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**ON- FARM PERFORMANCE EVALUATION OF DORPER SHEEP BREED
CROSSES IN WOLAITA AND SILTIE ZONES, SOUTHERN ETHIOPIA**

MSc THESIS

BY

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DEPARTMENT OF ANIMAL PRODUCTION STUDIES

MSC PROGRAM IN TROPICAL ANIMAL PRODUCTION AND HEALTH

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**ON- FARM PERFORMANCE EVALUATION OF DORPER SHEEP BREED
CROSSES IN SILTIE AND WOLAITA ZONES, SOUTHERN ETHIOPIA**



**A Thesis submitted to the College of Veterinary Medicine and Agriculture of Addis
Ababa University in Partial Fulfillment of the Requirements for the Degree of
Master of Science in Tropical Animal Production and Health**

By

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As members of the Examining Board of the final MSc open defense, we certify that we have read and evaluated the thesis prepared by: **Ermias Belete Bena**, entitled: **on- farm performance evaluation of Dorper sheep breed crosses in Siltie and Wolaita Zones, Southern Ethiopia**. And recommend that it be accepted as fulfilling the thesis requirement for the degree of Masters of Tropical Animal Health and Production.

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DEDICATION

This thesis manuscript is dedicated to my father, Belete Bena (1955-1995), who was always immersed in fantasy about my success though death come ahead of his reveals a bit before my success in joining of the Alage ATVET College.

STATEMENT OF AUTHOR

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

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BIOGRAPHICAL SKETCH

The author, ERMIAAS BELETE BENA was born on March 1979 in Bitana town of Duguna Fango Woreda, Wolaita Administrative Zone. He attended his elementary education in Panggo Humbbo Elementary School from 1986 to 1991 and his junior education at Bitana Hamus Junior School from 1992 to 1993. He also attended his Senior Secondary education at Boditi Preparatory and Senior Secondary School from 1994 to 1995. He joined Alage ATVET and was awarded a Diploma in Animal Health in 1998. Soon after graduation, he was employed by the Ministry of Agriculture as Animal Health Assistant, at Wolaita zone Agriculture and Rural Development Main Department and served for four years. He also joined Wolaita Sodo University and awarded a B. Sc of Degree in Animal and Range Sciences in 2003. Then he was employed by Minister of Education, Wolaita Sodo University, as a GA I in Animal and Range Sciences Department and till he joined the School of Graduate Studies of Addis Ababa University to pursue Master of Science degree in Tropical Animal Production and Health in September 2012.

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LIST OF ABBREVIATIONS

AARC	Areka Agricultural Research Center
AFL	Age at First Lambing
BED	Breeding, Evaluation and Distribution
BoA	Bureau of Agriculture
Bw	Birth weight
CSA	Central Statistics Agency
ESAP	Ethiopia Society of Animal Production
FCT	Farmer Training Center
GLM	SAS procedure for general linear models
ha	Hectare
ILRI	International Livestock Research Institute
kg	Kilogram
Lm	Lamb mortality
Ls	Litter size
Ma	Market age
MAWAO	Mirab Azernet Woreda of Agricultural Office
Mw	Market weight
masl	Meters above sea level
MoARD	Ministry of Agriculture and Rural Development of Ethiopia Government
NMA	National Metrology of Agency
OoARD	Office of Agriculture and Rural Development
PA	Peasant Association
SARI	Southern Agriculture Research Institute
SNNPR	Southern Nations Nationalities and Peoples Region
SPSS	Statistical Package for Social Sciences
Uk	United kingdom
Wa	Weaning age
Ww	Weaning weight
WZFED	Wolaita Zone Finance and Economy Development

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ABSTRACT

A flock monitoring study on whole sampled households was conducted from November 2013 to April 2014 with the objectives of evaluating the reproductive and productive performance of Dorper sheep breed crosses, to determine the current production systems and to identify factors influencing the performances of Dorper sheep. The study woreda were purposively selected from Wolaita and Siltie zones and 65 households were monitored by establishing all farmers who received the breed Dorper sheep as sample frame. Data collected through questionnaire (survey) were entered into Statistical Package for Social Sciences (SPSS). Reproductive and growth data were subjected to GLM procedure of Statistical Analysis System (SAS) with fixed model. An index was calculated to provide overall ranking for qualitative data. Mean birth weight, weaning weight, weaning age, market age, market weight, litter size, age at first lambing and sexual maturity for Dorper sheep were 2.25 ± 1.72 kg, 17.30 ± 0.98 kg, 3.16 ± 0.55 months, 12.66 ± 1.39 months, 30.66 ± 3.26 kg, 1.48 ± 0.71 , 11.81 ± 1.37 months and 5 ± 0.74 months, respectively. Location, season, birth type, parity, sex and genotype had significantly ($P < 0.05$) affected weaning weight. Season had influence on weaning age. Location, birth type, parity and genotype had significantly ($P < 0.05$) affected market age. Season, birth type and genotype had influence on market weight in Dorper sheep. Age at first lambing was significantly ($P < 0.05$) affected by genotype. Pre-weaning mortality rate of Dorper sheep was 2.93%. The primary purpose of Dorper sheep was for meat. Water shortages, feed scarcity and quality deterioration during dry seasons are the main challenges facing smallholder sheep farmers. Dorper sheep is able to consume diverse feed source and plant species that cannot be easily consumed by local sheep. In Siltie Dorper sheep was housing in the separate house. The major problems for Dorper sheep production in the areas were lack of overall extension supports (lack of awareness of market on the breed and its product), especially in Wolaita zone. To overcome the problems facilitating market opportunities by connecting the marketing route of this locality with big market players was recommended. Further study is needed to characterize meat quality and carcass yield percentages from locally available feeds of Dorper sheep in the area.

Key words: *Dorper, Ethiopia, husbandry, on -farm, performance, Siltie and Wolaita*

1. INTRODUCTION

Small ruminants are integral part of livestock keeping in Sub-Saharan Africa, Ethiopia (Kosgey *et al.*, 2008) that support regular income in both tangible and/or intangible manners to a large human population through the sale of live animals and skins (Abebe *et al.*, 2010) and provide their owners with a vast range of products and services such as immediate cash income, meat, milk, skin, manure (Adane and Girma, 2008). They are also considered as a living bank against the various environmental calamities (crop failure, drought and flooding) and have socio-cultural values for diverse traditional communities (Edea *et al.*, 2010).

According to Gatenby (2002), sheep production is considered to be advantageous compared to other class of livestock production, due to their high fertility, short generation interval, adaptation in harsh environment and their ability to produce in limited feed resource they are considered as investment and insurance (Tsedeke, 2007). Sheep have multipurpose functions providing meat, manure and as source of income (Shigdaf *et al.*, 2013). Moreover, they have special features, such as their being small in size, which implies low initial investment in starting and expanding sheep production as a business, efficient utilization of marginal and small plot of land, in connection to this are also sources of foreign currency (Berhanu *et al.*, 2006).

Ethiopia has around 25.5 million sheep (IBC, 2007; CSA, 2011) that may be grouped into about 14 traditional sheep populations (Gizaw *et al.*, 2007; 2008). Most of the sheep population of the country is kept by smallholder farmers and sheep production in the country is traditional (EARO, 2001). Sheep are found widely distributed across the different agro-ecological zones of the country (Gizaw *et al.*, 2007). Moreover, sheep production in Ethiopia has great potential to contributing more to the livelihoods of the people in low-input, smallholder farmers and pastoralists under traditional and extensive production systems (Kosgey and Okeyo, 2007).

However, comparing the presence of large and diverse sheep genetic resources similar to other tropical countries, the productivity of indigenous sheep is very low mainly due to low genetic potential for functional traits as compared to improved tropical and temperate breeds. For example among indigenous sheep breed of Ethiopia the Hararghe Highland sheep had lower growth performance and carcass values as compared to the indigenous Black head Ogaden sheep (Tsegaye *et al.*, 2013). Due to these reasons tropical countries have been implementing crossbreed of indigenous animals with improved exotic genotypes to improve the genetic potential of indigenous animals.

Within the aim of improving indigenous sheep productivity, in Ethiopia crossbreeding has been undertaken employing several exotic breed such as Merino breed from Italy has been crossed with the indigenous Arsi sheep in the Agarfa ranch (BOA, 2000), Bleu du Maine from France, Rambouillet from Spain, Romney and Corriedale from Kenya, and Hampshire from UK (Tibbo, 2006) were mainly crossbred with the indigenous Menz at Debre Berhan ranch. Consequently, due to assumed phenotypic similarity to the local sheep the Awassi breed was imported from Israel, and was crossed with the indigenous Menz (Rummel *et al.*, 2005).

However, efforts made so far did not bring significant change in developing countries in the tropics mainly because of sustainability problems (poor performance of imported breeds from the temperate developed world into tropical countries has created a negative image for genetic improvement programmes) (Rewe *et al.*, 2002; Ayalew *et al.*, 2003). In addition to this, less involvement of producers in the program due to genetic improvement programmes have mostly been implemented without taking into consideration all the needs of the farmer (Rewe *et al.*, 2002; Wollny *et al.*, 2002).

Therefore, applying on other exotic sheep breed of solution looking improvement programs (crossbreeding with the aim of combining the desirable attributes in the two breeds) are necessary to increase and sustain the productivity of sheep in the areas so as to meet the demands of the human population on them and a breeding programme was set up that was supported with a good recording scheme (Rewe *et al.*, 2002).

Development of genetic improvement programmes for sheep will only be successful when accompanied by a good understanding of the different farming systems and when simultaneously addressing several constraints – e.g., feeding, health control, management, and cost and availability of credit and marketing infrastructure (Baker and Gray, 2004). This requires that genetic improvement efforts be geared towards improvement of growth, reproduction and adaptability traits under the prevailing circumstances. One of the initial steps in setting up such improvement strategies for the sheep is performance evaluation based on available performance data and applying appropriate evaluation procedures (Kosgey *et al.*, 2003; Kosgey, 2004; Gicheha *et al.*, 2006).

Performance (reproductive and production) recording is an important tool to suggest the breeding policy for a given area. Reproductive (age at first lambing, lambing interval, lamb mortality and litter size) and productive (birth weight, weaning weight, pre and post weaning weight) performances are important early indicators of adaptability and management adequacy (Abegaz *et al.*, 2002; Getahun, 2008). However, recording in general is hardly practiced in any livestock species in the country, to identify the performance and management gaps (Awigichew, 2000; Tibbo, 2006).

On-farm monitoring involves monitoring the productive and reproductive performance of a breed on selected representative households based on improved exotic sheep breeds. Periodic monitoring of the population dynamics and flock structures of a breed is also suggested for the purpose of assessing the risk status of a breed (FAO, 2007). On-farm performance assessment concerned with the whole farm environment provides information in location specific production conditions that could lead to breed improvement options that are appropriate to the system (Getahun, 2008). However, unlike on station experiments, on-farm study is influenced by many factors which could not be controlled.

The Dorper sheep breed, locally called Dorsian, is a synthetic sheep breed developed in South Africa from a cross between the Blackhead Persian ewes with the Dorset Horn rams sheep breeds, and to produce maximum number of lambs with good mutton qualities under the adverse conditions of the arid regions of the country by the Department of Agriculture, breed society and some farmers was established in 1950 in the Republic of South Africa (Cloete *et al.*, 2000).

The Dorper improved exotic sheep breed well perform and thrive in all agro ecological climate and have high fertility, short generation interval, adaptation in harsh environment and their ability to produce in limited feed resource and has been exported to many countries throughout the world including Zimbabwe, Zambia, Kenya, Mauritius, Malawi, Burundi, Israel, Saudi Arabia, and Australia (De Waal and Combrinck, 2000; Milne, 2000). Their ability to walk long distances in search of pasture and adaptability to the harsh environmental conditions (Owen *et al.*, 2005) and together with some unique traits, like resistance to gastrointestinal nematodes which increases their importance to resource-poor farmers and pastoralists (Baker *et al.*, 2002).

Recently, the Dorper was imported from South Africa to evaluate the breed as a potential performance. The first Dorper batch imported to Areka Agricultural Research Center took place in Autumn of 2008, with first round 3 rams and second round 38 rams were imported (AARC, 2012). Mante Dubo experimental site of Areka Agricultural Research Centre (AARC) is established in 2008 during the introduction of Dorper sheep and establishment of breeding, evaluation and distribution (BED) site for the breed establishment, along with a genetic improvement programme to improve mutton yield of local sheep. With the aim of improving local sheep productivity under farmer production systems, Areka Agriculture Research Center distributed 75% and 50% of Dorper sheep breed to smallholder farmers in two zones; Damot Gale and Damot Sore woreda of Wolaita zone and Mirab Azernet woreda of Siltie zone.

However, lack of recorded data on the performance of sheep breed and all aspects of management, lack of regular sheep health program and market information makes it difficult to assess the importance and contribution of the past attempts to improve the sector. As a result, there is a need to assess management practices and define the present performance of Dorper sheep breed; has until now not been evaluated under Ethiopia production systems in above discussed districts. Thus, studying the performance of Dorper sheep will generate baseline information to development agents, researchers, policy makers and other stakeholders so that intervention can be made available to improve performance of sheep under Ethiopia production systems. Therefore, the objectives of the research were:

- To evaluate the reproductive and productive performance of Dorper sheep crosses under farmers management conditions and
- To assess management practices and to identify factors influencing the performances under farmer production systems in three districts of the zones.

