



HUSBANDRY PRACTICES AND PRODUCTIVITY OF ARSI-BALE
GOATS IN AGARFA DISTRICT OF
OROMIA REGIONAL STATE, ETHIOPIA

M.Sc. THESIS

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HUSBANDRY PRACTICES AND PRODUCTIVITY OF ARSI-BALE
GOATS IN AGARFA DISTRICT OF
OROMIA REGIONAL STATE, ETHIOPIA

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DEDICATION

I dedicate this thesis to my beloved parents my mother and sister for their support and words of encouragement during my moments of anxiety.

LIST OF ACRONYMS

AARDO	Agarfa Agriculture and Rural Development Office
ACES	Alabama cooperative extension system
ADWG	Average Daily Weight Gain
AEZ	Agro-ecological zones
ANOVA	Analysis of variance
ATVET	Agricultural Technical, Vocational and Educational Training
AFEDO	Agarfa Finance and Economy Development Office
BZFED	Bale Zone Finance and Economy Development
CSA	Central Statistical Authority
ESAP	Ethiopian Society of Animal Production
ESGPIP	Ethiopia Sheep and Goat Productivity Improvement Program
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
HHs	Households
IBC	Institute of Biodiversity Conservation
ILRI	International Livestock Research Institute
IPMS	Improving Productivity and Market Success of Ethiopian Farmers
KBW	Kid Birth Weight
M.a.s.l	Meter Above Sea level
NGOs	Non Governmental Organizations
NMSA	National Meteorological Service Agency
PCC	Population Census Commission
RW	Rain Water
SE	Standard error
SPSS	Statistical Package for Social Sciences
TLU	Tropical Livestock Unit

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ABSTRACT

This study was conducted in Agarfa district with the objectives; to assess the husbandry practices and reproductive performance, to evaluate the productive performance and estimate offtake rates and also to identify the major constraints and opportunities of Arsi-Bale goats production in Agarfa district. Semi-structured questionnaire survey was carried out on 150 interviewees who are selected randomly from the three agro-ecologies. On-farm monitoring of the growth performance of kids owned by farmers was also conducted. The data obtained from the survey was analyzed using descriptive statistics such as frequencies, percentages; while data on growth performance was analyzed applying Analysis of Variance using General linear model procedure of SPSS version 17.0. The result showed that the average land holding per household was 2.3 ± 0.13 ha. Goats were the most ($p < 0.05$) widely reared livestock species next only to cattle in terms of TLU. The main purpose of keeping goats in the study area was for income generation. The major feed and water sources were natural pasture and river water respectively. Most farmers let their goats alone to graze. The most common type of goats house in the study area is the one which is constructed attached to the family house sharing the common wall. Small proportion of farmers practice weaning of kids to maintain body condition of dams. Most farmers (40%) in the study area practice castration of goats for fattening and selling, of which only (50%) of farmers used modern method of castration. The major reason for culling of goats in the area was old age (71.2%). Most of the kidding (34.7%) in the study area were from September to November. The overall mean age at first mating (female), age at first mating (male), age at first kidding and kidding interval were reported to be 7.28 ± 0.04 , 8.48 ± 0.05 , 14.57 ± 0.04 and 7.11 ± 0.03 months respectively. The overall mean birth weight and two month weight of kids were found to be 2.38 ± 0.1 kg and 6.94 ± 0.2 kg respectively. The mean average daily weight gain was 76.2 ± 1.9 g/day up to two months. The birth weight of kids born from first parity does (irrespective of sexes) was significantly lower ($P < 0.001$) than kids from second and above parity does. The triplets had significantly lower ($P < 0.001$) birth weight than twins and triple born kids. The effect of sex too indicated that the buck kids were significantly heavier ($P < 0.001$) than the doe kids. Kids that were born from first and fifth parity does had significantly lower ($P < 0.01$) average daily weight gain than kids from second, third, fourth and sixth parity does. Single born and male kids had significantly heavier ($P < 0.01$) average daily weight gain than twins and female kids. The survival rate and commercial offtake rates of goats in the area was 91.67% and 16.6% respectively. Disease and parasites and drought were reported to be the two major constraints of goats production in the area. Even though the current overall productivity of goats in the area is fairly encouraging as compared to other indigenous Ethiopian goats breeds, full potential need to be exploited by improving husbandry practices, offtake potential and solving production constraints.

Key words: husbandry, productivity, offtake rates and Arsi-Bale goats

1. INTRODUCTION

Agriculture in general and animal husbandry in particular play an important role in enhancing the livelihood of the agrarian community especially in the developing nations. Chinnaiyah (2014) estimated that more than 70% of the people are directly or indirectly associated with this sector for their livelihood and also livestock possessions are perceived as an indicator of wealth status especially among the rural households in India.

Similarly Sivapathi (2011) pointed out that animal husbandry is the corner stone of rural economy and the activity play key role in the enhancement of the economic status of the society in general. Livestock sector provides employment opportunities to the unemployed and under employed members of both rural and peri- urban societies (Sivapathi, 2011).

The livestock subsector has gross contribution to the national economy of Ethiopia and still promising to rally around the economic development of the country and provide the needed animal protein that contribute to the improvement of the nutritional status of the people, besides plays an important role in providing export commodities, such as live animals, hides, and skins to earn foreign exchanges for the country(CSA, 2014).

Ethiopia has one of the largest livestock populations in the African continent with an estimated population of 28.16 million heads of goats. Most of the goats are distributed across the different agro-ecological zones of the country(CSA, 2014). However, the potential of these caprines are yet to be fully exploited (EARO, 2000; Kassahun and Solomon, 2009). There is an increase in the demand (both within and for export) for meat from small ruminants. Nevertheless the gap between demand and supply is widening, indicating an urgent need for improving the productivity of small ruminants through scientific interventions.

As reported by Isaac and Titilayo (2012) rearing of small ruminants play an essential function in the livelihood among the households in the developing countries by supplying the most readily available source of credit much needed to meet the immediate socio-economic requirements.

Small ruminants are a vital component of animal husbandry in Sub-Saharan Africa (SSA) and are primarily reared to meet various functions such as for immediate cash sources, milk, meat, wool, manure, and saving. They also have various social and cultural role that vary among different cultures, socio-economies, agro-ecologies, and locations in tropical and sub tropical Africa (Kosgey, 2004).

Earlier studies by Peacock (1996) indicated small ruminants are replacing the large ruminants in densely populated highlands of Ethiopia. In spite of these, dairy goats offer alternative to dairy cattle in many such areas (Mohamed *et al.*, 2002).

Goats are distributed in diverse agro climates ranging from high altitude mountains to deserts (Galal, 2005). The caprines are widely distributed in the tropics and are important to the subsistence, economic and social livelihoods of a human population in these areas (Dossa, *et al.*, 2007).

Rearing of goats can easily integrate as an important component of the farming systems and increase the diversity of livestock production, lowering economic risk during the times of crop failure, and reducing the fluctuations in cash flow especially under harsh environments (Pollott and Wilson, 2009). Over the period of time there is a shift in production system in the country, while extensive grazing areas are now being converted into croplands and thus there is dearth of feed resources for the ruminants. Thus, lack of grazing lands is favoring rearing of small ruminants over the cattles (Adane and Girma,2008).

Agarfa district has a large population of sheep and goats which is only next to that of cattle population. However, in spite of this potential, the husbandry practices has been left to continue as it has been done traditionally and the productivity is sub optimal, this is attributed to several factors viz. degraded grazing land, high mortality of the young and mature livestock, poor infrastructure for animal health besides that the livestock farming is not market oriented(AARDO, 2013). Since, the above factors have not been studied in the area, there is a pressing need to study the current husbandry practices and productivity at farmers level to fill the existing gap. Moreover, it is crucial to determine the status and prospects of the sector to maintain its contribution among the community members. Thus the study aims to describe the husbandry practice and productivity of the goats reared in the Agarfa district with an aim to usher economic development for community rearing these animals. Hence, the specific objectives of this study were:

- To assess goats husbandry practices and reproductive performance in the area
- To evaluate the productive performance and estimate offtake rates of the goats reared in the area
- To identify the major constraints and opportunities of goat production in the area

2. LITERATURE REVIEW

2.1. Role of goats in livelihoods of smallholder farmers

Goats play an important role for socio-economic improvement of the economically challenged members of the society, besides providing an employment opportunity for the youth and are also gender friendly (Lebbie, 2004; Tilahun and Goestseh, 2005). The low cost of maintenance, ability to adapt to harsh environment and low initial capital make goats an ideal candidate for economic sustainability at the end of the small and marginal farmers (Silanikove, 2000, Peacock, 2005 and Degen, 2007).

Table 1. Benefits obtained from small ruminants

Products	By-products	Indirect benefits	Intangible benefits
Meat			Reduction and spread of risk from crop operations
Milk	Manure as Fertilizer		Generation and accumulation of capital
Skins		Weed control	Generation of income and smoothing out cash flow
Fibre	Dung as fuel		Fulfilling social, cultural, religious needs and obligations
Horns	and for biogas production		Providing status or prestige in the immediate community
Offal			Use in sport, culture and recreation

Source (Pollott and Wilson, 2009)

Goats are more prolific in comparison to the cattles (Peacock, 2005). Nutritionally the milk and meat of goats have higher digestibility because the fat globules of milk are too small and the muscle fibers of meat are narrower than those of the large ruminants (Parker, 1998).

2.2. Genetic Diversity and Distribution of goats

Studies from IBC (2004) indicate that Ethiopia has long been known as a entryway of genetic material from Asia to Africa, and its diverse ecology served to diversify and develop the genotypes it received. In the tropics many livestock breeds have been identified on the bases of physical, morphological and functional characteristics and more than 350 tropical breeds of goats have been identified (Banerjee *et al.*, 2000).

According to the classification by FARM-Africa (1996) goats in study area belong to the Arsi-Bale breed, the key identifying features of this breed are hairy at the high land but not in the lowland. The most common coat colors are combined patchy pattern. The breed is relatively tall with a predominantly straight facial profile. Males have curved and straight horns mainly pointing backward with some pointed straight upwards. Ruffs and wattles are present in both sexes.

2.3. Goats Husbandry Practices in Ethiopia

Goats management depend on the animal's age, health, nutrition and pregnancy status, besides the production needs of the community who rear them and the environment where they are reared. Thus, rearers must be aware of the individual needs and provide proper care practices that ensure animal well-being that might be well-organized in terms of production as the management needs vary with age and sex of the animals (Collar *et al.*, 2000).

2.3.1. Feeds and feeding systems of goats in Ethiopia

Performance of livestock in general and goats in particular are influenced by several factors, especially their nutrition, if there is optimal feed resource utilization, it is estimated that up to five-fold increase in tropical livestock productivity can be achieved (Alemu, 2008). To combine feed ingredients into the cheap but most efficient ration, producers must meet the

nutritional requirements of animals depending on their stages of growth and production/ reproduction (ACES, 2002). Tsedeke(2007) described that optimum utilization of seasonal available feeds through preservation of crop residues and grasses and strategic supplementation with low cost alternatives like development of improved forage is vital to balance seasonal feed supply and animal requirements. Goats are browsers and will readily eat woody plants and shrubs. If goats are turned out to browse, the area should be inspected first to be sure there are no toxic plants that will be a threat to the goats, or to humans via transmission of toxins in the milk (Tsedeke, 2007). As indicated in a study in Goma district by Belete (2009) feed resources of goats were limited to communal grazing, aftermath grazing, roadside grazing and river side grazing. Similar observation have been reported by Solomon *et al.* (2010) who also observed that crop residues and non-conventional feeds including weeds, leftovers, tillers and traditional brewers grain too are fed to the goats. Similarly Tesfaye(2009) in his study at Metema district reported that the major feed resources in the area was natural pasture. While result of a study by Wondwosen(2007) indicated that native goat are generally raised on natural vegetation.

2.3.2. Watering of the goats

Water is an indispensable nutrient for metabolic activities such as digestion, nutrient transport, electrolyte balance, lubrication of joints, regulating the body temperature, rumen function, and excretion of body waste(Collar *et al.*, 2000).

According to the results of a study by Belete (2009) the major water source (56.9%) for small ruminants reared in Goma district is river water, however during the wet season, the respondents indicated that main water source is the accumulated rain water in the ditches and ponds (42 %) followed by river water. In contrary to this Endeshaw (2007) reported that the

ponds are the major water sources during the rainy season while in the dry season; rivers are the most common water sources in Dale district. Furthermore, Endeshaw (2007) indicated that in Dale district during the dry season (in the lowlands) the livestock rearers may travel up to 10 kms to the watering point. Thus travelling long distances will wastes energy of the animals which otherwise could have been used for productive purposes. Similarly Tesfaye (2009) reported that most farmers in Metema district allow their goats to drink water once day.

2.3.3. Housing of the goats

Sheep and goats housing should meet animal requirements and serve a producer's needs at the lowest possible cost (Solomon and Alemu, 2009).

There are several housing systems for goats but the two main housing types are confinement (intensive) and loose (extensive). A combination of housing types is employed on some farms. The type of housing needed depends on local weather conditions, resources available and whether the animals are being raised for milk, meat, fiber or as companion animals. Any system will require the ability to separate groups of animals. The housing should allow groups of milking does, dry (non-lactating) does, newborn kids, growing kids, and bucks to be housed apart from each other (Collar *et al.*, 2000).

Goats do not require elaborate housing because they are generally hardy animals that tolerate hot and cold weather as long as they are provided with simple shelter to protect from rain or snow in winter and from heat in summer.

They are extremely inquisitive, playful, and sure-footed animals that have a strong propensity to climb and these attributes should be considered when planning for their housing or confinement. Fencing to keep goats in and predators out is the most challenging aspect of goats housing (Collar *et al.*, 2000).

According to the result of a study by Yenesew (2010) in West Gojam respondents indicated the presence of separately constructed goats houses. However, many of the goats share the dwelling of their owners and under such condition, the rooms are usually separated and partitioned with locally available materials. While these partitioned are used to separate the animals from the people, the goats are housed together irrespective of the sex and age groups.

2.3.4. Breeding management of the goats

Breed improvement in the tropics is constrained by several challenges, which include small flock sizes, single-sire flocks, lack of animal identification, lack of performance and pedigree recording, low level of literacy and organizational shortcomings and flock mobility (Kiwuwa, 1992). In small ruminant controlled mating is more difficult to manage at the village level and even when achieved, the lack of improved indigenous stock is a constraint (McDermott *et al.*, 2010). In the study area breeding is mostly panmictic with no production or reproduction records, if at all there are any records then they are verbal and based on recall method, the results of which are highly questionable. Studies by Solomon *et al.* (2010) too indicated that panmictic breeding of caprines common in the rural areas of Ethiopia. Thus one of the easiest method to improve the native breeds is to introduce exotic/ improved breed, provided that the introduced breed is well adapted to the local conditions (Pollott and Wilson, 2009).

