly slaughter type animals. From the terminal markets and slaughterhouses and slabs, meat reaches consumers through a different channel and a different set of traders/businesses (Elias *et al.*, 2007).

2.5. Opportunities and Constraints of Cattle Fattening in Ethiopia

2.5.1. Opportunities

Among the agri-business sector, cattle fattening is one of the outstanding strategy to the development of economy. Fattening is considered profitable as a business in general terms especially for countries with large cattle population like Ethiopia. The participants that play part in fattening package fetch's a good profit in a short period of time per head of cattle that they kept in fattening (Ayenew *et al.,* 2012). As a result, large number of smallholder producers participated in the fattening activities. These are due to many opportunities (variable agro ecology, huge number of livestock population, and feed resource of agricultural by-products, cheap labor, good fattening weather and good indigenous knowledge of fattening activity and recent introduction of some improved forages) that make the land of fattening suitable for them (Abdi *et al.,* 2013). According to Shitahun (2009), the good opportunities important to enhance the performance of fattening activities are availability of crop residues, high irrigation potential, better meat type cattle, and the better potential of breed in feed conversion efficiency and resistance to disease and high demand of finished cattle in the market. In addition, the smallholder producers used these potentials jointly with advice of experts in the area; cattle fattening activity were one among outstanding strategy to improve their income.

2.5.2. Constraints

Ethiopia, with enormous livestock resource, believed to be the top country in Africa. Despite of this potential, the contribution of this sector in the agricultural economy of the country remains lower and productivity or output per animal is among the lowest in the world (Negassa *et al.,* 2011). This is due to major factors that hinder the livestock production system in general and beef production particularly. Beef production is one of the commodities of livestock sector that

extremely low in production due to facing of many challenges and remains as a form of subsistence. According to Shitahun (2009), the factors that hamper the performance of cattle fattening practices are feed shortage, lack of capital, shortage of labor, and health problem in sequence of importance. In west Hararghe, according to Abdi *et al*. (2013), similarly the factors that hinder the performance of cattle fattening practices are feed shortage, animal health, feed cost, land shortage, water shortage, housing problem, shortage of agro-industrial by-products, lack of capital, market problem and lack of market information, lack of credit, extended drought, lack of improved breed and poor husbandry management and technical skill on feeding and fattening.

2.6. Effect of Concentrate Feed Supplementation on Beef Cattle Performance

2.6.1. Feed intake

In rural area of high lands of Ethiopia cattle fattening is closely allied with grazing pasture, green grass and crop residues. However, farmers have fattened their cattle traditionally by tethering where nutritionally insufficient grasses are available and with no supplements. Because of this, cattle are being fattened for extended periods up to one and half years before selling them. This leads to the relatively poor productive and reproductive performance of the animals. Supplementations with concentrate are therefore, common strategies often used in improving performance of ruminants depending on grazing pastures or crop residues (Dziba *et al.,* 2007). One way of improving the performance of grazing cattle during periods of scarcity of feed would be to use concentrate supplementation. The supplements increase the feeding value of the entire diet by direct addition of nutrients over and above supplied by the pasture and other roughages. They usually increase the supply of energy from the roughage due to increased intake and/or digestibility of the herbage on offer (Crowder *et al.,* 1982). The

concentrate feed intake of cattle was higher than that of basal diet. This can be truth to the fact that with increased concentrate feeding, basal diet intake falloff due to substitution effect (Jokthan *et al.,* 2009). The high concentrate intake could also be due to the palatability of the concentrates over the basal diets.

2.6.2. Weight gain

Despite the adaptation of most of indigenous animals to the nutrient stress, it can be argued that these adaptation mechanisms are only often sufficient to balance nutrient requirements for maintenance. This leads to the relatively poor productive and reproductive performance of the animals. Supplementation with protein and energy are therefore, common strategies often used in improving performance of ruminants depending on grazing pastures or crop residues (Dziba *et al.,* 2007). The improved feed digestibility and rumen fermentation characteristics results in increases in dry matter intake and subsequently availability of energy for tissue development in the animal and hence improvements in growth and meat yield. It is therefore justifiable to note that improvements in dry matter intake and rumen fermentation characteristics make supplementation of fibrous feed materials with concentrate a prerequisite for improved ruminant production (Bitew *et al.,* 2012). The weight gain of fattening animal fed with concentrate feed (maize offal, wheat offal, race offal and sorghum panicle diet) was higher than that of traditional fattening system performed only with the fed of basal diet. However, with the supplementation of concentrate feed, the bulls obtain higher average daily weight gain 0.87kg/day (Olayiwole *et al.,* 1981); 1.07kg/day (Ikhatua and Olayiwole, 1982); 0.645kg/day (Aberash, 2000); 0.69 - 0.91kg/day (Lamidi *et al.,* 2007); 0.602kg/day (Shitahun, 2009) and 0.7kg/day (Jokthan, 2013). In other word, this means the nutrient composition of those diets were higher and making the more nutritious and of benefits to beef cattle. The bulls that provide

palatable feed gained high average daily weight gain point out the better rate of conversion of feed to production (meat) (Jokthan, 2013). Thus, Smallholder cattle farmers can adopt the use of the concentrate based diets in fattening rations.

2.7. The Nutritional Value of Ingredients

2.7.1. Chemical composition and supplementary value of Maize

Maize (*Zea mays L.)* is an important food and feed crop of the world. Maize ranks first in production and yield among main cereals in Ethiopia (Luque *et al.,* 2006). Maize is cultivated two times a year and potentially able of producing huge amount of food grains per unit area. Maize has superior dietary value as it contains about 72% starch, 10% proteins, 4.8% oil, 8.5% fiber, 3% sugar and 1.7% ash (Chaudhary, 1993). Maize is used for animal feed, food and in industry as raw materials for production and brewing. It has become the most important raw material for animal feed and several industrial processes due to its low price and widespread distribution. Seventy percent (70%) of maize produced worldwide is used for livestock feed (Onimisi *et al.,* 2009). The leaf and stalk are also used for animal feed. Studies conducted by Fekadu and Alemu (2000) revealed that, in Hararghe highlands of eastern Ethiopia thinning of maize could provide as much as 67 - 89% of the diet of fattening oxen during the months August – September. In addition, Adugna (2008) reported that in Wolaita thinning, the whole crop and boiled grain are provided as supplemental feed for fattening cattle. As reported by Tsigreda (2010), maize stover is chemically composed of 91.64, 5.25, 82.25, and 47.85% DM, CP, NDF and ADF, respectively.

2.7.2. Chemical composition and supplementary value of Sorghum

Sorghum (*Sorghum bicolor L.)* is the fifth major staple cereal cultivated worldwide in warmer climates. Sorghum is the second most important cereal produced in Ethiopia. Ethiopia is also

the second largest producer of sorghum in Eastern and Southern Africa after the Sudan (Demeke, 2013). Sorghum grain is mostly used as an energy source and is a good feedstuff for poultry, pigs and ruminants. Its composition is roughly similar to that of maize and it is particularly rich in starch (more than 70% of the dry matter). Crude protein content in sorghum grain ranges from 9 to 13% DM and is slightly higher than that of maize, though much more variable depending on growing conditions (Sauvant *et al*., 2004).

2.7.3. Chemical composition and supplementary value of Haricot Bean

Haricot bean (*Phaseolus Vulagris L*), locally known as '*Boleqe*' also known as dry bean, common bean, kidney bean and field bean is a very important legume crop grown worldwide (Luque, 2006). Dry beans are mostly prepared as nifro (boiled grain), mixed with sorghum or maize and wet (local soup) and also with kocho. The protein content is (22%) and its amino acid composition is high in lysine, it complements cereals and other staple foods in the diet (MoAR, 2009). Studies conducted by Takele and Habtamu (2009) and Deribe (2015) reported that feeding half-boiled haricot bean seeds for fattening animals was locally - innovated feeding strategies in Sorro and Soddo Zuria sites of Wolaita zone.

2.8. Beef Fattening Research Gaps

Beef cattle fattening activity is one of the commodity of livestock in agriculture sector. It is a regular activity to improve the income of producers. Although, in rural Ethiopia smallholder producers practicing traditional fattening, the productivity gained is very low. Thus, fatteners can't earn much profit from this activity. Therefore, research works have an effort in generating various technologies to transform the traditional fattening system to semi-intensive and intensive fattening system. Hence various research outputs support the producers on how to manage their fattening husbandry for further improvement. However, many researches were

carried out in the area of beef fattening activities, but still there existed a gap which had not applicable within farming communities. For example lack of crop residue treatment, proper utilization of supplementation and proper breed selection. On top of this there is poor linkage between research and agricultural offices remain the sector under expectation. According to Ponnusamy and Kumaran (2008) weak extension works on scaling up is often cited as a major reason why many existing proven technologies are not widely applicable by farmers. It is a clear indication that feed resource utilization (Shitahun, 2009; Fikru, 2015); fattening and marketing of cattle are undeveloped in rural area (Teshager *et al*., 2013). Moreover, the adoption and use of improved feed technologies remained limited (Deribe *et al.,* 2013), calling for exploring locally available feed resources (Deribe *et al.,* 2013; Mekonnen *et al.,* 2009), giving due emphasis on indigenous knowledge on adapted feed resources in the crop-livestock farming systems. Therefore, action research is needed and looking strategies to improve farmer's innovative technologies that provide the cattle with boiled maize and haricot bean grain (Adugna, 2008 and Deribe, 2015). Demonstrative studies have a key role to disseminate new adopted technology to the farmers. Therefore, this study was initiated to solve knowledge gaps through contact extension/farmers involvement/ in practicing on – farm demonstration to support the existed fattening practices of the area to improve production and productivity of cattle and to boost the income of smallholder fatteners.

3. MATERIALS AND METHODS

3.1. Description of the Study Area

The study was carried out in Bonke woreda, Southern Ethiopia. Bonke is one of the 15 woredas in Gamo Gofa Zone and lies between 5°55′N latitude and 37°15′E longitude with an altitude range of 600-4200 m.a.s.l. The land area of the Woreda is estimated to be 85,940 km^2 and bordered on the south by the Dherashe and Alle woreda, on the west by the Weito River which separates it from Kemba, on the northwest by Deramalo, on the north by Dita, and on the east by Arba Minch Zuria woreda. The agro-ecology of the woreda is classified in to three zones: Dega (46%), Woina Dega (30%) and Kola (24%). The mean annual average rainfall and the mean annual average temperature of the woreda are 1400 mm and 13.05^oC, respectively (BoARD, 2014; BoFED, 2014). The estimated human population of the woreda was about 205,739 of which 102,458 male and 103,281 are females (BoFED, 2015). The total population of cattle, sheep, goats, poultry, equine, camel and honeybees colonies was estimated to be 145,477; 252,551; 57,695; 136,232; 37, 732; 35 and 10,433, respectively (BoARD, 2015).

3.2. Study Design and Data Collection Method

The study was comprised of both survey and on - farm feeding experiment. The survey assesses cattle fattening and marketing system in the woreda and the feeding experiment was conducted on-farm to evaluate the effect of concentrate feed supplementation with locally available resource on weight gain & economic benefit of indigenous cattle. The design and procedures of each part is described below.

3.2.1. Part I. Assessment of cattle fattening practice and marketing system

3.2.1.1. Study Design

3.2.1.1.1. Sample selection procedure and sample size

Bonke woreda was stratified into three based on agro-ecology (Dega, W/Dega and Kola). Two kebeles per agro-ecology were selected purposively based on the potential of high value livestock commodities by the livestock and irrigation commodities value chain for Ethiopian smallholders (LIVES) project and active participation of farmers in cattle fattening practice. Then 20 households (10 Men and 10 Women) from each kebele who has been engaged in cattle fattening practice were selected and interviewed. To generate gender disaggregated data both female headed households and women's within male headed households were considered.

3.2.1.2. Methods of data collection

Both secondary and primary data were collected. The primary data were collected through structured questionnaires form household farmers, key informant interviews, focus group discussions and field observations. Secondary data were collected from zonal and woreda livestock and fisheries office, and marketing and cooperative departments. The data were collected by enumerators with close follow up and monitoring by the researcher. The procedures employed for data collection for survey part are described below.

Household survey

Cross-sectional survey was conducted using semi-structured questionnaire. Thus, a total of 120 households were interviewed in the survey. The data collected through the questionnaire included sex and age of the household head, family size, education level and economic variables such as land holding, livestock holding, livestock production and cattle fattening practice, major challenges and constraints, and opportunities of cattle fattening, availability and

source of livestock feed; total amount feed produced, feed management options, feed conservation practices, fattening animal selection practices, source of animal for fattening, crop production system, cattle health delivery system, disease and parasites, housing, and livestock market situation, marketing constraints, marketing channel, access to market information and market opportunities in the study districts (Annex 2).

Focus group discussion [FGD]

In each of the interviewed kebele, one focus group established and discussion was carried out by using a checklist prepared for this purpose. The participants in the focus group discussions were comprised of 8-12 farmers of which about 4-6 were women. The participants were selected through active participation of development agents and kebele leaders by considering their age and experience on cattle fattening practices. Specifically, they were drawn from farmers, and kebele administrators. During focus group discussion, issues such as agricultural activities practiced, breed type exist in the area and fattening system and practice, feeding practice and feed conservation methods, systems and utilization of communal feed resources, and major constraints and opportunities for cattle fattening and marketing situations and marketing channel were discussed.

Key informants interview

The key informants were selected based on their good knowledge on cattle fattening and marketing and their willingness and co-operation to participate in providing information to the study. Then, four key informant interviews were made separately with participants selected from livestock trader, local butcher, office of marketing & cooperative, Office of livestock and fisher experts.

