Review on Sheep and Goat management practices, Constraints, Opportunities and Marketing Systems in Ethiopia

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In the present review, an attempt has been made to briefly sheep and goat management practices, marketing systems, constraints and opportunities in the country to deliver summarized and synthesized information for the beneficiaries, users and help the researchers to develop well-organized strategies to improve their productivity in Ethiopia. Sheep and goats are an integral part of livestock keeping in Sub-Saharan Africa that are mainly kept for immediate cash sources, milk, meat, wool, manure and saving or risk distribution. There are about 31.3 million sheep and 32.74 million heads of goats in the country, playing an important role in the livelihood of resource-poor farmers. Sheep and goat productions are highly affected by feed shortage, disease and parasites, water shortage, management, high predatory, and market instability. There are opportunities to increase their production like population growth, increasing urbanization, rising incomes, the domestic demand for meat, the establishment of different agro-industrial parks, several development partners involved in higher learning; research and development are currently dedicated to sheep and goat development. Depending on this review it is imperative to practice modern production systems with better technology in urban and rural areas to improve the traditional system through feed supplementation and better health care.

Keywords: Constraints, Opportunities, Management, Marketing, Sheep

INTRODUCTION

Ethiopia is among the few countries in the world with huge livestock population due to its suitable environmental conditions within the different ecological zones (Tilahun and Schmidt, 2012). These potentials make the country a noticeable source for animal genetic diversity (Hussen, 2015). According to the report of CSA (2018), the country is a home for about 60.51 million cattle, 31.3 million sheep, and 32.74 million goats.

Contribution of livestock to the livelihood of the people especially in the rural area and the national economy of the country is momentous by generating income to the smallholder farmers, creating job opportunities, providing drought power, ensuring food security, providing services and contributes to the asset, social, cultural and environmental values and sustain livelihoods of the people and also sources of foreign currency (EARO, 2000; Ehui et al., 2003; Belete et al., 2010; Kassahun, 2004; Markos, 2006; Endeshaw, 2007; Getahun, 2008; FAO, 2009; Berhanu et al., 2006; Behnke, 2010; Endalew et al., 2016 and Estefanos et al., 2014). In terms of contribution to the national economy, livestock contributes about 16.5% of the Gross Domestic Product (GDP), 35.6% of the agricultural GDP, 15% of export earnings and 30% of agricultural employment and currently the subsector supports and sustains livelihoods for 80% of the rural population (Metaferia et al., 2011 and Duressa, 2014).

Ethiopia possesses one of the largest sheep and goat populations in the continent that serves multiple functions to communities that herd them. The country is home to huge and genetically diverse indigenous sheep and goat
populations that are widely distributed across all agro-ecologies with traditional production systems that are vital for the current and future livelihoods of the large rural poor farmers (Gizaw et al. 2007; Abegaz, 2007; Hassan et al., 2012 and Yayneshet, 2010). Likewise, sheep and goat production in Ethiopia has great potential to subsidizing more to the livelihoods of the people in low-input, smallholder farmers and pastoralists under traditional and extensive production systems (Kosgey and Okeyo, 2007). According to the report of FAO (2017), the total annual meat production comes from cattle (63%), sheep (25%) and goats (12%). At the national level, sheep and goat account for about 90% of the live animal/meat and 92% of skin and hide (FAO, 2017) export trade value. In the lowlands, sheep with other livestock are the mainstay of the pastoral livelihoods. Average yields per animal slaughtered are estimated to be 110 kg of beef and 10 kg of mutton (Adugna et al., 2012). The per capita consumption of meat in Ethiopia is about 10 kg which is less than one tenth of that consumed in the United States of America (FAO, 2004). Furthermore, the annual total meat demand of the Middle Eastern countries is about 207 thousand tons of meat and 12 million heads of animals; however, live animals and livestock products such as meat, hides and skins constitute only 15% of the export revenue of the country (Abebe et al., 2010; Adane and Girma, 2008 and Behnke, 2010).