To improve the existing genotypes in the country two projects were initiated in the recent past(FARM-Africa,1996) and Ethiopia Sheep and Goats productivity improvement program (ESGPIP) in 2008. However, the overall impact of the projects as far as breed improvement were far from satisfactory which might be attributed to lack of adaptability of the introduced breeds and their management as a whole.

2.3.5. Health management of goats

The safeguarding of animals in a healthy state is of utmost importance to ensure sustainable livestock development (Pollott and Wilson, 2009). Sheep and goats are very susceptible to parasites due to their close grazing behavior and slow-to-develop immunity (Schoenian, 2007). Thus, the rearers need to be made aware of the diseases prevailing in the area and regular vaccination camps can be organized along with sensitization programs to take care of the veterinary health problems (Pollott and Wilson, 2009; Schoenian, 2007). In Ethiopia, 5-7 million sheep and goats die each year due to diseases and the overall economic loss in meat industry due to parasitic diseases is estimated at US\$ 400 million annually (ESGPIP, 2007). Farmers' indigenous knowledge that was handed down over generations in handling and treating livestock health problems are enormous and are still useful in Ethiopia. These should also be appreciated and supported with scientific knowledge (Yoseph, 2007).

2.4. Reproduction and Production Characteristics of Goats in Ethiopia

2.4.1. Age at first mating

There are scanty studies on the age at mating for specific Ethiopian goat breeds. Early maturing females are known to have a relatively long and fruitful reproductive life. In the tropics the buck are generally ready to breed between the age of 8-12 months and for does it is around 8-16 months age (Peacock, 1996). According to Adugna and Aster (2007) small ruminants reach age at puberty around one year of age in pastoral and agro-pastoral production systems of southern Ethiopia.

2.4.2. Age at first kidding

Age at first kidding can be defined as the age at which does give birth for the first time. It is a function of puberty, age at first breeding and conception and successful completeness of pregnancy. The reproductive traits including age at first kidding (AFK) are influenced by several genetic and non genetic factors (Alexander *et al.*, 1999; Awemu *et al.*, 1999).

Results of a study by Banerjee *et al.* (2000) and Peacock (1996) indicate that many of the African goats breeds give birth to their first kids at 12-18 months of age. Adugna and Aster (2007) indicated that the age at first kidding under the pastoral and agro pastoral production system is around 18 months.

Table 2. The age at first kidding of some Ethiopian goats breeds

No.	Breed	Age at first kidding	Sources
1	Arsi-Bale	367.84 days	Tatek <i>et al.</i> (2004)
2	Woito-Guji	452.352± 7.448 days	Endeshaw(2007)
3	Short-eared Somali	376.96 days	Belete(2007)
4	Western highland goats	370.88±5.17 days	Demissie <i>et al.</i> (2014)
5	Central Highland goats	407.9±40.48 days	Mengistie <i>et al.</i> (2013)

2.4.3. Kidding interval

Reproductive efficiency is associated to the length of parturition interval in small ruminants (Ibrahim, 1998).The kidding interval (KI) and the first post partum estrus are important traits which contribute to the productive efficiency of goats (Greyling, 2000). The interval between kidding is an important predictor of life time productivity of does (Awemu *et al.*, 1999) and is highly influenced by both genetic and non genetic factors (Odubote, 1996, Mesfin *et al.*, 2006). It contributes largely to the productive efficiency and it has been reported to be affected by nutrition, suckling, parity (number of times kidded) and breed (Banerjee *et al.*, 2000).

Table 3. The kidding interval of some Ethiopian goats breeds

No.	Breed	Kidding interval	Sources
1	Arsi-Bale	246.24 days	Tatek <i>et al.</i> (2004)
2	Woito-Guji	257±0.16 days	Endeshaw(2007)
3	Keffa	240.16 days	Belete (2007)
4	Western highland goats	224.656±2.736 days	Demissie <i>et al.</i> (2014)
5	Central Highland goats	307.9±14.20 days	Mengistie <i>et al.</i> (2013)

2.4.4. Litter size

Prolificacy is a trait favored for enhancing the profitability of the goat husbandry, however as the trait is influenced by both genetic and more of non genetic factors, care has to be taken to ensure that the does receive proper nutrition, especially at the time of mating, at the last trimester of gestation and after kidding to maintain the lactation yield.

There may be fetal abortion among the does pregnant with multiple births in absence of proper nutrition of the does during the gestation period and low birth weights of the kids born from prolific does and mortality of the neonate kids have also been reported(Singh *et al.*,2002).

Average litter size of 1.3 and 1.34 had been reported previously for Dale and Dalocha district goats types respectively(Endeshaw, 2007; Wondwosen, 2007). Moreover, Tsedeke (2007) and Belete (2009) indicated the average litter size of Alaba and Goma district goats to be 1.6 and 1.75 respectively.

2.4.5. Birth weight and growth rate of goats

In small ruminant production birth weight and weaning weight are economically important traits which are controlled by polygene (Supakorn and Pralomkarn,2009).

Birth weight is one of the important factor influencing the productivity, as it is strongly correlated with growth rate, adult size, and kids viability and is strongly influenced by the

genetics, sex of kids, birth type, age of dam, feeding conditions, season of birth and production system (Banerjee *et al.*, 2000). The economic value of goats depends up on growth, reproductive and productive efficiency, as it determines the meat producing ability up to marketable age (Singh *et al.*, 2002).

Several studies have been conducted to evaluate birth weight and growth rate of goats in Ethiopia. Accordingly Tatek *et al.* (2004) reported that the overall mean birth weight, weaning weight and pre-weaning growth rate(irrespective of sexes) of Arsi Bale goats reared in Arsi Negelle district were 2.28 ± 0.037 kg, 8.39 ± 0.16 kg, and 72.21 g/day, respectively. While Zeleke (2007) reported that the overall mean birth weight of Somali goats reared at Haramaya University farm was 3.19 kg. In another study, Wondwosen (2007) and Belay and Mengistie (2013) reported the average birth weight of goats in Dalocha district and Abergele goats was 1.64 ± 0.08 kg and 1.91 ± 0.04 kg respectively which is lower than those reported by Zeleke (2007). Whereas Tesfaye (2009) indicated that the overall mean birth weight of goats reared at Metema district of North Gondar Zone was 2.28 ± 0.04 kg.

Another study carried out in Adamitulu Jido Kombolcha district by Girma *et al.*,(2011) indicated that most of the kids (irrespective of sex) born weighed between 2.1-2.9 kgs and the study further indicates that mortality among the kids with low birth weight was significantly higher. Similarly a study by Alula *et al.*, (2014) at Adamitulu Jido kombolcha district indicated that the overall mean birth weight of kids was 2.04 ± 1.03 sd Kg.

2.6. Offtake rates of goats in Ethiopia

At the herd or flock level, the total voluntary disposal of animals by sale, slaughter, exchange and/or giving is known as gross offtake. The measure thus includes disposals for commercial and non-commercial purposes. It only measures outflows and takes no account of acquisitions or inflows into the herd, flock or area(ILRI,1990).When gifts, slaughter for home consumption or ceremonies, and exchanges between producers are relatively unimportant, the sales rate (or commercial offtake rate) can be used to approximate the gross offtake rate. When acquisitions (i.e. purchases, exchanges or gifts) are significant, the 'net offtake rate' or 'net disposal rate' should be used. Acquisitions may come from commercial or non-commercial sources(ILRI,1990).

Samuel(2005) concluded that, offtake rates of local goats are influenced by several factors such as sex of the goats, offtake types, locations and season and also reported that the overall Offtake rate of local goats in Adaa Liben district was 16.3 ± 4.88 percent. Goats due to their short reproductive cycles and high incidence of multiple births have higher offtake rates when compared to large ruminants (Adane and Girma,2008). The average offtake rates of goats in Ethiopia is estimated to be about 36%, which is lower than those from many tropical countries (Amha, 2008). Study by Dereje *et al.*(2014) indicates that the ways of removal and inflow of the goats were births, purchase, sells, exchanges, deaths, slaughters and others. The study also indicates that the average gross and commercial offtake rate by the three goats (Bati, Harerghe highland goats and short-eared Somali goats) was around 35 and 24 percent respectively. The gross offtake rate, commercial offtake rate and net offtake rate of the local goats in Alaba district was 12.8, 9.9 and 9.1 percent respectively(Tsedeke, 2007).

3. MATERIALS AND METHODS

3.1. Description of the Study Area

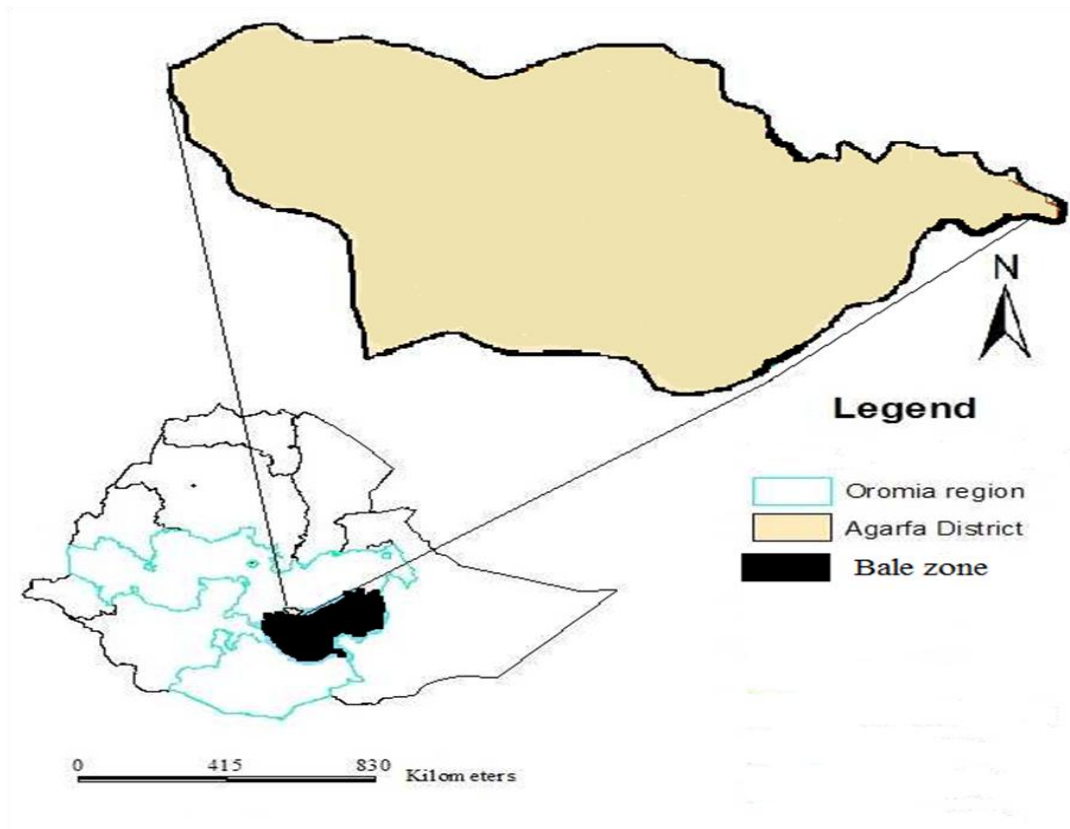
3.1.1. General

This study was conducted at Agarfa district, northern part of the Bale zone of Oromia Regional State, south eastern Ethiopia. The district is one of the 18 district and 2 urban administrative towns in Bale zone where both crop and livestock productions are interdependent farm enterprises and have comparable importance. According to the 2007 Ethiopian Population census, total population of the district was estimated to be 104,412(87% rural,13% urban) which is third in Bale Zone (PCC,2012). The predominant farming system in the study site is crop livestock mixed farming. The agrarian residents in the area practice rain-fed mixed farming(BZFED,2008).

3.1.2. Location and climate

Agarfa district is located at a distance of about 460 km south east of Addis Ababa and is situated in Bale Zone of Oromia Regional State between Latitude($7^{\circ}06'-7^{\circ}10'$)N and Longitude ($39^{\circ}12'-39^{\circ}20'$)E. It is located around the border of Arsi zone following the rugged and broken terrain of Wabe Gorge. It is found in the extreme northwestern Corner of Bale zone, and bounded by Shirka district of Arsi zone in the north, West Arsi zone in south west, Dinsho in south, Sinana in southeast and Gasera in north east. The total area of the district is $1,343\text{km}^2$ (BZFED,2008).

Agarfa district has two major river basins; Genale river basin to the south, southeast and southwest and Wabe Shabele river basin in north and Northwest part of the district(BZFED,2008).



Source(NMSA,2014)

Figure 1. Map of the study area

The average annual temperature and rainfall of the district is 17.5°C and 800mm with maximum and minimum ranges of 25 °C and 10 °C, and 1200 mm and 400 mm respectively. The altitude ranges from 1,250 to 3,855masl (AFEDO,2006; BZFED,2007).

The district comprises of three major agro-ecological zones(AEZ):Lowland cover 17.95% of the district with rugged and fragile landscape, Highland cover 23.37% of the district and Midland cover 58.72% of the district (BZFED,2014). Regassa (2006) characterize these AEZ by Lowland(warm semi-arid, at 500-1500m above sea level),Midland(cool and semi-arid, at 1500-2400m) and Highland(cool and humid, higher than 2400m).

3.1.3. Livestock population

Agriculture is the back bone of the economy of the district. It provides means of occupation for almost all population of the district. Moreover, animal husbandry is another sector of the district economy. From early days, livestock rearing has played an important role in the life of districts population. In the rural and lowland areas, rearing is the main stay of the people (BZFED, 2014). Livestock population is estimated to be 181,548 cattle, 79,159 sheep and goats, 33,777 equine, and 40,150 poultry (BZFED, 2014).

3.2. Sampling Methods and Data Collection

3.2.1 Sampling techniques

Before the main sampling, objective of the study was explained and discussed with district administration officials, livestock experts and informants to ensure their cooperation. The study sites were selected in consultation with the authorities of the respective Bureau of Agriculture. The sample for the study was selected using stratified random sampling method by classifying the district into three agro-ecological zones as suggested by Regassa (2006): Midland, Highland and Lowland to get representative peasant associations and farmers of the district. Then, the peasant association(PA) representing each agro-ecological zone were selected by proportional random sampling based on the number of PAs in each AEZ. Accordingly, three PAs were selected from Midland while only one PAs was selected from each Highland and Lowland AEZ. From the Midland agro-ecological zone Ambentu, Amigna and Sabaja were included in the study while from Highland Galema Hebeno was selected. Makala represented the Lowland agro-ecological zone. A total of five out of the 19 peasant association in the district with dry season road accessibility were selected to undertake the study.

The households owning at least two goats were identified from each sample PAs and among the identified goats owners the respondents were selected randomly. Accordingly,30 HHs per peasant associations were interviewed. Those selected PAs had proportionally equal number of goat owning HHs .

3.2.2. Data Collection

Both primary and secondary data were used on various aspects of goats husbandry practices and productivity for this study. The primary data were collected from the identified respondents using pre-tested questionnaire which was translated in the local language and monitoring on growth performance of goats. To describe the study area, baseline secondary data were obtained from the respective offices.