2. LITERATURE REVIEW

2.1. Sheep Production System and Husbandry in Ethiopia

In several Sub-Saharan African countries similar to those in many other developing countries mixed crop/livestock production in subsistence manner is the predominant mode of agricultural production system (Tesfaye *et al.*, 2004). In Ethiopia, the small ruminant production system in different agro-ecological zones is not studied fully and farmers' needs and production constraints have not been identified. Improvement in small ruminant productivity which is low in Ethiopia can be achieved through identification of production constraints and introduction of new technologies or by refining existing practices in the system (EARO, 2001).

According to Tibbo (2006), there are two sheep production systems in the country based on input- output flow. These are the traditional smallholder management system and the private commercial and parastatal production system. The traditional subsistence smallholder management system is the most common one in the country and sheep are kept as an adjunct to other agricultural activities along with other livestock species. But the parastatal and commercial production system represents a minor portion of the sheep production system in the country. When closely examined, these two broad categories could be further classified as three major different production systems; highland sheep-barely, mixed crop-livestock and pastoral and agro-pastoral production systems(Tibbo, 2006; Solomon *et al.*, 2008) characterized by different production goals and priorities, management strategies and practices, and constraints (Deribe, 2009).

Getahun (2008) also reported four production system categories based on the prevalent agricultural activity; small ruminant in annual crop-based systems (Northern, North Western and central Ethiopia), small ruminant in perennial crop-based systems (mainly southern and south-western highlands), small ruminant in cattle-based systems (agro-pastoral and arid areas), and small ruminant dominated systems (pastoral and arid eastern and Northeastern areas).

Zelege (2009) reported enset-coffee-cereal-livestock production system from the central Southern region, though some studies describe this system simply 'enset-coffee' system. Sheep are reared in mixed crop-livestock and pastoral systems of southern region of the country (Deribe, 2009). However, the production system referring specifically for small ruminants was not reported. Damot Gale and Damot sore woredas of Wolaita zone (Melese *et al.*, 2013), Adilo Woreda of Kambata Tambaro zone, Badawacho Woreda of Hadiya zone and Mirab Azernet woreda of Silte Zone are sharing similar farming system and are generally categorized under the mixed crop-livestock production system of the central mid and highlands of southern region (Getahun, 2008, Melese *et al.*, 2013). There are still micro-level differences under the broad categories of each farming system. On-farm recording aids to consider those differences in the production system.

Farmers are practicing animal husbandry in different production systems and agro ecologies. In a mixed farming systems, small ruminants are confined and tethered in a wooden hut during the night and are only allowed grazing and browsing during the day under the supervision of a herdsman, particularly young men or women (Deribe, 2009). The enclosure of livestock in huts or kraals is done mainly to protect them from theft and predation (Webb and Mamabolo, 2004; Tsedeke, 2007). Until crops harvested, flocks are usually tethered and maintained under nutritional stress. During dry season almost all owners release their animals to roam around while during the rainy season animals are herded or tethered; tethering being more frequent for goats than for sheep (Jaitner *et al.*, 2001). Tethering in dry season and herding in wet season is reported for Goma Woreda of Oromia region (Belete, 2009).

Sheep fattening is a common practice in different parts of the country, though the degree of fattening and resource base differs markedly. About 39.0 % of the farmers owning small ruminants practice some form of fattening before marketing and majority of the farmers sale their animals early before attaining optimum market weight (Solomon *et al.*, 2005; Getahun, 2008). The major management practice used to obtain stability of structure is selling or slaughtering of males not required for other production functions, for home consumption and/or performance of rituals (Webb and Mamabol, 2004) and

selling stock, supplementation and maintenance feeding as a strategy of management during drought. In the central highlands of Ethiopia, pregnant ewes were housed separately during the last few weeks of pregnancy until about 2-4 weeks postpartum. Rams not required for breeding would be sold or castrated before puberty (Taye *et al.*, 2009).

2.2. Sheep Breed of Ethiopia

Ethiopia has a large sheep population in Africa, which is estimated at 25.5 million sheep (Workeneh, 2004; IBC, 2007; CSA, 2011). Different sheep are widely distributed across different agro ecological zones of the country. Generally, based on phenotypic attribute there are six recognized indigenous sheep breed types in the country, which are further classified in to three breed groups: the fat-tailed hair type (3 breeds), the fat-tailed coarse wool sheep (2 breeds) and the fat-rumped hair sheep. The DAD-IS (2006) database also mentions three other breed types; namely Akale Guzai, Barka and Bonga. Further, Solomon (2008) grouped Ethiopian sheep breeds into 14 traditional populations (Simien, Sekota, Farta, Tikur, Wollo, Menz, Gumz, Washera, Horro, Adilo, Arsi, Bonga, Afar and Black head Somali) in 9 breeds within 6 major breed groups (Short-fat-tailed, Washera, Thin-tailed, Long-fat tailed, Bonga and Fat-rumped following morphological and molecular characterization (FAO, 2007; Solomon, 2007).

2.3. Role of Sheep for Livelihood of Smallholders in Ethiopia

Production of Sheep can contribute to the economy and environmental sustainability of the farm under operation and add value to the farm's biological diversity and may fit economic and biological niches that would otherwise stay unfilled even in the future (Ann *et al.*, 2000). Sheep play an immense role in the livelihoods of rural farms and serve as a living bank for many farmers, and closely linked to the social and cultural life of resource poor farmers (Workeneh, 2000), particularly youths and women headed households. There is a linkage through manure since the manure of small ruminants is commonly used to fertilize home gardens and crop lands (Legesse *et al.*, 2008). Sheep are

the major suppliers of meat for rural communities, especially during periods of public festivals (Tsedeke, 2007); Ameha (2008) reported an estimated sheep skin output of 8.3 million in the year 2000 and contribute 77 thousand metric tons from mutton production. Low capital requirements for starting or expanding small ruminant production means that risks are low and the enterprise is well suited to low-input systems (Tibbo, 2006). Increasing human population, urbanization and incomes, coupled with changing consumer preferences are creating more demand for these animals and their products (Kosgay *et. al.*, 2008).

The main reasons household sale sheep are to generate cash for purchasing food and farm inputs, school and medical expenses, pay credit, purchase livestock and build assets. During drought, the risk of crop failures and food shortage sheep are the preferred one for sale and to satisfy the farmers need. In addition to the live animals, skins are important marketable byproduct in Alaba (Deribe, 2009). Even if skins are used for various household purposes, about 60% of total produced skins are marketed. However, one-third of the total household sale skins to illegal traders (Tsedeke *et al.*, 2011) and about 90% meat, 92% skin and hide export trade value from sheep and goat production in the country (FAO, 2004).

2.4. Factors Influencing Performance of Sheep

Identification of constraints which can put obstacle for sheep production and genetic improvement programme should be the prior step before trying for its implementation (Baker and Gray, 2004). Disease, limited market access and information, feed shortage/frequent drought and water shortage are among the main sheep production constraints in the country. Disease, feed shortage, predators and labor shortage were the most pertinent constraints for sheep production in Horro and Adiyo Kaka (Bonga) and had significant influence on sheep productivity (Zewdu, 2008).

2.4.1. Feed and water shortage

Tesfaye (2008) has mentioned that the major constraint of sheep production in Menz and Afar areas are feed shortage/frequent drought and disease each with varying intensity. Feed shortage problem is similar throughout the country, being serious in high human population areas where land size is diminishing due to intensive crop cultivation and soil degradation. The better use of available feeds and the use of non-conventional feeds for supplementation are growing (Belete, 2009) to alleviate the problem. Seasonal feed shortages, both in quality and quantity, and the associated reduction in livestock productivity in different parts of the country (Tessema *et al.*, 2003). Water shortages is a common problem for both human and livestock consumption in most rift valley parts of the country. It has been reported to be a limiting factor for animal productivity in most mid and lowland areas of Southern region. In south-eastern part of the country there is also critical shortage of water; however, there are breeds adapted to lowland agro ecologies through their physiological adaptation mechanisms (Belete, 2009).

2.4.2. Disease

Diseases and parasites are also contributing for higher production losses, particularly in young stocks. Respiratory Disease Complex (RDC) is among the most important diseases and associated complexes in small ruminants' husbandry and management (Deribe, 2009). Early mortalities (as high as 50% in lambs) are among the most important losses associated to managements like cold stress, starvation, mis-mothering, etc. (Tibbo, 2006). Also Tesfaye (2008) has mentioned that the major constraint of sheep production in Menz and Afar areas are feed shortage/frequent drought and disease each with varying intensity. Similarly Solomon (2007) also identified disease problem was the first and the most important production constraint of Gumez sheep in North Western Lowland of Amhara Region.

2.4.3. Market access and information

Ethiopia's huge livestock population, proximity to the export markets and other conducive conditions gave the country a comparative advantage in livestock trade (Belachew and Jemberu, 2003). There are several livestock trading constraints in Ethiopia. They also reported that inadequate market infrastructure, absence of market information system, absence of market oriented livestock production system, inadequate number of exporting firms with low level of capacities, inadequate knowledge of international trade, low level of quarantine facilities and procedures, prevalence of various diseases, repeated bans, excessive cross-border illegal trade and stiff competition are the major challenges that hinder the smooth livestock trade in Ethiopia.

Due to lack of market information, the available livestock markets in the country are loosely integrated. Lack of market information may also increase the marketing cost. The highland areas in the country are livestock deficit due to higher population density (Belachew and Jemberu, 2003). The Ethiopian cattle, sheep and goat are the preferred livestock types in the Middle East Countries. This is due to the meat produced from this animals is organic in nature and the meat is of good taste (Belachew and Jemberu, 2003). The major problems in traditional management system is that the system is not market oriented, underdeveloped marketing and infrastructure system, and poor financial facility (Azage *et al.*, 2006, Berhanu *et al.*, 2006). Long market chain is an important barrier for producers and inhibits them from direct benefiting through sell of their animals without involvement of brokers (Endrias and Tsedeke, 2006).

Poor marketing information and problems of credit facilities (Berhanu *et al.*, 2006; Endrias and Tsedeke, 2006) reduced the benefit gained by the smallholders. Inadequate infrastructure like road accessibility and marketing facilities are also contributing for the reduced benefit made from the sale of animals by the producers (Tibbo, 2006). Reports indicate that because of lack of standardized marketing systems with transparent market price information farmers cannot receive their sufficient return from sheep production as they gain according to trader prices and also lack of access to domestic and export

markets hold back them from obtaining incentive benefits. As the result of poor quality skins farmers received low prices from skin marketing. The extension system provides little or no technical support to farmers regarding production, preservation and marketing of skin (Tsedeke *et al.*, 2011). To boost the enormous contribution of the livestock sector to the national economy, improving animal productivity and establishing standardized marketing systems are very important.

2.5. Flock Structure and Ownership Patterns

Flock structure is defined as the proportion (in terms of head) of the flock of sheep, which is formed by different age and sex classes of animals. Flock composition in terms of age and sex classes has been taken as an indicator of the management objectives for the owner and the production (reproductive, mortality and off-take rate) of the flock (Ayalew *et al.*, 2002).

The proportion of different age and sex classes in the flock can form flock structure. Most of the time flock structure can reflect objective and strategy of the production. A study result in north western lowland of Amhara region indicated that out of the total sampled Gumuz sheep under farmers management condition, about 42.58% were adult females, while the proportion of rams in a flock was only 5.8 % (Solomon, 2007). In Menz sheep flock breeding ewes take a major portion (46.8%) followed by lambs (19.2%) and ewe lambs (14.3%) and low proportion (5.65%) of breeding rams and castrates (3.92%). Similarly, in Afar pastoral system breeding ewes were dominant (49.2%) followed by lambs (23.6%) and ewe lambs (18.1%) as well as 2.83% breeding rams and 0.8% castrates (Tesfaye, 2008). According to CSA (2003), about 73.4 percent of the entire sheep population was females, and 26.4 percent were males.

Sheep ownership varies depending on the wealth status and the overall farm production objectives (Deribe, 2009). In the highlands, sheep are kept in small flocks of about 5 sheep per household by nearly 40 % of all smallholders. However, at higher altitudes (2800-3000 m) one can find flocks with 30 to more than 100 sheep (Awigichew, 2000;

Samuel, 2005). An average flock size of sheep of Alaba is 5.0 (Tsedeke, 2007). High percentage of single ownership was reported from traditional sector of Ethiopian highlands (Amelmal, 2011), which gives guarantee for testing technological innovations. The owner and care taker relationship was also reported.