The levels of foreign exchange earnings from livestock and livestock products are also much lower than would be expected, given the size of the livestock population (Berhanu et al., 2007). This is due to the low productivity and the absence of a market-oriented production system limits the volume of marketable livestock (Hailemariam et al., 2008; Belete et al., 2010). 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). Both the amount of feed quantity and poor quality of the available feed resources limit animal productivity (Yayneshet, 2010 and Adugna et al., 2012).

The existing feedstuffs often provide low digestible energy, protein, minerals and vitamins to support optimum animal productivity (Yayneshet, 2010). Below such circumstances, there is a need to look for locally available alternative feed resources to improve livestock production and to maximize the benefits from the sub-sector. One potential way of increasing the availability of feeds for smallholder farmers could be through the use of fodder trees and shrubs (Ajebu et al., 2013). In many tropical countries tree forages such as fodder trees and shrubs are used as a component of livestock diets because these feeds have good nutritive values, and positively impact rumen microbial function and microbial yield and these feed improving livestock productivity in developing countries, including Ethiopia (Franzel et al., 2014; Singh and Makkar, 2002; Leng, 1997).

Sheep and goat production is careful to be profitable compared to large ruminants, due to their high fecundity, short generation interval, adaptation in harsh environment and their ability to produce in limited feed resources they are considered as an investment and insurance (Gatenby, 2002 and Tsedeke, 2007). Sheep and goats have multipurpose functions providing meat, manure and as a source of income (Shigdaf et al., 2013). Even though, the large potential of small ruminants in the country their productivity is low. Different related factors contribute for low productivity: feed shortage both in quality and quantity, health constraints, poor feeding system, health management, inadequate veterinary services as well as the absence of good management poor genetic potential; policy issues, market inaccessibility and institutional problems and the problem of credit facilities and others (Alemayehu, 2002; Bayou, 1998; Markos, 2006; Sisay, 2006; Tsedeke, 2007; Getahun, 2008; Lightfoot et al., 2005; Zinash et al., 2001 and Berhanu et al., 2006). The current study is therefore; carry out to review sheep and goat production, management practices, marketing systems, constraints and opportunities in Ethiopia.

LITERATURE REVIEW

Population and genetic variation of sheep and goats in Ethiopia

Conservation of livestock genetic diversity is basic to the long-term survival of most species and should be done based on comprehensive information regarding the structure of the populations, including sources of genetic variability within and among populations. It also requires adequate implementation of conservation priorities and sustainable management programs (Sheriff, Belay and Haile, 2013; Sheriff and Bireda, 2016; Mahmoudi, Babayev, Hayeri Khiavi, Pourhosein and Daliri, 2011) and widely used to categorize livestock species in the world [46] (Cardellino and Boyazoglu, 2009).

Ethiopia is believed to be one of the major gateways for domestic sheep and goat migration from Asia to Africa, and its diverse ecology served to further diversify and develop the genotypes it (Devendra and McLeroy, 1982; Melinda et al., 2006 and IBC, 2004). The sheep and goat population of Ethiopia estimated at 31.3 million sheep and 32.74 million goats, respectively (CSA, 2018) is one of the largest and most diverse in Africa (EARO, 2000; Workneh et al., 2004; Getinet et al., 2005). Sheep and goats, sustained virtually under the traditional subsistence oriented management systems, constitute an important livestock component in all ecological zones and agricultural systems in the country (EARO 2000; CACC, 2003).

The previous research (FARM Africa, 1996) on phenotypic characterization indicated that there are about 12 goat
types in Ethiopia while, a genetic study that used microsatellite markers showed only eight distinctively different types of goats in Ethiopia (Tesfaye, 2004). Conversely, the current molecular study on the domestic goats by Getnet (2016) does not support the former classifications of the indigenous goat populations. After a detailed analysis of the goat population based on production systems, agro-ecologies, goat families, admixture and phylogenetic network analyses he classified the 12 Ethiopian goat populations into six goat breeds (Getnet, 2016) and 14 traditional sheep (IBC, 2004; Workneh et al., 2004 and Gizaw, 2008) populations have been identified based on a combination of their morphological appearance and management systems.