Household survey and Group Discussion

After identification of study peasant associations, household survey were carried out using semi-structured questionnaire. A total of five trained enumerators(one for each PAs) were hired, to administer the questionnaire to the 150 selected households with the active involvement and under close supervision of the researcher that allowed replacement of sampled HHs in times of involuntary response or unavailability. To strengthen the information collected from the questionnaire survey three group discussions with eight participants including different age groups per AEZ were held and also key informant interview was carried out with 25 key informants(15 elders above 50 years of age; 2 government officials; 3 supervisor and 5 experts famous for their experience).

The questionnaire covered various aspects of all species of livestock with more details on goats husbandry practice and productivity. The specific data which were collected include: household characteristics, land and livestock holding, purposes of keeping goats, slaughtering

of goats and milk consumption, husbandry practices of goats, reproductive performance of goats such as (age at first mating, age at first kidding, kidding interval and litter size), inflow and outflow of goats and constraints and opportunities of goats production in the area. Data from household survey (most recent and easy to recall) were used to estimate offtake rates of flocks for a period of time extending from March/April 2014 to March/April 2015.

Different diseases were identified with the help of veterinarians during the survey.

Flock monitoring and body weight measurement

To undertake these monitoring households that had does in advanced stage of pregnancy were selected purposively from lowland area where goats are dominantly found with the assistance of development agents. The flock monitoring study were carried out for two months on 60 Arsi-Bale kids of either sex. Death of kids were recorded starting from their birth until the whole period of monitoring.

Data was obtained on birth weight of kids, type of birth, sex of kids, and parity of does. The birth weights of the kids was taken within 24 hours of kidding using the Salter scale with capacity of 50kg and 100g precision. The subsequent weights of kids was taken at 10-days interval. The body weight was taken at dawn after overnight separation of the kids from their dams before the kids were allowed to suckle and browse.

3.3. Data analysis

Data collected through questionnaire were entered into statistical package for social sciences(SPSS)version 17.0 for windows. Screening outliers were employed before conducting the main analysis. The data obtained from the survey was analyzed using descriptive statistics such as frequencies and percentages. Pearson's Chi-square (χ^2) was used for categorical variables to assess a statistical significance of a particular comparison. The data of livestock

holding and reproductive traits were subjected to one-way analysis of variance to compare means. An index was calculated to provide ranking of the purpose of keeping goats, reported reasons for feed shortage and constraints of goats production in the area as suggested by Kosgey (2004) using the formula: Index =the sum of [3 x respondents in rank 1+2x respondents in rank 2+1x respondents in rank 3] for individual variables divided by the sum of [3 x respondents in rank 1+2x respondents in rank 2+1x respondents in rank 3]for all variables.

The growth rate of kids was calculated as a difference between two months body weight and kids birth weight divided by the number of days in the whole period of monitoring. In addition to this, General Linear Model (GLM) of Univariate analysis of variance procedures was used for estimation of the magnitude of the effect of parity, type of birth and sex on birth weight and average daily weight gain. The difference between means was separated using Tukey HSD test. For kids the sex, parity and birth type of the monitored goats were fitted as fixed independent variables, while birth weight and pre-weaning growth performance to two month were fitted as dependent variables.

Parameters like survival rate, pre-weaning mortality rate, gross offtake rate, net offtake rate and commercial offtake rate (ILRI,1990) were computed on percentage basis using their respective formulas below.

$$\text{Survival rate(\%)} = \frac{\text{Number kids survive during monitoring}}{\text{Number of kids born during monitoring}} \times 100 \text{-----equation 1}$$

$$\text{Pre-weaning mortality rate(\%)} = \frac{\text{Number of kids died during monitoring}}{\text{Number of kids born during monitoring}} \times 100 \text{-----equation 2}$$

$$\text{Gross offtake rate(\%)} = \frac{\text{Gross offtake(TLU)}}{\text{Total Opening Stock (TLU)}} \times 100 \text{-----equation 3}$$

$$\text{Net offtake rate (\%)} = \frac{\text{Gross offtake(TLU)} - \text{Acquisitions(TLU)}}{\text{Total Opening Stock (TLU)}} \times 100 \text{-----equation 4}$$

$$\text{Commercial offtake rate(Sales rate)(\%)} = \frac{\text{Sales(TLU)}}{\text{Opening Stock(TLU)}} \times 100 \text{-----equation 5}$$

Gross offtake in iod (t) (TLU) = sum of sales(TLU) + slaughters(TLU) + exchanges(TLU) + gifts(TLU)

Acquisition = Sum of purchases + exchanges or gifts

The effects of fixed factors(sex, birth type and parity) was fitted in the statistical model below.

$$Y_{ijkl} = \mu + S_i + B_j + P_k + (B \times S)_{ji} + (P \times S)_{ki} + \varepsilon_{ijkl} \quad \text{Where,}$$

Y_{ijk} = observation (birth weight, average daily weight gain) on the n^{th} kid of the i^{th} sex and the j^{th} birth type born in the k^{th} parity

μ = overall mean

S_i = fixed effects of the i^{th} sex ($i=2$)

B_j = fixed effects of the j^{th} birth type ($j=3$)

P_k = fixed effects of the k^{th} parity ($k=6$)

$(P \times S)_{ki}$ = interaction effect between sex of kid and parity of the dam

$(B \times S)_{ji}$ = interaction effect between sex of kid and birth type

ε_{ijkl} = random/ error effect

4. RESULTS

4.1. Household resources

4.1.1. Household characteristics

The household characteristics contains sex, age group, marital status, religion and educational level of the respondents in the study area. Table 4 shows the proportion in percentage of respondents with different characteristics across the three agro-ecologies.

Table 4. Socio-economic characteristics of households by agro-ecologies in Agarfa district

		HH characteristics in Agro-ecologies(%)				P-value
Descriptor		Highland (N=30)	Midland (N= 90)	Lowland (N=30)	Overall (N=150)	
Sex of HH	Male	83.3	87.8	100	89.3	*
	Female	16.7	12.2	0	10.7	
Age of HH	15-30	20.0	14.4	10	14.7	*
	31-45	40.0	53.3	63.3	52.7	
	46-65	40.0	32.2	26.7	32.7	
	Single	0	3.3	0	2	
Marital status of HH Heads	Married	90	93.3	100	94	*
	Widowed	10	1.1	0	2.7	
	Divorced	0	2.2	0	1.3	
Religion of HH heads	Orthodox	56.7	8.9	0	16.7	*
	Muslim	40	90	100	82	
Educational status of HH	Protestant	3.3	1.1	0	1.3	*
	Illiterate	20	17.8	16.7	18	
	Literate	80	82.2	83.3	82	

*Values across the rows are significant *(P<0.05), HH-Households, N-Number of respondents,*

Values in the body are percentages of the households under the respective category across columns

In the study area, higher numbers of the goats owning households were male headed. Most of the respondents were married. Most of household heads were Muslim followed by Orthodox Christians and Protestant respectively. Most of the interviewed respondents were literate and higher literacy was observed among the respondents from the lowlands. The occupations of all of the households were farmers.

4.1.2.Land and Livestock holding

The study further indicates that most of the respondents(95.3%) have their own land which they use for cultivation besides some of the respondents also indicated that they have some land allotted for grazing purpose(42.7%) and some farmers in the lowlands also did indicate that they have set aside some area for orchards. The results also show that the average land holding per household in the study area was around 2.3 ± 0.13 ha. The following Table 5, shows the average number of livestock holding in the district

Table 5. Average Livestock Holding (in TLU)

Species	Agro-ecologies			
	Highland(N=30) (Mean±S.E)	Midland (N=90) (Mean±S.E)	Lowland(N=30) (Mean±S.E)	Overall (N=150) (Mean±S.E)
Cattle	6.62±0.6	5.61± 0.3	6 ±0.7	5.89± 0.26
Goats	2.57± 0.2 ^b	1.12± 0.1 ^a	4.1±0.5 ^c	2 ± 0.16
Sheep	0.37± 0.14 ^b	0.02± 0.01 ^a	0.01± 0.01 ^a	0.09± 0.03
Horse	2.05± 0.27 ^b	0.17±0.04 ^a	-	0.52± 0.08
Mule	0.9±0.19 ^a	0.18±0.04 ^a	0.7± 0.1 ^b	0.42± 0.01
Donkey	1.89± 0.12 ^b	1.37± 0.09 ^a	2.40± 0.23 ^c	1.68± 0.08
Chicken	0.13± 0.02	0.35±0.14	0.01± 0.01	0.25±0.01

Mean values with different superscripts^(a,b,c) across rows are significantly different (P<0.05), N-Number of respondents, TLU-Tropical Livestock Unit, SE-Standard Error

As clearly seen from the table above respondents of the highland owned higher number of cattle, sheep, horse and mule than households in midland and lowland AEZ. Similarly higher number of households in midlands owned chicken as compared to the other AEZ. The results also indicated that the highest numbers of goats and donkey were observed in the lowlands.

4.1.3. Purpose of keeping goats

The findings presented in Table 6 indicate that most of the respondents rear goats as a source of their income followed by those reared for meat and other socio-cultural purposes.

Table 6. Purpose of keeping goats in the study area

Purpose of Keeping goats	Response of HH (N=150)			Weight	Index	Rank
	1 st	2 nd	3 rd			
Sale (income source)	108	25	12	386	0.42	1
Meat	12	91	32	250	0.27	2
Socio-cultural purposes	10	16	50	112	0.12	3
Milk	8	0	53	77	0.08	4
Skin	7	0	43	64	0.07	5
Banking	4	0	21	33	0.04	6
Total				922		

N-Number of respondents, Values in the body are number of the households under the respective category across rows

4.1.4. Slaughtering of goats

The results presented in Table 7 indicate the reasons for slaughtering of goats and their age during slaughtering in the study area. The main reasons for slaughter are festivals and birth of a child in the family. The findings indicate that in the midland the goats are usually slaughtered during the birth of a child in the community followed by use of meat for festivals. The table

further indicates that in the highlands and in the lowlands most of the goats are slaughtered during festivals such as Easter, New year, Ed Al Fetir and others. The study further indicated that the goats are slaughtered irrespective of the sexes in all the studied agro-ecologies.

Table 7. Goats slaughtering occasions for household consumption(%) and slaughtering age

Reasons	Agro-ecologies			
	Highland (N=30)	Midland (N=90)	Lowland (N=30)	Overall (N=150)
Festivals	53.3	40	70	48.7
Home consumption	3.3	1.1	0	1.3
Births in the family	16.7	41.1	13.3	30.7
Wedding	26.7	17.8	16.7	19.3
Preferred sex type				
Bucks only	46.7	34.4	46.7	39.3
Both	53.3	65.6	53.3	60.7
Slaughtering age(months)	Mean±SE	Mean±SE	Mean±SE	Mean±SE
Bucks	9.00±0.17 ^a	9.64±0.12 ^a	15.10±0.76 ^b	10.61±0.25
Does	10.20±0.20 ^a	11.12±0.12 ^a	14.13±0.97 ^b	11.54±0.23

N-Number of respondents, Values in the body are percentages of the households under the respective category across rows, Mean values with different superscripts(^{a,b}) across rows are significantly different ($P < 0.05$)

The mean age of slaughtering male and female goats in the lowland agro-ecology is significantly greater than($P < 0.05$) the highland and midland agro-ecologies.

The consumption of goats milk is quite common in the study area, 76% of the respondents indicated that they use goats milk for consumption, especially for infants with digestive disorders, this is because goats milk is easily digestible when compared to cow milk. In terms of agro-ecology high milk was consumed in the lowland followed by midland area.

4.2.Goats Husbandry Practices

Most common feed resources in the study area were natural pasture, crop residues(wheat and barley straw, maize stover and leaves) and also crop aftermath. Atela(local brewery byproduct) and Asharo in midlands, and sugar cane top and leaves, and cactus(*Opuntia ficus indica*) to some extent in the lowlands were included as year round common feed resources of the study area.

4.2.1. Feed resources availability and feeding management

Table 8. Seasonal goats feed availability in the study area(%)

Feed types	Sep- Nov	Dec- Feb	Mar- May	Jun- July	All season	Shortage irrespective of season	P-value
Natural pasture	18	0	0	2.7	76	3.3	*
Stubble Grazing	14	80	0	0	0	6	*
Maize grain	12	8	0	0	5.3	74.7	*
Atella(local brewery byproduct)	1.3	2.7	0	0	12	84	*
Asharo(roasted grain)	4	8	0.7	0	27.3	60	*
Sugar cane top and leaves	0	0.7	0	0	18.7	80.6	*
Private grazing land	2	26	5.3	0	10.7	56	*
Crop residues	9.3	6.7	0.7	0	29.3	54	*
Conserved feeds	3.3	0	0	0	0.7	96	*
Concentrates(cereal grain)	3.3	0	0	0	1.4	95.3	*
Fruit leftover	3.3	0	0	0	1.4	95.3	*
Weeds	65.3	0	0	0	0	34.7	*

*Values across the rows are significant *(P<0.05), Values in the body are percentage of the households under the respective category across rows*

From the feed type that are available in all season, natural pasture accounts the largest proportion followed crop residues. The other feed types such as grazing after math, conserved feeds ,concentrates and weeds are season dependant feed type. For majority of respondents weeds are abundant feed resources for goats from September to November and grazing aftermath, roasting barley grain(asharo), maize grain and crop residues are more abundant from December to February.

In lowlands, many goats owners use different plants as a feed for goats. The major plants that are utilized by households includes; Dhaddacha (*Acacia tortilis*), Hammaressa(*Acacia brevispica*),Daboobeessa (*Rhus natalensis*), Burquqee (*Acacia nilotica*), waacu(*Acacia seyal*), Saphansa(*Acacia mellifera*). Shrubs bushes and tree leaves are readily available in this area when compared to the midlands and highlands.

Table 9. Reported reasons for shortage of feed in the study area

Particulars	Rank of HH (N-150)			Weight	Index	Rank
	1 st	2 nd	3 rd			
Shrinkage of grazing land	70	37	19	303	0.54	1
Drought	24	50	14	186	0.32	2
Increase of animal population	5	18	29	80	0.14	3
Total				569		

N-Number of respondents, HH-households, Values in the body are number of the households under the respective category across rows

Most of the farmers (75.3%) in the area reported feed shortage problem especially in dry season. The findings from Table 9 above indicated that the reasons for feed shortage was primarily attributable to shrinkage and decline in productivity of the grazing lands, which can also be a fallout of overstocking and therefore overgrazing over the years. Drought were the

second major challenge which was identified by the respondents which was correlated with feed shortages especially in the months between February and May as indicated in Table 8.

Different systems of grazing were practiced in the area which include free grazing whereby there is no herder assigned to take care of the goats, herded grazing whereby herders are assigned to take care of the goats. The results of the study (Table 10) further indicates that most of the respondents preferred to graze their goats alone while some of them took their goats to graze with other species of livestock. However, it was also observed that grazing of sheep along with the goats was not commonly practiced in the area.