2.6. Dorper Sheep Breed and Its Crosses

2.6.1. Diversity and ecology of natural habitat of the Dorper breed

In the 1940s, the Dorper breed, a white-bodied sheep with a black head, was developed in the Karoo region of South Africa by crossing the imported Black Head Persian (a fat-rumped hair breed adapted to harsh, arid environmental conditions) and the British Dorset Horn. The Dorper sheep thrive in arid to semi-tropical climate and are suitable for areas with rainfall of only 100 to 760 mm. Although this breed was developed originally for the more arid areas of the South Africa, today they are widely spread throughout the country. The breed has performed well in Namibia and has been exported to many countries throughout the world including Zimbabwe, Zambia, Kenya, Mauritius, Malawi, Burundi, Israel, Saudi Arabia, and Australia (De Waal and Combrinck, 2000; Milne, 2000).

The Dorper sheep breed is generally recognized as one of the most popular mutton, hardy composite, an early-maturing breed, and well-managed ewes can lamb at the age of 13 - 15 months breeds in South Africa (Fourie *et al.*, 2009). Dorper lambs gain on average from 240 to 280 g per day under vastly different environmental conditions, with dressing percentages of approximately 50% (Cloete *et al.*, 2000). Dorper sheep are generally less-selective grazers, utilizing shrubs and bushes to a greater extent and consuming a larger number of plant species and less herbage per metabolic body size, compared with other breeds (Brand, 2000). Dorper rams can be used as terminal sires to produce lambs with high growth rates, better post-weaning feed efficiency, and superior carcass traits (Snowder and Duckett, 2003).

2.6.2. Breeding purposes of Dorper sheep breed

The need for a Dorper sheep breed suitable for the production of slaughter lambs under the adverse conditions of the arid, extensive regions of South Africa resulted in the formation of the Dorper breed (the new composite breed sought to combine the hardiness of the Black-headed Persian with the mutton production capability of the Dorset Horn) (Snowder and Duckett, 2003). The hardiness and adaptability of the Dorper (able to withstand dehydration and quickly replenish body weight losses when water becomes available) led to a rapid increase in popularity (Cloete *et al.*, 2000).

The productivity of indigenous sheep is very low mainly due to low genetic potential for functional traits as compared to improved tropical and temperate breeds. To overcome this problem, efforts made so far to bring significant change in developing countries in the tropics, but did not have significant change mainly because of sustainability problems and less involvement of producers in the program (Rewe *et al.*, 2002; Wollny *et al.*, 2002 and Ayalew *et al.*, 2003). Therefore, the breeding objective of improved exotic sheep breed with indigenous one is to create an adapted breed capable of producing fast-growing lambs with good carcasses under grazing conditions (Milne, 2000).

2.6.3. Reproductive performance of Dorper sheep

Any successful livestock production program is a result of good reproductive performance of sheep. To obtain meat, milk and fiber the existence of birth and survival is necessity (Tesfaye, 2008). Reproductive performance depends on various factors including age at first lambing, litter size, lamb mortality, lambing interval and the life time productivity of the ewe. However, it is influenced more by environmental factors such as nutrition, management and climate rather than genetic factors.

2.6.3.1. Age at first lambing (AFL)

Dorper ewes lambed for the first time at an average age of 346 days (11.5 months) breeds in South Africa (Fourie *et al.*, 2009). Dorper ewes born in the autumn were reported to

conceive for the first time at their first mating at an average age of 328 days and a live weight of 45.9 kg and the majority of ewe lambs that were born in winter conceived at an average age of 252 days and a live weight of 44.7 kg (Cloete *et al.*, 2000).

Age at first lambing is affected by breed, husbandry practices, level of nutrition, disease or parasitic burdens, year and season limits early growth and it can put obstacle for early maturity for giving first birth (Getahun, 2008). Age at first lambing recorded easily in a farmers stock. There is a big variation among production system and breeds for this trait (12-24 months). These variations could be due to genetic and environmental differences (Girma, 2008; Abegaz *et al.*, 2002). In most traditional systems, first lambing occurs at 450-540 days. The average age at first lambing of 447 days and 399 days were reported for Bonga and Horro sheep, respectively (Zewdu, 2008). Solomon (2007) also reported the average age at first lambing of Gumuz sheep was 410.1 days.

2.6.3.2. Lambing Interval

The interval between two successive parturitions is called lambing interval and it can be affected by season of lambing or nutritional accessibility, breed and number of parity of ewes and management practice (Amelmal, 2011). Reproductive efficiency is related to the length of parturition interval; i.e. ewe with long lambing interval has lower reproductive efficiency (Deribe, 2009). At least three times lambing is expected per two years under normal circumstances (Girma, 2008).

Dorper sheep has a long breeding season which is not seasonally limited so that lambs can be dropped at any time of the year. Lambing intervals is 8 months (Budai *et al.*, 2013). A lambing percentage of 150% can be reached under good conditions while, in exceptional cases, 180% can be attained. Thus on average a Dorper ewe can produce 2.25 lambs on an annual basis (Cloete *et al.*, 2000). Among other breeds of sheep in Ethiopia that had short lambing interval are Menz (8 and half months) and Afar sheep (9 months) (Tesfaye, 2008). According Zewdu (2008) lambing interval was around 8.9 months for Bonga ewes and 7.8 month for Horro ewes. Solomon (2007) reported a lambing interval

of 6.64 months for Gumuz breed which could reflect that the breed can produce three lambing in two years even under the traditional management system.

2.6.3.3. Litter size

Litter size rate mainly influenced by breed, level of nutrition, season and age. Significantly age of the dam can have effect on number of lambs per lambing. Until the age of five years or fourth parity litter size can be increased then it decreased slightly above this age (Baker *et al.*, 2002). The average litter size of Dorper ewes is 1.19 to 1.5 and was affected by ewe age, multiple birth rates increasing to an age of 4 years, followed by a tendency towards a decline. Ewes born as multiples had a higher litter size than single contemporaries (Snyman and Herselman, 2005). According to Zewdu (2008) a twinning rate of 39.9 % or litter size of 1.40 and 36 % or litter size of 1.36 were obtained for Horro and Bonga sheep breeds, respectively and the two breeds showed relatively better multiple births under the existing feed shortages. And report of Tesfaye (2008) where low twinning rate of both Menz and Afar sheep breeds was recorded.

2.6.3.4. Lamb mortality

Lamb losses during pre-weaning period due to poor milking ability of dam and poor management before one year of age vary from 6.4 % to 45% (Deribe, 2009). This could be a major influencing factor of productivity of a flock (Awigichew, 2000; Abegaz *et al.*, 2002). Lamb mortality rate varies from one flock to another depending mostly on management level (Awigichew, 2000).

Slow growth rate associated with mortality has been limiting factors for profitability of the indigenous sheep breeds and more than half of the causes of mortality were similar and attributed to pneumonia as reported from the study on Horro and Menz sheep of Ethiopian highlands (Mukasa-Mugrewa *et al.*, 2002; Tibbo, 2006). Mortality rate was higher for lambs born in dry season, compared to those born in the wet season (Deribe,

2009). Significant effect of season, flock size and sex of animals on survival was reported (Gemeda *et al.*, 2002) for Horro sheep. The same author reported that coughing (23.8%) and diarrhoea (23.5%) are among the major clinical signs for mortality of sheep. Mortality rate of 3% from on-station and of Dorper sheep breed was reported (Table 1). The Dorper sheep breed of Purebred lambs' survival rate averaged between 92-94%, lower limits for twin and triplet lambs and higher survival rates for single born lambs (Budai *et al.*, 2013).

2.6.3.5. Reproductive life span

Long reproductive life span in tropical (unfavorable) condition is one of the adaptation traits of tropical livestock (Amelmal, 2011). Literature sources on the longevity of Dorper sheep are scarce. Dorper ewes remained in the breeding flock for an average of 4.7 seasons in Zimbabwe (Cloete *et al.*, 2000). The longer flock life of the Mutton Dorper ewes in this study contributed to a higher overall lamb yield. Long term reproductive performance (long living, high fertility, ability to produce more offspring) of dams should be given more importance in selection programs. The Ethiopian indigenous sheep average reproductive life span of Horro and Bonga ewes were 7 years and 7.4 years, respectively (Zewdu, 2008).

2.6.4. Growth performance of Dorper sheep

2.6.4.1. Birth weight

Birth weight of animals is one of the most important factors influencing the pre-weaning growth of the young and has a positive correlation between birth weight and subsequent live body weight development (Awgichew, 2000). For breeding (selection), feeding and health care and for market age determination knowing the body weight of a sheep is important. However, this fundamental knowledge is often unavailable for sheep in the small scale farming sector, due to unavailability of scales (Zewdu, 2008). The average

birth weight of pure and cross breed under intensive production system was 3.5kg and 3kg, respectively (Gavojdian *et al.*, 2013).

According to Sisay (2002) variation exists between indigenous and exotic sheep breeds for body weight traits. There are number of reports on body weight and linear body measurements among them recently, Mengiste (2008) reported 28.3 for body weight for Washera female sheep. Similarly the same author reported 32.3 for body weight for Washera male sheep. Among the indigenous sheep breeds Bonga male sheep had 48 kg body weight (Tibbo and Ginbar, 2004), So Bonga sheep can be mentioned as large sized breed and superior in its body weight.

2.6.4.2. Weaning weight

Weaning weight is a trait of great economic importance in meat sheep production since it has influence on growth rate and survival (Taye *et al.*, 2009). When Dorper ewes are mated annually, it is usually attempted to market lambs directly from the ewes. Under accelerated lambing systems, where early rebreeding is a pre-requisite, it is necessary to subject lambs to early weaning (Schoeman, 2000). Birth type and sex are sources of variation in lamb pre-weaning growth rate (Taye *et al.*, 2009). The indication is that lambs heavier at birth have larger adult weight and higher growth capacity (Awgichew, 2000; Taye *et al.*, 2009). Parity can also affect pre-weaning growth rate, from birth to 30 days of age. Lambs from second and third parity dams grew better than first and fifth parities (Tibbo, 2006).

Dorper lambs that were weaned at 2-3 months with an average age of 52.8 days and an average live weight of 18.2 kg had a survival of 0.96 from weaning to 100 days of age (Cloete *et al.*, 2000). Similar author reported that post-weaning growth in these lambs was 0.206 kg per day to 100 days of age. Pre weaning performance of Dorper sheep ranged from 0.24 to 0.28 kg per day. It also underlines the ability of the Dorper breed to thrive under sub-optimal conditions. Dam age affected lamb pre-weaning gain in Dorpers, the general pattern being an incline to a dam age of 4- 6 years, followed by a decline (Schoeman, 2000).

Table 1: Reproductive and productive performance of Dorper sheep breed

Performances	Pure Dorper		Crossed Dorper		Production systems	Sources
	M	F	M	F		
Bw (kg)	4	3.5	3.2	3.2	Intensive	Fourie <i>et al.</i> (2009)
Ww (kg)	28.2	20	18	16	Intensive	Cloete <i>et al.</i> (2000)
Ls		1.4		1.4	Semi	Schoeman (2000)
AFL(mo)		12		13	Semi	Fourie <i>et al.</i> (2009)
LI (mo)		8		8	Intensive	Budai <i>et al.</i> (2013)
Wa (mo)	2	3	2	3.5	Intensive	Budai <i>et al.</i> (2013)
Mw (kg)	70	46	50	36	Intensive	Fourie <i>et al.</i> (2009)
Lm (%)	3	3	3	3	Intensive	Gavojdian <i>et al.</i> (2013)

Bw; birth weight, *Ww*; weaning weight, *Ls*; litter size, *AFL*; age at first lambing, *LI*; lambing interval, *Wa*; weaning age, *Mw*; market weight, *Lm*; lamb mortality, *mo*; months and semi; semi intensive production

3. MATERIALS AND METHODS

3.1. Description of the Study Areas

3.1.1. Siltie Zone

Siltie zone is one of the 14 zones of the Southern nation nationality and people's regional government. It is located at 173 km from Addis Ababa the capital city of Ethiopia and 177 km from the regional town Hawassa. It has eight woreda, of which Mirab Azernet was purposively selected based on Dorper sheep distribution. The Woreda is located in 2889 masl, 7.43-7.66°N latitude and 37.86-37.90°E longitudes. It has two different agro-climatic conditions, Dega and Woina-dega and consisting 37% and 63%, respectively. The annual average minimum and maximum temperature range from 14 to 17°C, respectively and the average annual rainfall ranges from 1200 mm (Melesse *et al.*, 2013). There are three distinct seasons; big rainy season (June, July, August and September); dry season (January, February and March); small rainy season (October, November and December) (MAWAO, 2013; NMA, 2013).

3.1.2. Wolaita Zone

Wolaita zone located at 330 kms to the south-west of Addis Ababa and 160 km from Hawassa, the regional capital city. Its altitude ranges from 1200 to 2950 masl. It has twelve woreda, of which, two woreda (Damot Gale and Damot Sore) were purposively selected based on Dorper sheep distribution. Damot Gale and Damot Sore woredas are located in between 6°51" and 7°35" North Longitude; and 37°46" and 38°1", respectively. Agro ecology of the areas is 62% highland (Dega), 38% midland (Weina Dega) and 58% highland (Dega), 42% midland (Weina Dega), respectively. The average temperature varies from minimum 13.6°C to maximum 25.1°C and 14°C to maximum 21°C, respectively. The annual average rainfall in Damot Gale and Damot Sore is 1175 mm and 1200 mm, respectively. In a bimodal pattern with three distinct seasons; dry (November to February), small rains from March to June and big rains from July to October in both districts (NMA, 2013, WZFED, 2013). Geographical location of the study areas are indicated in Figure 1.