Molecular characterization based on the traditionally recognized populations using microsatellite reported Twelve goats (Nubian, Afar, Abergelle, Arsi-Bale, Woyto/Gujji, Hararghe Highland, Short eared Somali, Long eared Somali, Central Highland, Gmuz, North-West highland and Guinea Bissau) (Tesfaye et al., 2006; Tesfaye, 2004; Addisu et al., 2002) and fourteen sheep (Menz, Sekota, Semien, Tikur, Wollo, Farta, Washera, Adilo, Arsi Bale, Horro, Bonga, Afar, HBS, Gumz) (Solomon, 2008) separate genetic entities or breeds in the country. Indigenous sheep and goat genetic resources have developed specific adaptations to survive under hostile local environmental conditions (climatic stresses, poor quality feed, seasonal feed and water shortage, endemic disease and parasite challenge) that make them suitable for use in the traditional, low-input production system (IBC, 2004).

Table 1: Sheep populations and their characteristics with respect to tail type, affinity to ethnic communities and distribution over ecological zones.

<table>
<thead>
<tr>
<th>No</th>
<th>Population</th>
<th>Tail type</th>
<th>Zone</th>
<th>Community</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Simien</td>
<td>Fat-tailed</td>
<td>I</td>
<td>Amhara</td>
</tr>
<tr>
<td>2</td>
<td>Sekota</td>
<td>Fat-tailed</td>
<td>I</td>
<td>Agaw/Tigray</td>
</tr>
<tr>
<td>3</td>
<td>Farta</td>
<td>Fat-tailed</td>
<td>I</td>
<td>Amhara</td>
</tr>
<tr>
<td>4</td>
<td>Tikur</td>
<td>Fat-tailed</td>
<td>I</td>
<td>Amhara</td>
</tr>
<tr>
<td>5</td>
<td>Wollo</td>
<td>Fat-tailed</td>
<td>I</td>
<td>Amhara</td>
</tr>
<tr>
<td>6</td>
<td>Menz</td>
<td>Fat-tailed</td>
<td>II</td>
<td>Amhara</td>
</tr>
<tr>
<td>7</td>
<td>Gumz</td>
<td>Thin-tailed</td>
<td>II</td>
<td>Gumz</td>
</tr>
<tr>
<td>8</td>
<td>Washera</td>
<td>Fat-tailed</td>
<td>III</td>
<td>Amhara/Agaw</td>
</tr>
<tr>
<td>9</td>
<td>Horro</td>
<td>Fat-tailed</td>
<td>III</td>
<td>Oromo</td>
</tr>
<tr>
<td>10</td>
<td>Adilo</td>
<td>Fat-tailed</td>
<td>III</td>
<td>WKH2</td>
</tr>
<tr>
<td>11</td>
<td>Arsi-Bale</td>
<td>Fat-tailed</td>
<td>III</td>
<td>Oromo</td>
</tr>
<tr>
<td>12</td>
<td>Bonga</td>
<td>Fat-tailed</td>
<td>III</td>
<td>Kaffa/Sheka</td>
</tr>
<tr>
<td>13</td>
<td>Afar3</td>
<td>Fat-rumped</td>
<td>IV</td>
<td>Afar</td>
</tr>
<tr>
<td>14</td>
<td>BHS</td>
<td>Fat-rumped</td>
<td>IV</td>
<td>Somali</td>
</tr>
</tbody>
</table>


**Ecological zones**

I. Sub-alpine: Cool to very cold sub-moist/dry alpine mountains and plateaus, low vegetation, 3008 m a.s.l, 1102 mm rain, maximum 22.1 oC, minimum 7.6 oC.
II. Humid lowland: Hot sub-humid lowland plain, high vegetation, 637 m a.s.l, 894 mm rain, maximum 37.7 oC, minimum 20.1 oC.
III. Wet highland: Tepid to cool wet highlands, very high vegetation, 1367 m a.s.l, 3744 mm rain, maximum 23.8 oC, minimum 13.1 oC.
IV. Arid lowland: Hot arid lowland plain, very low vegetation, 894 m a.s.l, 404.5 mm rain, maximum 33.2 oC, minimum 17.4 oC.