3.2.2. Part II. The on – farm feeding experiment

3.2.2.1. Experimental study site and sampling techniques

The experiment was conducted in Danible Ottora Kebele, one of the kebele's involved in cross sectional survey in this study, based on transportation access, market potential and better experience in fattening and interest of farmers' to be involved in the trials. Then six farmers from the kebele was purposively selected based on the number of fattening cattle, better experience in fattening and willingness of farmers to be involved in the study.

3.2.2.2. Training and awareness creation

Before commencement of the study, awareness was created for selected households and livestock development agent of Danible Ottora PA on the objective of the study, gaps on existed fattening activities, and improved fattening system. Specific skill based training was also organized for the same targets on improved and short cycle cattle fattening system. This included concentrate feed formulation from locally available feed resources, feeding systems, health management, short cycle fattening, and fattening as a business (moving from subsistence to market oriented system).

3.2.2.3. Experimental feed preparation

Experimental feed was prepared from locally available feed resources. Maize (*Zea mays L.)* and Sorghum (*Sorghum bicolor*) were used as energy source while Haricot bean (*Phaseolus vulgaris L.)* was used as protein source and salt was used as mineral source. These feed ingredients were selected based on their availability in the area. The contribution of these ingredients to total concentrate mix was 58% for maize, 21% for sorghum, 20% for common beans (roasted) and 1% for salt. The ingredients were weighted and mixed manually before milling. The formulated concentrate supplemented to animals was the same in composition but

different in quantity according to the respective treatments as described in the following section. The ration preparation was assumed to meet metabolizable energy (6.82 Mcal/head/day) and protein (0.501 kg/head/day) requirements of an animal weighing 200 kg with expected body weight gain of 1 kg per head per day as recommended by NRC (2000).

3.2.2.4. Experimental design and treatments

The experiment involved 3 dietary treatments. Treatment 1 was feeding basal diet (farmer's practices alone); Treatment 2 constituted feeding basal diet (farmers' practice) supplemented with concentrate at 1% of body weight; and Treatment 3 constituted feeding basal diet (farmers' practice) supplemented with concentrate at 1.5% of body weight. The experiment was laid down using Randomized Completed Block Design (RCBD) with 3 treatments and 6 blocks (households). Each household was contributed 3 uniform fattening animals at the same time, and treatments were randomly allocated to the animals in each household separately. Initial body weight was considered as a covariate to adjust final body weight.

3.2.2.5. Experimental Animal and feeding management

A total of 18 experimental animals (9 castrate and 9 non – castrate), drawn from 6 HHs, were used for feeding trial. Each farmer allocated 3 fattening animals which were relatively similar in type, age and body condition. The animals were treated for internal and external parasites by using albendazole and acaricide and treated against trypanosomiasis before commencement of the experiment. Animals were allowed to adapt dietary treatment for 15 days. The actual experiment lasted 70 days. The daily amount of concentrate mixture (Treatments 2 and 3) was offered twice per day at about 8:00 AM and 6:00 PM. The animals were housed in individual pen during the night and part of the day. All animals had free access to clean water. Water

trough was purchased from local market while feeding trough was made from locally available woody materials.

3.2.2.6. Data collection and management

3.2.2.6.1. Supplement feed intake

After acclimatization period (15 days), the amount of concentrate supplement feed offered and refused was recorded daily throughout the experimental period to determine daily supplemental feed intake of animal.

3.2.2.6.2. Body weight gain and body condition score

Since this study was undertaken under farmer's management in rural setting, heart girth (cm) measurement was employed to estimate body weight of the animals. Body weight of the animals was estimated using a prediction equation of $Y= 164.0-3.950x+0.03142x^2$ (where, Y= Live weight (kg); x= Heart girth (cm)) developed for Ethiopian zebu cattle (Taylor and Galal, 1980). Initial, final and 10 days interval heart girth measurement was undertaken and body weight of the animals was estimated accordingly. Average daily body weight gain was determined as a difference between the final and initial body weight divided by the total number of actual feeding days. Body condition score of fattening animals was determined following the procedures of Nicholson and Butterworth (1989) in 1-9 scale where 1 is emaciated and 9 extremely obese. Body condition score was taken at the beginning, end and every 10 days consistent with heart girth measurements.

3.2.2.6.3. Feed samples and chemical analysis

Feed samples were collected from the supplement and the basal diet. A handful concentrate supplement was sampled from the offer every week and pooled over the feeding period. Samples of Maize stover were also taken from the basal feed commonly fed to the animals. The

individual feed ingredients used during the experiment were taken to Hawassa University College of Agriculture Nutrition Laboratory for Chemical analysis. The samples were dried in forced dry oven at 65^0C to constant weight. The dried samples were milled to pass through a 1 mm Wiley sieve size. Dry matter (DM) and ash were determined using the procedure of AOAC (1990). Nitrogen content of the feed was determined using kjeldhal procedure. The crude protein (CP) was computed as N × 6.25. The Acid detergent fiber (ADF) and Nutrient detergent fiber (NDF) content were determined according to Van Soest *et al* ., (1991) using ANKOM ®200 Fiver Analyzer (ANKOM Technology corp., Fairport, NY, USA).

3.2.2.7. Partial budget analysis

Partial budget analysis was employed to determine the profitability of fattening of indigenous animal with concentrate supplementation. The economic analysis includes calculation of variable cost and benefits. Purchase price of each animal, feeds (basal diet and concentrate mix), labour and medication costs are recorded. The selling prices of each experimental animal were determined by inviting well – experienced cattle dealers & traders who know the prevailing market price of different size of animal. The variable costs included cost of the various feed staffs employed. The difference between sale and purchase prices was taken as total return (TR) in this profitability analysis. Net income (NI) are calculated as the amount of money left when total variable costs (TVC) subtracted from the total returns (TR)

$$NI = TR – TVC$$

The changes in net income (△NI) are calculated as the difference between changes in total return (△TR) and the change in total variable costs (△TVC)

$$\triangle NI = \triangle TR - \triangle TVC$$

The marginal rate of return (MRR) that measures the increase in net income (△NI) associated with each additional unit of expenditure (△TVC) was calculated as MRR = (△NI/△TVC) × 100

3.3. Statistical Analysis

Data collected from the survey were entered and managed using MS Excel computer program. Descriptive statistics, chi-square test were employed to describe and compare the various variables of cattle fattening practices and marketing systems. Data on feed intake, body weight gain and body condition score were analysed using the General Linear Model Procedure of statistical package for Social Science (SPSS 16). Initial body weight was included in the model as covariate. The treatment means were separated by using Tukey Test. The model used for the experiment was:

$Y_{ijk} = \mu + t_i + c_j + (tc)_{ij} + b(Fwt- Iwt)+e_{ijk}$ Where:

Y_{ijk} = individual variable; μ = the overall mean; t_i = the i^{th} effect of treatment (i = 3) and c_j = the j^{th} effect of cattle type (castrate and non - castrate) (j = 2); tc_{ij} = interaction effect of the i^{th} effect of treatment and the j^{th} effect of cattle type; b = linear regression of initial body wt (Iwt) on subsequent body weight gains; Fwt = final body weight; e_{ijk} = the random error associated with y_{ijk}.

4. RESULTS

4.1. Assessment of Cattle Fattening Practice and Marketing System

4.1.1. Socio-economic characteristics of Households

The average age of the interviewed HH heads was 36.33 ± 1.23 years, and it ranged from 22 to 72 (Table 1). There was no significant difference ($p>0.05$) in average age and family size of the HHs among the different agro ecology. On the other hand, the average number of family members with <5 years old was higher ($p<0.05$) for mid-altitude and low land agro-ecology compared to those in highlands.

Table 1 Scio – economic characteristics of households

Parameters		Agro ecology (mean ± SE)			Overall mean (n = 120)
		Highland (n = 40)	Mid – altitude (n = 40)	Lowland (n = 40)	
Sex of HHs (%)	M	50	50	50	50
	F	50	50	50	50
Age of HHs (year)	Range	22 – 50	22 – 58	22 – 72	22 – 72
	Average	39.25±10	36.18±1.16	33.58±1.49	36.33±0.74
Family size	Range	2 – 15	4 – 14	3 – 12	2 – 15
	Average	7.58 ± 0.37	7.55 ± 0.37	7.55 ± 0.39	7.56 ± 0.21
Average number of family in age/year	< 5	0.88±0.16 [b]	1.38 ±0.17 [a]	1.65 ±0.18[a]	1.30 ±0.1
	5 – 15	3.25 ±0.26	2.75 ±0.29	2.60 ±0.24	2.87 ±0.16
	16 – 45	3.08 ±0.22	3.08 ±0.26	3.03 ±0.2	3.06 ±0.13
	>45	0.35 ±0.08	0.38 ±0.12	0.33 ±0.1	0.35 ±0.06

Among interviewed household heads, 81.67 % were literate while 18.33 % were illiterate (Table 2). The number of illiterate was higher in highland compared to those in mid-altitude

and lowland agro-ecologies. From the interviewed respondents, around 35 % attended junior secondary school while 29.17 % had attended elementary school.

Table 2 The educational level of interviewed households

Level of education (%)	Agro ecology			Overall mean (n = 120)
	Highland (n = 40)	Mid – altitude (n = 40)	Lowland (n = 40)	
Illiterate	27.5	17.5	10.0	18.3
Basic education	5.0	15.0	5.0	8.3
Elementary	27.5	15.0	45.0	29.2
Junior secondary	32.5	40.0	32.5	35
High school	5.0	12.5	7.5	8.3
Higher education	2.5	-	-	0.9

4.1.2. Major occupation and source of income of the Household

This study indicated that the major occupation (95%) and source of income (100%) of interviewed households was crop production and livestock rearing.

4.1.3. Land holding and use pattern

The survey result indicated that the average land holding per household in the study area was 1.65 ± 0.11 ha, and it was significantly higher ($p<0.05$) in lowland and mid-altitude than highland agro-ecology (Table 3). There was no significant ($p>0.05$) difference in land allocation for improved forage production and forest cover among the agro-ecologies.

The average private grazing land was 0.21 ± 0.04 ha per household, and this accounted for only 12.73% of the average total land holding. The average private grazing/pasture land holding was significantly ($p< 0.05$) higher in mid-altitude compared to highland agro-ecology.

Table 3 Average (± SE) land holding and use patterns of the households in the study area

Land allocation (ha)	Highland	Mid-altitude	Lowland	Overall
Total land	1.17 ± 0.09^{b}	1.83 ± 0.17^{a}	1.96 ± 0.26^{a}	1.65 ± 0.11
Homestead/backyard	0.25 ± 0.02^{b}	0.35 ± 0.03^{a}	0.39 ± 0.04^{a}	0.33 ± 0.02
Crop production	0.63 ± 0.07^{b}	1.04 ± 0.10^{a}	1.06 ± 0.15^{a}	0.91 ± 0.07
Forage production	0.06 ± 0.01	0.05 ± 0.02	0.03 ± 0.01	0.04 ± 0.01
Private grazing land	0.15 ± 0.02^{b}	0.29 ± 0.04^{a}	0.20 ± 0.04^{ab}	0.21 ± 0.02
Forest cover	0.09 ± 0.02	0.11 ± 0.02	0.08 ± 0.02	0.09 ± 0.01
Vegetable production	$16x10^{-4} \pm 15x10^{-4b}$	$2x10^{-3} \pm 2x10^{-3b}$	0.11 ± 0.06^{a}	0.04 ± 0.02

[a - b] means with different superscript within a row are significantly different (P< 0.05); ha - hectare, SE - standard error

The study also showed that, although there was difference in terms of management and use, there was a communal grazing land across the 3-agro-ecological zones. In highlands, the communal grazing land (also known as *Halila)* was used by a group of farming community. According to focus group discussion with this group, *Halila* is reserved for wet season (June-September) to let their animal graze during Meskel (*Masqala*) holiday festivity. Since the society has bylaws on the use of grazing land, nobody send his/her cattle to the area from June to half of September.

The dominant crops grown in the study area showed slightly variation among the different agro-ecologies (Table 4). Thus, farmers in lowland area allocate more land ($p<0.05$) for cultivation of teff and maize compared to those in mid-altitude agro-ecology. The dominant crops in highland area included barley, wheat, vegetables and fruits (apple). Whereas sorghum production was higher in mid-altitude (0.09 ha) compared to lowland. Average land area allocated for barley (0.19 ha) and wheat (0.3 ha) were significantly ($p<0.05$) larger in highland than two agro-ecologies. The average size of land allocated for faba beans (0.06 ha), field peas

(0.04 ha) and Irish potato (0.15 ha) productions were significantly ($p < 0.05$) larger for highland than mid-land agro-ecologies.

Table 4 Major food crops grown and average area (mean ± SE) coverage (ha) per crop

Parameters (ha)	Highland	Mid-altitude	Lowland	Overall
Teff	-----	0.4 ± 0.05^{b}	0.59 ± 0.07^{a}	0.45 ± 0.06
Maize	-----	0.25 ± 0.04^{b}	0.9 ± 0.12^{a}	0.58 ± 0.08
Sorghum	-----	0.09 ± 0.02^{a}	0.002 ± 0.007^{b}	0.03 ± 0.01
Haricot bean	-----	0.02 ± 0.01^{b}	0.09 ± 0.02^{a}	0.06 ± 0.15
Barley	0.19 ± 0.03^{a}	0.09 ± 0.02^{b}	0.07 ± 0.02^{b}	0.12 ± 0.01
Wheat	0.30 ± 0.03^{a}	0.18 ± 0.05^{b}	-----	0.24 ± 0.04
Faba bean	0.06 ± 0.01^{a}	0.03 ± 0.01^{b}	-----	0.03 ± 0.05
Field Pea	0.04 ± 0.01^{a}	0.01 ± 0.005^{b}	-----	0.02 ± 0.03
Irish potato	0.15 ± 0.02^{a}	0.001 ± 0.006^{b}	-----	0.05 ± 0.01

$^{a-b}$ means with different superscript within a row are significantly different ($P< 0.05$); ha - hectare, SE - standard error

4.1.4. Livestock holding and their economic importance

4.1.4.1. Livestock ownership of the households

The average number of local cattle and chicken per HH was higher ($p<0.05$) for lowland and mid-land agro-ecology compared to highland (Table 5). On the other hand, the average numbers of crossbred cattle and exotic chicken holding per HH was higher ($p<0.05$) for highland compared to mid-altitude and lowland agro-ecologies. The average number of sheep per HH was higher ($p<0.05$) in highland and mid-altitude than in lowland agro-ecology. On the other hand, the average number of goat holding per HH was higher ($p<0.05$) for low land compared with highland and mid-attitude. The average equine holding per HHs was not significantly

(p>0.05) differing among the altitude zones. Farmers in the lowland own more (p<0.05) traditional beehives compared with highland areas.