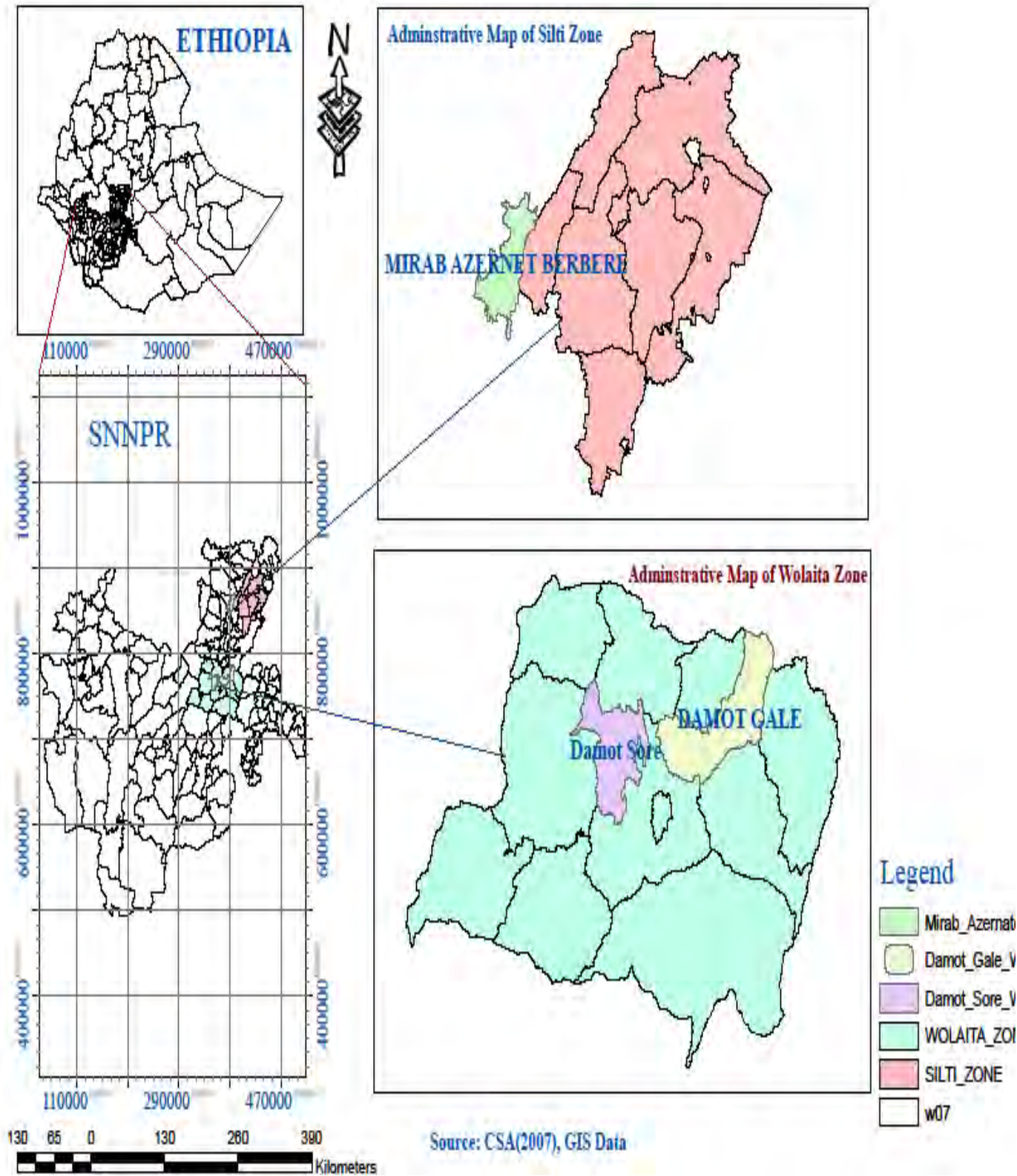


Figure 1: Location of study area

3. 2. Distribution of Improved Breeds in the Study Areas

Improved breeds of sheep (Dorper) were introduced over the years in order to increase lamb production and carcass yield and quality crossing with local sheep. Development agents (DAs) collect money from model farmers based on their interest and locally available feed resources for the purchase of Dorper sheep from Areka Research Center. The first 75% and followed by 50% Dorper sheep batch were distributed at the rate of farmer need to Wolaita and Siltie zones to make awareness about improved sheep breed (Dorper) in the entire studied district and to transfer technology and the research center disseminated the breed through by different governmental institutions and NGO indicated as the following Table 2.

Table 2: Distributed Dorper sheep breed in number, where it distributed and blood groups of the breed.

Parity	Blood group and sex				Delivered to	Year		
	75%		50%					
	Sex		Sex					
	M	F	M	F				
1 st	12	7	5	86	61	25	Azernet and wolaita	2010/11
2 nd				75	51	24	Wolaita	
3 rd				8	3	5	Mirab Azernet	2011/12
4 th				31	13	18	others	

Male; male, F; female and others; distribution of Dorper sheep to other zones

Source: (AARC, 2012)

3. 3. Sampling Technique

All farmers who received improved breed (Dorper sheep) were a sample frame. A total of 65 households (48 from Mirab Azernet district, Siltie zone, 9 from Damot Gale and 8 from Damot Sore district, Wolaita zone) were monitored and considered purposively for the household survey in the current study based on Dorper sheep breed distribution. Sampling frame was established in a purposive sampling procedure selected to administer the questionnaire for production system and socio-economic study based on distribution of Dorper sheep. Households were purposively whole sampled from each Peasant Association based on the distribution of Dorper sheep. Secondary information on the

distribution, and number of Dorper sheep across the different woreda was obtained from agricultural offices of the respective zone and district before starting the actual field work.

3. 4. Data Collection Procedure

A structured questionnaire, group discussion, field monitoring and secondary sources were used to gather qualitative and quantitative data on sheep production system and husbandry practices.

3. 4. 1. Data collection

A structured questionnaire, group discussion, field monitoring and secondary sources were used to gather qualitative and quantitative data on sheep production system in general and Dorper sheep breed in particular and husbandry practices. Structured questionnaires were prepared to collect information on the existing socio-economic characters (sex, age, education level, household size, livestock possession and major production constraints), reproductive performances (age at first lambing , lambing interval, litter size and lambing pattern), flock structure, feeds and feeding management, water source and watering, major diseases of sheep in the area, sheep production system and husbandry practices from each flock owners and key informants via interview. Organized group discussion were held with clan or village leaders, Woreda agricultural Experts (extension agents), sheep owners (female and male member) of the society who are known to have better knowledge on social and economic status of the area. Discussions were focused on the improved Dorper sheep population, chain of sheep market and current status and major constraints of sheep, production system, and social bylaws on communal interest like communal grazing land, watering point. Discussions were held using a prepared check list.

3. 4. 2. Flock monitoring

Flocks of 65 households were monitored between November 2013 and April 2014. Prior to sampling, previous survey results and secondary data from the Office of Agriculture

and Rural Development (OoARD) on overall agricultural production, socioeconomics and crop-livestock integrations were reviewed, and experts of animal husbandry consulted. Field visit was also made to gather pre- information and select the study Kebeles, villages and thereby the households.

For each Kebele, flock density one enumerator was recruited from the respective locality (5 for the whole study (2 enumerators for Wolaita zone and 3 enumerators for Silte zone). All the data collectors are diploma completed, unemployed and able to speak local language and Amharic. Training and demonstration was undertaken before commencement of the study. All animals were identified and numbered at the start of the study. Reproductive data (age at first lambing, lambing interval, and litter size), productive (birth weight and weaning weight) and mortality data were recorded (Appendix 2 and 3). Within 24 hours of the new born; date of birth, birth weight, type of birth, sex of lamb and ewe/dam parity were taken. Weaning weight was recorded on 90th day. Weights were taken by using balance scale.

Flocks were visited to record animal numbers, entries, and exits from the flocks, reasons for changes, and animal weights. Very few ram fattening practices were recorded in the study site and the data were insufficient for meaningful analysis. Entries were recorded as births, purchases, and other reasons, which included loans to farmer, returns from loans made earlier to other farmers, and gifts. Exits were recorded as deaths, sales, shareholding, and return to owner (gifts back), slaughter for festivals and ceremonies, and any other reason such as slaughter for home consumption, and theft or loss.

3. 4. 3. Case histories

To grasp adequate information on the parameters like age at first lambing, lambing interval, lamb mortality, litter size, case histories of breeding females was taken according to Kaufmann (2005, Appendix IV). This is because the monitoring time was still short to record these events. The breeding females whose histories were recorded were those that gave birth at least once. Case histories were done giving priority for older

females assuming that they were more informative. Twenty seven case histories were recorded on breeding ewes.

3. 5. Data Management and Statistical Analysis

Data collected through questionnaire (survey) were entered into Statistical Package for Social Sciences (SPSS, 2011 ver. 20). An index was calculated to provide overall ranking for qualitative data such as purpose of keeping Dorper sheep according to the following formula: Index = Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular qualitative variables divided by Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all qualitative variables considered. Reproductive and growth data were subjected to GLM procedure of Statistical Analysis System (SAS). Statistical significance for quantitative data was done using F test. Fixed effects fitted in the model included the effects of location (2); sex (2); parity (3); birth type (Single, twin and multiple) and season of birth (dry, small and big rainy season).

The statistical fixed model is explained as follows:

$$Y_{inlmjyo} = \mu + L_i + X_j + P_l + B_m + S_n + e_{ijlmnyo},$$

Where;

$Y_{inlmjyo}$ = Weights and weaning of the n^{th} lamb

μ = the overall mean

L_i = the fixed effect of the i^{th} location

X_j = the fixed effect of j^{th} sex

P_l = the fixed effect of l^{th} parity

B_m = the fixed effect of m^{th} type of birth

S_n = the fixed effect of n^{th} season

$e_{inlmjyo}$ = the random error

4. RESULTS

4.1. General Household Information and Production System

4.1.1. General household information

A total of 65 households (48 from Mirab Azernet district, Siltie zone, 9 from Damot Gale and 8 from Damot Sore district, Wolaita zone) were monitored and considered purposively for the household survey in the current study based on Dorper sheep breed distribution. The result of demographic and socio-economic characteristics of the households is presented in Table 3. From the total of 65 household heads that participated in the flock monitoring, male headed household accounted for the largest proportion of the studied samples (respondents) throughout the study areas. Thus, the proportion of male headed household in Damot Gale, Damot Sore and Mirab Azernet woreda was 66.7%, 100% and 75%, respectively. Interviewed households in the study area have different educational backgrounds. The largest proportion (44.4%) of household heads in Damote Gale were primary (grade 5-8) whereas in Damot Sore, (62.5%) of household are in high school (grade 9-12). The largest proportion in Mirab Azernet (33.3%) was elementary (grade 1-4) (Table 3).

Table 3: Sex, education and age structure of the households in the study area

Household		Wolaita				Siltie	
		Damot Gale		Damot Sore		Mirab Azernet	
		N	%	N	%	N	%
Sex	Male	6	66.7	8	100	36	75.0
	Female	3	33.3	0	0	12	25.0
Education	Illiterate	1	11.1	2	25	15	31.3
	Elementary	3	33.3	1	12.5	16	33.3
	Primary	4	44.4	0	0	11	22.9
	Secondary	1	11.1	5	62.5	6	12.5
Age	<30	1	11.1	0	0	15	31.3
	31-40	6	66.7	6	75	21	43.8
	41-50	2	22.2	2	25	8	16.7
	51-60	0	0	0	0	4	8.3

4.1.2. General production system or farming activities

In all the studied districts, about 99% of farmers practice mixed crop-livestock production system, is the dominating system and similar to most parts of the central southern region. The major crops grown include; barely, wheat, bean, pea and *enset* and including taro and teff in Wolaita zone. *Enset* is a major crop grown throughout the study sites of all the studied districts, contributing much more for the household food and cash income.

4. 2. Livestock Species Composition

Table 4: Average (\pm SD) livestock species composition in the three districts

Location and livestock		N	Mean flock size	SD	Minimum	Maximum
Damot Gale	Cattle	5	3.22	1.56	1.00	6.00
	Sheep	9	4.00	1.00	3.00	6.00
	Goat	2	0.44	0.72	1.00	2.00
	Donkey	2	0.55	0.52	1.00	1.00
	Poultry	7	7.77	1.39	6.00	10.00
	Mule	3	0.66	0.50	1.00	2.00
	Horse	1	0.33	0.50	1.00	2.00
Damot Sore	Cattle	4	3.25	1.03	2.00	5.00
	Sheep	8	6.12	2.10	3.00	9.00
	Goat	1	0.62	0.74	1.00	2.00
	Donkey	2	0.75	0.46	1.00	2.00
	Poultry	5	6.50	1.41	5.00	9.00
	Mule	1	0.50	0.53	1.00	2.00
	Horse	2	0.12	0.35	1.00	2.00
Mirab Azernet	Cattle	32	1.52	1.41	1.00	5.00
	Sheep	48	4.00	1.85	1.00	9.00
	Goat	24	0.60	0.64	1.00	2.00
	Donkey	12	1.16	0.37	1.00	2.00
	Poultry	46	6.12	1.80	2.00	10.00
	Mule	42	0.72	0.60	1.00	2.00
	Horse	7	0.35	1.65	1.00	2.00

The largest average number of livestock possessed by the three woreda was poultry, sheep, followed by cattle and livestock composition was 7.77, 4.00 and 3.22 in Damot

Gale, 6.50, 6.12 and 3.25 in Damot Sore and 6.12, 4.00 and 1.52 in Mirab Azernet woreda, respectively presented in Table 4.