**Importance of Sheep and Goats in livelihoods of smallholder farmers in Ethiopia**

Sheep and Goats in Ethiopia contribute considerably to the economy and food security of the country. However, sheep and goats in Ethiopia and most developing regions are kept under traditional extensive systems (Solomon et al., 2010). In addition to their ability to flourish and reproduce in harsh environments, sheep and goat for many of the smallholder farmers are the major or only source of income and wealth, need low initial investment and maintenance costs, can use marginal land and crop residues, produce milk and meat in readily usable quantities, easily cared by most family members and important in feeding the rapidly increasing population of the developing world (Dessalegn, 2018; Ewnetu et al., 2006; FAO, 2009; Endeshaw et al., 2011; Tilahun and Goetsch, 2005; Solomon et al., 2013; Tibbo et al., 2006; Kugonza et al., 2001; Semakula et al., 2010; Arse et al., 2013; Legese and Fadiga, 2014; Zahra et al., 2014 and Byaruhanga et al., 2015).

Sheep and goat are considered as insurance mainly against crop failure, like saving, socio-cultural and ritual purpose (Tibbo, 2006; Adane and Girma, 2008; Habtemariam et al., 2012). Therefore, sheep and goats are vital to the livelihood of smallholder farmers and the economy of the country. About 14% of the total value of livestock output was contributed by small ruminants (Degefu, 2003). Currently, small ruminants in Ethiopia contribute 154,000 tons of meat (Mourad et al., 2015), about one-fourth of the domestic meat consumption; half of the domestic wool requirements; 40% of fresh skins and 92% of the value of semi-processed skin and hide export trade. Sheep and goats provide about 12% of the value of livestock products consumed and 48% of the cash income generated at farm level, 25% of the domestic meat consumption and 46% of the value of national meat production. Sheep and goats, respectively, contribute 20.9% and 16.8% of the total ruminant livestock meat output or about 13.9% and 11.2% of the total domestic meat production, with a live animal and chilled meat export...
surpluses. Per capita consumption of sheep and goat meat (kg/person per year) in Ethiopia is 8 kg while the global average is 38 kg (104 kg/day) (Ameha, 2008). They are the major suppliers of meat for rural communities, especially during periods of public festivals (Tsedeke, 2007).

Scholars found that the average size of sheep and goat was different. As Abegaz B. et al., 2018 showed that in Esera District of Dawro Zone, Southern Ethiopia, the average size of sheep and goat flock was 7.27 ± 0.551, 6.60 ± 0.225 and 4.64 ± 0.216 and 2.90 ± 0.293, 4.90 ± 0.257 and 8.38 ± 0.278 in highland, midland and lowland agro ecology respectively. The overall average flock size of sheep and goat per households was 6.08 ± 0.183 and 5.69 ± 0.236 in his study areas. Moreover, average sheep flock size 6.10 reported by Deriba (2009) in Alaba Southern Ethiopia, 5.33 reported by Selamawit and Matiws (2015) in Gedio Zone of southern Ethiopia, 4.8 reported by Dhaba, et al. (2012) in Illu Abba Bora Zone of oromia region and 3.6 reported by Belete (2009) in Goma District of Jimma zone. The average goat flock size was higher than 4.5 reported Deriba in Alaba Southern Ethiopia, 3.99 reported by Dhaba, et al., (2012) in Illu abba bora Zone of oromia region, 3.46 reported by Selamawit and Matiws (2015) in Gedio Zone of southern Ethiopia and 2.1 reported by Belete (2009) in Goma District of Jimma zone. Driver of live animal and meat product trade were increasing human population and urbanization, Rising per capita income – Increasing demand for meat, milk and milk products, Increasing in domestic price of live animal and meat products , Improving infrastructure – roads, phone, universities, etc, Favourable enabling environment, State Ministry for Livestock, EMDIDI, GTP, AGP, LMD, LMP, etc , Globalization and market opportunities . However, for meat product export promotion , there should be upgrading the country’s meat and its product export to the importing countries standard market requirement with quality improvement, expanding commercialization of production and marketing of livestock, diversifying into other products such as the processing of sausages and other similar types of meat and boosting domestic consumption (Mengesha, 2015).