Table 5 Livestock species and ownership (mean ± SE) of the households

Livestock species	Livestock structure in altitude (TLU)			
	Highland	Mid-altitude	Lowland	Over all
Local cattle	1.21 ± 0.23^{b}	6.15 ± 0.55^{a}	6.2 ± 0.56^{a}	4.52 ± 0.34
Cross bred cattle	3.8 ± 0.71^{a}	0.08 ± 0.05^{b}	0.0 ± 0.0^{b}	1.29 ± 0.28
Total cattle	5 ± 0.74	6.23 ± 0.58	6.2 ± 0.56	5.81 ± 0.36
Sheep	0.41 ± 0.07^{a}	0.33 ± 0.08^{a}	0.05 ± 0.02^{b}	0.26 ± 0.04
Goat	0.003 ± 0.003^{b}	0.03 ± 0.01^{b}	0.11 ± 0.03^{a}	0.05 ± 0.01
Local Chicken	0.01 ± 0.003^{b}	0.04 ± 0.004^{a}	0.05 ± 0.01^{a}	0.03 ± 0.003
Exotic Chicken	0.02 ± 0.07^{a}	$1x10^{-3} \pm 9x10^{-4b}$	$1x10^{-4} \pm 9x10^{-5b}$	$1x10^{-3} \pm 2x10^{-3}$
Equine*	0.35 ± 0.09	0.23 ± 0.07	0.39 ± 0.11	0.32 ± 0.05
Traditional hive (No)	0.2 ± 0.1^{b}	1.43 ± 0.32^{ab}	1.23 ± 0.48^{a}	0.95 ± 0.2
Modern hive (No)	0.2 ± 0.14	0.05 ± 0.03	0.05 ± 0.03	1 ± 0.05
Mean total	5.73 ± 0.84	6.86 ± 0.66	6.79 ± 0.63	6.46 ± 0.41

n = number of respondents; TLU – tropical livestock unit; SE = standard error; $^{a-b}$ means with different superscript within a row are significantly different (P< 0.05); *equine included horse, mule and donkey

4.1.4.2. Purposes of keeping livestock

The purpose of keeping livestock as ranked by the respondents in the study area is presented in Table 6. Livestock producers ranked milk and milk products followed by income and draught power as a major driving force for keeping livestock in the area. The purpose of keeping livestock as a source of meat is low compared to other traits described above. Farmers sold their animals whenever they need cash for food, seed and other family requirements.

Table 6 The importance of livestock rearing

Parameters	Respondents' rank (%)						Index
	1st	2nd	3rd	4th	5th	6th	
Milk and milk product	49.17	12.50	23.33	15.00	-	-	0.24
Income source	35.83	22.50	35.0	6.67	-	-	0.23
Draught	14.17	35.83	30.83	18.33	0.83	-	0.21
School fee	0.83	28.33	10.83	60.0	-	-	0.18
Meat	-	0.83	-	-	99.17	-	0.10
Skin and hide	-	-	-	-	-	100.0	0.05

Index=sum of all single purpose rank [(6 for 1) + (5 for 2) + (4 for 3) + (3 for 4) + (2 for5) + (1 for 6)] divided by sum of all weighed purposes of livestock rearing mentioned by respondent

4.1.5. Small holder cattle fattening practices

This study showed that about 86.6% of cattle fatteners did not participate in any kind of training with respect to improved cattle fattening and husbandry. Among these fatteners, about 95% were from highland, 87.5% from mid-altitude and 77.5% from lowland agro-ecologies.

4.1.5.1. Source and type of fattening cattle

According to focus group discussion, the dominant cattle breed used for fattening in the study area is indigenous. Although there are few numbers of crossbreds, they are used for breeding and milk production. The major source of fattening cattle in the study area was through purchasing from market (69.1%) followed by raising at home (24.2%; Table 7). Although this was consistent across the three agro-ecologies, the proportion of fatteners who raise cattle for fattening at home was higher for mid-altitude compared to highland and lowland agro-ecological set up. This study also showed that majority of the smallholder producers (56.7%) use purchased animals for cultivation of cropping land before commencement of the fattening in the study area. However, majority of the producers (42.5%) in highland fatten cattle immediate after the purchase.

Most of the cattle fatteners (86.7%) in the study area use castrate for fattening compared to non-castrates. Accordingly, almost all fatteners in highland (95%) and mid-altitude (100%) were engaged in fattening castrate. However, fatteners in lowland agro-ecology combine fattening castrate (65%) with non-castrate (35%). Concerning physiological stage of the fattening animals, most of the producers (83%) in the study area use matured & old oxen while the use of younger animal is less common. This study also revealed that cattle fattening in the highland agro-ecology partly depends on culled cows (32.5%).

Table 7 Source and type of cattle used for fattening in the study area

Variable (%)	Agro ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Source of fattening cattle				
▪ Raised at the farm	20.0	42.5	10.0	24.2
▪ Purchased from market	70.0	47.5	90.0	69.1
▪ Culled cattle at the farm	10.0	10.0	-	6.7
Use of purchased cattle before fattening				
▪ Let them plough cropping land	32.5	77.5	60.0	56.7
▪ Fatten immediately	42.5	12.5	37.5	30.8
▪ Keep them for some months	25.0	10.0	2.5	12.5
Type of fattening cattle				
▪ Castrated	95.0	100.0	65.0	86.7
▪ Non castrated	5.0	-	35.0	13.3
Physiological stage of preferred cattle				
▪ Old oxen	30.0	15.0	10.0	18.4
▪ Matured oxen	27.5	85.0	82.5	65.0
▪ Young bull	10.0	-	7.5	5.8
▪ culled cow	32.5	-	-	10.8

4.1.5.2. Frequency of fattening and number of cattle per fattening cycle

The chi-square ($\chi 2$) test shows that the frequency of fattening per year was significantly different ($p<0.05$) among the agro ecology (Table 8). In highland, majority of the farmers fatten cattle once within a year (60%), while it was three times per year for mid-altitude (42.5%) and two times per year for lowland (70%) agro-ecologies. Moreover, majority of the smallholder cattle fatteners (61.7%) fatten only one cattle per fattening cycle while the proportion of fatteners who fatten two animals per cycle was 32.5% in the study area. Smallholder cattle fatteners in highland entirely depend on fattening one animal per cycle while those in mid-altitude and lowland combine fattening one to three animals per cycle.

Table 8 Frequency of fattening and number of cattle per fattening cycle per annum

Variables (%)	Agro ecology			Overall (n=120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Frequency of fattening per year				
⁾ Once per year	60.0	30.0	5.0	30.7
⁾ Two times per year	25.0	27.5	70.0	40.8
⁾ Three times per year	15.0	42.5	25.0	27.5
Number of cattle fattened per fattening cycle				
⁾ 1	100	55.0	30	61.7
⁾ 2	-	40	57.5	32.5
⁾ 3	-	5.0	12.5	5.8

4.1.5.3. Criteria for terminating and duration of fattening

The criteria for terminating fattening cattle was significantly ($p<0.05$) different among agro-ecological zones. Thus, majority (90%) of the respondents indicated that the most common

criteria used to decide fattening period was body condition of the animals. According to this study, smallholder producers fatten cattle especially during the months of May to September targeting Meskel holiday in September. However, there is variation in the duration of fattening among the agro-ecologies. Consequently, majority of the respondents in the highland, mid altitude and lowland fatten cattle for six months, three months and five months, respectively.

Table 9 Criteria for terminating and duration of fattening period in the study area

Variables (%)	Agro ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Criteria for terminating finishing period				
⁾ Feeding length	10.0	10.0	-	6.7
⁾ Body condition	80.0	90.0	100.0	90
⁾ Anticipated price	10.0	-	-	3.3
Duration of fattening				
⁾ Three month	5.0	40.0	25.0	23.3
⁾ Four month	7.5	25.0	15.0	15.8
⁾ Five month	17.5	10.0	52.5	26.7
⁾ Six month	50.0	20.0	7.5	25.9
⁾ > Six month	20.0	5.0	-	8.3

4.1.5.4. Feed resources and feeding practice of fattening cattle

The major type of feed resources for the fattening animal in the study area were natural pasture, crop residues, stubble grazing, grass hay and feed supplements. The availability of feed resources varied depending on the seasons with respect to quality, quantity and type of feed (Table 10). The dominant dry season feed resource are crop residues (maize and sorghum stovers, straws from barley and teff, and halums of haricot bean, faba bean and peas), stubble

grazing and feed supplements (parts of root and tuber crops i.e sweet potato, banana and enset; atella (local beverage by-product), boiled maize grain and bole (salty soil lick). While, important feed resources during the wet season are grazing natural pasture (private and communal land), weeds and tillers from field crops. Besides, cattle fatteners also provide Amole chewu (salt lick) as mineral supplements.

Table 10 Major feed resources used by cattle fatteners in the area.

Variables (%)	Major feed resources	
	Dry season (n = 120)	Wet season (n = 120)
Natural pasture	12.3	69.8
Crop residues	55.7	15
Stubble grazing	13.3	7.7
Hay	5.2	-
Feed supplements	10.8	7.5
Browse trees	2.7	-

There was significant ($p<0.05$) difference in cattle feeding practices among the agro-ecological zones (Table 11). Thus, in highland agro-ecology, around 67.5% of the households' use combination of tether grazing and stall feeding during the fattening period. However, majority of the households in lowland (82.5%) and mid-altitude (72.5%) agro-ecology use stall feeding for cattle fattening. This study also revealed that free grazing was less common (2.5%) while tether feeding (19.2%) was the second common form of feeding system of fattening cattle in the study area.

Table 11 Feeding system and mineral supplementation for fattening

Variable (%)	Agro ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Feeding system				
▪ Free grazing	7.5	-	-	2.5
▪ Tether grazing	20	22.5	15	19.2
▪ Stall feeding	5	72.5	82.5	53.3
▪ Tether grazing and stall feeding	67.5	5	2.5	25.0
Mineral supplementation				
▪ Yes	65	100	47.5	70.8
▪ No	35	-	52.5	29.2

4.1.5.5. Feed shortage and coping strategies

The majority of respondents (73.3%) in the study area revealed that they face feed shortage where the problem was higher in mid-altitude (90%) and lowland (85%) compared to highland (45%; Table 12). Accordingly, majority of the households in the highland (62.5%) use farm residues, while majority of those in lowland (70%) rely on stored feed and about 37.5% of producers in mid-altitude rely on purchased feed.

Table 12 Feed shortage and coping strategies in the study area

Variable (%)	Agro ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Do you face shortage of feed				
▪ Yes	45.0	90.0	85.0	73.3
▪ No	55.0	10.0	15.0	26.7
If yes, coping mechanisms				
⁾ Rely on stored feed*	12.5	15.0	70.0	32.5
⁾ Rely on farm residues[#]	62.5	30.0	30.0	40.8
⁾ Rely on the natural pasture[@]	25.0	17.5	-	14.2
⁾ Purchase from the markets	-	37.5	-	12.5

*Stored feed = hay, maize grain by boiling; [#]farm residue= cereal straw, maize stover, sorghum stover and banana and enset leaf; [@]natural pasture = by cut and carry system from the enclosure area

4.1.5.6. Feeding calendar and feed utilization improvement practice

Feed types commonly employed and feeding calendar of the area is presented in Table 13. Feed supply is generally good from June to December while it is poor from January to May. Although different in abundance, natural grazing land and enset leaf are commonly utilized by livestock throughout the year. The Natural grazing land and stubble grazing are dominant feed resources during June to August, while maize stover is dominant during September to November. *Tef* straw and sweet potato are important feed resources used to bridge the gap during the dry season.

Table 13 Feed resources and Feeding calendar in the study area

Feed type	Months of the year											
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
Pasture	**	**	**	**	*	*	*	*	**	***	***	***
Stable grazing	-	-	-	**	**	-	-	-	-	**	***	**
Maize stover	***	***	***	**	*	-	-	-	-	-	-	*
Sorghum stover	*	*	*	*	*	-	-	-	-	-	-	-
Teff straw	-	-	-	*	*	*	*	*	-	-	-	-
Barley straw	*	*	*	*	-	-	-	-	-	-	-	-
Enset leaf	*	*	*	*	*	*	*	*	*	*	*	*
Sweet potato	-	-	-	*	*	*	*	-	-	-	-	-
Bole	-	-	*	-	-	*	-	-	-	-	-	-

***months with high feed availability; ** months with good feed availability; *months with low feed availability; - months with poor feed availability

According to focus group discussants, silage making and treatment of crop residues are not practiced in the study area (Table 14). This was mainly due to lack of awareness and skill (91.7%) by the respondents. In highland agro-ecology, the utilization of wheat straws for animal feed was very minimal and farmers stated that they use wheat straw as a covering material for the house constructed from locally available materials. The focus group discussants informed that wheat straw is hard and can't be digested, and the leaf of the same crop residue could damage the mouth of the livestock's when fed during the rainy season. Although the use of maize stover as animal feed is common in the lowlands, it is poorly utilized since producers collect it late, stack it outside in an open area and feed to livestock as it is without chopping and/or treatment.