4.3. Dorper Sheep Flock Composition and Dynamics

The 65 households had a total of 136 Dorper sheep crosses, of which 61(44.8%) were males and 75 (55.2%) were females (Table 5). There were 32 adult Dorper sheep, of which 13 (9.5%) were males. Birth was the routes of entry into the flocks. Over 6 month period, 34 lambs were born, with a mean litter size of 1.48 (Table 5).

Table 5: Structure, entry and exit of Dorper sheep in the study area (values shown are totals across 65 households)

Start 2013)	(November, (n)	Male			Female			Total
		Young	Adult	Total	Young	Adult	Total	
	(n)	42	27	69	39	21	60	129
	%	34.09	20.4	54.5	29.54	15.9	45.5	100
Entries	Births	15	0	15	19	0	19	34
	Total	15	0	15	19	0	19	34
Exit	Sale	6	10	16	0	0	0	16
	Death	2	0	2	1	0	1	3
	H/ slaughter	0	4	4	0	2	2	6
	Others	1	0	1	1	0	1	2
	Total	9	14	23	2	2	4	27
End (April, 2014)								
	(n)	48	13	61	56	19	75	136
	%	35.29	9.55	44.8	42.42	13.9	55.2	100

Others indicate mechanical damage, theft and losses.

4.4. Reproductive and Productive Performance of Dorper Sheep

4.4.1. Reproductive and productive performance

Variance analysis for the effect of location, season and blood group on sexual maturity, age at first lambing and litter size is shown in Table 6. Age at first lambing (AFL), sexual maturity and litter size of ewe Dorper sheep were varied by location, season and genotype. Age at first lambing is influenced by genetics. Sexual maturity and Litter size were not influenced by location, season and genotype and observed differences were not significant ($P > 0.05$) level of significance.

Table 6. Variance analysis for age at first lambing, sexual maturity and litter size of ewe Dorper sheep

Source	df	Age at first lambing		Sexual maturity		Litter size	
		Mean square	F	Mean square	F	Mean square	F
Zone	1	0.0148	0.9297	2.4938	0.4040	0.0473	0.7612
Season	2	0.6880	0.6958	0.8926	0.2179	0.8227	0.2158
Genotype	1	12.6654	0.0161*	0.4937	0.3521	0.0033	0.9359

The least square means (months) of age at first lambing, sexual maturity and litter size of ewe of Dorper cross breed sheep was 11.81 months, 5 months and 1.48 (Table 7).

Table 7: Least square means and standard errors for age at first lambing, sexual maturity (in month) and litter size of ewe Dorper cross breed sheep

Source of variation	N	Age at first lambing LSM(\pm SE)	Sexual maturity LSM(\pm SE)	Litter size LSM(\pm SE)
Overall	27	11.81 \pm 1.37	5.00 \pm 0.74	1.48 \pm 0.71
Location		NS	NS	NS
Siltie	18	11.77 \pm 0.51	5.16 \pm 0.27	1.50 \pm 0.26
Wolaita	9	11.89 \pm 0.70	4.66 \pm 0.38	1.44 \pm 0.36
Season		NS	NS	NS
Dry season	10	12.20 \pm 0.60	4.90 \pm 0.32	1.20 \pm 0.31
Small rainy season	5	11.60 \pm 0.77	5.40 \pm 0.42	1.40 \pm 0.40
Big rainy season	12	11.58 \pm 0.00	4.91 \pm 0.29	1.75 \pm 0.54
Genotypes		**	NS	NS
50% cross of Dorper	13	11.07 \pm 0.53 ^a	4.84 \pm 0.28	1.88 \pm 0.27
25% cross of Dorper	14	12.50 \pm 0.65 ^b	5.14 \pm 0.36	1.96 \pm 0.26

Means within each subclass with different superscript (a,b) letters differ significantly ($P < 0.05$); NS- non significant.

4.4.2. Reproductive and productive performance of lamb

Birth weight, weaning weight, weaning age, market weight and market age were varied among the two zones. Weaning weight and market age mainly dependent on location, birth type, parity and blood group and observed differences were significant ($P < 0.05$) level of significance. The least square means (kg) of birth weight, weaning weight, weaning age (month), market age (month) and weight(kg) of Dorper sheep lamb was 2.25, 17.30, 3.16, 12.66 and 30.66, respectively (Table 8 and 9). Weaning weight, market age and market weight were affected by birth type and blood group. Location had significance on weaning weight and market age, whereas season had significance on weaning weight and market weight. Weaning weight also affected by parity and sex of lamb.

Table 8: Variance analysis for birth weight, weaning weight, market weight and age of Dorper cross breed sheep (lamb)

Source of variation	df	Bw	Ww	Wa	Ma	Mw
		Ms	Ms	Ms	Ms	Ms
Zone	1	2.721 ^{NS}	8.367*	0.059 ^{NS}	15.744 *	35.892 ^{NS}
Season	2	1.010 ^{NS}	0.485**	1.010*	0.796 ^{NS}	1.378 *
Birth type	2	1.009 ^{NS}	4.075*	0.204 ^{NS}	0.604 *	41.619 *
Parity	2	2.637 ^{NS}	3.020*	0.225 ^{NS}	3.317 *	9.308 ^{NS}
Sex	1	0.615 ^{NS}	0.005*	0.698 ^{NS}	1.172 ^{NS}	20.754 ^{NS}
Genotypes	1	0.016 ^{NS}	162.877 ***	0.185 ^{NS}	136.921***	41.221 *

P<0.05=*, *p*<0.01=**, *p*<0.001=*** of significance; NS= non significant; Ms = mean square; Bw; birth weight, Ww; weaning weight, Wa; weaning age, Ma; Market age and Mw; market weight

Table 9: Least square means and standard errors for birth weight, weaning weight and market weight (in kg), weaning age and market age (in month) of Dorper cross breed sheep (lamb).

Source	N	Bw LSM(+SE)	Ww LSM(+SE)	Wa LSM(+SE)	Ma LSM(+SE)	Mw LSM(+SE)
Overall	65	2.25±1.72	17.30 ±0.98	3.16±0.55	12.66±1.39	30.68±3.26
Location		NS		NS		NS
Siltie	48	2.34±0.87	17.72±0.49 ^a	3.18±0.28	12.87±0.70 ^a	30.47±1.65
Wolaita	17	2.00±0.94	16.11±0.53 ^b	3.11±0.30	12.05±0.76 ^b	31.29±1.78
Season		NS			NS	
Dry season	15	2.88±0.68	16.40±0.39 ^b	3.13±0.22 ^{ab}	12.40±0.55	28.51±1.29 ^b
Small rainy	12	2.03±0.58	17.29±0.33 ^a	3.50±0.19 ^a	12.50±0.47	31.75±1.11 ^a
Big rainy	38	2.07±0.51	17.65±0.35 ^a	3.07±0.25 ^b	12.81±0.40	31.21±1.02 ^a
Birth type		NS		NS		
Single	40	2.07±0.77	18.20±0.44 ^a	3.20±0.24	12.30±0.62 ^b	32.05±1.45 ^a
Twins	17	2.78±0.76	16.30±0.43 ^b	3.05±0.24	12.94±0.62 ^{ab}	27.97±1.45 ^{ab}
Multiple	8	2.00±0.75	14.93±0.41 ^c	3.25±0.23	13.87±0.61 ^a	29.65±1.40 ^b
Parity		NS		NS		NS
1	12	1.96±0.65	15.79±0.37 ^c	3.08±0.21	13.66±0.53 ^a	30.00±1.24
2	20	2.70±0.51	16.70±0.29 ^b	3.05±0.16	12.90±0.41 ^{ab}	29.83±0.96
3	33	2.08±0.64	18.21±0.25 ^a	3.27±0.30	12.15±0.36 ^b	31.45±1.18
Sex		NS		NS	NS	NS
Male	38	2.47±0.47	17.62±0.27 ^a	3.26±0.15	12.68±0.38	31.36±0.89
Female	27	2.09±0.56	16.85±0.21 ^b	3.03±0.04	12.62±0.32	29.74±0.78
Genotypes		NS		NS		
50% cross	37	2.20±0.47	19.00±0.27 ^a	3.24±0.15	11.21±0.38 ^b	31.85±0.89 ^a
25% cross	28	2.31±0.43	15.05±0.29 ^b	3.07±0.08	14.57±0.42 ^a	29.14±0.78 ^b

Means within each subclass with different superscript (a, b, c) letters differ significantly ($P < 0.05$); NS- non significant. Bw; birth weight, Ww; weaning weight, Wa; weaning age, Ma; Market age and Mw; market weight

4. 5. Purpose of Keeping Dorper Sheep Crosses

The primary purpose of keeping Dorper sheep in the entire woredas was reported that for meat (lamb production) with an index value of 0.28, 0.28 and 0.30 in Damot Gale, Damot Sore and Mirab Azernet, respectively, followed by income generation with an index value of 0.25 0.23 and 0.24, respectively and for breeding with index value of 0.19, 0.20 and 0.22, respectively as presented in Table 10.

Table 10: Purpose of keeping(index) Dorper sheep breed crosses as ranked by respondents in the study areas.

Purpose	Wereda's		
	Damot Gale	Damot Sore	Mirab Azerenet
For meat	0.28	0.28	0.30
As income source	0.25	0.23	0.24
For manure	0.13	0.14	0.11
For skin	0.13	0.14	0.11
For breeding	0.19	0.20	0.22

Index= sum of (3 X number of household ranked first + 2 X number of household ranked second+ 1 X number of household ranked third) given for each purpose divided by sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for all purpose of keeping Dorper sheep in a production system.

4.6. Feed Sources and Feeding

Feed resources commonly used by farmers in the study area across the different seasons. Natural pasture was the major feed source in rainy season across all the studied woredas. According to respondent 77.8%, 37.5% and 64.6% used as feed source during dry and wet seasons in Damot Gale, Damot Sore and Mirab Azernet woreda, respectively. However, the major feed resource commonly used in dry season was crop residue as reported by 22.2, 50 and 64.6% of the farmers in Damot Gale, Damot Sore and Mirab Azernet woreda, respectively.

4.7. Water Sources and Watering

According to the respondent, river was the major water source in dry season across all the study woreda (88.9, 50 and 50% of the farmers in Damot Gale, Damot Sore and Mirab Azernet respectively). Similarly, river was the major water source during rainy season in Damot Gale (50%), Damot Sore (75%) and Mirab Azernet (87.5%). During the dry season, Damot Gale (11.1 %), Damot Sore (25%), and Mirab Azernet (37.5%) farmers allowed their flock to take water as they needed and when they want, where as 47.5%, 10.3% and 15% of the farmers allowed access to water only once per day. On the other hand, during rainy season majority of the farmers in Damot Gale (65%), Damot Sore (34%) and Mirab Azernet (75.2%) provided water as they needed and when they want.

4.8. Housing systems

Sheep are housed in different ways. The majority of the respondent in Mirab Azernet (95.8%), house their sheep in the separate house and housing sheep in main house was also reported by some farmers in the same woreda. However, the all respondents of Damot Gale and Damot Sore woreda (100%) house their sheep in the main house with families.



Figure 2: A) 50% Dorper sheep breed feeding and watering at FTC in Mirab Azernet



B) 25% of Dorper sheep breed tethered with tree and watering from pond in Wolaita



C) 25% of Dorper sheep offspring (2.5kg) and 50% of Dorper sheep offspring (4.5kg) of one month, to reflect blood group difference in Wolaita and Siltie left to right



D) One year old 50% Dorper sheep ram feeding *chat* leftover in Mirab Azernet

E) Crop forage integration in Wolaita zone

4.9. Adaptability of Dorper Sheep

Based on the data obtained within six months from flock monitoring, the average pre weaning mortality of the Dorper sheep lamb was 2.93%. As the result indicated that the pre weaning mortality rate was highest in Siltie (2.20) and female (2.20) than in Wolaita (0.73) and male (0.73).

According to the respondent (Table 11), majority of the respondent in Damot Gale (66.7%), Damot Sore (87.5%) and Mirab Azernet (85.4%) woreda exposed Dorper has high adaptability. Moreover, fast growth of Dorper sheep as indicated 44.4, 37.5 and 29.2 % in Damot Gale, Damot Sore and Mirab Azernet, respectively, followed by easy to manage, 33.3, 25.0 and 39.6% in Damot Gale, Damot Sore and Mirab Azernet made reasons to future expand of improved sheep breed.