Table 10. Grazing management of goats in the studied agro-ecologies(%)

Particulars	Agro-ecologies			
	Highland	Midland	Lowland	Overall
	N=30	N=90	N=30	N=150
Keeping ways during grazing				
Goats alone	73.3	68.9	80	72
Together with sheep	10	4.4	3.3	5.3
Together with Cattles	16.7	26.7	16.7	22.7
Grazing in dry season				
Free grazing	93.3	100	100	98.7
Herded grazing	6.7	0	0	1.3
Grazing in wet season				
Free grazing	16.7	13.3	40	30
Herded grazing	83.3	86.7	60	70

N- Number of respondents, Values in the body are percentages of the households under the respective category across columns

It was also observed that free grazing was common during the dry season. In the wet season when there are standing crops in the fields the respondents preferred to hire herders in all the studied agro-ecologies. However, in the lowlands the respondents indicated that they still preferred free grazing of their goats even during the wet season.

4.2.2. Water sources in the study area

The findings presented in Table 11 indicated that major source of water for goats are river, spring and ponds. Source of water varies during dry and rainy seasons in the studied agro-ecologies. During dry season most of the HHs in the highlands use river only followed combination of river and well. Whereas most of the HHs in the midlands in the same season use river water only followed by combination of river and spring. Lowlanders use river only in the same season. In the rainy season most of the respondents use river only.

Table 11. Water sources in different seasons in Agarfa district(%)

Season	Water Source	Agro-ecologies			Overall N=150
		Highland(N=30)	Midland(N=90)	Lowland(N=30)	
Dry	River only	76.7	77.8	100	82
	River + Pond	6.7	0	0	1.3
	River+ Spring	3.3	18.9	0	12
	River +W	13.3	3.3	0	4.7
Rainy	River only	60	66.6	56.7	63.3
	Pond+RW	10	0	0	2
	River+RW	13.3	15.6	43.3	20.7
	River+RW +Spring	10	15.6	0	11.3
	River+RW+W	6.7	2.2	0	2.7

N-Number of respondents, W-Well, RW-Rain Water, Values in the body are percentages of the households under the respective category across columns

The findings from table 12 indicate that relatively most of the respondents during dry season in the highlands and lowlands agro-ecologies travelled a distance of less than a kilometer while more than half of respondents in the midlands reported that the distance travelled to reach the watering point was between 1-5 kilometer in the same season. During rainy season most of the respondents in the highland followed by lowlands and midlands travelled to reach the watering point less than a kilometer, while less proportion of respondents in the midland reported to travel to reach the watering points between 6-10km during both seasons.

Table 12. Distance to watering points during different seasons in the study area(%)

Parameter	Agro-ecologies	N	Distance in Km			
			< 1 km	1-5 Km	6-10 Km	>10 km
Dry season						
	Highland	30	76.7	23.3	0	0
	Midland	90	34.4	55.6	5.6	4.4
	Lowland	30	66.7	33.3	0	0
	Overall	150	49.3	44.7	3.3	2.7
Rainy season						
	Highland	30	96.7	3.3	0	0
	Midland	90	41.1	53.3	5.6	0
	Lowland	30	66.7	33.3	0	0
	Overall	150	57.4	39.3	3.3	0

N-

Number of respondents, Km=kilometer, "<" less than than, ">" greater than, Values in the body are percentages of the households under the respective category across rows

The result of table 12 further indicates irrespective of agro-ecologies, most of the respondents reported that the distance travelled to reach the watering point was less than a kilometer followed by between 1-5 kilometer during the dry and rainy season. Respondents of the highland and lowland agro-ecologies did not go beyond 5 kilometer during both seasons.

The results presented in Table 13 indicate that in the highlands the water is provided once daily during the dry season while it is provided freely during the rainy season. The results further show that in the midlands and the lowlands most of the respondents provide water once a day. Water is freely available during wet season in all agro-ecologies, though it is proportionally higher in the highlands.

Table 13. Frequency of watering of goats in different season in the study area(%)

Parameter		N	Frequency of watering			
			Freely available	Once a day	Every two days	Every three days
Dry season						
Agro-ecology	Highland	30	6.7	93.3	0	0
	Midland	90	22.2	63.3	7.8	6.7
	Lowland	30	23.3	46.7	30	0
	Overall	150	19.3	66	10.7	4
Rainy season						
Agro-ecology	Highland	30	96.7	0	3.3	0
	Midland	90	33.3	53.3	6.7	6.7
	Lowland	30	30	60	10	0
	Overall	150	45.3	44	6.7	4

N-Number of respondents, Values in the body are percentages of the households under the respective category

4.2.3.Goats housing system

The findings pertaining to the goats housing system presented in Table 14 indicate that most of the HHs in the lowlands followed by midlands and highlands construct their goats house attaching to the main house, while less proportion of respondents in the highlands followed by midlands have a separately constructed goats house. Irrespective of agro-ecologies most of respondents prefer to rear their goats in a house attached to their main house. The findings also indicate that in the three agro-ecologies most of the households practice separation of their goats from other livestock.

Table 14. Goats housing system in the study area(%)

Type of goat house	Agro-ecologies			Overall (N=150)
	Highland (N=30)	Midland (N=90)	Lowland (N=30)	
In the main house	0	1.1	0	0.7
A house attached to the main house	63.3	87.8	90	83.3
A separately constructed goats house	36.7	11.1	10	16
Separation of goats during night				
Yes	73.3	66.7	96.7	74
No	26.7	33.3	3.3	26

N-Number of respondents, Values in the body are percentages of the households under the respective category across columns

The findings presented in Table 15 show that lowlanders have corrugated iron roofing. Thatched (grass) roofing is common in the highlands followed by midlands. The roof of goats house(irrespective of agro-ecologies) are made up of grass followed by corrugated iron. The result further show that most of the HHs in the midlands followed by lowlands and highlands the floor of goats house are made up of mud, while stone in the highlands is quite common. The floor of the goats house(irrespective of agro-ecologies) are made up of mud.

Table 15. Types of materials used by respondents for housing(%)

Housing materials	Agro-ecologies			Overall	P-value
	Highland(N=30)	Midland(N=90)	Lowland(N=30)	(N=150)	
Material for roof					*
Corrugated iron	0	4.4	60	14.7	
Grass	100	93.3	10	78	
Plastic Material	0	2.3	0	1.3	
Mud	0	0	30	6.0	
Material for floor					*
Mud	16.7	95.6	93.3	79.3	
Stone	63.3	1.1	6.7	14.7	
Wooden Paved	0	1.1	0	0.7	
Grass	0	2.2	0	1.3	
Straw	20	0	0	4.0	

*Values across the rows are significant *(P<0.05),N-Number of respondents, Values in the body are percentages of the households under the respective category across columns*

The findings in Table 16 show that irrespective of the seasons the dwellings of the goats are cleaned daily, the respondents also indicated that the houses are swept with ash from the kitchen being sprinkled to absorb the residual moisture from the feces and urine.

Table 16. Goats house cleaning frequency and ways in different seasons(%)

Cleaning frequency	Seasons	
	Dry(N=150)	Rainy(N=150)
Daily	84	99.3
Once week	8	0
Twice week	7.3	0
Three times week	0.7	0.7
Cleaning Ways		%
Sweeping with broom only		16.7
Sweeping and applying ash only		72.0
Washing and applying ash only		11.3

N-Number of respondents, Values in the body are percentages of the households under the respective category across columns

4.2.4. Weaning and Castrating practice of goats

The results pertaining to the weaning and castrating practice by the respondents in the three agro-ecologies are presented in Table 17. The findings indicate that most of the respondents do not practice weaning of the kids. The findings also indicate that castration is commonly practiced by the respondents in the lowlands while very few of the rearers in the midlands responded that they practice castration in their flock.

Table 17 .The proportion of households who practice weaning and castration(%)

Descriptor	Agro-ecologies				
	Highland (N=30)	Midland (N=90)	Lowland (N=30)	Overall (N=150)	
Weaning	6.7	1.1	3.3	2.7	
Castration	53.3	15.6	100	40	
Age	<6 month	50	0	6.7	16.7
	6-12 month	0	0	33.3	16.7
	12-18 month	0	42.9	6.7	13.3
	18-24 month	12.5	35.7	53.3	38.3
	24-30 month	0	7.1	0	1.7
	>30 month	37.5	14.3	0	13.3
Purpose	fatten and sale	100	100	70	85
	Control unwanted breeding	0	0	30	15
Method	Local only	100	85.7	0	46.7
	Burdizzo only	0	0	100	50
	Local+Burdizzo	0	14.3	0	3.3

N-Number of respondents, HH-Household, Values in the body are percentages of the households under the respective category

The results pertaining to the age of the castration indicated that in the highlands, the rearers castrate their bucks at weaning or post weaning stage. While in the midlands the castration is usually practiced at the yearling or by 18 months of age, followed by those castrating the bucks at an age between 18 months and 24 months of age. The results from the table further indicate that in the lowlands the bucks are usually castrated at a relatively older age of 18-24 months. The respondents of all the agro-ecologies also indicated that castration is practiced to fatten the bucks for sale while some of the respondents (in the lowlands) reported that they castrate the bucks to deter them from unwanted breeding. The methods of castration are both of traditional and Burdizzo castrator. The local method of castration was prevalent in the highlands and the midlands while the Burdizzo castrator was preferred by the respondents in the lowlands. Most of respondents select their bucks for castration with large body length and height, though the proportion is higher in the highlands. The preference of goats with white patchy coat color have been reported in the lowlands and the midlands, besides the respondents also indicated that they preferred horned goats over the polled ones (Table 18).

Table 18. Selection of bucks for castration and fattening in the study area(%)

Selection criteria	Agro-ecologies			
	Highland N=30	Midland N=90	Lowland N=30	Overall N=150
Body length & height	93.3	66.7	13.3	61.3
Local ecotype	6.7	5.6	10	6.7
Color and horn orientation	0	14.4	20	12.7
Age of the does	0	13.3	56.7	19.3

N-Number of respondents, Values in the body are percentages of the households under the respective category across columns

4.2.5.Culling of goats

The results in Table 19 indicate that the main reason for culling of the goats was old age.

Table 19. Reasons for culling goats by household in the study area(%)

Reasons	Agro-ecologies			Overall (N=150)
	Highland (N=30)	Midland (N=90)	Lowland (N=30)	
Old age	91.7	67.3	40	71.2
Health problem	0	8.2	60	12
Reproductive problem	8.3	12.2	0	9.6
Physical defect	0	4.1	0	2.4
Unwanted physical characteristics	0	8.2	0	4.8

N-Number of respondents, Values in the body are percentages of the households under the respective category across columns

4.2.6.Goats breeding management

In the study area,90.7 percent of the respondents reported to practice selection of breeding male and female goats. The practice of selective mating was not deliberately performed.

Table 20.Goat breeding practices by household in the study area(%)

Breeding Practices	No. of HHs	% of total HHs
Selection Criteria		
Body length & height only	96	70.6
Color and horn orientation	5	3.7
Local ecotype only	4	2.9
Body length & height + Local ecotype	31	22.8
Type of mating		
Uncontrolled	150	100
Source of breeding males		
Own only	26	17.3
Neighbors only	26	17.3
Own + Neighbors	98	65.4

No.-Number, HHs-Households, Values in the body are percentages of the households under the respective category across columns

About 88 percent of the interviewed households reported that they try to have more offspring from the father/ mother of the kid, if the kid is good(i.e. progeny selection).

In the district, half of respondents select their goats for breeding based on body length and height only and followed by combination of body length and height and also breed. All of the respondents use uncontrolled type of mating as the bucks run with flock throughout the year(Table 20).

More than half of the total respondents use combination of own and neighbors bucks for breeding, while only small proportion of farmers use breeding bucks from neighbor's flock only.

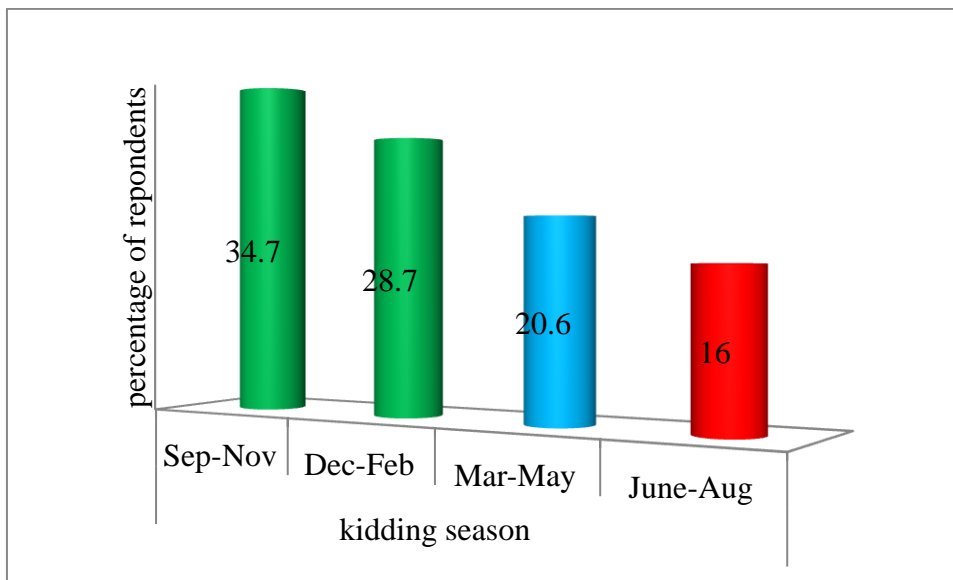


Figure 2. Reported Season of kidding in Agarfa district

Kidding takes place all year-round while peak kidding was observed from September to November (Figure 2).This implies that most of the conception occurred during the short rainy season, which extends from March to June.

4.2.7. Goats health management

Farmers of the study area were able to identify the types of diseases affecting their goats by recognizing the common symptoms through experience. Accordingly Table 21 indicates the various expected disease and parasites reported by farmers.

Table 21. Reported Goats health problems in Agarfa district(%)

Reported Symptoms	Suspected disease and parasites		Agro-ecologies			
			Highland	Midland	Lowland	Overall
	Local Name	Common Name	N=30	N=90	N=30	N=150
Emaciation, loss of appetite, diarrhea	Albaatii	Internal parasite (worm infection)	23.5	19	6.7	16.2
Emaciation, restlessness, irritation of skin	Maxxantuu qaama alaa	Ectoparasites	41.2	46.6	50	46.7
High fever, coughing	Sombe	Pneumonia	23.5	19	3.3	15.2
Blisters in their mouth & feet	Masaa	Foot and Mouth Disease	11.8	8.6	10	9.5
Swelling (around the neck, tongue)	Moorulla	Faciolosis	0	1.7	0	1
Orbit around them self	Martoo	Listeriosis	0	1.7	0	1
Sudden death with bleeding through opening	Abbaa Sangaa	Anthrax	0	3.4	6.7	3.7
Swelling around the teat and openings	Dolla	Goats pox	0	0	23.3	6.7

N-Number of respondents, Values in the body are percentages of the households under the respective category across columns

Disease and parasite are the major constraint that are affecting goats production in Agarfa district. Based on the symptom of disease that are reported by the interviewed households, different diseases were identified with the help of veterinarians. From the below listed diseases and parasites, ectoparasites are the most common health problems that were reported by most of the farmers (Table 21).