The majority of the households in the study area reported that they do not use improved forage, mainly due to the fact that they have limited access for it. Moreover, insufficient land size, lack of awareness and poor knowledge, poor access for information and lack of inputs such as forage seeds are the major determinants.

Table 14 Crop residue improvement mechanisms and forage development

Variable (%)		Agro ecology			
		Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	Overall (n = 120)
Experience in silage making	▪ Yes	-	-	-	-
	▪ No	100.0	100.0	100.0	100.0
Experience in crop residue treatment	▪ Yes	-	-	-	-
	▪ No	100.0	100.0	100.0	100.0
Reasons for not making silage and urea treatment					
▪ Shortage of money		15.0	5.0	-	6.7
▪ Lack of proper tools		2.5	2.5	-	1.6
▪ Lack of knowledge		82.5	92.5	100.0	91.7
Do you produce improved forage					
▪ Yes		50.0	40.0	17.5	35.8
▪ No		50.0	60.0	82.5	64.2

4.1.5.7. Housing of fattening cattle

Smallholder cattle fatteners use 3 types of houses/enclosures for the cattle in the study area (Table 15). The dominant housing types commonly employed in the area was that they keep their animals in the living room (Table 15). According to the focus group discussion and field observation cattle houses were constructed by using locally available materials such as grasses, wheat straw, bamboo tree and woods.

Table 15 Type and importance of housing for cattle in the study area

Variable (%)		Agro-ecology			Overall (n = 120)
		Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Do you provide Housing for cattle	▪ Yes	100.0	100.0	87.5	95.8
	▪ No	-	-	12.5	4.2
Type of house					
▪ Corrals		22.5	10	65	32.5
▪ In living rooms		65	90	25	60.0
▪ Barn		12.5	-	10	7.5

4.1.5.8. Water resources for fattening Cattle

Except few households water shortage is not a common problem in the area (Table 16). The majority of the households in all agro ecology travel < 1 km to provide water for their animals. Large proportions (55%) of the households in the mid-altitude provide water at home.

Table 16 Water source and watering frequency of fattening cattle

Variable (%)	Agro ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Do you face shortage of water				
▪ Yes	-	15	22.5	12.5
▪ No	100.0	85	77.5	87.5
Distance travelled for watering				
▪ Watered at home	30.0	55.0	7.5	30.8
▪ < 1 km	70.0	40.0	87.5	65.8
▪ 1 - 5 km	-	5.0	5.0	3.4
Watering frequency				
▪ Once in a day	17.5	30.0	47.5	31.7
▪ Twice in a day	82.5	70.0	52.5	68.3

4.1.5.9. Major diseases and veterinary services

According to focus group discussion, prevalence of disease & parasite was one of the major problems hindering cattle production in general and cattle fattening in particular in the study area. Majority of respondents (62.5%) reported that they face health problem in their fattening activity was higher in lowland (67.5%) and mid-land (65%) compared to highland (55%; Table 17). The major diseases of cattle included trypanosomosis (local name: wotsale), anthrax (local name: Aba senga), blackleg (local name: Aba gorba), pasteurollosis and Foot & Mouth Disease (Didme) are major diseases of cattle. Besides, ticks, mites and flies are reported to be the major external parasites while gastro-intestinal nematodes and liver fluke are the major internal parasites causing considerable loss of animals in the area.

Bonke woreda has 5 veterinary clinics' located in 5 different PAs (Peasant Administrations). These PAs are Chosha, Denible Ossa, Dhimale Fusse, Garbansa Soroge and Geresssie O1. Majority of respondents (89.17%) replied that they have access of health assistance through government veterinary clinics, while 10.83% were assisted through community health workers established by south west Kallehiwot church (Table 17). However, it was reported that the assistances was not sufficient and veterinary supplies are inadequate. According to key informants' interview, the animal health assistances (experts) are expected to provide the service for 2-3 villages within the district.

Table 17 Major diseases of cattle and veterinary service in the study area

Variable (%)	Agro ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Do you face any health problem?				
▪ Yes	55.0	65.0	67.5	62.5
▪ No	45.0	35.0	32.5	37.5
Type of Veterinary health center				
▪ Government veterinary clinic	87.5	80.0	100.0	89.17
▪ Community health workers	12.5	20.0	-	10.83

4.1.5.10. Availability of credit service for fattening package

In this study, most of the respondents reported that they do not have access to any sort of credit service for cattle fattening in the Woreda (Table 18). Although there are micro-finance institutions established at woreda level, they do not have a program to support cattle fattening.

Table 18 Availability and access of credit service for beef fattening activity

Variable (%)		Agro ecology			Overall (n = 120)
		Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Availability of Credit for fattening	▪ Yes	2.5	2.5	-	1.7
	▪ No	97.5	97.5	100.0	98.3
Getting chance of credit access	▪ Yes	2.5	2.5	-	1.7
	▪ No	97.5	97.5	100.0	98.3

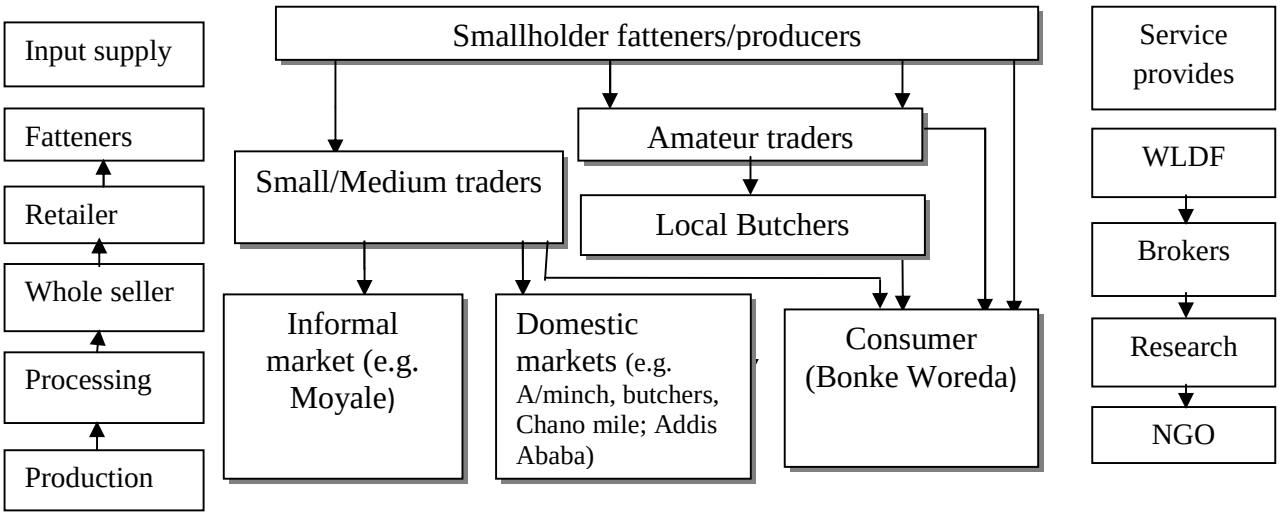
4.1.6. Cattle marketing places and market channel

Livestock markets are categorized into primary, secondary, and terminal markets based on types of major market participants, volume of supply per unit of time and the purpose of buying

(Ayele *et al.*, 2003; Abbey, 2004; ACDI/VOCA, 2006b). In Bonke district there are about 6 cattle marketing places. These are Geressie (woreda town), Danible Ottora, Dhimale Fusse, Chosha, Beza and Tsadho markets. However, these markets are undeveloped and characterized by poor market infrastructures. With the exception of woreda town market at Geressie, cattle marketing places are open and not fenced. In addition all markets are set once in a week except the woreda town market which is held twice in a week. There are different types of market participants involved in cattle marketing in each of the markets listed above. These include producers, amateur traders, small/medium traders, brokers/commission agents, local butchers, and consumers (Figure 1). The major channels identified were:

1. Producer --→Consumer
2. Producer --→Amateur Trader --→Consumer
3. Producer -→Amateur Trader --→Local Butcher --→Consumer
4. Producer-→Amateur Trader--→Local Butcher---→small/medium traders-→Consumer

As illustrated in the figure 1 the beef cattle marketing of the area have two pathways. The first was to the domestic market (Arba minch, Chano mile; Addis Ababa) of the country through formal market, while the second pathway was to the Moyale through informal (illegal) market.



WLDF – Woreda Livestock Development and Fisher, NGO – Non – governmental organization

Figure 1 The beef cattle marketing channel of the Bonke woreda

The majority (78.3%) of the households purchase fattening animals from local market (Table 19). In the highland and lowlands, the selling place for fattened cattle was within the village. Regarding transportation, fattening cattle were trekked on foot while purchasing and selling.

Table 19 Purchasing and selling market of fattening cattle

Variable (%)	Agro-ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Market place of purchasing animal				
▪ Village	17.50	22.50	20	20
▪ Local market within the district	82.50	77.50	75	78.3
▪ Market located out of the district	-	-	5.00	1.7
Market place of selling fattened animals				
▪ Village	95.0	2.5	95.0	64.2
▪ Local market within the district	5.0	87.5	5.0	32.5
▪ Market located out of the district	-	10.0	-	3.3
Transportation of fatten animal ▪ Trekking	100	100	100	100

4.1.6.1. Selection criteria of purchasing fattening cattle

Different criteria have been used for purchasing of cattle to be fattened (Table 20). Accordingly the selection criteria of fattening cattle in the study area were frame size of animals ranked 1st with an index value 0.165 followed by heath, body condition, coat color, price were 2nd, 3rd, 4th and 5th with an index value 0.148, 0.138, 0.116 and 0.107, respectively. Besides, age, adaptation, horn size/type and breed of animals were among identified criteria to choose the fattening cattle by smallholder producers.

Table 20 Ranking criteria of selection of the fattening cattle with their index value

Criteria of selection	Respondents' rank (%)									Index
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	
Frame size	30.83	22.5	28.33	8.33	0.83	8.33	-	0.83	-	0.165
Health	27.50	15.0	24.17	10.83	3.33	5.83	4.17	8.33	0.83	0.148
Body condition	10.0	25.0	11.67	23.33	10.83	6.67	9.17	0.83	2.5	0.138
Color	15.0	8.33	8.33	7.5	15.83	18.33	15.0	10.83	0.83	0.116
Price	1.67	5.83	10.0	20.0	24.17	15.83	6.67	12.5	3.33	0.107
Age	2.5	18.33	14.17	14.17	6.67	4.17	5.0	4.17	30.83	0.101
Adaptation	0.83	2.5	0.83	7.5	21.67	20.83	25.0	20.0	0.83	0.085
Horn size/type	9.17	2.5	0.83	5.0	7.5	8.33	17.5	15.0	34.17	0.072
Breed	2.5	-	1.67	3.33	9.17	11.67	17.5	2.5	26.67	0.068

Index=sum of all single selection criteria rank [(9 for 1) + (8 for 2) + (7 for 3) + (6 for 4) + (5 for5) + (4 for 6) + (3 for 7) + (2 for 8) + (1 for 9)] divided by sum of all weighed selection criteria

4.1.6.2. Access to market information

This study showed that about 85.8% of respondents had no access to market information before the purchase and sale (Table 21). However, about 56.7% of the producers received assistance on cattle marketing from development agents. The selling and buying price of the cattle in the market is determined through negotiations between producers and traders (63.3%), through brokers (24.2%), sellers (11.7%) and least by buyers (0.8%). It was noted that negotiations between producers and buyers were always based on visual estimations of animal weights by traders.

Table 21 Market information and marketing system of fattening cattle

Variable (%)	Agro ecology			Overall (n = 120)
	Highland (n = 40)	Mid-altitude (n = 40)	Lowland (n = 40)	
Access for market information				
▪ Have access	92.5	77.5	87.5	85.8
▪ No access	7.5	22.5	12.5	14.2
Access for advise on marketing				
▪ Have access	72.5	45.0	52.5	56.7
▪ No access	27.5	55.0	47.5	43.3
Decision on selling fattened cattle				
▪ Relative advantage of price	85.0	100.0	97.5	94.2
▪ Proximity of the market	15.0	-	2.5	5.8
Price determination at the market				
▪ Seller	10.0	5.0	20.0	11.7
▪ Buyer	-	2.5	-	0.8
▪ Broker	2.5	7.5	62.5	24.2
▪ Negotiation between seller and buyer	87.5	85.0	17.5	63.3

4.1.6.3. Determinants of price

According to key informants, season, proximity to urban market and market information are the major determinants of price in the study area. During the survey period, the average price of finished cattle was 13500 ETB. Minimum and maximum selling prices for finished cattle were ETB 10000 to 19000, respectively. According to the group discussant, the trend of cattle price in the study area shows a gradual change. Thus, smallholder producers are not satisfied with the prevailing cattle price.

4.1.7. Opportunities and constraints of fattening

There are huge opportunities for cattle fattening in the study area. These included the availability of large number of cattle in the area, experience of cattle fattening, diverse and suitable agro- ecology for fattening, availability of agricultural by-products, high irrigation potential for improved forage development, initiation of the introduction of improved forage species and cheap labor force.