Table 11: Adaptability and the reasons for future expansion of Dorper sheep breed by respondents

Parameters		Wolaita				Siltie	
		Damot Gale		Damot Sore		Mirab Azernet	
		N	%	N	%	N	%
Blood group	50%	6	66.7	3	37.5	28	58.3
	25%	3	33.3	5	62.5	20	41.7
Adaptability	High	6	66.7	7	87.5	41	85.4
	Medium	2	22.2	0	0	7	14.6
	Low	1	11.1	1	12.5	0	0
Reasons for future expansion							
	Fast growth	3	33.3	2	25.0	19	39.6
	Easy to manage	1	11.1	2	25.0	9	18.8
	Colorful meat	4	44.4	3	37.5	14	29.2
	Minimized risks	1	11.1	0	0	1	2.1
	Market demand	1	11.1	1	12.5	5	10.4

4.10. Disease

In this study, ecto parasite, fasciollosis, pasterollosis, eye diseases and indo parasites were the most frequently reported diseases of sheep across all the studied woreda (Table 12). Almost all farmers in Damot Gale, 82.5% in Damot Sore and 90.4% in Mirab Azernet districts use modern drugs to treat their sheep against the disease. Similarly about 96.4 %, 89 % and 75% of farmers in Damot Gale, Damot Sore and Mirab Azernet woreda, respectively, get veterinary service from governmental clinics.

Table 12: List of diseases reported by farmers in the study woredas

Name of diseases and its symptoms			Study area					
Common name	Local name	symptoms	Damot Gale		Damot Sore		Mirab Azernet	
			N	%	N	%	N	%
Ecto parasite	<i>Danquwa</i>	Itching	3	33.3	1	12.5	3	6.3
Pasterollosis	-	Nasal discharg	2	22.2	2	25.0	17	35.4
Eye disease	<i>Ayfiya sahuwa</i>	Lacrimation	1	11.1	4	50.0	8	16.7
Indo parasite	<i>Sheniya</i>	Diarrhea	1	11.1	1	12.5	13	27.1
Fasciollosis	-	emaciation	2	22.2	1	12.5	7	14.6

Local name of the diseases were given in Wolaita language

4.11. Constraints

Information collected on constraints in Dorper sheep (Table 13) in the study area revealed that market problem was the most important problem influencing Dorper sheep production and productivity in Damot Gale (44.4%) and in Damot Sore (50%) districts, but water shortage was the most important problem in Mirab Azernet (35.4%). On the other hand, lack of extension support at farmer level, diseases and feed shortage 22.2% in Damot Gale, 25% in Damot Sore and 27.1% in Mirab Azernet district, respectively were considered standing second from the list of constraints. The third constraint claimed by 11.1% in Damot Gale and 12.5% in Damot Sore and 10.4% in Mirab Azernet districts were disease, feed shortage and lack of technology transfer respectively. Lack of extension support and lack of technology were mentioned also as constraints (Table 13).

To improve the existing state of sheep productivity farmers exposed the directions to looking solutions through discussion and suggested; getting 50% Dorper sheep at affordable price from government, training on improved sheep production concerning to awareness on the breed and to be organized as association of sheep farmers to curve living standards and to increase quality of product were put as options to improve sheep productivity in entire studied districts. According to respondents 85% in Siltie and 65% in Wolaita, as option exposed purchasing price of dorper sheep should be affordable.

Around 95% of respondents in Wolaita zone reflected that awareness creation on Dorper sheep is one of improvement way of current sheep production.

Table 13: Major constraints of Dorper sheep production in three studied districts

Constraints	Wolaita				Siltie	
	Damot Gale		Damot Sore		Mirab Azernet	
	N	%	N	%	N	%
Diseases	1	11.1	2	25.0	5	10.4
Water shortage	1	11.1	1	12.5	17	35.4
Feed shortage	0	0	1	12.5	13	27.1
Market problem	4	44.4	4	50.0	5	10.4
Lack of extension support	2	22.2	0	0	3	6.3
Lack of technology	1	11.1	0	0	5	10.4

5. DISCUSSION

5.1. General Household and Information Production System

5.1.1. General household information

Out of the 65 respondents, the majority was male 66.7% in Damot Gale, 100% in Damot Sore and 75% in Mirab Azernet (Table 3) and some were illiterate in both zones. Some of the herders were those who interrupted learning from junior schools and attracted in to farming activities. Educated female is by far less than that of males in the community. This is to be expected because families in most developing countries are reluctant to send their female children to school. However, this situation has been improving in recent years. During the time of the survey, all children of the interviewed household that reached school age (>7years) were sent to school and therefore no illiterate children were encountered. This indicates that, the communities in the studied area are quite aware of the benefits of sending children (including girls) to school. The availability of schools within a reasonable distance from homestead (a school within Kebele) is the other encouraging factor for children's education. This reflects good sense for technology transfer in the future.

5.1.2. General production system or farming activities

Farmers practice mixed crop-livestock production system is the dominating system and is similar to most parts of the central southern region. This agrees with (Tesfaye *et al.*, 2004) and Deribe (2009). Cropping is totally dependent on rainfall. Prolonged dry season and uneven distribution of rainfall during the study period have been observed to put pressure on cropping and feed development.

5. 2. Livestock Species Composition

The largest average number of livestock possessed by the three woreda was poultry, sheep, followed by cattle. As sample frame establishment, this study involved farmers

who owned Dorper sheep, as a major criterion, all respondent (100%) across the study area had local and crossed sheep. The current mean sheep holding was 4, 6.12 and 4 in Damot Gale, Damot Sore and Mirab Azernet respectively (Table 4) is higher than the previous results of 3.6 sheep (Belete, 2009), 2.2 sheep (Fikre, 2009), 0.8 and 1.6 sheep in Wolaita and Dauro zones (Endrias and Tsedeke, 2005) in south and south western part of the country, 2 in Kombolcha and Gursum (Workenh, 2000), 1 in Debre Zeit (Samuel, 2005), 1.6 in Boricha Woreda (Kebebe *et al.*, 2006). And lower than the previous results of 6.1 sheep in Alaba (Deribe, 2009), 6.97 sheep in Dire Dawa (Aden, 2003), 11.35, 9.72 and 10.75 sheep in Tocha, Mareka and Konta, of Dawuro zone, respectively (Amelmal, 2011). This also because of selection of household was based on the improved sheep breed.

5.3. Dorper Cross Breed Sheep Flock Composition and Dynamics

Of the total monitored, Dorper sheep flock composition and dynamics 55.2% was females and 44.8% was male sheep (Table 5). The present findings are slightly higher number of female and lower number of male which agree with the report of CSA (2008), which is 73.38% females and 26.62% male sheep. This also agree with previous studies of (Endeshaw, 2007; Tsedeke, 2007; Getahun, 2008; Belete, 2009, Deribe, 2009) in Ethiopia, irrespective of the differences in a production system and resource base. The higher female number in the flocks of the semi intensive production system was because they are retained for breeding in order to diffuse technology transfer while fewer males are kept for breeding and immediately finishes for market. Early removal of males (since the breed reaches market age within 6-10 months), was also confirmed by the monitored farmers during continuous surveying period. Birth was the reason for entry, accounting for 15 male lambs (44%) and 19 (56%) female lambs. With respect to this current results agreement with reported by CSA (2008), 90.2% entry of sheep in Alaba Woreda was through birth in the year 2007/2008.

The exit routes vary widely among the study sites within the Woreda. 27 Dorper sheep exited in the flocks monitored during six month period (Table 5). Sale, deaths, home

slaughter and others were the major routes of flock exits. Sell for income generation accounted for 59.2% exits in the flocks. Death due to diseases, concentrate and forage bloats and other digestive disorders contributed 11.1% in the flocks. More male sheep, ram than female stock sheep (22.2%) exited for ceremonial and holiday slaughter. Others (thefts, weak births, mechanical damage, distocia and losses) contributed for 7.4%. Exits of Dorper sheep through sale is mainly associated with the immediate and seasonal cash needs. The finding of exits through sale of this study, similar to the report of (60.5%) in Alaba woreda (Deribe, 2009) and is higher than that of the previous report (29%) in the same Woreda (Tsedeke, 2007). The higher proportion is due to since the blood types of the breed is improved, and reaches for market weight for short period of time within a given flocks. Higher exits through sale (69.4%) was reported (Belete, 2009) from the flocks monitored about six months, which is due to huge number of local sheep breed and large number of mean flock size of local sheep breed.

Exits for home consumption (slaughtering) were mainly during Easter and Ethiopian New Year and, Muslem holidays “Id Al Adaha (Arafa), Id al Maulid, ‘Id Al-fatir (Ramadan), of the total slaughtered animals (22.2% of sheep), about 15% were slaughtered during Muslem holidays because of in Siltie zone rather than Wolaita zone, created awareness and colorful meat quality with its taste for home consumption curved high slaughtered Dorper sheep and 7.2% were slaughtered in eastern Ethiopia but lower than that of Belete (2009), who reported 28.8%, in Gomma Woreda of Oromia region.

5.4. Reproductive and Productive Performance of Dorper Sheep Crosses

Farmers in the two zones, agree with two major breeding seasons of sheep, namely December to January and between March and April in Siltie zone whereas in Wolaita zone starting from November and starting from April. So some differences were observed among the zones. Likewise, about half of the respondents agree that September and October are periods of high births.

Based on the discussions with key informants, it was gathered that April and May is the time of weeding and thinning of annual crops and some perennials like *Enset* and banana. Hence, increased availability of feed from crop residue may provoke on set of heat and subsequent breeding for sheep. Likewise, feed is more available during October and November due to the availability of harvesting crops.

5.4.1. Reproductive and productive performance

5.4.1.1. Age at first lambing

A total of 27 ewes were assessed for their life histories in the study area. Age at first lambing (AFL) varied by location and season, although observed differences were not significant ($P > 0.05$) level of significance (Table 7). Age at first mating is influenced by genetics. The current finding of least square means age at first lambing of Dorper sheep, 11.81 months was comparable with the previous reports 11.5 months of ewe sheep of Dorper (Fourie *et al.*, 2009) and age at first mating 328 days with 45.9kg of body weight (Cloete *et al.*, 2000). There is micro difference existed due to difference in production systems. Age at first lambing of local sheep breed of 17.01 months (Samuel, 2005), 20.7 in pastoral and agro-pastoral system of Southern Ethiopia (Adugna and Aster, 2007), Getahun (2008) for Adilo sheep (14.6), 470.10 days for Menz sheep (Tesfaye, 2008), 12.43 months (Deribe, 2009), Zewdu (2008), Solomon (2007) and 12.88 months of Dawuro sheep (Amelmal, 2011) were previous reports, higher than current findings. This is due to there is wide difference on age at first lambing in African sheep mainly due to difference in genotype and management practices (Solomon, 2007). Earlier age at first lambing of Dorper sheep in the current study might be associated with genetic makeup and better management than local sheep managed under different production systems.

5.4.1.2. Sexual maturity

Sexual maturity was recorded. The current finding of least square means sexual maturity of Dorper sheep, 5 months was comparable with the previous reports of Budai *et al.*,

(2013) and Cloete *et al.*, (2000). But disagrees with the previous result of 8.7 months (Endashew, 2007), sexual maturity of local sheep. This great variation is due to genetic makeup differences. Ewes that gave birth in April must have conceived during the months of November to January, after crop harvest. Similarly, Tsedeke (2007) and Deribe (2009) reported that in traditional farming system of Ethiopia higher conceptions were reported during crop harvesting, period, November to February. Endeshaw (2007), Solomon (2007), Tesfaye (2008) and Zewdu (2008) also reported two major breeding seasons, September to October and March to April, reflecting differences in availability of feed resources. During this period they probably had enough feeds from grain leftovers in the field, grasses and weeds at farm boundary and tree and shrub browse leaves. Short sexual maturities of Dorper sheep breed expose high production of lamb, which increase meat production for the demand.

5.4.1.3. Litter size

The least square means and standard errors of litter size of Dorper sheep in the present study was 1.48 ± 0.71 . Of the total births, 73.6%, 26.15% and 12.30 % cases of single, twins and multiple (Table 6). Analysis of variances of litter size is presented in Table 6. The present result was in agreement to the findings of Cloete *et al.* (2000), Schoeman (2000), Synyman and Hersalman (2005). The current findings of litter size is higher than Getahun (2008) reported litter size of 1.42 Adilo sheep and Mukasa Mugrewa *et al.* (2002), Tesfaye (2008) and Zewdu (2008) also reported litter size 1.14 of indigenous sheep in western Ethiopia, which is due to genetic effect. However, Deribe (2009) reported 1.51 of Alaba sheep perhaps due to may be relatively larger grazing area and less tethering pressure in Alaba special woreda.

5.4.2. Reproductive and productive performance of lamb

5.4.2.1 Birth and weaning weight

Location, season, sex, birth type, parity and blood group had no influence on birth weight and observed no differences were significant ($P > 0.05$) level of significance. The mean birth weight obtained in this study, 2.25kg was comparable with Demeke *et al.* (2004), Tibbo (2006), Getahun (2008), Berhanu and Aynalem (2009) of indigenous sheep. However, Gavojdaian *et al.* (2013) reported 3kg and 3.5kg for crossed and pure Dorper sheep. This reflects that the variation of blood group and production systems. Births in the late dry and small rainy seasons could be disadvantageous due to poor quality and limited quantity feed, especially as little supplementary feeding is practiced in the studied areas.