Treatment of sick animals

From the interviewed households, 93.3 percent of them are accustomed with treating their animals at public veterinary clinics while the rest 1.3 percent and 5.4 percent treat their goats with traditional medicines and by medicines purchased from private drug venders, respectively. With regard to access to veterinary service, less number of households 16 percent in Agarfa district get access to this service in nearby area. Almost all of the households 91.3 percent in Agarfa district get their animals treated with payment. In 2015 G.C 16 percent of households get vaccine to their goats. In the study area, while most of the farmers stop branding by understanding its possible consequences on the quality and price of skin, very small proportion of households is still practicing it. Their major reason of branding is to treat their sick animals.

4.2.8.Labor division in goats management

Labor division is a key issue to manage and form different tasks in goats production activities. The allocation of labor in the study area to each family member who participate in different goats husbandry practices determined based on their age, sex and type of duty formed.

In the area most of goats owners face problem of labor shortage for herding and watering of their goats, especially during dry season 62 percent of them face problem of labor shortage when students are at school and while 38 percent reported during rainy season when crops are

planted, consequently flocks need to be herded to avoid damage on crops. The division of labor by household members is presented in Table 22. All household members were involved in different husbandry practices of goats. However, husbands were more responsible for several routine activities of goats production in the area.

House wives are primarily responsible for cleaning goats barn and milking while husbands are responsible for works such as herding, taking care of kids and sick animals, fattening management, construction of goats barn, sale of animals. According to the findings of this study, most of the decisions on use of income were made by both husband and wife.

Table 22. Division of labor and gender role by households for goats husbandry practices

Activities	Household members (%)					
	Husband	House wife	Sons	Daughter	Hired labor	No labor Division
Herding	16	0.7	15.3	0.7	2	65.3
Feeding goats	16.7	0.7	10.7	0.7	1.3	70
Taking to water points	14.7	1.3	38	0.7	4	41.3
Clean goats barn	0	42	0.7	40	0	17.3
Take care of kids	15.3	12	6.7	8	0	58
Take care of sick	26	4.7	3.3	2.7	0.7	62.7
Fattening management	29.3	0.7	4	1.3	4	58.7
Construction of shelter	67.3	0	6	0	8.7	18
Milking	0	66	0	9.3	0	0.7
Sale Animals	59.3	2	1.3	0	0	37.3
Decide on use of income and benefits	24.7	1.3	0	0	0	74

HH-Household, Values in the body are percentages of the households under the respective category

The future plan for goats expansion by household is presented in Table 23. From the total interviewed households, most of them have great interest to expand goats production in the area though shortage of grazing lands and feeds is their major limiting factor for expansion.

The reason of expanding goats production in the study area includes high market demand, easy to manage and keep and immediate returns. From the listed reason, high market demand takes the highest proportion.

Table 23. Reason of goats production expansion by respondents(%)

Goats expansion	Agro-ecologies			
	Highland (N=30)	Midland (N=90)	Lowland (N=30)	Overall (N=150)
HH who want to expand goats production	100	87.8	100	92.7
Reason of expansion				
High market demand	3.3	31.6	0	18.7
Easy to manage and keep	0	1.3	0	0.7
Immediate returns	10	3.8	0	4.3
For multiple reasons	86.7	63.3	100	76.3

N-Number of respondents, HH-Household, Values in the body are percentages of the

households under the respective category across columns

4.3. Reproductive performance of goats

Age at first mating for either sex, the age at which does give birth for the first time, the period between two consecutive kidding and the total number of kids born per kidding obtained from the interviewed sample households in the study area is presented in Table 24.

4.3.1. Age at first mating

There is no significant difference in age at first mating of does among the two agro-ecologies though there was significant difference ($P < 0.05$), in age at first mating of bucks among agro-ecologies, the lowland area goats are significantly late in age at first mating than the rest.

Table 24. Mean reproductive performance of goats in the study area

Parameters	Agro-ecologies			
	Highland	Midland	Lowland	Overall
	(N=30) (Mean±S.E)	(N=90) (Mean±S.E)	(N=30) (Mean±S.E)	(N=150) (Mean±S.E)
Age at first mating (female) (months)	7.37±0.09	7.21±0.04	7.40±0.09	7.28±0.04
Age at first mating (male) (months)	8.30±0.09 ^a	8.44±0.06 ^a	8.77±0.10 ^b	8.48±0.05
Age at first kidding (months)	14.77±0.08 ^b	14.60±0.05 ^b	14.30±0.12 ^a	14.57±0.04
Kidding interval(months)	7.53±0.09 ^b	7.00±0.00 ^a	7.00±0.00 ^a	7.11±0.03
Average litter sizes (single, twin, triplets)	1.50±0.09	1.49±0.05	1.60±0.09	1.51±0.04

Mean values with different superscripts^(a,b) across rows are significantly different ($P < 0.05$),

N-Number of respondents, SE-Standard Error

4.3.2. Age at first Kidding

There is significant difference ($P < 0.05$), in age at first kidding among the different agro-ecologies of the study area in particular the difference occurred in lowland area goats i.e. the lowland area goats are significantly shorter in age at first kidding than the midland and highland areas, where as the latter two areas goats did not significantly ($P < 0.05$), differ in age at first kidding.

4.3.3. Kidding interval and litter size

There is also significant difference in kidding interval among the different agro-ecologies of the study area in particular the difference in kidding interval occurred in highland area goats

i.e. the highland area goats are significantly longer in kidding interval than the midland and lowland areas goats, where as the latter two areas did not differ in kidding interval. There was no any significant difference in litter size of goats which are found in different AEZ.

4.4.Productive performance of goats

The results pertaining to the mean body weight change of kids, the mean body weight at birth and the mean daily pre-weaning body weight gain, the effect of fixed factors on birth weight and pre-weaning mean daily weight gain and survival rate of Arsi-Bale kids under traditional management are presented in this topic.

4.4.1. Pre-weaning Growth performance

There was variation in the mean body weight of kids(irrespective of sexes) starting from birth to sixty day(figure 3).

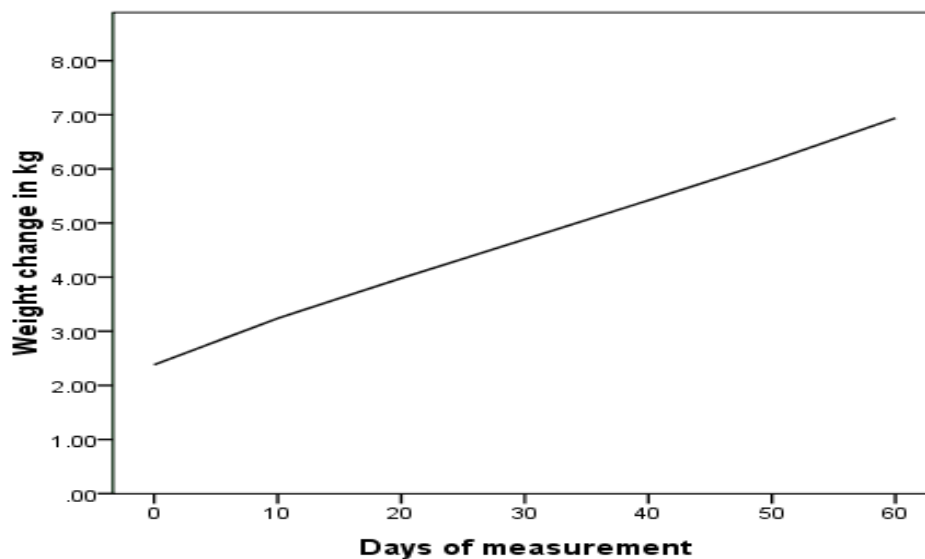


Figure 3. Mean body weight change of kids up to two months in the area. The results as presented in Table 25, indicate mean birth weight of Arsi-Bale kids(irrespective of sexes) in the present finding was 2.38 ± 0.1 kg. The birth weight of kids that were born from first parity does(irrespective of sexes) was significantly lower($P < 0.001$) than those kids that

were born from second and above parity does. while birth weight of kids that were born from the sixth parity does(irrespective of sexes)was significantly heavier($P<0.001$) than those kids that were born from first,second,third, fourth and fifth parity does. whereas kids born from second and third parity does did not significantly($P<0.001$) differ in birth weight.

Table 25. Effect of parity, type of birth and sex on birth weight and Average Daily Weight Gain(ADWG)

Variable	KBW(kg)		Pre-weaning ADWG(g/d)	
	N	Mean±S.E	N	Mean±S.E
Parity		***		**
1	12	1.64±0.1 ^a	9	60.8±4.9 ^a
2	13	2.26±0.1 ^{ab}	12	76.9±4.1 ^{ab}
3	7	2.57±0.2 ^{ab}	7	77.6±7.4 ^{ab}
4	9	2.60±0.2 ^{bc}	8	82.7±4.9 ^{ab}
5	13	2.58±0.1 ^b	13	65.5±4.1 ^a
6	6	3.37±0.2 ^c	6	92.1±5.9 ^b
Type of birth				
Single	17	2.70±0.1 ^b	17	84.3±3.6 ^b
Twin	40	2.45±0.1 ^b	38	68.9±2.4 ^a
Triple	3	1.20±0.1 ^a		
Sex Male	27	2.49±0.1 ^b	26	78.1±3.5 ^b
Female	33	2.29±0.1 ^a	29	73.7± 2.6 ^a
Overall	60	2.38±0.1	55	76.2±1.9

Mean values with different superscripts(^{a,b,c}) across columns are significantly different

***($P<0.001$), **($P<0.01$),N-Number of observations, KBW-Kid Birth Weight, Kg-Kilograms,

ADWG-Average Daily Weight Gain, g/d-grams day, SE-Standard Error

The table further indicates that there was no significance difference ($P < 0.001$) in birth weight of the single born and the twins, however the triplets have significantly lower ($P < 0.001$) birth weight than the former two types. The effect of sex too indicated that the buck kids were significantly heavier ($P < 0.001$) than the doe kids.

The average daily weight gain of Arsi-Bale kids (irrespective of sexes) in the present finding was 76.2 ± 1.9 g/d as indicated in Table 25. Kids that were born from first and fifth parity does yielded significantly lower ($P < 0.01$) average daily weight gain than kids born from second, third, fourth and sixth parity does. Kids that were born from the sixth parity does yielded significantly heavier ($P < 0.01$) average daily weight gain than kids born from first, second, third, fourth and fifth parity does. whereas kids born from second, third and fourth parity does did not significantly ($P < 0.01$) differ in average daily weight gain. Kids that were born in single were significantly heavier ($P < 0.01$) in their average daily weight gain than twin. Average daily weight gain of males were significantly heavier ($p < 0.01$) than females.

4.4.2. Survival rate of Arsi-Bale kids under traditional management

From total monitored goats 55 kids (91.67 %) survived while 5 kids (8.33%) were died. The proportions of kids died with parity were; three from parity one, one from parity two and one from parity 4 were died for unknown reason. Generally the trend in figure 4, shows kids from first parity does had lowest survival rate than kids from second and above parity does. Twin born kids and female kids had lowest survival rate than kids from single born kids and male kids respectively in the study area.

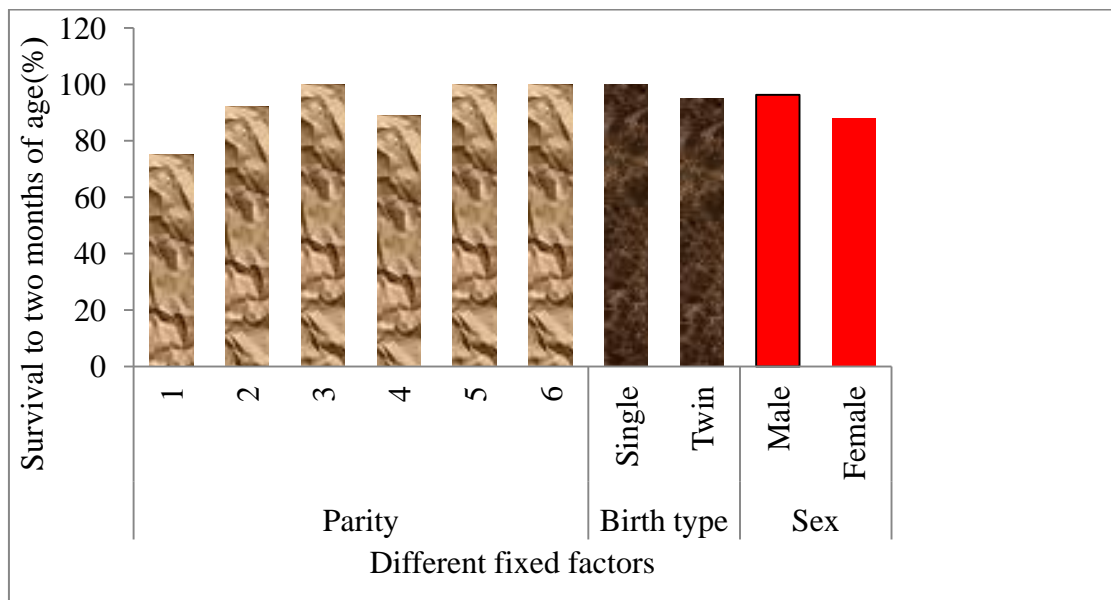


Figure 4. Effect of fixed factors on Survival rate of Arsi-Bale goats

4.5. Offtake rates of Arsi-Bale goats in the study area

The flow of goats in and out of the flocks at household level during the reference period of one year is presented in Table 26. There was significant variation between studied location in average number of goats flowing in and out of the flock. The contribution of birth for flock growth or restocking was higher in the midlands as compared to the highlands and lowlands. While purchases accounted higher for goat inflow in the highlands. In terms of outflow combination of sale, death and slaughter accounted higher in the lowlands than highlands and midlands. Sale only accounted larger for goats outflow in the midlands. The major factor for outflow of flock in the study area was through combination of sale, death and slaughter which is followed by sale only. In the study area, the major means of replacing goats which are lost in various ways was home born followed by replacement through purchase. In the current study,

the contribution of gifts and exchanges for both inflow and outflow of goats at household level was worthless.

Table 26. Route of goats flock entry and exit in Agarfa district(%)

Routs	Agro-ecologies			
	Highland (N=30)	Midland (N=90)	Lowland (N=30)	Overall (N=150)
Entry Ways				
Home born	71.4	96.1	72.4	85.8
Purchase	28.6	3.9	27.6	14.2
Exit Ways				
Sale only	14.3	47.8	3.4	27.6
Death only	4.8	10.4	0	6.1
Slaughter only	28.5	6.3	0	9.1
Sale + death	4.8	4.2	3.6	4.1
Sale + Slaughter	33.3	14.6	3.4	15.3
Death + Slaughter	0	2.1	10.3	4.1
Sale + Death + Slaughter	14.3	14.6	79.3	33.7

N-

Number of respondents, Values in the body are percentages of the households under the respective category across columns

The offtake for commercial and non-commercial purposes by households (average gross offtake rate), Acquisitions from commercial or non-commercial sources by the households(net offtake rate) and the supply of live goats by the households to the market(commercial offtake rate) across the agro- ecologies were about 21.2%,18.8% and 16.6% respectively. Significantly higher offtakes were observed in lowlands as compared to the other agro-ecologies.