Even though, cattle fattening has contributions to socio-economic development of producers, the participation of smallholder farmers in the fattening activity is yet traditional and hindered by many challenges. Thus, this study indicated that cattle production and productivity were very low and producers may not get reasonable benefits from their fattening activity (Table 22). According to the interviewed producers, shortage of feed is the major constraint ranked as 1^{st} with the index value of 0.158 followed by shortage of land (2^{nd}), disease (3^{rd}), knowledge and extension gap (4^{th}), credit service (5^{th}), shortage of grazing land (6^{th}), marketing (7^{th}), road access (8^{th}), breed (9^{th} rank) and drought (10^{th} rank) with an index value of 0.133, 0.113, 0.113, 0.105, 0.098, 0.096, 0.07, 0.064 and 0.049, respectively.

Table 22 Rank of constraints of beef cattle fattening activity

Constraints	Respondents' rank (%)										Index
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Shortage of feed	37.5	35.83	7.50	10.83	2.50	3.33	0.83	-	1.67	-	0.158
Shortage of land	42.5	11.67	5.83	3.33	8.33	5.83	5.00	5.83	1.67	10.00	0.133
Disease	11.67	15.0	23.33	6.67	3.33	9.17	5.00	7.50	11.67	6.67	0.113
Credit service	3.33	15.0	13.33	18.33	15.00	6.67	17.50	5.83	0.83	4.17	0.113
Shortage of grazing land	-	4.17	15.0	16.67	19.17	21.67	12.50	7.50	2.50	0.83	0.105
Marketing	3.33	6.67	10.83	15.0	20.83	11.67	8.33	3.33	9.17	10.83	0.098
Road access	0.83	1.67	5.83	23.33	10.83	14.17	29.17	13.33	0.83	-	0.096
Drought	0.83	-	4.17	-	15.00	18.33	9.17	25.83	21.67	5.00	0.070
Knowledge and extension gap	-	3.33	8.33	1.67	5.00	5.83	10.00	27.50	25.83	12.50	0.064
Breed	-	6.17	5.83	4.17	-	3.33	2.50	3.33	24.17	50.00	0.049

Index=sum of all single constraint rank [(10 for 1) + (9 for 2) + (8 for 3) + (7 for 4) + (6 for5) + (5 for 6) + (4 for 7) + (3 for 8) + (2 for 9) + (1 for 10)] divided by sum of all weighed constraint.

4.2. On – farm Feeding Experiment

4.2.1. Chemical composition of the feeds

The CP content of the feeds was the highest for haricot bean, lowest for maize stover, and moderate for the formulated ration (Table 23). On the other hand, maize stover contained the highest fiber fraction while cereal grains and formulated ration had the lowest.

Table 23 Chemical composition of experimental feed ingredients of feeding trial

Feedstuffs		DM%	Chemical composition (% in DM)				Energy* (Mcal/KG DM)
			CP	ASH	NDF	ADF	
Maize stover	▪ Offered	96.83	3.18	7.34	83.77	44.91	2.1[+]
	▪ Refusal	97.0	2.36	5.89	81.86	51.21	-
Maize grain		95.78	9.73	3.04	29.21	3.87	3.88[#]
Sorghum grain		96.50	8.46	4.17	31.11	8.79	3.54[@]
Haricot grain		94.93	19.66	3.69	51.95	11.88	3.53[#]
formulated concentrate		95.96	12.62	4.90	29.97	5.34	3.69[Ω]

DM = Dry Matter; CP = Crude Protein; OM = Organic Matter; NDF = Neutral Detergent Fiber; ADF = Acid Detergent Fiber; *energy content of the feeds was estimated from literature (Adugna, 2007[+]; Getenesh *et al*., 2014[#] and Firisa *et al*., 2013[@]) and calculated value [Ω]

4.2.2. Body weight change and body condition score

The mean initial and final body weight and body condition score, total weight gain and average daily gain of the experimental animals is presented in Table 24.

The total body weigh change and average daily gain were highest ($p<0.05$) for animals supplemented with T3 followed by T2 and T1. However, there was no difference ($p>0.05$) in body condition score among the treatments. There was no difference observed in total weight change, average daily gain and body condition score for castrate and non - castrate.

Table 24 Effect of concentrate supplementation on heart girth, body weight and body condition score

Parameters	Treatment (mean ± SE)			Cattle type (mean ± SE)	
	T1	T2	T3	Castrate	Non – castrate
Initial body weight (Kg)	255.89 ± 14.18	255.35 ± 14. 18	282.73 ± 14.18	287.85 ± 11.58	241.46 ± 11.58
Final body weight (kg)	278.63 ± 9.05[c]	313.39 ± 7.62[b]	345 ± 12.08[a]	312.37 ± 8.79	312.31 ± 7.05
Total body weight gain (kg)	13.97 ± 9.05[c]	48.73 ± 7.62[b]	80.35 ± 12.08[a]	47.72 ± 8.79	47.65 ± 7.05
Average daily gain (g/day)	199.54 ± 129.20[c]	696.15 ± 108.81[b]	1147.80 ± 1.12 [a]	681.61 ± 125.60	680.71 ± 100.71
Initial BCS (no)	4.22 ± 0.12	4.23 ± 0.12	4.39 ± 0.12	4.18 ± 0.11	4.37 ± 0.11
Final BCS (no)	7.58 ± 0.24	8.59 ± 0.24	8.66 ± 0.25	8.15 ± 0.23	8.4 ± 0.23

[a, b, c] means in the same row with the same group with different letters are statistically different ($P<0.05$); T1 – control (farmers practice); T2 – farmers practice + 1% of body weight (BW) concentrate supplementation; T3 – farmers practice + 1.5% of BW concentrate supplementation; BCS – body condition score; d = day

The greater weight change was recorded for animals supplemented with 1.5% of BW concentrate (T3) followed by those supplemented with concentrate at 1% of BW (T2) (Figure 2). However, non-supplemented animals (control group under farmer's management) maintained low body weight with minimum body weigh change during the feeding period.

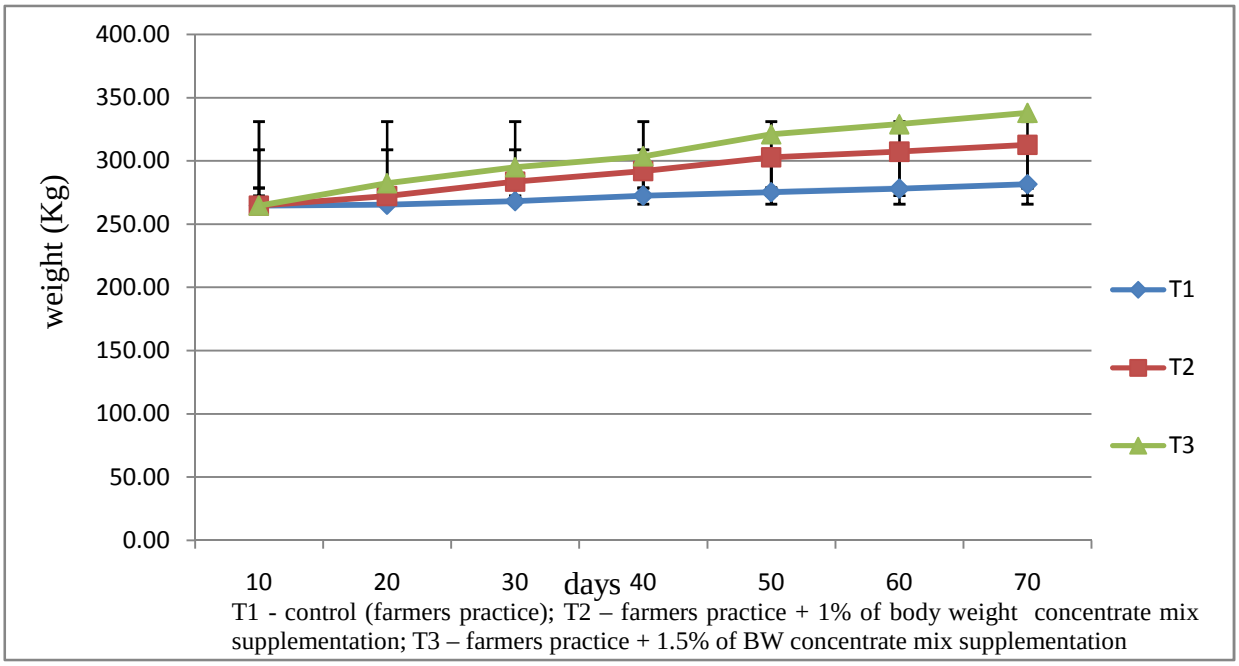


Figure 2 body weight gain of experimental animals allotted to three feeding treatments

4.2.3. The partial budget analysis

The partial budget analysis conducted to assess the economic return of the effect of supplementation of fattening cattle with concentrate formulated from locally available feed resources is presented in Table 25. The net return for the supplemented group (T2 & T3) was higher ($P<0.05$) than that of non-supplemented group kept under farmers management (T1). Among the supplemented groups, marginal rate of return was higher for animals supplemented with T2 compared to others supplemented with T3. Although the net return was higher for castrate compared to non-castrate, marginal rate return turned to be higher for non-castrate compared to castrate.

Table 25 Partial budget analysis for fattening cattle supplemented with formulated ration

Parameters (average)	Treatment (mean ± SE)			Cattle type (mean ± SE)	
	T1	T2	T3	Castrate	Non – castrate
Purchase price (ETB)	6928.33 ± 302.77	6683.33 ± 302.77	7200 ± 302.77	7800 ± 247.21^{a}	6074.44 ± 247.21^{b}
Selling price (ETB)	9600 ± 403.45^{c}	11400 ± 403.45^{b}	12600 ± 403.45^{a}	12700 ± 329.42^{a}	10222.22 ± 329.42^{b}
Total return (ETB)	2755 ± 413.29^{c}	4716.67 ± 413.29^{b}	6400 ± 413.29^{a}	5066.67 ± 337.45	4181.11 ± 337.45
Total feed cost (ETB)	700 ± 39.56^{c}	935.39 ± 39.56^{b}	1336.09 ± 39.56^{a}	1041.48 ± 32.30^{a}	939.51 ± 32.30^{b}
Concentrated feed (ETB)	-	702.06 ± 44.54^{b}	1161.09 ± 44.54^{a}	999.72 ± 44.54^{a}	863.43 ± 44.54^{b}
Maize stover (ETB)	700 ± 0.0	250 ± 0.0	175 ± 0.0	375 ± 0.0	375 ± 0.0
Medication and lobour (ETB)	230 ± 0.0	210 ± 0.0	210 ± 0.0	216.67 ± 0.0	216.67 ± 0.0
Total variable cost (ETB)	930± 36.37^{c}	1162.06 ± 36.37^{b}	1546.09 ± 36.37^{a}	1258.14 ± 29.70^{a}	1167.29 ± 29.70^{b}
Net return (ETB)	1825 ± 428.21^{b}	3571.27 ± 428.21^{a}	4853.91 ± 428.21^{a}	3808.52 ± 349.64	3024.93 ± 349.64
△NI	-	1596.27 ± 176.69^{b}	3278.91 ± 176.69^{a}	2624.45 ± 176.69	2250.73 ± 176.69
△TVC	-	232.06 ± 44.54^{b}	616.09 ± 44.54^{a}	492.22 ± 44.54	355.93 ± 44.54
Marginal rate of return (%)$^{@}$	-	687.8	532.2	533.2	632.3

△NI – change in net income; △TVC – change in total variable cost, T1 – control (farmers practice); T2 – farmers practice + supplemented with concentrate at 1% of body weight; T3 – farmers practice + supplemented with concentrate at 1.5% of body weight; $^{a-c}$ superscript means in the same with different letters are statistically different ($P<0.05$); SE – standard error of mean; Marginal rate of return (%) was computed as the additional revenue generated from change from control (farmers practice) (T1) to farmers practice + supplemented with concentrate at 1% of body weight (T2) and farmers practice + supplemented with concentrate at 1.5% of body weight (T3).

5. DISCUSSION

5.1. Assessment of Cattle Fattening Practice and Marketing System

5.1.1. Socio – economic characteristics of Household

The average family size of the households in the current study was lower than 9.65 reported for Burji woreda of southern Ethiopia (Seid and Berhan, 2014). However, it was higher than 6.22 reported for Bure Woreda (Shitahun, 2009), 6.7 reported for Chencha and 5 for Mirab Abaya woreda of southern Ethiopia (Yilkal, 2015). Pertaining to the educational status, the percentage of literacy in this study was higher than most reports: 46% in Burji woreda of segen zone (Seid and Berhan, 2014), 68.7% in Chencha and 76.7% in Mirab Abaya woreda (Yilkal, 2015), and 65% in Alaba woreda of SNNPR (Tsedeke, 2007). The higher literacy rate in the current study might be due to the fact that expansion of adult education and settlement of adults in their area after completing elementary and/or high schools.

5.1.2. Source of livelihood and land holding

Consistent with the current study, Abdi *et al.* (2013) reported that crop - livestock production is the major livelihood and source of income in west Hararghe area of Oromia regional state. The average total land holding in the current study was comparable to 1.55 ha per household reported for Bure woreda (Shitahun, 2009). However, the result of this study was higher than 0.85 ha per household reported for high lands of east and west zones of Hararge (Estefanos *et al.*, 2014) and 1.18 ha reported for Chencha (Yilkal, 2015). It was also less than 1.77 ha reported for national (CSA, 2015), 2.21 ha reported Mirab Abaya woreda (Yilkal, 2015), 3.6 ha reported for Burji woreda of Segen zone (Seid and Berhan, 2014). The lower mean land holding per household compared to those latter districts in the current study area might be due to dense population.

5.1.3. Livestock holding and their economic importance

The mean total livestock holding per HHs in the current study (6.46 ± 0.41TLU) was higher than 3.77 ± 0.12 TLU reported for Chiro District of west Hararghe zone (Bezahegn, 2014), 3.47- 4.44 TLU reported for highland and mid-altitude areas of Dale district of Sidama zone (Endeshaw, 2007), but lower than 10.82 TLU reported for lowlands of Dale district of the same zone (Endeshaw, 2007). The importance of cattle keeping in the study area was consistent with literature (Seid and Berhan, 2014).