In 2011, the value of global meat exports was estimated at USD 105 billion, and Ethiopia accounted for less than one percent of this total (0.75 percent or USD 79 million), of which most is chilled sheep and goat carcasses (USAID, 2013). Despite the increase in the number of abattoirs and corresponding capacities, the value addition has not proportionately increased due to the reason that none of the current functional meat processing industries and export abattoirs produced semi processed and processed meat products. The slaughter houses in the country have inadequate facilities for processing, thus not performing value addition for incurring cost. Out of meat produced, there is little or no meat converted into proceeds value added products. Therefore, in order to increase the processed value added, Ethiopia needs to invest in modern abattoirs and meat processing industries of international standard with all the necessary facilities to qualify for exporting processed and further processed meat products.

The function of sheep and goats in a crop-livestock mixed farming system

Sheep and goats contribute significantly to the subsistence, economic and social livelihoods of a large human population in low-input, smallholder production systems in developing countries (Workneh, 2000; Tibbo, 2006). They are important to the socio-economic well-being of people in developing countries in the tropics in terms of nutrition, income and provide both tangible benefits such as cash income from animal sales, meat for home consumption, manure, fiber and skins and intangible benefits such as savings, insurance against emergencies, employment, cultural and ceremonial purposes (Dhabe et al., 2012; Kefyalew et al., 2013; FAO, 2009; Endeshaw, 2007; Tsedeke, 2007; Belete, 2009; Tesfaye, 2009; Yenesew, 2009; Workeneh, 2000; Degefu, 2003; Tibbo, 2006 and Legesse et al., 2008). They also serve as insurance against crop failure and death of large ruminants (Belete et al., 2015; Ayalew et al., 2002, Ehui et al. 2000; Getahun, 2008; Kosgey et al., 2008). Increasing the human population, urbanization and incomes, coupled with changing consumer preferences are creating more demand for these animals and their products (Kosg et al., 2008).

Distinct features of sheep and goats

Sheep and goats are closely related since both belong to family Bovidae whereas they are different in species. Sheep may be distinguished from goats by the presence of a beard, strongly odoriferous tail-glands of the male, the absence of facial glands and lachrymal pits in the skull, the absence of foot glands in the hind feet. The body covering of sheep and goats differs widely between the two species, hair in case of sheep and wool in case of goats. Sheep may be distinguished from goats by the presence of a beard, strongly odoriferous tail glands of the male, the absence of facial glands and lachrymal pits in the skull, the absence of foot glands in the hind feet. The body covering of sheep and goats differs widely between the two species, hair in case of sheep and wool in case of goats. Sheep tails also hang down, even when short or docked, while the short tails of goats are held upwards. Sheep breeds are also often naturally polled (either in both sexes or just in the female), while naturally polled goats are rare (though many are polled artificially). Sheep are primarily herbivorous mammals: most breeds are close grazers on surface vegetation and short height herbage, avoiding the taller woody parts of a plant that goats readily consume (Agrawal et al., 2014). Sheep have an upper lip that is divided by a distinct philtrum (groove), the goat does not. Sheep have 54 chromosomes and goats have 60 chromosomes. Sheep tails also hang down, even when short or docked, while the short tails of goats are held upwards. Sheep breeds are also often naturally polled (either in both sexes or just in the female), while naturally polled goats are rare (though many are polled artificially). Sheep are primarily herbivorous mammals: most breeds are close grazers on surface vegetation and short height herbage, avoiding the taller woody parts of a plant that goats readily consume (Agrawal et al., 2014). The sheep is usually stockier than its relative the goat; its horns, when present, are more divergent; it has scent glands in its face and hind feet. In all wild species of sheep, the outer coat takes the form of hair, and beneath this lies a short
undercoat of fine wool that has been developed into the fleece of domesticated sheep.