Mean weaning weight of Dorper sheep found in the present study, 17.30 kg was comparable to 18.2 kg for Dorper sheep (Cloete *et al.*, 2000). The present result was lower than previous result of Daniel and Herd (2005) reported weaning weight of 33.4 kg under intensive production systems, this variation is due to difference in production system. Weaning weight is strongly influenced by location, season, birth types, parity, sex, breed (genotype) and production system. Least square means and standard errors for weaning weight (Table 9). Male lambs had slightly higher and significant ($P < 0.05$) weaning weight than female. This type of effect has been reported in the literature (Hassen *et al.*, 2004; Gardner *et al.*, 2007; Yilmaz *et al.*, 2007, Deribe, 2009). Location had significant ($P < 0.05$) effect on weaning weight. Parity effect was found significant ($P < 0.05$) on weaning weight (Table 9). The effect of type of birth was also significant and single born lambs were heavier than their multiple contemporaries at weaning. Season had significant ($P < 0.05$) effect on weaning weight.

5.4.2.2. Market weight and age

Since Dorper sheep breed growth fast, it attains optimum market weight in short period of time. Majority of the farmer's sale their animals early before attaining optimum market

weight was reported by Solomon *et al.* (2005) and Getahun (2008). The mean market weight and market age of current study of Dorper sheep breed was 30.68kg and 12.66 months, respectively. The current finding of market weight was lower than the report of 36 for female crossed and 70 for male pure Dorper sheep (Fourie *et al.*, 2009). Market weight and market age were affected by birth type and blood group. Parity and location also had significant on market age of lamb. Season had significant on market weight. In Siltie zone, Dorper lamb reached market age at 12.87 months, which was significantly higher ($P<0.05$) than those in Wolaita zone, 12.05 months. Feed is more available in Mirab Azernet area as discussed earlier and housing separately their sheep. Because of better feeding and management, does become in heat within shorter time after lambing. Dorper sheep lamb in Wolaita had significantly lower weaning weight 16.62 kg ($p<0.05$) than Siltie (Table 9).

5. 5. Purpose of Keeping Dorper Sheep Crosses

Farmers keep Dorper sheep for many reasons, the major reasons being that they are the source of food for meat and income generation as cash and a form of savings was reported to be for meat (lamb production) with an index value of 0.28, 0.28 and 0.30 in Damot Gale, Damot Sore and Mirab Azernet respectively, followed by income generation with an index value of 0.25, 0.23 and 0.24 in Damot Gale, Damot Sore and Mirab Azernet respectively. The finding is in agreement with (Braker *et al.*, 2002). Amelmal (2011) also reported the reason for keeping sheep in Mareka woreda was for meat (index= 0.21) and Konta farmers was both for income generation with comparable index values of 0.18.

Besides these major reasons, some respondents in Damot Gale, Damot Sore and Mirab Azernet indicated with index=0.19, 0.20 and 0.22, respectively used Dorper ram as breeding purposes through natural mating for themselves and for neighboring per ram they cost 10 birr. This reflects that they are gaining income. And they used the manure's of Dorper sheep for fertilizer. This agrees with Endashew (2007) and Amelmal (2011). Farmers with no cattle reared sheep for the purpose of manure, because, 'enset' particularly at its early stage require high amount of manure. Traditionally farmers

decompose manure and kitchen wastes by depositing on the back yards in the form of heap and after a long period of decomposition they used the compost for back yard vegetables, enset and coffee as organic source of fertilizer. Discussions with key informants and flock holders in two zones showed that farmers appreciate the capability of Dorper to produce lamb, as meat better than local sheep, with minimum input. The fact is that, Dorper sheep are able to consume diverse feed source and plant species that cannot be easily consumed by local sheep: like Crop residues (straw of wheat, teff, barley), *chat* leftover and pods and broken seeds of haricot bean), was mentioned as the amazing desirable feature of Dorper sheep breed.

5. 6. Feed Sources and Feeding

Feeds are a major input in sheep production systems. Sheep are tethered around homestead (Figure 2b). Tethering is to reduce risks of crop damage, protect from predators, and save labor. Dorper sheep were fed with fillers and tillers, weeds, green residues of crops and grasses in wet season. There are local bylaws and binding rules that restrict the movement of animals and avoid damage to crops by small ruminants; particularly goats during cropping season (Deribe, 2009). As a result, sheep are tethered at homestead under nutritional stress. Depending up on the extent of damage, elders in the community punish the one who release his (her) animal(s) and damage crops. Similar local punishment rules were reported at Alaba (Deribe, 2009) and Damot Gale Woreda of Wolaita Zone (Fikre, 2009). Legesse *et al.* (2008) also reported the management techniques (tethering) suggested. When all the crops were harvested, small ruminants roam freely across the villages during the dry season. This period is a favorable time for feeding upon crop residues (aftermath, stubbles, grain leftovers, weeds, and boundary protected areas). As farmer group identified, feed is sourced from farm yard and purchase. Feed scarcity and quality deterioration during dry seasons are the main challenges facing smallholder sheep feeders, this agrees with Takele and Habtamu (2009).

5. 7. Water Sources and Watering

Water is the first tool for production parameters. Water availability is an issue in the study Woreda, particularly in Mirab Azernet. Rivers, surface water in wet season and pond water in early dry seasons are the major water sources (Figure 2a and 2b). Group herding is practiced to reduce the pain of travelling long distances everyday and every other day due to water shortages. Similar findings were reported on the water shortage in the rift valley areas of Oromia region and the neighboring zones (Tsedeke, 2007), SNNPR in Alaba (Deribe, 2009). Loss of time and energy while travelling to and from water points was also reported (Samuel, 2005).

5. 8. Housing Systems

Housing system for sheep depends on the management systems. In the Mrab Azernet district, the system of house used separate house for their sheep is different from that of Wolaita of Damot Gale and Damot Sore districts, used main house. Discussion with key informants and field observation in the area revealed that the materials used for housing also vary according to the economic status of the family. Dorper sheep are kept in house during night to protect them from predators, theft and abrupt climatic changes. Pregnant ewes at late gestation and new born at early stage of development (2-3 weeks) are kept separately to reduce the risk of physical injuries. Confinement and poor sanitation has created a favorable environment for disease transmission. This was reported in a condition when one animal in the flock was affected by infectious diseases; all the rest in that flock were also affected (Deribe, 2009). Similar reports by Lemma (2002) that poor housing favors disease and other complexes due to overcrowding in traditional production system. The majority of the respondent in Mirab Azernet (95.8%), house their sheep in the separate house and main sheep house was also reported by some farmers in the same woreda. However, the all respondents of Damot Gale and Damot Sore woreda (100%) house their sheep in the main house with families. Farmers using Kitchen to house sheep is not practiced due to thefts in the entire studied areas. This is agreeing with the previous study report of Fikre (2009) in Damot Gale, Wolaita zone.

5. 9. Adaptability of Dorper Sheep Crosses

In the entire studied area, the Dorper had high adaptation, 75.5% (Table 11). Similarly, Cloete *et al.* (2000) and Gavojdian *et al.* (2013) reported the Dorper sheep breed performed well under semi-intensive management conditions, proving to be an adaptable breed to new rearing conditions. Unlike other improved sheep breed, Dorper sheep breed has good adaptation under different climatic conditions. Thus farmers should be encouraged to use the breed for crossbreeding with the native or local breeds. According to the respondent (Table 11), majority of the respondent in Damot Gale (66.7%), Damot Sore (87.5%) and Mirab Azernet (85.4%) woreda exposed Dorper has high adaptability due to the breed is so voracious, as well as had good appetite. Moreover, fast growth of Dorper sheep as indicated 44.4, 37.5 and 29.2 % in Damot Gale, Damot Sore and Mirab Azernet respectively, followed by easy to manage, 33.3, 25.0 and 39.6% in Damot Gale, Damot Sore and Mirab Azernet made reasons to future expand of improved sheep breed. The high adaptability traits, early maturity and easy to manage the breed made superiority in the studied area, this finding agrees with the previous report of Cloete *et al.* (2000), Schoeman (2000), Fourie *et al.* (2009), Budai *et al.* (2013) and Gavojdian *et al.* (2013).

Pre-weaning mortality was low in Dorper breed (2.93%), due to the breed is so voracious, non selective bushes and has good appetite which develops immunity to against with diseases. And males (0.73) had lower pre weaning mortality than female (2.20). The current mortality rate was agrees with Gavojdian *et al.* (2013) the report of 3% in intensive production systems and high survival rate Budai *et al.* (2013). The degree to which lambs survive to marketable age is one of the key indicators of the efficiency of sheep production (Shigdaf *et al.*, 2013). Under traditional production systems, indigenous sheep mortality was reported 20.9% of Belete (2009), 19.5% of Getahun (2008) and 10.6% of Awigichew (2000). This previous report of indigenous sheep was higher than present report of pre weaning mortality of Dorper sheep, the breed is able to consume diverse feed source and plant species that cannot be easily consumed by local sheep.

5.10. Disease

The major diseases reported in the studied Woreda are endo parasites, fasciollosis, eye diseases, ecto parasites and pasteurellosis. Typical disease symptoms like coughing, swelling on neck, diarrhoea, bloating, lacrimation, emaciation with pale of mucous and swollen neck were reported before the death of animals. Fasciollosis in Damot Sore and Mirab Azernet woreda and internal parasitic disease in Damot Gale woreda were reported during the early dry season. This report is agreement with Deribe (2009), Pneumonia and parasitic diseases were reported in the area during the early dry season in Alaba special woreda. The majority of farmers had access to veterinary services in less than one km distances. Almost all farmers in studied area use modern drugs to treat their sheep against the disease, however some farmers use simple drugs from open market and traditional medicine. A farmer suggested through group discussion is that this traditional medicine (*ancciciya, danbbursa haytta, boorissa unkuwa, bootta zaafiya, hayta tukiya, tummuwa(necci shinkurt), kirkkissanne humbbuwa taphuwa*) could be used to treat different diseases in Wolaita. Similarly, Markos (2000) in Awassa Zuria and Endrias and Tsedeke (2006) in Woliata and Dauro zones also reported the wide application of ethno-veterinary practices to flocks and herds with health problem.

5.11. Constraints

In the present study areas, market problem was reported as first major problem in Wolaita zone and water and feed shortage in Siltie zone. Market problem as major problem in Wolaita zone reflects, lack of awareness on Dorper breed and its products, besides advantages rather than Siltie zone, Mirab Azernet woreda. On other hand, water and feed shortage at village level, pronounced particularly in dry season and none harvesting season, respectively. Lack of technology transfer knowledge through extension service and training was the other constraint in three districts as it was reported by Belachew and Jemberu (2003), Tessema *et al.* (2003), Azage *et al.* (2006), Berhanu *et al.* (2006), Endrias and Tsedeke (2006), Tibbo (2006), Solomon (2007), Tesfaye (2008), Belete (2009) and Tsedeke *et al.* (2011).

As an option getting 50% improved Dorper sheep by affordable cost, training on awareness creation and organizing farmers as cooperatives were raised through group discussion. Majority of the respondents in three districts purchased Dorper sheep with 100 birr/ kg from Areka Agriculture Research center at high cost based on the degree of blood group of the breed, with respect to this they seek to get improved breed at affordable price. Some other respondents consider training on awareness creation and organizing farmers as cooperatives as an important option to enhance sheep productivity.

6. CONCLUSIONS AND RECOMMENDATIONS

A flock monitoring study on whole sampled households was conducted from November 2013 to April 2014 in Siltie and Wolaita zones to evaluate the reproductive and productive performance of Dorper sheep. Considerable differences were seen among the two studied zones regarding to location (agro ecologies), management systems, reproductive performances and market information on the breed Dorper sheep. However, there were also some similarities among two zones. The Dorper sheep crosses has good performance and high adaptability. Age at first lambing of Dorper sheep was 11.77 ± 0.51 months in Siltie zone and 11.89 ± 0.70 months in Wolaita zone. Age at first lambing influenced by blood group and had significance. Location, season, parity, sex, birth type and genotypes had significant effect on weaning weight, market age and weight. The pre weaning mortality rate of Dorper sheep breed was lower in Wolaita than Siltie zone, 0.73% in Wolaita and 2.20% in Siltie. Market problem was identified in Wolaita zone. Separate house housing of management was observed in Siltie zones. As sheep production improvement option getting 50% improved Dorper sheep crosses by affordable price, training on awareness creation and organizing farmers as cooperatives were raised through group discussion in Siltie zone.

In view of the above, the following recommendations were suggested;

- ❖ Facilitating market opportunities by connecting the marketing route of this locality with big market players (traders, wholesalers, processors or exporters) and establishing big and standardized livestock market in nearby areas should be encouraged
- ❖ Integrated crop forage production especially under sowing legumes like desmodium species under enset crop is should be recommended and it helps to utilize the same land for more than one crop without affecting the yield of the perennial crops and reduce feed shortage
- ❖ Housing Dorper sheep in separate house was good practice, so sharing the practice for the others through training, experience share and field trip should be needed.