5.1.4. Small holder farmer cattle fattening practice

Improved capacity (knowledge, skill and attitude) of the producers, access for inputs/services supply and market information are instrumental for improved cattle fattening. However, in this study, most of the respondents did not receive any kind of training on improved cattle fattening system. Consequently, traditional fattening practice is the dominant form of cattle fattening system in the area. Consistent with the current study, Ahmed *et al*. (2010) reported that most of the fatteners in rural areas of Bangladish did not take any training on improved cattle fattening system.

5.1.4.1. Source and type of fattening cattle

The current study showed that the source of fattening cattle for majority of the respondents' in the study area was through purchasing from market which is inconsistent with Tehsager (2013). However, consistent with the current findings, Takele and Habtamu (2009) and Shitahun (2009) reported that producers use purchased animals for cultivation of cropping land for a season or long before the fattening in Wolaita zone and Bure woreda, respectively. According to Shewangizaw *et al*. (2014) castration of fattening cattle was common for fattening in south region, which is in agreement with the current findings. Castration of cattle before the fattening

is believed to enable the animals put more body weight and minimizes aggressive behavior (make them docile). In line with the current study, Shewangizaw *et al*. (2014) reported that farmers in central part of southern Ethiopia commonly fatten mature and older animals. This might be attributed to the demand of the society for fat carcass and better fattening efficiency of the animal than bulls. Contrary to the current study, Fikru (2015) reported that cattle fatteners in Harshin districts of Somali region prefer to fatten steers and bulls than castrate.

5.1.4.2. Frequency of fattening and number of cattle per fattening season

Consistent with the current study, Takele and Habtamu (2009) reported that most of the producers in Wolaita area fatten cattle two times per a year. On the other hand, Teshager (2013) reported that majority of respondents in Ilu Aba Bora area fatten cattle once a year. With regard to number of animals fattened per fattening period, the same author reported that all households owning one cattle were engaged in cattle fattening implying that it is common to fatten one cattle per fattening cycle. Similarly, Takele and Habtamu (2009) reported that majority of the households fatten one cattle per fattening cycle. Contrary to the current study, Umar *et al*. (2008) and Sarma and Ahmed (2011) reported that fatteners hold five cattle on average per fattening cycle in Borno State of Nigeria and Rajbari district of Bangladsh, respectively. The difference in number of cattle fattened per fattening cycle might be due to difference in working capital, feed availability, capacity gap of fattener and market demand.

5.1.4.3. Duration of cattle fattening

The long duration of cattle fattening without or with minimum supplementary feed was consistent with several studies reported earlier (MoA, 1996; UNDP, 2003). Habtemariam (2000) also reported that producers could take more than one year for fattening cattle in western and eastern parts of the country. Discordant with the preceding report and findings of the

current study, the duration of cattle fattening in Wolaita area was 4 months (Takele and Habtamu, 2009) and 3 – 4 months in central southern region of Ethiopia (Shewangizaw *et al.*, 2014). Differences in cattle fattening length may be due to variation in type and quantity of feed ingredients used, agro ecology of the area, type of fattening animal, market demand and capacity gap of the producers. Similar to the current study Estefanos *et al*. (2014) reported that the duration of cattle fattening is determined by anticipating future market price, rate of live weight change of the animal and cost of feed.

5.1.4.4. Feed resources and feeding practice of fattening cattle

Consistent with the current study, Takele and Habtamu (2009) and Belete *et al*. (2010) reported that crop residue and natural pasture are the major feed resources used for fattening cattle in southern Ethiopia and Amhara National Regional State, respectively. Moreover, Adugna *et al*. (2012) reported that natural pasture and crop residue are the major feed resources of livestock in the highlands of Ethiopia. On the other hand, in agreement with current findings, Alemayehu (2005) indicated that the contribution of agro – industrial by – products is minimal/or in accessible for rural smallholder producers and restricted to some urban and pre – urban farms. Takele and Habitamu (2009) and Shewangizaw *et al*. (2014) also noted that supplementation of concentrate feed for fattening cattle is the growing practice in Wolaita Zone of southern region. The feeding system practiced by households in the study area agreed with Shewangizaw *et al*. (2014) who indicated that most of the producers in central southern region use stall feeding, while few households use both stall feeding and grazing. With respect to mineral supplementation, Seid and Berhan (2014) reported that smallholder producers in Burji area provide Amole chewu/salt and Bole as a mineral supplement for the cattle. In addition, Daniel

(2008) indicated that smallholder producers in Borena zone strongly believed that supplementation of salt is useful to condition fattening cattle.

5.1.4.5. Feed utilization and feed shortage coping mechanisms

Consistent with the current study, Fikru (2015) reported that due to capacity gap, smallholder farmer's was poorly store and utilize crop residues, and conservation of feed in a form of hay and silage was at its infancy. Similarly, Gezu *et al*. (2014) reported that feed improvement through urea treatment and conservation through silage making were not common in lemo and Soro woredas. Shitahun (2009) also reported that wheat straw was not wisely utilized in Bure area. The poor utilization practices of wheat straw is partly attributed to farmers perception where they believe that wheat straw can't be digested, and the leaf of the straw could snick the mouth and tongue of livestock, particularly, when fed during the rainy season, and results in poor milk yield and body weight gain. Contrary to the current findings, various scholars stated that wheat straw is widely used as animal feed (Getahun, 2006; Seid and Berhan, 2014).

The dry season of feed shortage reported by the households in the study area is in line with the finding of Seid and Berhan (2014) who reported that starting from mid - January until mid April were critical months of feed shortage. According to Gezu *et al*. (2014) shortage of livestock feed occurred in the season from March to May in Lemo and Soro districts of Hadiya zone of southern Ethiopia. In addition, Daniel (2008) reported that the critical feed scarcity occurred in from February to April in Borena zone of Oromia region. The coping strategies pursued to overcome feed shortage during the dry season in study area are consistent with Gezu *et al*. (2014) who reported feed storage during the period of surplus, use of browse trees, and purchase of supplementary feeds in Lemo and Soro woreda.

Lack of introduction and low adoption of improved forage in the study area was in line with the finding of Andualem *et al.* (2015) who reported that there was no improved forages cultivation for cattle at farmer's level in Esera district of Southern Ethiopia. This might be due to insufficient land, capacity gap, lack of access for information, poor extension service and lack of inputs such as forage seeds.

5.1.4.6. Housing of fattening cattle

The current study showed that there were three types of houses used for fattening cattle. These were housing in the living room with the family, corrals and barn. Consistent with this, Shitahun (2009) reported that the dominant housing type of fattening cattle in Bure area was housing within the living room with family. Similarly, Estefanos *et al*. (2014) reported that stall with floor, family house, veranada and kraal were the major housing types used for cattle in East and West Zones of the high lands of Hararghe. The result of current study was inconsistent with Daniel (2008) who reported that the majority of respondents house their cattle in open constructed barn at night in Borena zone. In addition Fikru (2015) reported that most of the fatteners keep their fattening cattle at home stead shed that was constructed for cattle separately. The difference in housing type of fattening cattle in different areas might be due to differences in agro-climate, attitude & capacity gap of producers and market orientation.

5.1.4.7. Water resources for fattening Cattle

In this study farmers use different water resources for their cattle, and water shortage was not a common problem in study area. Moreover, most of the fatteners water their animals within less than 1.0 km distance. In line with this, Fikru (2015) reported that most of the respondents in Harshin area water their fattening cattle within <1.5 km distance while others water at home without energy expenditure. Unlike the present findings, Shitahun (2009) reported that majority

of the cattle fatteners in Bure area water their animals within less than 2 km distance, which is a little bit far. With regard to watering frequency, consistent with the current study, fattening cattle in Harshin area offer drinking water once and twice per day (Fikru, 2015) and Shitahun (2009) reported that it was twice and three times per day in Bure area. The difference in watering distance and frequency might be attributed to differences in watering sources, agro-climate, and season of fattening, feed type and capacity of producers.

5.1.4.8. Major diseases and veterinary services

The current study indicated that prevalence of disease is one of the major hindrances for cattle production in the area. In line with this, Mekonen *et al*. (2012) reported that diseases were among the major factors that limit cattle owners' benefits as a result of mortality in western Oromia area. consistent with the current study, blackleg, anthrax, Trypanosomosis, Pasteurollosis, FMD (foot and mouth disease), LSD (Lumpy Skin Disease) and CBPP (contagious bovine pluro pneumonia) were found to be the major disease occurred in West Hararghe zone of Oromia reginal state (Abdi *et al.*, 2013). Similarly, according to the same author, Ticks, mites and flies were reported as major external parasites while gastro-intestinal nematodes and liver fluke were the major internal parasites causing considerable loss of animals in the same area. The veterinary health services provided to overcome diseases and parasites that limit the performance of cattle fattening in the area was inadequate. Currently, veterinary health assistants are providing health service to the community through mobile service bases (one health assistant assigned to 2-3 villages). Contrary to this result, Shitahun (2009) reported that due to establishment of health centers in nearby kebeles, farmers access veterinary service within 5 km distance in Bure area. It is, therefore, important to improved access for veterinary service in the study area through establishment of health centers and assignment of health

assistants taking into account livestock population and disease prevalence of the area. Equally important, encouraging & incentivizing private veterinary health service provider to operate in rural areas where there is potential for cattle fattening should be looked into.

5.1.4.9. Availability of credit service for fattening package

Access and availability of credit service have a great role in promoting market oriented fattening system. According to Feder (1985), adoption of new technologies is associated with availability of credit. However, consistent with the current study, Gurmessa and Daniel (2013) reported that majority of producers in Fentale woreda have not accessed any sort of credit service for beef cattle fattening package. The current findings was similar with the results of Abdi *et al*. (2013) who reported lack of credit service availability for cattle fattening in west Hararghe zone of Oromia region. It should be noted that, in promoting market oriented fattening package, access to credit services plays a great role to increase small holder participation in cattle fattening activity, and this need to be looked into for the study area.

5.1.5. Cattle marketing practices

According to different scholars livestock markets are categorized into primary, secondary, and terminal markets based on types of major market participants, volume of supply per unit of time and the purpose of buying (Yacob, 2002; Ayele *et al.*, 2003; Abbey, 2004; ACDI/VOCA, 2006b). Consistent with the current findings, Fikru (2015) reported that, marketing system in Harshin district was undeveloped and characterized by inadequate market infrastructures. In agreement with the same author, cattle marketing places in the study area were open place/not fenced (except in district town) for a mixture of livestock species including finished cattle. Concerning cattle marketing route, Daniel (2008) noted two main livestock marketing routes

where one goes up to Moyale border market while the other extends up to Addis Ababa terminal markets, which is consistent with the present findings.

The current study indicated that majority of the fatteners purchase fattening animals from local market and sell in the same market. Consistent with this findings, Fikru (2015) reported that majority of fatteners in Harshin area sell their fatten cattle in the local market. On the other hand, many scholars' authors (Ayele *et al.,* 2003; Elias *et al*., 2007; Teshager *et al.,* 2013 and Fikru, 2015) reported that the mode of transportation for fattened cattle was trekking on foot, which is in agreement with the current findings.

5.1.5.1. Selection criteria of purchasing fattening cattle

The selection criteria for purchasing fattening cattle in the current study were similar with the finding of Shitahun (2009) who reported that price, health, body size/frame, age and adaptability were the major selection criteria employed by cattle fatteners in descending order in Bure woreda, Ethiopia. Moreover, Mekonnen *et al*. (2012) reported that farmers give better attention for traits like body size, physical appearance, coat color and hump size in western Oromia. According to Takele and Habtamu (2009), Abdi *et al*. (2013) and Shewangizaw *et al*. (2014) cattle fatteners select fattening animals based on colour, sex, height, body condition, and hump size in Wolaita, west hararge and central southern regional area, respectively. Besides, Teshager *et al*. (2013) reported that breed type (local) was one of the preferred criteria for purchasing fattening cattle in Ilu Aba bora area. Contrary to the current study, almost all traders in Amhara region of Ethiopia do not take coat colour as criteria for selection of fattening animals (Belete *et al.,* 2010).

5.1.5.2. Access to market information

Market information is crucial to reduce information gaps. It is required by fatteners to make fair and proper decisions and strengthen their negotiating ability during transaction with buyers and consequently prevent possible exploitation by better informed traders. However, in the current study most of the smallholder producers do not get access to market information before selling their cattle. This is the reason why the fattener's sale their fatten cattle in low price and can't fetch more profit from fattening practice and not expand their farm by increasing number of animals per fattening. Contrary to this, Daniel (2008) and Teshager *et al*. (2013) reported that in Borena and Ilu Aba bora area most of the producers get market information before taking their livestock to market. Regarding types of market information sources those cattle fatteners consult, however, are limited. Most of the farmers obtained market information from their neighbors and relatives. Daniel (2008); Teshager *et al*. (2013) and Denis Mpairwe *et al*. (2015) reported cattle price are mainly determined through negotiations between producers and traders, sellers fixing prices for their animals and least by users fixing prices which is consistent with the current study.

5.1.5.3. Determinants of price

Similar to the current study, Daniel (2008) pointed out that the reason for price variation among different market were number and kind of traders, proximity of the markets to the urban centers, availability of roads, markets infrastructure, brokers, number of cattle and body condition in Borena area. The current study revealed that price seasonality, proximity to urban market and market information gaps are considered to be the source of risk for the small holder farmers that are involved in the fattening activities. In addition, consistent with the current study Ayenew (2012) reported seasonal fluctuation of price, lack of capital, lack of input cost

(shortage of feed), disease and shortage of grazing land put the producers at risk. However, the smallholder producers stated that to solve the market problems and to make the producers profitable in their fattening package broadening market access through market value chain, sharing adequate market information, and improvement in market infrastructures are necessary. According to Daniel (2008) some smallholder producers are not satisfied with the prevailing price of cattle existed and suggested solutions to improve price in the area which agrees with the current study.