Sheep and goats are highly adaptable to a wide range of environments (Desta, 2011). Sheep are predominantly grazers while the goats are browsers and in the process of grazing/browsing both the species resort to intensive selection on plant parts rich in nutrients and pick up a wide range of vegetation from the rangeland. Both lambs and kids are mono-gastric animals at birth while starting eating grasses and green feeds microbes inhabit their rumino-reticulum within two months transformation, lambs and kids became small ruminants (Agrawal et al., 2014). Goats are particularly destructive to an environment. However, if used correctly, goats can be a conservation tool that helps protect the biodiversity of plant species (Markos, 2006). Many of the problems associated with goats, in particular goats, are the result of man incorrectly managing these animals or trying to raise too many livestock in areas unsuited for the practice (IBC, 2004; Adane and Girma, 2008).

**Sheep and Goat production system and Husbandry Practices in Ethiopia**

**Description of Sheep and Goat production system**

Different scholars classify sheep and goat production systems in different ways depending on the purpose of classification. Based on dominance of agricultural activity, Getahun (2008) classified traditional small ruminant production systems into four subsystems: small ruminant in the annual crop-based system located in northern, northwestern, and central highlands; small ruminant in perennial crop-based, mostly found in southern and southwestern highlands; small ruminants in cattle based systems, these systems usually exist in agro-pastoral and semi-arid areas; small ruminant dominated systems found in pastoral and arid areas of eastern and northeastern Ethiopia, where sheep and goats are the dominant livestock species. Sheep and goats in Ethiopia and most developing regions are kept under traditional extensive systems. Based on the purpose of sheep and goat, three production systems namely, Extensive, Semi-intensive and Intensive were identified (Etalema and Abera, 2018 and Alemitu and Abera, 2018).

Goat production in Ethiopia is described under a low input production system and is operated by smallholder farmers. This production system accommodates almost all of the goat population of the country (Solomon et al., 2008). In Ethiopia, sheep and goats are maintained in two broad production systems namely mixed and pastoral and agro-pastoral farming systems (Matawork et al., 2016). Extensive systems of production share common characteristics, such as small flock sizes, communally shared grazing, uncontrolled mating, absence of recording, low productivity per animal, relatively limited use of improved technology and use of on-farm by-products rather than purchased inputs (Girma, 2008).

On the other hand, Solomon et al., (2008) classified sheep production systems in Ethiopia into five subsystems based on feeding, veterinary care, housing practices, Subalpine sheep–cereal system (>3000 m), Highland cereal–livestock system (2000–3000m), Highland perennial crop system(1500–2000 m), Lowland crop–livestock system (agro-pastoral) this is Sub-moist/ moist lowland (>1000 m) and Pastoral system, this is Semi-arid/arid (≤1000 m). Moreover, three major and two minor sheep and goat production systems are described based on the degree of integration with crop production and contribution to livelihood, level of input and intensity of production, agro-ecology, length of growing period and relation to land and type of commodity to be produced (Solomon A. and Solomon G., 2015). These are highland sheep–barley system, mixed crop–livestock system, and pastoral and agro-pastoral production systems and the other two currently not used widely were Ranching and Urban and peri-urban (landless) sheep and goat production system. Livestock production is of subsistence nature. Market-oriented or commercial production is almost non-existent (Solomon et al., 2008 and Solomon et al., 2010).

The comparative advantage and possible for better livestock production by livestock species in different areas vary significantly due to alterations in resource endowment, climate, population, the prevalence of disease, level of economic development, research support and government economic policies (Beets et al., 1990 and Deribe, 2009). The main type of agricultural production system in many developing countries is mixed crop/livestock production in a subsistence manner (Tesfaye et al., 2004). Moreover, in Ethiopia, sheep and goats are maintained under two broad production systems (EARO, 2000).

**Highland sheep–barley system**

This system is found in the highlands above 3000 m.a.s.l. where the major crops are grown are barley and pulses such as fava beans, lentils, etc. Temperature is the main factor determining productivity in the highland sheep–barley production system. At times, night temperatures fall below 0°C and frosty nights are common, particularly between October and January. Cropping intensity in these areas is generally low. Sheep are the dominant livestock species. The main feed resource base includes wasteland grazing, stubble and sometimes straw. Sheep flock sizes range from 30 to several hundred heads (Solomon et al., 2008).