4.6.Constraints and Opportunities of Goats Production

4.6.1. Constraints of goats production

As indicated in Table 27, diseases and parasite infections which was especially caused by infestations of ectoparasites was the major and bottleneck production constraint followed by drought because of shortage of rainfall even during rainy season and its result feed shortage. Lack of technologies such as the less accessibility of supplementary feeds to solve the feed shortage, labor shortage for herding is a problem of dry season when students are at school, and problem of marketing in terms of market distance, seasonal price fluctuation and lack of optional market outlet.

Table 27. Major constraints of goats production in the study area

Constraints	Rank of HH response(N=150)			Weight	Index	Rank
	1 st	2 nd	3 rd			
Diseases and parasite infections	41	30	22	205	0.28	1
Drought	40	42	10	214	0.29	2
Feed and grazing land shortages	15	35	23	138	0.19	3
Lack of technologies	13	20	30	109	0.15	4
Labor shortage	5	15	0	45	0.06	5
Predators	3	2	0	13	0.02	6
Marketing problem	1	2	0	17	0.01	7
Total				727		

N-Number of respondents, HH-Households; Values in the body are numbers of the households under the respective category across rows

4.6.2. Opportunities of goats production

The interviewed households reported that the district has permanent water sources and natural vegetations which are growing widely and found not at specific site. Especially in the lowland area the problem forces the farmers to practice subsistence farming and still supported by the safety net program of the government to achieve their day to day food demand. Therefore, the existence of large marginal and degraded land in some portion of the area can be taken as a great opportunity of goats production, if the extension system supports forage development (specifically feed conservation during excess time) and, the land is managed properly. As respondents indicated, the immediate return in goats production can be also taken as opportunity for farmers to mitigate their existing problem.

Availability of Agarfa ATVET College in the district and presence of various organizations involved in minimizing the economic, social and cultural problems of the district such as United Nation Development Program(UNDP),Agricultural Growth Program(AGP) and Oromia Credit and Saving Share Company (OCSSA) are also some opportunities to be engaged in goats production in Agarfa district. Young male flocks have huge demand by the export abattoirs. With the increased competitiveness in the market, farmers have bright future to change their living condition if they produce goats in adequate quality and quantity. The establishment of slaughtering and meat processing facilities in different parts of the country and the increment in price of goats can be also taken as an opportunity to engage in goats production.

5.DISCUSSION

5.1. Household resources

As shown in Table 4, most of the sample household heads in Agarfa district were Muslim followed by Orthodox Christians and Protestant and this is comparable to the value reported for Alaba district of SNNPR which had a higher proportion of Muslim(Tsedeke, 2007).

The literacy rate(82%) as observed in this study was higher than reports in Alaba district of SNNPR (Tsedeke, 2007). This might be due to the existence of farmers training center in the district. The observation are in close accordance with those of (Endeshaw, 2007; Belete, 2009) in Dale and Goma district respectively.

The average land holding per household(2.3 ± 0.13 ha) across all the studied agro-ecologies was more or less similar to what was reported by Tsedeke (2007). Whereas lower land holding have been reported by Belete (2009). The farmers having high land holdings can allot some of their lands for private pasture land besides can have high amount of crop residues which can help in tide over the fodder scarcity. The respondents with small land holdings on the other hand need to be specifically imparted the skills for storage of fodder, which to some extent can help to minimize the fodder scarcity.

As observed in this study there is no significant difference in mean number of cattle holding among the agro-ecologies. This could be due to the importance of cattle among the studied agro-ecologies. The present finding also indicated higher flock of goats in the lowland which might be attributed to the preference of the rearers and the ability of goats to survive and perform under harsh environmental conditions. The observation are similar with those of (Tesfaye, 2007; Demissie *et al.*,2014)

The rearing of goats as a source of income (Table 6) is similar to those reported by several authors from different parts of the country (Endeshaw, 2007; Tsedeke, 2007; Demissie *et al.*, 2014).

Goats slaughtering occasions consumption are in agreement with findings of Tsedeke (2007) and Belete (2009) who reported many of the households consume meat during festival times. This might be because the carcass of the goats is small and can be consumed in a meal or at most in a day as refrigeration of meat is not possible in the rural areas due to lack of infrastructure and refrigeration equipments.

The overall mean slaughtering age obtained in the present study which is 10.61 ± 0.25 and 11.54 ± 0.234 months respectively for male and female goats is relatively higher than the findings of Tsedeke (2007) who indicated that slaughtering age of male and female goats in Alaba district were 7.1 and 7.4 months, respectively. While it is lower than reports of Dereje *et al.*, (2014) for (Bati, Hararge Highland and short-eared Somali) goats which was (12.9, 16.9 and 22.9) months respectively.

The study also indicates that drinking of goats milk is quite common in the study areas, the findings are also in agreement with those of Tsedeke (2007) and Getahun (2008). In Ethiopia it has been reported that there is an increase in tendency of consuming milk of small ruminants as it is becoming difficult to rear large ruminants especially under shrinking land holdings (Adane and Girma, 2008). However, contrary to the present findings, Belete (2009) reported that milk of does is not utilized by the agrarian community in the Goma area. The difference as observed may be attributed to the high average goats holding per household in the study district.

5.2.Goats Husbandry Practices

The importance of natural pastures as an important source of fodder has been reported by several authors in the past (Tesfaye, 2009; Belete, 2009; Tsedeke, 2007). However, with shrinkage of pastures the respondents prefer to rear livestock with different feeding habits, as goats are browsers they consume the plants which are generally not consumed by grazers.

According to the current result, the reason for keeping goats alone is due to their browsing behavior, especially in the degraded pasture lands where they less compete with the other livestock, the observations are in close accordance with Belete (2009).

In dry season most(98.7%) of respondents in the study area practice free grazing and the result concur with the findings of Tesfaye (2009) who reported that extensive system of grazing is the only grazing practice in Metema district of North Gondar Zone. However, Belete (2009) observed that while extensive grazing was common in the wet season most of the respondents either tether their livestock or practice cut and carry system for feeding their livestock, this is primarily because of shrinkage of grazing land in the area studied.

The observation are in close accordance with Belete (2009) and Endeshaw (2007) who reported that the major water source for small ruminants in Goma and Dale district is river. The presence of an all weather water source like river or springs are preferred over seasonal water sources by all communities. However, rivers can also be a source of contamination especially if diseased carcass are disposed off upstream, moreover spread of diseases and parasites can commonly occur from such sources. Hence, care should be taken by the farmers to vaccinate and provide antihelmenthics to their animals at regular intervals.

The distance travelled to reach the watering points vary from location to location(Table 12). Studies by Endeshaw (2007) indicated that the distance travelled was significantly higher in the

dry season than those observed in this study, while the reverse was true during the wet seasons. This may be attributed to seasonal watering points like ponds in the location studied.

The frequency of providing water to the goats as observed in the study (Table 13) is in close accordance with finding of Tesfaye (2009) and also Endeshaw(2007).

However, it was also observed by Tesfaye (2009) that during the wet season the farmers in the studied location allowed water adlib to their flocks. Water is one of the important nutrients much needed for all biological activities and hence limiting its availability can have serious consequences on the well being of an animal and also affect its production and reproduction ability. Therefore, the respondents need to be made aware of the water conservation methods which can ensure adequate availability of this important nutrient all the year round. In doing so they can ensure that optimum productivity can be obtained from their livestock(Collar *et al.*, 2000).

Lack of separate houses for the livestock can have zoonotic implications where diseases and parasites can be transmitted from the goats to their owners, besides the feces and other excretions from the goats can also have additional health related implications, the observations are in close accordance with the findings of FARM-Africa (1996) and also Tsedeke(2007). This might be attributed to the local tradition is that, sheep and goats survive less in the absence of smoke from the house fire as understood from key informant farmers during group discussion.

However, contrary to the present findings, Tesfaye (2009) reported that most of the respondents in the cotton based farming system and some of the farmers in the sesame based farming system have a tradition of housing their goats in a separate hut with a slated wooden floor.

This result regarding the materials used for goats house construction are in accordance with respondents in other parts of the country (Endeshaw, 2007; Yenesew, 2010). The use of mud floor at one end is beneficial as it easily soaks up the urine thereby keeping the room dry, however there are also chances of contamination in case of any communicable diseases besides the cracks are safe places for the external parasites to hide. Similarly the thatched roof on one hand is easy and cheap to construct, however such roofs are prone to hazards associated with fire and can also harbor snakes and other types of reptiles which can be potentially hazardous to the goats and their owners alike(Shumba,1994). The respondents may have preferred the thatched roof because it is cheaper to construct and repair as all the materials used in its construction are locally available.

The results pertaining to the general cleaning practices of the goats houses indicated that most of the respondents ensured at least a certain degree of hygiene was being maintained for the goats houses which was appreciable. Cleanliness of the livestock houses are needed to prevent the spread of any communicable diseases and is generally good for the livestock and their owners alike. The present observations regarding the pattern of cleanliness is in close accordance with those reported by Yenesew (2010).

However, the findings from Table 17 indicate that most of the respondents are not quite aware of the importance of early weaning, the overall values are lower than reported by Tsedeke (2007).

The result pertaining to the practice of castration indicated that the respondents were aware of the importance of castration, the findings are in accordance with that of Tsedeke (2007) from Alaba district. However, the age and methods of castration varied across the agro-ecologies. The respondents are to be made aware about the importance of castrating the buck kids at an

early age and that too using the castrator. The respondents too need to be appraised on the hygiene to be maintained to prevent infections in case of open method of castration.

The study further indicates that most of the respondents in the lowlands prefer to use the burdizzo castrator, which is in consonance with the findings of Belete (2009). In contrast to the present findings a study by Tsedeke (2007) indicated that traditional methods of castration are prevalent among the respondents in Alaba area.

The reasons for castration as informed by the farmers was basically for fattening which is in consonance with the findings of Tsedeke (2007). The findings in Table 20 indicate that the respondents select their goats based on body length and height. Bucks and does with large body length and height are preferred by the respondents. This is in line with the objective of rearing the goats i.e. for income generation. Animals with large skeletal structure are expected to have a higher body weight thereby fetching higher price which are in accordance with findings of (Tsedeke,2007;Belete, 2009 and Yenesew, 2010). However animals which have larger body length and height usually will need a higher maintenance ration and need to be properly fed to achieve optimum reproduction and production potential.

The importance of the native genotypes by the respondents may be because of the native breeds have better adaptation when compared to the crossbreds or may be the respondents were not quite aware of the production attributes of the crossbred animals, the findings are in close accordance with those of(Tsedeke,2007 and Demissie *et.al.*,2014). The observations for white with patchy coat color over complete white and other solid colors indicates that it may be deliberately selected. While white color can attract the predators, but importance of white coat color in the lowlands may be attributed to minimizing the thermal stress. The preferences of horned animals may be attributed to aesthetics and also because such animals will be able to

protect themselves and their kids against predators , the findings are in close accordance with the observations of (Tsedeke,2007 and Demissie *et.el.*,2014).

The major reason for culling goats in the area coincides with the results of Tsedeke (2007) and Belete (2009) and who reported in Alaba and Goma area one of the reasons for culling small ruminants was old age. The importance of culling does with poor fertility rates, such as older does that are no longer reproducing and unhealthy ones are may be to increase the income generation activity there by the profitability. Major kidding season of goats in Metema district and in Enebse Sar Midir district is similar with the finding of the present study(Tesfaye, 2009 and Demissie et al.(2014). Because as indicated in Table 8 goats in the area obtain surplus feed resources from the month of June-October and January, thus, adequate nutrition for reproductive process and access to breeding males creates favorable situation to the reported intensive flock breeding. In the current study, external parasites, particularly ticks and mange mites in the area have significant health problem. Ticks suck blood thereby reducing the condition and productivity of goats and they can also predispose the animals to tick-borne diseases. The observation is similar with the report of several authors viz(Adugna and Aster,2007; ESGPIP,2007 and Schoenian, 2007).

The availability of veterinary care as indicated by the respondents is better than those reported from Alaba district where most of the respondents indicated the use of ethno veterinary methods of treating the sick animals(Tsedeke,2007). The incidences of branding of the sick animals is also lower than those reported by Tsedeke (2007) and Belete(2009) from Alaba and Goma district. The lower incidences as observed is an welcome step as it is expected that the quality of the skin of these animals will be of better quality and also indicates that they are better aware of the improved husbandry practices and avoid superstition. The findings from

Table 22, indicate that the respondents face shortage of labor pertaining to the daily husbandry practices for their livestock, this is particularly true for activities such as herding and taking the goats for watering. The constraint as indicated in the study are higher than those reported by several authors viz (Tsedeke, 2007; Belete, 2009 & Demissie *et al.*2014).

5.3. Reproductive performance of goats

Finding from table 24, indicate values for the average age at first mating for both male and female goats are relatively earlier than reports of Adugna and Aster(2007). This is may be due to variation in agro-ecology of the two areas. The age at first Kidding(14.57 ± 0.044 months) obtained in this study is in accordance with the values reported by Wondwosen (2007), Endeshaw (2007) and Tesfaye(2009) from Dalocha, Dale and Metema districts, indicating that the values are attributable to breed character. The age at first kidding as observed is higher than those reported by Tsedeke (2007) from Alaba district and Belete (2009) from Goma district. The differences may be attributed to variation in the breed and also on genotype X environmental effects.

The average kidding interval(7.11 ± 0.025 months) observed in the present study was comparable with the reports by Belete (2009). However, higher values for the trait have been reported by Wondosen (2007), Endeshaw (2007) and Tesfaye (2009) from Dalocha, Dale and Metama districts, the differences may be attributed to both genetic and non genetic factors. While, lower kidding intervals are desired because the lifetime productivity of the goats are expected to be higher and is more profitable (Awemu et al., 1999). However, it is slightly longer than those reported by Tsedeke (2007).The differences observed may be attributed to changes in breed and management of the goats in the study area. The average litter size(1.51 ± 0.041) in the area indicates that the does are moderately prolific and the values are

relatively higher than those reported for Dale and Dalocha district goats types by Endeshaw (2007) & Wondwosen (2007). However, higher prolificacy have been reported by Tsedeke (2007) & Belete (2009) from Alaba and Goma districts. This could be due to both genetic and more of non genetic factors.