5.1.6. Opportunities and constraints of cattle fattening

The huge numbers of indigenous cattle, availability of agricultural products, irrigation potential for producing improved forage and crop residues, increased demand for fattened cattle in the local market are among the opportunities for improved cattle fattening in the study area. Similarly, Abdi *et al*. (2013) reported that availability of diversified cattle breeds, good fattening weather, and better income generated, experience in cattle fattening, introduction of some im;proved forage varieties as an opportunity for cattle production in West Hararghe area. Unlike Daniel (2008) and Shitahun (2009) who reported shortage of labour and water scarcity among the limiting factors of cattle fattening in Borena and Bure areas, respectively. Cheap labour and the existence of yearlong perennial rivers are among the opportunity for multiple cattle fattening in the study area. However, shortage of feed, shortage of land, prevalence of disease, capacity gap and weak and lack of market oriented extension service provision, poor access for credit, shortage of grazing land, undeveloped marketing system and poor access for market information, poor road access and low genetic potential of local animals for functional traits are identified as a major constraints threatening cattle fattening in the study area. These constraints are consistent with the previous report (Shitahun, 2009; Gebregziabher and

Gebrehiwot, 2011; Belay *et al.,* 2012; Abdi *et al.,* 2013; Estefanos *et al.,* 2014; Shewangizaw *et al.,* 2014 and Fikru, 2015).

5.2. On – farm Feeding Experiment

5.2.1. Chemical composition feedstuff

The crude protein content of maize stover used in the current study was lower than 4.78 -7.44% reported by Tsigreda (2010) and Deribe *et al*. (2013), but higher than 2.38% reported by Zinash *et al*. (1998). The NDF constituent of maize stover used in the present experiment were higher than 72.1% reported by Deribe *et al*. (2013), but comparable to 82.25% reported by Tsigreda (2010). The ADF constituent of maize stover was comparable with 44.85% reported by Deribe *et al*. (2013), but lower than 51.7 - 53.9% reported by Andualem *et al*. (2015) and Girma *et al*. (2014). The difference might be due difference in variety, soil fertility, climate, harvest time and conditions. Furthermore, it could be due to the exposure of crop residues to the sun and rain for long as observed during the current survey. Farmers left the stover in the field for long time after harvest of the grains without provision of shed. The present CP content of maize grain was lower than 11.1% reported by Adebabay *et al*. (2013) and slightly higher than 9.2% reported by Getahun (2014). However, NDF value was higher than 20.6% reported by Amensissa (2010). The value of ADF figure in the current experiment was higher than 3.4% reported by Getahun (2014) and lower than 9.5% reported by Amensissa (2010). The CP content of sorghum grain used in the current study was lower than 10.2% reported by Adugna (2007) and 10.26% reported by Firisa *et al*. (2014). However, NDF and ADF contents were higher than 13.63% and 7.7%, respectively reported by Firisa *et al*. (2014). The present CP content of haricot bean grain was lower than 22.36% reported by Tonissi *et al*. (2013). However, the values of NDF and ADF were higher than 40.43% and 5.42% reported by the same author.

5.2.2. Body weight change and body condition score

The higher body weight gain for supplemented group (T2 and T3) compared to the control maintained under farmer's management practice indicates the better quality and higher nutrient composition of supplemental feed. The higher body weight gain for animals supplemented with T3 compared with T2 could be due to the higher level of concentrate supplementation and better intake. The average daily weight gain of experimental animals supplemented with concentrate (T3 and T2) in the current study (696.15 – 1147.8g/day) was higher than 470g/day reported for Zebu oxen grazing on natural pasture and supplemented with wheat bran (Tesfaye *et al.,* 2002); 602- 645 g/day reported for zebu cattle and Boran breed in Bure Woreda and Kuriftu feed lot, respectively (Shitahun, 2009; Aberash 2000) and 650g/day reported both for Ogaden bulls (Yoseph *et al.,* 2011) and Adet highland zebu (Adebabay *et al.,* 2013) supplemented with concentrate. On the other hand, although it was higher than T2, the average daily gain of animals supplemented with T3 was higher than 697 g/day reported for Arsi oxen fed on different forage legumes and concentrate (Nega *et al.,* 2002). Moreover, the average daily weight gain for indigenous cattle supplemented with T3 in the current study was higher than 836 g/day reported for Boran cattle fed on different forage legumes and concentrate (Nega *et al.,* 2002), and 913 g/day reported for Fogera breed fed on grass hay and concentrate (Adebabay *et al.,* 2013). The difference occurred in average daily body weight gain among the different studies might be due to difference in the quality and quantity of feed offered, physiology of the animals and breed. The average total weight gain of experimental animal under T3 in the current study (80.35 Kg) was higher than 66.2 kg and 74.5 kg reported for zebu cattle in Bure woreda and Ogaden bulls at Haramaya University beef farm, respectively (Shitahun, 2009; Yoseph *et al.,* 2011). However, average total weight gain of the current study

was lower than 91.64 Kg reported for Zebu cattle fatten in sub kola agro-ecology of Bure woreda (Shitahun, 2009). The difference could be attributed to differences in composition and quantity of the supplemental feed, breed and length of feeding period (110 days for Zebu cattle & 84 days for Ogaden bulls).

The mean body condition score of indigenous cattle supplemented with concentrate at 1% (T2) and 1.5% (T3) of body weight showed improvement compared to the control managed under the farmers practice (T1). This could be attributed to the quality and quantity of the supplement. The findings of this study was higher than the values reported for Ogaden bulls grazing native pasture and supplemented with different proportion of agro-industrial by products and grass hay (Yoseph *et al.,* 2011). The difference could be attributed to differences in breed, quality and quantity of supplement & basal diet, and body condition scoring experiences of technicians.

5.2.3. The partial budget analysis

This study demonstrated that feeding the intervention diet (homemade concentrate) to fattening animals increased net return for producers engaged in cattle fattening. The net return from the use of different diets indicates the economic efficiency (Cheeke, 1999). Accordingly, cattle fed on maize stover and stubble grazing supplemented with concentrate at 1.5% of body weight (T3) had a higher profit than those supplemented at 1% of body weight (T2) and the control (T1). Accordingly, supplementation with T2 & T3 increased the net return by 95% & 166%, respectively, compared to the control. Among the treatments, supplementing fattening cattle with T3 improved net return by 34% compared to T2. The trend in net return due to the current supplementation was consistent with average body weight gain. Similar to the current study Adebabay *et al*. (2013) reported that the provision of supplementation for fattening cattle

improved animal performance and economic return. Fattening cattle supplemented with T3 had higher body weight gain than supplemented at T2. Thus, even though cattle in T3 showed good performance in live weight gain and net return, it had the lower MRR (%), which might be due to the higher quantity of provision of supplementation. However, the marginal rate of return (MRR%), which enables one to compare extra variable cost with extra net benefit, was higher for T2 compared to T3.

6. SUMMARY AND CONCLUSION

The study was conducted in Bonke woreda of Gamo Gofa zone of southern Ethiopia to assess fattening and marketing system, and effect of concentrate feed supplementation with locally available feeds on weight gain of indigenous cattle. The results indicate that fattening activity was a gateway for the smallholder producers to get in an economy. Beef cattle fattening practice is traditional in the study area. In highland, majority of the farmers fatten cattle once within a year, while it was three times per year for mid-altitude and two times per year for lowland agro-ecologies. The most common criteria used to decide fattening period was body condition of the animals. The available feed material for beef fattening were crop residues, green grass and natural pasture without any supplementary feed resources. The majority of farmers' practices stall feeding. Keeping fattening cattle in family house was dominant housing type. The cattle marketing system was undeveloped (traditional) and characterized by inadequacy of market infrastructural facilities. The selection criteria used during purchasing fattening cattle were frame size, heath, body condition, coat color and price.

Availability of large number of indigenous cattle, agricultural by-products, diverse and suitable agro - ecology, high irrigation potential, recent introduction of some improved forage varieties, cheap labor force and experience in fattening are good opportunities that leads farmers to practice fattening in order to boost their income. However, the fattening practice in the area was hindered by many factors such as shortage of feed and grazing land, disease and parasites, knowledge and extension gap and lack of credit service.

The current study demonstrated that supplementation of indigenous fattening cattle with homemade concentrate mix from local available feed resource had an effect on fattening performance of indigenous cattle and economic advantage. The effects in biological performance were higher for cattle supplemented at 1.5% of body weight concentrate supplemented than at 1% body weight. The results of partial budget analysis also indicated that supplementation at 1% of body weight returned a higher profit margin than supplementation at 1.5% of body weight. Thus, supplementation at 1% of body weight concentrate mix was recommended from economic point of view.

In conclusion, the study revealed that smallholder producers were engaged in traditional cattle fattening practices. Hence, in future to improved fattening practice, animal husbandry managements such as proper utilization of available feed resources and improved forage development, prevention of animal diseases and timely beef market information need attention to transform cattle fattening from traditional to market oriented business operation.

As a scope for future research work in the study area, the follow point can be considered:

- Assessment of availability, nutrient composition and digestibility of the major feed resource.

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8. APPENDICES

Table 1 Conversion of livestock to tropical livestock unit (TLU)

Livestock species	Tropical livestock unit (TLU)	
	Local breed	Cross-breed
Oxen	1.1	1.9
Cows;	0.8	1.8
Young bulls	0.6	0.8
Heifers	0.5	0.7
Calves	0.2	0.4
Sheep	0.1	-
Goat	0.1	-
Donkey	0.5	-
Horse	0.8	-
Mule	0.7	-
Poultry	0.01	-

Source: (Bekele, 1999; ILCA, 1990; Gryseels, 1988); TLU= tropical livestock unit

Table 2 Feed and material cost used in the conduct of the experiment

Feed Item	Cost
Maize stover	10 ETB/bale
Maize grain	350 ETB/qt
Sorghum grain	280 ETB/qt
Haricot bean	550 ETB/qt

ETB - Ethiopian birr/currency, qt – quintal

Table 3 Body condition scoring system for beef cattle

Features	Condition	Score
Marked emaciation (animal would be condemned at ante mortem examination	L^-	1
Transverse processes project prominently, neural spines appear sharply	L	2
Individual dorsal spines are pointed to the touch; hips, pins, tail head and are prominent. Transverse processes visible, usually individually	L^+	3
Rips, hips and pins clearly visible. Muscle mass between hooks and pins slightly concave. Slightly more flesh above the transverse processes than in L^+	M^-	4
Ribs usually visible, little fat cover, dorsal spines barely visible.	M	5
Animal smooth and well covered, dorsal spines cannot be seen, but are easily felt.	M^+	6
Animal smooth and well covered, but fat deposits are not marked. Dorsal spines can be felt with firm pressure, but feel rounded rather than sharp.	F^-	7
Fat cover in critical areas can be easily seen and felt; transverse processes cannot be seen or felt.	F	8
Heavy deposits of fat clearly visible on tail – head, brisket and cod; dorsal spines, ribs, hooks and pins fully covered and cannot be felt even with firm pressure.	F^+	9

Source: Adapted from Butterworth (1989)

ANNEXES

Annexes 1: Questionnaire used for the survey in woreda level

Zone: _____ Woreda: _____Date: _____

Data to be collected by secondary sources (woreda level):

1. Human population under different age and sex category in the woreda:

Age /year	Sex		Total
	Male	Female	
≤5 years			
5<x<15 years			
15≤x ≤45years			
> 46years			
Total			

2. Total land use classification in the woreda (ha)

No	Type of land use		Hectares
1	Homestead /backyard		
2	Cultivated land for crop production		
3	Land for forage production	Private	
		Communal	
4	Grazing land(pasture land)	Private	
		Communal	
5	Wood-land and/ or shrub-land open for grazing		
6	Protected forest land		
7	Area occupied by different construction		
8	Area occupied by church and mosque		
9	Urban land		
10	Unusable land		
	Total		

3. Type of crops produced in the woreda / year

No	Crops	Area (ha)	Average Yield (qt)
1			
2			
3			
4			
5			

4. Total livestock number and their major uses in the woreda

Species	Type	Number of livestock			
		Local breed	Cross breed	Exotic breed	Total
cattle	Ox				
	Bull				
	Cow				
	Calf				
	Heifer				
	Steer				
Sheep					
Goat					
Poultry					

5. What are the major feed resources in the woreda? (Rank 1, 2, 3…in order of feed cover)

Rank	Type of feed resource						
	Natural pasture	Untreated	Crop-residues	Stubble	grazing	Hay	Silage
Dry							
Wet							

6. What is the average number of cattle being fattened per fattening period per household? …
7. How many cattle are being fattened last year in the dega, woinadega and kola agro ecology respectively?……..., ……..…… & ……..…
8. How many cattle markets are available in the woreda? ……
9. What are the cattle breeds available in the woreda? …….
10. What type of cattle breeds are currently used for fattening purpose in the woreda? …… ……..……
11. What criterions have been used by the producers for buying fattening cattle? ……... ……..……
12. Do you think that animals in the woreda have adequate feed throughout the year?
    1. Yes 2. No

12.1. If no, on which kebeles shortages of feed become more severe? ……

12.2. If no, on which months of the year shortage of feed become more severe? ……

13. When there is feed scarcity, what measures have been used by the farmers to alleviate feed shortage? (Rank in order) 1. Storing the feed during available in the area …. 2. Hay making ……. 3. Destocking…… 4. Using browse trees ……..