- ❖ In Siltie zone, there should be adequate supply of improved 50% cross of Dorper sheep crosses with least cost to farmers because of in the area there was awareness on the breed.
- ❖ Extension support should be needed by research institute and Agricultural office to improve institutional arrangements and management aspects
- ❖ Further study is needed to identify economically important diseases, characterize meat quality and carcass yield percentages from locally available feeds of Dorper sheep crosses in the area.

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8. APPENDIXES

Appendix 1: Questionnaire Format

Remainder to enumerators

1. Make brief introduction to each farmer before starting any questions, get introduced to farmers (great them the local way), get his name, tells him yours, the institutions you are working for, and make clear the purpose and objectives of your question.
2. Please ask each question so clearly and patiently until the farmer understands.
3. Please fill up the questionnaire according to the farmers replay (do not put your opinion).
4. Please try not to use technical terms while discussing with farmers and do not forget the local unit.

General Background

Enumerators' name _____ Farmer's name (HH head) _____

Sex: _____ Marital status: _____ Age category:
_____ Kebele name _____ village/*gote* name: _____

Date of commence of recording (DD/MM/2013/2014) _____

Appendix 2: Flock monitoring and dynamics

Flock dynamics follow-up format									
Breed/class	inventory (Number)	Monitoring 1						Mon. 2 date	Mon. 3 date
		Date			purchased	sold	Died		
		Birth Single	twin	triple					
Local									
Ewe									
pregnant									
suckling									
dry									
ram									
lambs									
<3month									
3-6month									
7-12mont									
Exotic									
Ewe									
pregnant									
suckling									
dry									
ram									
lambs									
<3month									
3-6mont									
7-12mont									
Crosses 50/75%									
Ewe									
pregnant									
suckling									
dry									
ram									
lambs									
<3month									
3-6mont									
7-12mont									

Appendix 3: Lamb weight

Lamb weight monitoring format													
Farmer name: _____													
Wereda: _____													
Zone: _____													
Ewe name	Breed	Parity	Lambing date	Birth Type	sex	Weight							
						date	kg	date	kg	date	kg	date	kg
Ewe #1													
Ewe #2													
Ewe #3													
Ewe #4													
Ewe #5													
Ewe #6													
Ewe #7													
Ewe #8													
Ewe #9													
Birth type : single, twin, triple													

- g. Insurance _____
- h. Others (specify) _____

III) Breeding

1. Do you have breeding ram by your own? a. Yes _____ b. No _____
2. If yes, how many _____?
3. What is the source of your breeding ram?
 - a. Born in the flock
 - b. Purchased from market
 - c. Gift from relatives
 - d. Rent
 - e. Others (specify) _____
4. For how many years on the average is the same breeding ram serving in your flock? _____
5. Is there any special management for breeding ram? a. Yes _____ b. No _____
6. If yes, specify type of management _____
7. For what purpose do you keep breeding ram in the flock?
 - a. Mating
 - b. Social culture
 - c. For fattening
 - d. Others (specify) _____
8. Do you keep the ram other than breeding?
9. If you do not have your own breeding ram, how do you mate your ewe?
 - a. Neighboring ram
 - b. Communal grazing areas
 - c. Unknown
 - d. Others (specify) _____
10. Do you practice selection for breeding male? a. Yes _____ b. No _____
11. If yes, at what age do you select the breeding male? _____ (years).
12. If your answer to question no 9 is no, mention the reasons: _____
13. Do you practice selection for breeding females? a. Yes _____ b. No _____
14. If yes, at what age? _____ (years).
15. If no, mention the reasons: _____
16. What are the major breeding (reproductive) problems that affected your flock productivity? Rank them according to their importance (1, 2, 3,.....; 1 for the most problem)

	<u>Problems</u>	<u>Rank</u>
a. Late age at first lambing	_____	_____
b. Long lambing interval	_____	_____
c. Repeat breeding	_____	_____
d. Abortion	_____	_____
e. Dystocia	_____	_____

- f. Long postpartum anoestrous period _____
 - g. Lamb mortality _____
 - h. Low growth rate _____
 - i. Others (specify) _____
17. Do you allow a ram to mate his:
- a. Mother? a. Yes _____ b.No; reason _____
 - b. Daughter? a. Yes _____ b. No; reason _____
 - c. Sister? a. Yes _____ b. No; reason _____
18. Do you allow your ram to serve ewe other than yours?
- a. Yes, why? _____
 - b. No, why? _____
19. Do you allow your ewe to be served by anyone else ram?
- a. Yes, why? _____
 - b. No, why? _____
20. Indicate type of housing/enclosure for your sheep flock
- 25.1. For adult sheep:
- a. in family house
 - b. separate houses
 - c. yard/corral
 - d. others (specify) _____
- 25.2. For suckling lamb
- a. in family house
 - b. separate house
 - c. together with their dam

IV) Reproduction characteristics of Dorper sheep

1. How many breeding female sheep do you have currently in your flock? _____
2. How many breeding female sheep do you have currently in your flock? _____
3. What is the average age at sexual maturity?
 - a. Male _____ months
 - b. Female _____ months
4. Do you fix age at first mating for the females? a. Yes _____ b. No _____
5. Do you fix age at first mating for the male? a. Yes _____ b. No _____
6. What is the lifetime production (longevity) of a ewe (year)?
 Minimum _____ Maximum _____ Average _____
7. What is the total number of lambing & number of lamb born by a ewe in her life time production?
 - a. No. lambing: Min. _____ Max. _____ Ave. _____
 - b. No.lamb: Min. _____ Max. _____ Ave. _____
8. Estimated weaning age of lamb (months): Minimum _____
 Maximum _____ average _____

V) Mortality

1. Which age group of sheep is most frequently dying?
 - a. Pre-weaning ($x \leq 3$ months)
 - b. post-weaned ($3 < x \leq 1$ year)
 - c. > 1 year
2. Which sex is more frequently dying? a. Male b. female
3. How many lambs were born in the previous months?
 - a. Male _____ b. female _____
4. How many of them were died? a. male _____ b. female _____
5. What clinical signs did you observe before their death?
 - a. _____ b. _____
 - b. _____ c. _____
6. What is/are the cause/s of such mortality?
 - a. disease (specify) b. feed shortage c. predators d. accident
 - e. unknown f. Poisonous plant (specify) g. others
7. At what season does your lamb die most frequently?
 - a. Autumn (Sep, Oct, Nov) c. spring (Mar, Apr, May)
 - b. Winter (Dec, Jan, Feb) d. summer (Jun, Jul, Aug)
8. What is the trend of mortality in your lamb?
 - a. Increasing b. decreasing c. no change
9. Why such trend was observed? _____
10. On which reproductive parameters is mortality of lambs mostly observed?
 - 10.1. Birth type: a. Single birth b. Twin birth c. Triple birth
 - 10.2. Parity: a. 1st b. 2nd c. 3rd d. 4th e. 5th f. 6th g. 7th

VI) Adaptability traits in Dorper sheep

1. Fill the table below by putting right marks where appropriate

No	Adaptability trait	Level of tolerance			
		Crosses			
		50%/75%			
		High	Medium	Low	
1	Drought and Heat tolerance				
2	Disease tolerance				
3	Withstand to feed and water shortage				
4	Others, specify				

12. What are the common disease that affects health and production of Dorper sheep?

Local name	Symptoms	Affected breed types	Age category	Seasons	
				Wet	Dry

13. What would you do when your sheep sick?

- 1=Treat with ethno veterinary practices 2=Sale immediately
 3=Slaughters immediately 4=Takes to veterinary center
 5=Treat with treatments from local traders 6=Others, specify

14. Are there any common ethno veterinary activities for sheep in your locality?

If yes, what are these activities? 1 = treating with parts of plant (stem, leaf, root)

2 = cutting/ branding with hot iron 3 = others

15. If treating with plant and or branding the body of sheep, for what diseases & how you administrate?

Fill in the following table

Local name of disease	Symptoms of disease	Ethno-vet practices	Affected breed types	Mode of administration

16. Did your sheep get vaccine in recent times? 1=Yes 2=No

If yes, which breed? 1= local breeds only 2= crosses only

3= exotic only 4 = all types

17. If yes, how? 1=after report of disease case

2=after certain animals died

3=before outbreaks.

18. Do you use medicines and drugs from open markets/illegal traders for sheep?

1=Yes 2=No

19. If yes, why? 1=Cheap 2=Not accessible to veterinary center

3=Not want to use veterinary center 4=others

20. Has there been any death of your sheep over the last 12 months? 1=Yes 2=No If yes,

21. Which breed? 1= local breeds male/female only
 2= crossbred male/female only
 3= exotic male/ female only
 4 = all types
22. If yes, in which season? 1 = wet season 2 = dry season 3 = in both seasons
23. If yes, (specify total number) in the order of ages _____
24. What were the major causes for death/loss of your sheep? (Rank)
 1=Diseases and parasite infections
 2=Nutritional deficiency and toxicity
 3=Mechanical causes 4=Predators 5=Undetermined 6= Ecto parasites
 7=others
25. Do you want to expand Dorper sheep flock sizes and production in the future?
 1=Yes 2=No , if yes (rank)

S N	Reasons to expand	Pure	Crossbred(F1)	Crossbred(F2)	All
1	High market demand				
2	Incentive market prices				
3	Easy to manage and keep				
4	Maximize benefits				
5	Immediate returns				
6	Colorful and quality meat				
7	Others, specify				

26. If no, why?
- 1=Shortage of grazing lands and feeds 2=Shortage of labor
 3=Prefer another animal species 4=Marketing problem
 5=Lack of capital to purchase animals and inputs 6=others, specify

VIII) Extension linkages

1. Have you received any improved management practices in sheep production?
 1=Yes 2=No

If yes, where you obtained?

- 1=Development agents 2=Community leader
 3=Market participant farmers 4=Neighbors
 5=Relatives and friends 6=Radio, television, news letter

2. How you received the information?
- 1=Training 2=Meeting 3=Written pamphlets
- 4=Heard from friends, relatives 5=Practical visited 6=others, specify
3. Did you receive training/advice of improved sheep management practice from DAs? 1=Yes 2=No
4. If yes, in what aspects?
- 1=Feeding (specify: feed production and feeding managements)
- 2=Health managements 3=Genetic improvements
- 4=Castration and fattening
- 5=Lambs rearing techniques 6=Housing of flock
- 7=Skin production (flaying, slaughter cares, transportation)
5. Did you apply the trainings/advices received to your sheep flocks?
- 1=Yes 2=No
6. If you applied the trainings/advices, did you achieve any improvements in your flocks?
- 1=Yes 2=No
7. If not, why?
- 1=Not affordable 3=Not accessible (not found in my areas)
- 2=Not simple to apply 4=socially and culturally not acceptable in my area
- 5=Not relevant to problems of my flock 6=Labor shortage 7=others, specify

Appendix 6: Check List for Focal Group Discussion

Woreda name _____

Kebele/village _____

1. How sheep herded across different seasons
2. Major feed resources during different seasons
3. Indigenous knowledge in managing the herd
4. sheep population and trends in the last years
5. sheep production and management improvement with improved sheep breed
6. Dorper sheep breed and benefits
7. The level of preference of Dorper sheep breed different traits
8. Any practice of rams sharing within the community
9. Farmers traits preference/selection criteria, breeding objectives and breeding practice
10. Constraints on sheep production
11. Cause of mortality and its occurrence across different age
12. Life time productivity of female Dorper sheep
13. Life time productivity of Dorper male sheep
14. Adaptability and survivable rate of the breed Dorper sheep

Appendix 7: Points for Secondary Data Collection

District name _____

1. Human population:
 - 1.1. In urban
 - a. Male _____
 - b. Female _____
 - 1.2. In rural
 - a. Male _____
 - b. Female _____
2. Livestock population:
 - a. cattle _____
 - b. goats _____
 - c. sheep _____
 - d. donkey _____
 - e. mule _____
 - f. horse _____
 - g. poultry _____
3. Average land holding per household (in ha) _____
4. Season of the year
 - a. Main rainy season from _____ to _____
 - b. Short rain season from _____ to _____
 - c. Dry season from _____ to _____
5. Topography of the districts (%):
Plain _____ Mountain _____ Plateau _____ Other _____
6. Climatic data (distribution and amount)
 - a. Annual average temperature _____ Maximum _____ Minimum _____
 - b. Annual average rain fall (mm) _____ Max. (mm) _____ Min.(mm) _____
 - c. Humidity (%): annual average _____ Min. _____ Max. _____
7. Agro-ecological zone of the district (%)
 - a. Lowland _____
 - b. Intermediate _____
 - c. Highland _____
8. Production system/farming system _____
9. Vegetation cover _____
10. Major soil types: a. _____
b. _____
c. _____
11. Opinion on relative importance of Dorper sheep in the farmers' livelihood (income contribution of the activity in percent) _____
12. Major sheep production constraints in the district _____
13. Major sheep disease, occurrence, mortality, and treatment _____
14. Major crops cultivated _____