5.4. Pre-weaning Growth performance and Survival Rate of Kids

The results in table 25, indicate that the average birth weight ($2.38 \pm 0.1 \text{Kg}$) of the kids irrespective of the sex is in accordance with those of Tesfaye (2009) and Alula *et al.*, (2014) from Metema and Adamitulu Jidokombolcha districts, indicating that it may be a breed effect and the birth weights are appropriate for many tropical breed of goats. However, it is lower than the report of Zeleke (2007), for Somali goats raised at Haramaya university farm was 3.19 kg, which might be attributed to better nutrition available to the does and husbandry practices at the farm. In contrast to this, Wondwosen (2007) and Belay and Mengistie (2013) reported that the average birth weight of kids born at Dalocha district and Abergele goats of Sekota district was lower than the present findings. The study further indicates that male kids were heavier at birth ($2.49 \pm 0.1 \text{Kg}$) when compared to the doe kids ($2.29 \pm 0.1 \text{Kg}$). The observations are in accordance with the findings of Banerjee and Jana (2010) and Ukanwoko *et al.* (2012) who indicated that differences due to sex were significant ($P < 0.05$) in Sirohi and South Eastern Nigeria Goats, respectively. This may be due to sexual dimorphism where androgen in males stimulate skeletal growth and muscular developments when compared to doe kids. The result of the present study pertaining to the effect of parity on the birth weight of the kids is in consonance with the results of Alula *et al.*, (2014) who reported that birth weight was significantly ($P < 0.001$) influenced by the parity of the dam and the type of birth for Arsi-Bale goats in Adamitulu Jidokombolcha district. This may be because the young doe may not

attained her mature body and organ weights and therefore the nutrition available may not be sufficient to maintain the weight of the growing fetus and that of the doe. The results of a study by Banerjee and Jana(2010) also indicated that the single born kids were heavier than the twins and the triplets in Sirohi Goats kids reared in hot and humid climate of west Bengal. The probable reason for heavier birth weights of single born kids is due to absence of intra-uterine nutritional and space competition in single born kids unlike that of twin born kids. The average pre-weaning daily weight gain of the kids as observed in this study ($76.2\pm 1.9\text{g/day}$) concur with the results of Wondwosen (2007) in Dalocha district goats. This reflects optimum growth of the kids at the pre-weaning stage ensures its survivability and also prepares itself to face the weaning stress of the kids.

The average pre-weaning daily weight gain as observed in the study was relatively higher than the result of Zeleke (2007) and Belay and Mengistie (2013) for Somali goats reared at Haramaya university farm and Abergele goats respectively. The overall average daily weight gain of the kids in the present study was lower than those reported by Tesfaye (2009) in Metema district goats. The variation in pre-weaning weight gain might have been emanated from differences of the fixed effects of the goats. The parity of dams had influence ($P<0.01$) on the pre-weaning daily weight gain of kids. Kids that were born from first and fifth parity does yielded significantly lower ($P<0.01$) average daily weight gain than kids born from second,third,fourth and sixth parity does. The significant influence of parity of dam on pre-weaning daily weight gain of kids is in compliance with the findings of (Zeleke.2007; Belay and Mengistie,2013 and Demissie *et al.*,2014). Single born kids gained significantly ($P<0.01$) higher daily weights as compared to twins, which is in consonance with the findings of (Belay and Mengistie,2013 and Demissie *et. al.*,2014). The higher daily weight gains attained in single

born kids is due to relatively higher amount of milk consumed per kid as there is no competition for dam's milk. In the current work, male kids gained higher ($P < 0.01$) daily weights as compared to female kids. This is in compliance with the results of several authors viz(Zeleke,2007; Belay and Mengistie,2013 and Demissie *et al.*,2014).This is a natural phenomenon that male kids grow faster than females, as their mature weight is also heavier.

The mortality rate of kids as observed in the present study (8.33%) was relatively lower than the findings of Hailu *et al.*, (2006),Girma *et al.* (2011) and Alula *et al.*, (2014) who indicated that mortality was higher among the kids with low birth weights for the same goat breed. The possible reason for incidence of pre-weaning mortality rates in kids born from fifth parity dams in the present finding may be due to unsuitable uterine environment for the proper growth of the fetus. The decline of pre-weaning mortality rate in the study presently might be due to better management. As it was explained in the group discussion, restriction of kids to run with their mothers at earlier stage was practiced.

5.5. Offtake rates of Arsi-Bale goats in the study district

The observations pertaining to the offtake of the goats are in close accordance with those of Endeshaw(2007) and Belete (2009). The relative higher outflow through sale of goats indicates that rearing of this animals is a viable employment option in the study area, however if the mortality of the does minimized can further improve the offtake from the sales of the goats and thus add to the profitability of the farmer. The present observations are however not in accordance with the observations of Tsedeke(2007) who reported that the major exit of the goats from the flock is due to high mortality. Further the results indicating that most of the replacement of the flocks are linked within house birth, which is in accordance with the observations of Tsedeke(2007) and Endeshaw(2007). In one way is good as the respondents

are self sufficient in the goat enterprise, however it also indicates that the flock may be inbred and therefore there will be problems associated with inbreeding in the long run.

The gross offtake rate obtained in this study (21.2%) was relatively lower than reports of Dereje *et al.*, (2014) and Belete(2007) which was 35 and 35.53 percent for the three goats types in Bati, Meta, and Kebri-Beyah and Goma district goats respectively. This might be because disposals for commercial and non-commercial purposes are not significant in the area. But gross offtake rate is relatively higher than the reports of Samuel(2005) and Tsedeke(2007). The net offtake rate in the current study(18.8%) was higher than the value reported by Tsedeke(2007) which was 9.1%. This could be because inflows are significant in the study district. Commercial offtake rate obtained in this study(16.6%) is relatively lower than the reports of (Dereje *et al.*, 2014) from goats raised at Bati, Meta, and Kebri-Beyah districts. However, the values are higher than the reports of Tsedeke (2007) from Alaba district. The lower commercial offtake rate in the study area may be attributed to poor marketing of livestock in general and goats in particular as most of the sales is by and large informal as the primary sale usually takes place at the farm gate and the animals usually exchange several hands before being slaughtered and thereby again a few hands before they finally land up on the table for consumption. Furthermore by unfair increment of livestock entrance tax to the local market Agarfa, enforce the respondents to sell their livestock illegally outside the market premises. Even though the major purpose of keeping goats is for sale in the study district, sales are sporadic based on immediate cash needs and goats are kept for multiple functions.

This concur with the finding of Tsedeke, (2007) who reported that the farmers prefer to sell sheep and goats at farm gates or the nearest local/primary markets.

5.6.Constraints of Goats Production

The present study revealed disease and parasite, drought and shortage of feeds were the major identified constraints of goats production in the area. The result reflect disease which is caused by the infestation of external and internal parasites and also shortage of feed due to the frequently recurring drought in the area is a major challenges to goats production. Solving the districts livestock health problem by the existing poor health care capacity(vet-post and personnel) is impossible, it requires attention for improving the health service to attain the full potential expected from Arsi-Bale goats resource of the district. Drought caused by recurring rain failure in the area and shortage of feed resources as a result of drought and also because of conversion of available grazing lands into crop cultivation as of early July. As clearly indicated in the group discussion, to cope up the problem respondents(mainly midlands) practice livestock mobility to river basins found in the lowland AEZ of the district and turn back to homestead around January when there is crop residue and crop aftermath to avoid crop damage by livestock mass while the cattle of the lowland AEZ respondents stay almost all over the year in the field where they settle. These is in agreement with the findings of Tesfaye (2009) who reported that disease is the major constraints of goats in Metema district goats. Similarly Tsedeke (2007)explained that diseases and parasites are overriding constraint in sheep and goats production followed by feed and nutrition in Alaba district goats. Furthermore the result concur with the results of Endeshaw(2007), Wondwosen(2007) and Yenesew (2010) who reported that disease and feed shortage are the major goats production constraints in Dale, Dalocha and Burie district respectively. Belete (2009) reported in accordance to the result of the present study feed and grazing land shortage were the most limiting constraint in small ruminant production in Goma district followed by disease and parasite.

6. SUMMARY AND CONCLUSION

Goats are multi-purpose livestock, reared in different parts of the globe for their meat, milk and fiber besides playing several socio-cultural roles.

With these facts, this study was conducted to assess the husbandry practices and reproductive performance, to evaluate the productive performance and estimate offtake rates and also to identify the major constraints and opportunities of Arsi-Bale goats production in Agarfa district. Household survey was carried out on respondents selected randomly from three agro-ecologies. Besides, on-farm monitoring of growth performance of Arsi-Bale kids owned by farmers was undertaken. Data collected were analyzed using SPSS v17.0 for Windows, qualitative traits were analyzed using frequencies and percentages and also chi-square test, The data of livestock holding and reproductive traits were evaluated using one-way ANOVA, an index was calculated to provide ranking, general linear model was used for estimation of the magnitude of the effect of fixed factors and the difference between means was separated using Tukey HSD test. Survival rate, pre-weaning mortality rate and offtake rates were computed on percentage basis.

Results pertaining to the household characteristics indicated that goats were the most widely reared livestock species only next to that of cattle population. Purpose of keeping goats in the area was for income source followed by for meat purpose and socio-cultural values. The study also revealed that the major feed and water sources were natural pasture and river water respectively. A house attached with the main house was most widely used housing system in the area. Small proportion of farmers practice weaning of kids to maintain body condition of dams. Mostly, castration was performed not to avoid unwanted breeding; rather it was done to fatten and sale goats. The basis for selection of goats for fattening is with body length and

height of goats. Culling of goats was done mostly when goats become old in age. The practice of deliberate selective breeding for increasing productivity of goats was not common. Predominantly uncontrolled mating was reported by respondents in the study district. Most of the kidding in the study area were observed to be from September to November. The study further indicated, age at first kidding and Kidding interval showed significant variation among agro-ecologies of the study area. The study also showed overall mean birth weight, two month weight of kids and mean average daily weight gain were close with findings of others. The birth weight of kids that were born from first parity does (irrespective of sexes) was significantly lower ($P < 0.001$) than those kids that were born from second and above parity does. The triplets had significantly lower ($P < 0.001$) birth weight than twins and triple born kids. The effect of sex too indicated that the buck kids were significantly heavier ($P < 0.001$) than the doe kids. Kids that were born from first and fifth parity does had significantly lower ($P < 0.01$) average daily weight gain than kids from second, third, fourth and sixth parity does. Single born and male kids had significantly heavier ($P < 0.01$) average daily weight gain than twins and female kids. The commercial offtake rate value of goats obtained in the present study was around seventeen percent. Disease and parasites and drought were reported to be the two major constraints of goats production in the area.

From the study, it is concluded that in comparison to previous findings the traditional husbandry practice of the area with regard to feeding management, breeding management, health management, housing management, castration and culling practice needs improvement. The reproductive performance of goats with regard to age at first mating, age at first kidding, kidding interval and litter size was fairly encouraging when compared to previous findings in other parts of Ethiopia. Even though the reproductive and productive performance of goats are

within satisfactory ranges the benefits obtained from goat production in terms of cash, meat, and milk is low due to low offtake rates and production constraints.

Therefore, to improve the husbandry practices appropriate development intervention should be made by providing training on appropriate forage and feed conservation development strategy, goat house construction according to its specification, importance of early weaning of kids, selection of desirable traits based on market claim and other demand driven and need based trainings. Respondents in the area should keep their does from unwanted mating by tethering, castration of the low-grade bucks, keeping unselected bucks separately and selling of inferior bucks. This practice could be used by starting community based breeding program and retention of selected bucks in the study district. Whereby breeding bucks(selected) could be shared by a number of households in organized group.

Reproductive performance of goats in the area could be further improved through appropriate strategies of husbandry practices. To improve the pre-weaning growth performance and survival rate of kids from first parity does and above, decision on age and body weight at first mating and supplementary feeding practices for pregnant and lactating first parity and multiple kids bearing does should be practiced. To increase the supply of live goats to the local market attention should be given to solve major marketing problems such as lack of access to market, price fluctuation of live goats and unfair livestock entrance tax to the local market Agarfa. An endeavor to improve the productivity of Arsi-Bale goats in the area should consider to solve the production constraints and marketing problems by exploiting the opportunities available for goats rearing in the area.

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8.APPENDICES

Appendix 1. The questionnaire

Section One: - General Information

I. Data collector

Name _____ Agro-ecology _____ Peasant As. _____ Village _____

II. Household Data

A. Demography, occupation and education level of the respondent

No.	Name of interviewee	Age	Sex		Marital status				Occupations				Educational level		Religion				
			1	2	1	2	3	4	1	2	3	4	1	2	1	2	3	4	
1																			
2																			

Code for the table

Sex: - 1. Male 2. Female Marital status: -1.Single 2.Married 3.Widowed 4.Divorced

Occupation: - 1. Farmer 2. Student 3. Trader 4. Unemployed

Educational level : - 1. Illiterate 2. Literate

Religion: - 1 Orthodox Christian 2. Muslim 3. Protestant 4. Others (specify)

B. Land holding and land use systems

1. Do you have land? a. yes b. no

2. If your answer is yes, how much land do you own? (In ha) _____

3. Do you have private grazing land? 1. yes 2. no

1. Why you keep goats? (Rank in order of importance)

No.	Purpose of keeping goat	Rank	No.	Purpose of keeping goat	Rank
1	Sale (income source)		6	Milk	
2	Meat		7	Skin production, others, specify	

2. What type of livestock species do you rear currently?

2.1.Cattle(no.)_____ 2.2.Goat(no.)_____ 2.3.Sheep(no.)_____ 2.4. Others_____

Section two: - Goat husbandry practices

A. Feed and water resources, seasonal calendars and feeding managements

1. What are the major basal feed resources of goats and their availability?_____

(in the table below put surplus, moderate and shortage across seasons)

AEZ	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Highland												
Midland												
Lowland												
Overall												

2. Do you feed crop residues to goats? (If the answer is no, go to question number 4)

1. yes 2. No

3. If your answer is yes, which type of crop residues do you feed to your goats? (Possible to give more than one answer)

1. Maize stover 2. Barley 3. Wheat straw 4. others_____

4. Do you graze goats? 1=Yes 2=No

5. How goat graze? 1=Sheep alone 2=Goat alone 3=both alone 4= With other livestock

6. How you practiced grazing your goats in the dry season?

1=Free grazing 2=partly kept/tethered grazing 3=fully kept/tethered grazing

7. How you practiced grazing goats in the wet season?

1=Free grazing 2=partly kept/tethered grazing 3=fully kept/tethered grazing

8. Is there feed shortage/constraint for goats? 1=Yes 2=No

9. If yes, when? 1=Dry season 2=Wet season 3=both

10. If there is feed shortage in your area, why? (Rank)

No	Reasons of feed shortage	Rank	No	Reasons of feed shortage	Rank
1	Shrinking and decline in productivity of grazing lands		4	Drought	
2	Increase of animal population		5	Others, specify	
3	Cultivation and settlement				

11. What are the common water sources of goat in this area?

Sources of water	River	Pond	Rain water	Water harvest	Deep well	Other Specify
Dry Season						
Wet Season						
Estimated distance(1hr=5kms)	Wet					
	Dry					