5. Purchasing feed supplement…….6. Traveling long distance for searching feed ……..... 7. Others (specify)…….....

14. What type of forage development /feed improvement strategies have been practiced in the woreda?……

……

15. What are the major problems affecting cattle fattening practice in the woreda?

….……...……

16. What are the major potentials for improvement of cattle fattening practice in the woreda?

….……...……

……

17. How much the last year average cattle price in the woreda before and after fettening?

……

……

Annex 2: Questionnaire used for the survey in the household level

General Information HH Id _____

Zone _____ Woreda _____Kebele Name _____Enumerator Name _____

Date of interview _____ Respondent name _____Mobile No. _____

Agro ecology _____ (1=Dega, 2= W/dega, 3=Kola), Altitude _____ masl,

Geographic coordinates: Latitude _____ to _____ N and Longitude: _____ to _____ E

1. HOUSEHOLD SOCIO-ECONOMIC CHARACTERISTICS

1.1. Name of interviewed household _____, Sex_____, Age _____

1.2. Level of education of the interviewed household (encircle one)

1. Illiterate 2.Basic Education 3.Elementary School 4. Junior Secondary

5. High School 6. Higher Education 7. Religious Education

1.3. Family size (including the head of the household) under different age category:

Age /year	Sex		Total
	Male	Female	
≤5 years			
5<x<15 years			
15≤x ≤45years			
> 46years			
Total			

1.4. Major occupation of the household head at present (encircle one) 1. Farmer 2. Business man 3. Government /private employee 4. Retired person 5. Other (specify) _____

1.5. What is income source for the households? 1. Livestock production 2.Crop production 3. Crop – livestock production 4. Non crop-livestock production

2. LAND USE PATTERN OF THE RESPONDENT (ha)

2.1. Average land holding under different land use

No	Type of land use	Hectares
1	Homestead /backyard	
2	Cultivated land for crop production	
3	Land for forage production	
4	Private grazing land(pasture land)	
	Total	

2.2. Type of crops produced by the family / year

No	Crops	Area (ha)	Average Yield (qt)
1			
2			
3			
4			
5			

3. LIVESTOCK HOLDING AND THEIR MAJOR USE IN THE FAMILY

3.1. Livestock ownership of the respondent (2007 E.C)

Livestock species	Composition	Indigenous breeds	Crossbreds	Remark
		No	No	
Cattle	Cows			
	Oxen			
	Bulls			
	Heifers			
	Calves			
Sheep				
Goat				
Chicken				
Equine				
Bee colony				

3.2. Purpose of keeping cattle

Purpose	Rank	Remark

4. CATTLE FATTENING PRACTICE

4.1. What are your reasons for starting cattle fattening activity? ……..……

4.2. Have you taken any formal training on cattle fattening? 1. Yes 2. No

If yes, where …….; and for how long? ……..……

4.3. Are there any organizations which assist you in your fattening activity? 1. Yes 2. No

If yes, list the name of organizations. ……..……

4.4. What is the breed of your fattening cattle? ……..…

4.5. What is the source of your fattening cattle?

1. Own production 2. Immediate purchase for fattening 3. Culled cattle due to old age & being unproductive 4. Supplied by agriculture office

4.6. What type of cattle do you prefer for fattening purpose? (Rank in the order of preference)

1. Old oxen 2. Matured oxen 3. Young bull 4. Old cow 5. Unproductive cow 6. Heifer 7. Other (specify) ……..

4.7. What breed of cattle do you prefer for fattening purpose? (Please list and rank)

No	Breed type	(Rank 1,2,3,… in the order of preference

4.8. How many times do you fatten the cattle per year?

1. Only one time 2. Two times 3. Three times 4. Four times 5. Other (specify) …

4.9. How many cattle do you fatten per fattening period? A. 1 B. 2 C. 3 D. 4 & above

4.10. How do you decide the end of finishing period?

1. By calculating feeding length 2. By considering body condition

3. Anticipated Current and future price 4. Others (specify) ……

4.11. On which months of the year do you prefer to start cattle fattening? ……

Why? ……

4.12. On which months of the year, demands for fattened cattle become high? ……

Why? ……

4.13. On which months of the year, demands for fattened cattle become low? ……

Why? ……

4.14. On the average, for how long do you fed the cattle to finish its fattening period?

1. For two months 2. For three months 3. For four month 4. For five months 5. For six months 6. Other (specify) …….…….

4.15. How do you feed your fattening cattle?

1. Free grazing 2. Tethering 3. Stall feeding 4. Others (specify) ……..

4.16. What type of feed have you offered to your fattening cattle?

Basal feeds……

Supplement feeds……..……

4.17. How much kilo gram do you offer per cattle per day from each type of feed?

Basal feeds……

Supplement feeds……...……

4.18. Do you supplement your animals with minerals? 1. Yes 2. No

4.18.1. If yes, list the type of mineral supplements ……

4.18.2. If not, why not? ……

4.19. In what sequence do you feed your fattening cattle per day?

1. Basal feeds first and supplemental feed next 3. Basal feeds at the middle

2. Supplemental feeds first and basal feed next 4. Supplemental feeds at the middle

5. There is no predetermined sequence of feeding 6. Other (specify) ……

4.20. How much it costs the daily feed of one fattening cattle? (Birr) ……

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

Please prioritize/rank the constraints

No	Constraints	Rank 1, 2, 3 …in the order of severity

4.21.1. Is there feed shortage for cattle in the area? 1. Yes 2. No

4.21.1.1. If yes, when is feed shortage critical (list the months)? ……

4.21.1.2. What is you feeding calendar?

Month	List of major feed types offered to animals		
	Basal diet	Supplement	Remark
Sept			
Oct			
Nov			
Dec			
Jan			
Feb			
Mar			
Apr			
May			
Jun			
July			
Aug			

4.21.1.3. What do you do to cope up with the feed shortage in this (these) month (s)?

1. Rely on stored feed 2. Rely on farm residues 3. Rely on the natural pasture

4. Send my animals to other areas 5. Rely on the market 6.Others (specify) ……

4.21.1.4. Type of feed resource

Season	Natural Pasture	Crop-residues	Stubble grazing	Hay	Silage	Feed supplement	Browse trees
Dry							
Wet							

4.21.1.5. Are you experienced in silage making? 1. Yes 2. No

4.21.1.6. Are you experienced in straw treatment with urea? 1. Yes 2.No

4.21.1.7. If no, rank the reasons in order? 1. Shortage of money 2. Lack of proper tools

3. Lack of knowledge and skill on how to do it 4. Others (specify): ……...…

4.21.1.8. Do you practice other forms of feed conservation techniques? ……..……...…

4.21.1.9. Do you produce improved forage? 1. Yes 2. No

4.21.1.9.1. If yes, please list the type of forage grown: ……

4.21.1.9.2. If No, why not……

4.21.2. Do you think that housing cattle is important?

4.21.2.1. If yes, list the benefits……

4.21.2.2. If not, why not……

4.21.2.3. Do you provide housing to your animals? 1. Yes 2. No

4.21.2.3.1. If not why not……

4.21.2.3.2. If you provide, what type of housing system do you use? 1. Home stead shades 2. In living rooms with the family 3.Barn (corral) 4. Other (Specify)

4.21.2.3.3. If you provide, what materials do you use to build cattle house?

……

4.21.3. Is there shortage of water for your cattle? 1. Yes 2. No

4.21.3.1. If yes, state the months of the year at which water shortage becomes severe.

4.21.3.2. What is the average distance travelled by cattle to the water source (point) during dry season? 1. Watered at home 2. <1km 3.1-5 km 4.6-10 km 5.>10 km

4.21.3.3. How frequently cattle are watered during dry season? 1. Once in a day 2.Twice in a day 3. Once in two days

4.21.3.4. What are the sources of water for your cattle (prioritize)……

NO	Water source	Distance (km)	Dry season	Wet season
1	River			
3	Tape water			
4	Pond			
5	Rainy water			
6				

4.21.3.5. What kind of problem do you face from different water sources?

……

4.21.4. Is there a problem of cattle disease? 1. Yes 2.No

4.21.4.1. What are the major diseases and parasites that affect your fattening cattle (please list and rank)

Major diseases		Rank	Mark peak month for	Actions taken by
Local name	Scientific name		the occurrences	the farmer
Parasites				

4.21.4.2. Do you have veterinary health center in your PA? Yes No

4.21.4.2.1. If yes, is it Government owned or private? …….....

4.21.4.2.2. Is yes, what kind of service do you get from them? …….

……

4.21.4.3. Who assist the health of your cattle?

1. Government vet. Clinic 2. Private Veterinarians 3. Traditional medication 4. Other …

4.21.4.4. How much do you pay on average per year for medication of your cattle? ……...

4.21.4.5. How much do you pay on average in a single trip to medicate your cattle? ……....…

4.21.5. Do you have access for credit? 1. Yes 2. No

4.21.5.1. If yes, list credit institutions in your area. ……

4.21.5.2. Have you ever get credit from these institutions? 1. Yes 2. No

4.21.5.2.1. If yes, for what purpose? …….....

4.21.5.2.2. If yes, how many times? ……

4.21.5.2.3. If no, why not? ……...……

4.21.5.3. Have you ever get credit service for cattle fattening? 1. Yes 2. No

4.21.5.3.1. If yes, how often? ……

4.21.5.3.2. If no, why not? ……

4.21.5.4. What are the challenges of accessing credit institutions for cattle fattening? ……

4.21.5.5. What would be your suggestion for improvement? ……...……...…

5. MARKETING OF FATTENING CATTLE

5.1. What is the source of you fattening cattle? 1. Raised at home 2. Purchased

5.1.1. If purchase, from where do you buy your fattening cattle?

1. In the village 2. At local market 3. Supplied by agriculture office (not known)

4. Out of the district market 5. Other (specify exact market place) …… ……

5.1.2. Which type of cattle do you buy for fattening?? A. Castrate B. non-castrate

5.1.2.1. If castrate, why: ……...……

5.1.2.2. If non-castrate, why: ……

5.1.2.3. If non-castrate, do you castrate before fattening or fatten non-castrate? ……

5.2. After purchase, what do you do with the fattening animals (both castrate and non-castrate)? 1. Let them plough cropping land 2. Fatten immediately 3. Keep them for some months 5. Others (specify)

5.3. If you let the animals (purchased) plough for how long do you use them?

.....

5.4. What criterions have you considered for buying fattening cattle?

No	Criteria/traits	(Rank in the order of your trait preference) (1^{st}, 2^{nd}, 3^{rd}, …)	Describe the traits
1	Age of the cattle		
2	Body size/frame		
3	Breed		
4	Health		
5	Body condition		
6	Price/ market value/		
7	Color		
8	Adaptation		
9	Horn size/shape		
10	Other (specify)----------		

5.5. Do you get market information before you buy/sell your fatten cattle? 1. Yes 2. No

5.6. If yes, from where do you get market information?

1. Extension agent 2.Relatives 3. Co-operatives 4.Neighbors 5. Own markets visit 6 other (specify)

5.7. Do you get advice on fatten cattle marketing issue form development/extension agent?

1. Yes 2. No

5.8. What is your reason of preference while you decide to sell your cattle at a particular market? 1. Relative advantage of price 2. Proximity of the market 3. Other

5.9. Where do you sell your fattened cattle most of the time?

1. In the village 2. In the district market 3. On contractual bases in the village 4. Out of the district market(specify) ……

5.10. How do you take your fatten cattle to the market? 1. Trekking 2.Trucking 3. Both

5.11. How do you sell your fattened cattle? ……...

5.12. Who determine the price at the market place? 1. Yourself 2. Buyer 3. Broker 4. Negotiation b/n seller and buyer 5. Other (specify)

5.13. To whom do you sell your fatten cattle? 1. Trader 2.Abattoir 3. Local butcher 4.Farmers 5. Other (specify)

5.14. What do you think is the reason for these price variations?

1. Difference in number of traders 2. Proximity to urban center

3. Difference in road and transportation facilities 4.Other (specify) ……

5.15. In which month of the year do you think is the cattle price become higher and lower?

1. Months of higher price? ……..……..…

2. Months of lower price? ……

5.16. In which holidays of the year do you think is the cattle price become higher and lower?

1. Holidays of higher price? …….…....…..

2. Holidays of lower price? …….

5.17. Why do you think is the reason for cattle price variation across months/season?

1. Drought 2.Shortage of grazing land 3.Seasonal fluctuation 4. Other (specify) ….....

5.18. Are you happy with the prevailing cattle price in your area? 1. Yes 2. No

Annex 3: Focus group discussion

1. What are cattle for you?
2. ;What are cattle fattening for you?
3. Role of livestock in crop production and livelihood
4. Cattle breed type exist in area and breeding practices
5. Methods of feed conservation system and most crop residues used as cattle feed
6. Marketing system and factors that force to sale cattle and Opportunities to improve marketing problem
7. Animal veterinary service
8. Access for credit
9. Challenges of cattle fattening
10. When did fattening as a business commenced in the area; what were the major reasons? What was the production system before? Is the number of fatteners increasing/ decreasing?

BIOGRAPHICAL SKETCH

The author, Guyo Demisse, was born in 1981/1989 at Berek, Burji woreda of Segen Zone in SNNPRs. He attended his primary, junior, secondary and preparatory education at Berek, Segen, Soyama and Konso, respectively, in the same Zone. He joined Arba Minch University in 2000/2008 academic year and graduated with Bachelor of Science Degree in Animal Science in 2002/2010. Thereafter, he was employed by the Ministry of Agriculture as a Livestock and forage development expert in Bonke woreda Agricltural and Rural development office served for three years. Then he joined the school of Graduate studies of the Hawassa University, in school of Animal and Range Sciences in October 2013, to pursue his M.Sc. study in Animal production.