12. What is the watering frequency you practices for your goats?

Interval	Freely available	Once a day	Once in 2 days	Every three day	Other Specify
Dry Season					
Wet Season					

13. Have you ever encountered water shortage? 1. Occasionally 2. Always 3. Never

B. Goat houses and its construction materials

1. Where do you shelter the goats during the night? 1. in the main house 2. A house attached to the main house c. a separately constructed sheep and goat house d. other (specify)_____

2. Do you keep some goat groups separately from the others during the night? 1. Yes 2. No

3. What is the type of material you used for the roof of your goat house?

1. Corrugated iron 2. Grass 3. Other (specify)_____

4. What is the type of bedding material you use for floor of your goat house?

1. Earth 2. Stone 3. Wooden paved 4. Grass 5. Leaves 6. Straw 7. Other (specify)

5. Do you clean goat house? 1. Yes 2. No

6. If your answer is yes, how frequently do you clean goat houses during the dry season?

1. Daily 2. 1 time week 3. 2 times week 3. 3 times week. other (specify)___

7. If your answer is yes, how frequently do you clean goat houses during the rainy season?

1. Daily 2. 1 time week 3. 2 times week 3. 3 times week. 4. Other (specify)

8. How do you do it, just with a broom and collect the droppings or wash it with water and do you sprinkle lime/ ash as a mild disinfectant_____

C. Goats health management

1. What are the common diseases and parasites that affect health and production of goat?

No	Name of the disease	Symptoms of the disease
1		
2		

2. What would you do when your goats sick? 1. Treated at public clinics 2=Sales immediately

3=Slaughters immediately 4. Treat them by buying modern drugs from the market

5= treat them using traditional medicine 6=others, specify

3. From where you usually obtain veterinary services?

1=from private vet clinics 2. Buy from public vet clinics

3. Buy from groceries 4. From traditional healers 5. Other (specify)

4. Is the veterinary services easily accessible in your locality/near distance? 1=Yes 2=No

5. How did you obtain services from these institutions? 1=Free 2=Payment 3=Credit 4=others

6. Did your goats get vaccine in recent times? 1=Yes 2=No

7. If yes, how? 1=after report of disease cases 2=after animals has died 3=before outbreaks
8. Do you use medicines and drugs from open markets/illegal traders for goats? 1=Yes 2=No
9. If yes, why? 1=Cheap 2=Not accessible to veterinary center 3=others
10. If not use, why? 1=The medicines don'twork 2=DAs and health experts advised not to use
3=Expensive 4=Not accessible 5=others
11. Do you bleed and/or brand your sick goats with hot iron? 1=Yes 2=No
12. If yes, why? 1= Treatment of sick animals 2= to identification 3=others, specify
13. If not, why? 1= affects quality of skin 2= Reduce price of skin 3=others

D. Goats breeding and reproductive managements

1. Do you select your male and female animals for breeding purpose? 1=Yes 2=No
2. If yes, what is your criteria for selection?_____Which sex do you select?_____
3. Do you also have some type of progeny selection?_____
- 4.What type of mating do you use? 1= Controlled 2=Panmectic/uncontrolled?
- 4.1.If it is controlled then how is it practiced?_____
- 4.2.If panmectic/controlled, why?_____
5. What are the common sources of breeding males for your flocks?

No	Sources of breeding males	Ram	Bucks
1	Own		
2	Neighbors		
3	Others, Specify		

6. When (season/months) during the year you observe intensive kidding?

No	Species	Intense breeding and conception months									
		Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Ma	Jun
1	Kidding										

7. How is the reproductive performance of goats in your farm?

No	Attributes	GOATS	
		Female	Male
1	Age at first mating		
2	Age at first kidding (months)		
3	Kidding interval (months)		
4	Average litter sizes(single, twin, triplets)		
5	Slaughter age (months)/marketing age		
6	Others...		

E. Kid rearing, castration and culling

1. Do you practice weaning of kids? 1=Yes 2=No

2. If yes, average age at weaning _____ months

3. Do you practice castration of goats? 1=Yes 2=No

4. If yes, why?

1=To fatten and sale 2=To control unwanted breeding

3=To tame them 4=Others

5. At what age will you castrate your goats? Goat ___ years/months

6. How do you select goats for fattening? (Rank)

No.	Criteria for fattening goat selection	Rank
1	Conformation (height, length and appearance)	
2	Breed (known local ecotypes)	
3	Physical characteristics (color, horn, tail length and width, ear etc)	
4	Age	
5	Others, specify (_____)	

7. Do you offer specific feeding and other management practices for castrated goats?

1=Yes 2=No

8. What is the common method to castrate your goats? 1=Local methods (using stone, stick, metal) 2=Burdizzo 3=Others,Specify

9. Do you practice fattening of goats for targeted market seasons and market places? 1=Yes

2=No

10. If yes, which season/months (Rank)?

No.	Season of Market	Rank	No.	Season of Market	Rank
1	New Year festival		4	Meskel	
2	Easter		5	Ed Al Fetir	
3	Christmas		6	Arefa	
			7	others, specify	

11. Is there emerging opportunity of increased demand and incentive price for fattened goats?

1=Yes 2=No

12. Do you practice culling of goats from flock? 1=Yes 2=No

13. If yes, reasons for culling (rank)?

No.	Reasons for culling	Rank	No.	Reasons for culling	Rank
1	Old		4	Physical defect	
2	Sick		5	color	
3	Reproductive problem		6	Others, specify	

14. How you sale young male goats?

1=Sale all when reach to marketing age 2=Sale holding some for breeding

3=Sale holding some to castrate and fattening 4=Others, specify

F. Goats and their products utilizations

1. If you slaughter goats for home consumption, usually when?

1=For festivals 2=Whenever slaughter age animals available 3=Wedding 4=Births in family 5=Others, specify

2. Which sex of goats you usually slaughter and at what age? _____

1=Male Castrate 2=Female 3=Both

3. Is milking and use of milk and milk products from goats common in your area? 1=Yes 2=No

4. If yes for what purposes you usually use the milk? 1= for children 2= for adult

3=Processing 4=Medicine(against which disease &how) 5=Others, specify

5. If no, why? 1=Cultural taboo 2=Religious taboo 3=Not common in the area 4=Others

G. Offtake rate of goats

1.How many goats did you have in the past12 months? (specify by structure and total number)

No	Structure	Total number
1	Kids<6 months	
2	Males 6-12 months	
3	Females 6-12 months	
4	Does	
5	Bucks	
6	Castrates	

2. How many goats do you have now? (specify by structure and total number)

No	Structure	Total number
1	Kids<6 months	
2	Males 6-12 months	
3	Females 6-12 months	
4	Does	
5	Bucks	
6	Castrates	

3. How many goats you sold and purchased in the last 12 months and with how much cost?

SN	Structure	Sold				Purchased			
		No	When/ Months	Unit Price	Total Price	No	When/ months	Unit Price	Total Price
1	Kids<6 months								
2	Males 6-12 months								
3	Females 6- 12 months								
4	Does								
5	Bucks								

4. Has there been any birth, death and Slaughter of your goats over the last 12 months?
1=Yes 2=No

5. If yes, (specify total number)

S N	Structure	Birth		Death		Slaughter	
		No	Total	No	Total	No	Total
1	Kids<6 months						
2	Males>6-12 months						
3	Females>6-12 month						
4	Does						
5	Bucks						

6. Has there been any loans, gifts and exchange of your goats over the last 12 months?
1=Yes 2=No

7. If yes, (specify total number)

S N	Structure	Loans		Gifts		Exchange/others	
		No	Total	No	Total	No	Total
1	Kids<6 months						
2	Males>6-12 months						
3	Females>6-12 month						
4	Does						
5	Bucks						

8. Who decides the age and price of selling the goats?_____What is the nearest market?_____

H. Goats Production and productivity constraints

1. What are the major constraints that hinder production of goats in this area? (Rank in order of importance)

No.	Constraint/problems	Rank	No	Constraint/problems	Rank
1	Disease and parasites		7	Marketing problems	
2	Feed and grazing land shortages		8	Lack of supplementary feed	
3	Water shortage		9	Improper extension service	
4	Labor shortage		10	Poor breed	
5	Drought problem		11	Predators	

2. Do you want to expand goats flock sizes and production in the future? 1=Yes 2=No

3. If yes, what is your reason?

4. If no, why?

Section three:- Social, Cultural and Economic Characteristics

A. Gender, labor allocation and decision on benefits from goats

1. Do you encounter labor shortage in goat production? 1=Yes 2=No 1.1 If yes, which Season?

2. For what major tasks you face labor shortage?

3. How you overcome the labor shortage? 1=Hire laborer 2=Use family labor 3=Use fence

4=Keep turn by turn with neighbor 5=Others, specify

4. Labor division in goats rearing ?(tick in the box)

	Attributes	Husband	House wife	Sons	Girls	Hired Labor	Others, Specify
1	Herd and/or tether						
2	Feeding animals						
3	Take to water points						
4	Clean sheep and goat barns						
5	Take care of lambs and kids						
6	Take care of sick animals						
7	Fattening managements						
8	Construction of shelter						
9	Milk						
10	Sale animals						
11	Decides on use of income and benefits						

Pre-weaning growth rate and Survival rate monitoring checklist

1. Birth weight data record sheet at Agarfa Woreda

Woreda-----Peasant Association-----

Owner name-----

DID	BD	Dam dentition	Parity	TB	KID	Sex	KBW	KBC	Remark

DID=dam ID, BD= birth date (dd/mm/yy), TB=type of birth, KID= kid ID, KBW=kid birth weight and KBC= kid body condition at birth.

2. Body weight change record sheet of kids in Agarfa Woreda

Kid information					Kid body weight						Remark
DID	KID	Sex	KBW	TB	D10	D20	D30	D40	D50	D60	

D10- body weight at 10 day, D 20- body weight at 20 day-----

3 Survival rate record sheets of kids in Agarfa Woreda

Kid information					Number of kids died						Cause of death	Remark
DID	KID	Se	KBW	NKB	D10	D20	D30	D40	D50	D60		

D10- number of kids died at 10 day, D20-number of kids died at 20 day-----

LIST OF TABLES IN THE APPENDIX

Appendix Table 1. Conversion factors used to calculate Tropical Livestock Unit (TLU)

Livestock Type	TLU (Tropical Livestock Unit)
Weaned Calf	0.34
Bull and Heifer	0.75
Young bull	0.8
Cow and Ox	1.00
Sheep and Goat(young)	0.06
Sheep and Goat(adult)	0.13
Donkey (Adult)	0.70
Horse and mule	1.10
Chicken	0.013

Source: Storck, et al. (1991)

Appendix Table 2. Percentage of households target seasonal festivals markets

Target Market	N	%
New Year festival	29	22.5
Easter	61	47.3
Christmas	6	4.7
Meskel	12	9.3
Ed Al Fetir	13	10.1
Arefa	8	6.2

N-Number of respondents

Appendix Table 3. One way ANOVA test for livestock holding in different agro-ecologies

ANOVA						
Species	Source	Sum of Squares	df	Mean Square	F	P-value
Cattle	Total	1521.777	149			
	Between Groups	23.354	2	11.677	1.146	0.321
	Error	1498.424	147	10.193		
Goat	Total	540.066	149			
	Between Groups	210.187	2	105.094	46.832	0.000
	Error	329.879	147	2.244		
Sheep	Total	20.382	143			
	Between Groups	3.061	2	1.530	12.457	0.000
	Error	17.321	141	.123		
Horse	Total	165.908	148			
	Between Groups	89.328	2	44.664	85.153	0.000
	Error	76.580	146	.525		
Mules	Total	69.381	149			
	Between Groups	13.116	2	6.558	17.134	0.000
	Error	56.265	147	.383		
Donkey	Total	155.820	149			
	Between Groups	25.730	2	12.865	14.538	0.000
	Error	130.090	147	.885		
Chicken	Total	149.244	149			
	Between Groups	2.482	2	1.241	1.243	0.291
	Error	146.762	147	.998		

Appendix Table 4. One way ANOVA for reproductive traits and slaughtering age in AEZ

ANOVA						
Parameters	Sources	Sum of Squares	df	Mean Square	F	P-value
Age at first service of male goat(months)	Total	45.440	149			
	Between Groups	3.551	2	1.776	6.231	0.003
	Error	41.889	147	.285		
Age at first service of female goat(months)	Total	30.240	149			
	Between Groups	1.084	2	.542	2.734	0.068
	Error	29.156	147	.198		
Age at first kidding(months)	Total	42.693	149			
	Between Groups	3.427	2	1.713	6.414	0.002
	Error	39.267	147	.267		
Kidding interval (months)	Total	14.293	149			
	Between Groups	6.827	2	3.413	67.200	0.000
	Error	7.467	147	.051		
Average litter size(single, double, triplets)	Total	37.473	149			
	Between Groups	.284	2	.142	.562	0.571
	Error	37.189	147	.253		
Slaughter age of male goat(months)	Total	1405.793	149			
	Between Groups	766.471	2	383.236	88.118	0.000
	Error	639.322	147	4.349		
Slaughter age of female goat(months)	Total	1227.260	149			
	Between Groups	271.338	2	135.669	20.863	0.000
	Error	955.922	147	6.503		

Appendix Table 5. ANOVA for effect of different factors on KBW

Source	Type III Sum of				
	Squares	df	Mean Square	F	P-value
Total	22.507	59			
Parity	6.089	5	1.218	8.915	0.000
Birth type	1.756	2	.878	6.429	0.004
Kid sex	.014	1	.014	.099	0.754
Error	5.054	37	.137		

Dependent Variable: Kid birth weight

Appendix Table 6. ANOVA for effect of different factors on ADWG

Source	Type III Sum of				
	Squares	df	Mean Square	F	P-value
Total	14303.395	54			
Parity	3444.270	5	688.854	4.734	0.002
Birth type	1722.636	1	1722.636	11.839	0.002
Kid sex	11.694	1	11.694	.080	0.778
Error	5092.573	35	145.502		

Dependent Variable: Average Daily weight Gain

LIST OF FIGURES IN THE APPENDIX



Figure 1. Browse plant in the lowland area(left) and goats while moving to grazing lands(right)



Figure 2. Separated goats house(left) and its roof(right) in the Midland area of Agarfa Woreda

BIOGRAPHICAL SKETCH

The author of the present thesis, Behailu Samuel, was born in 1989 G.C in Addis Ababa, Ethiopia. He started his education at Bole elementary school and completed his secondary education in Model Secondary school and he continued his preparatory education in Bishoftu preparatory school, and then he joined Mekelle University in 2007 G.C and graduated with B.Sc. degree in Animal, Rangeland and Wildlife Sciences in 2009 G.C.

After graduation, from 2009 to 2010 G.C, he served at East Wolega Zone being Animal science officer and then he served as an instructor in the department of Animal production at Agarfa ATVET College. He also served as Dean of Students at the college from 2012 to 2015 G.C. Since July 2013 G.C, he joined the school of graduate studies of Hawassa University, as a candidate for Master of Science degree in Animal Production.