Although sheep are reared mainly for meat, skins and coarse wool production for the cottage industry of the central highlands are subsidiary products. There is, therefore, a clear possibility of establishing more formal sheep production enterprises using appropriate
technology packages. Large sheep production ranches could be established where mainly meat or dual-purpose breeds could be maintained either by individual farmers or cooperatives. These highland areas are generally unsuitable for sustainable crop production (Solomon et al., 2008).

**Mixed crop–livestock systems**

These systems are predominantly found in highland agro-ecological zones where the climatic factors are conducive for farming of crops and raising livestock. Both sheep and goats are raised in mixed crop–livestock systems. This system is generally found in areas where the altitude ranges between 1500 and 3000 m.a.s.l. The area has adequate rainfall and moderate temperature and is thus suitable for grain production. The integration of crops and livestock is high in most areas. In this production system, livestock and crops are maintained as complementary enterprises. Livestock in general and small ruminants in particular play an important role in food security and food self-sufficiency in this production system. In the grain-based mixed production system, livestock is the main cash source for the purchase of agricultural inputs. Livestock is used as a savings and insurance mechanism. Cattle are the dominant livestock species and are kept mainly for draft power. Sheep and goats are change to meet small and immediate cash needs (Solomon et al., 2008).

Sheep are more dominant than goats in this production system. The major commodity is meat, while milk is a secondary product in some areas. Landholding per household is 2–3 hectares with some areas having much smaller holdings of less than 2 ha (Solomon et al., 2008 and Tsegaye et al., 2013). The major feed resources are natural pasture and crop residues. In some areas, one-fifth to one-third of the holding is used for grazing. In most of the areas, however, livestock generally depends on grazing communal land that is dwindling in size and productivity. Sheep and goats in this system experience year-round nutritional stress due to increases in cultivated land area. This results in very high grazing pressure and subsequent shortage of feed.

This area is also characterized by excessive soil erosion and soil nutrient depletion because of intensive cropping and overgrazing. The system of sheep and goat production for the most part is a low input /low output system except in some cases of concentrate supplementation and use of anthelmintic for fattening sheep and goats. There is a need to intensify production because of the high population density in these areas. Potential for intensive small ruminant production through finishing activities and stratification of production exists (Solomon et al., 2008). Small flock sizes predominate in the highland mixed crop-livestock systems because of land and capital limitations (Markos, 2006). Central, mid and highlands parts of the southern region of Ethiopia are categorized under the mixed crop-livestock production system (IBC, 2004).

**Pastoral and agro-pastoral production systems**

In pastoral and agro-pastoral areas sheep and goats are important components of the farming system, which benefit smallholder farmers in generating cash income as well as milk. Although there was a potential in the area, the productivity of sheep and goat remained quite low. Therefore, it is crucial to systematically describe the production systems to plan and design appropriate research and development interventions that are relevant to the specific systems (Getahun, 2008). Pastoral systems are associated with agro-ecological zones (AEZ) that are too dry to sustain crop production. These are characterized by little or no crop agriculture and residence and their movement is limited in search of grazing and water in terms of both distance and duration (Markos, 2006). Under Ethiopian conditions, pastoral systems of production are found at altitudes below 1500 m.a.s.l. and where the annual precipitation is less than 500 mm. Livestock is maintained as a activity. Fifty percent of household revenue comes from livestock or more than 20% of household food energy is derived directly from livestock or livestock-related activities (Solomon et al., 2008).

Rangeland is the mainland resource. There are more goats than sheep in this system. Milk and meat are the two outputs. In drought years, goats gain more importance as suppliers of milk to the household. Goats also help to control bush encroachment. Pastoralists depend on their livestock not only for their income but also for their survival. Livestock management is, therefore, directed towards risk minimization, which tends to reduce productivity. Pastoralism is ecologically, economically and socially important for sustainable development in dry lands (Solomon et al., 2008).

The Agro-pastoral system is characterized by less integration with crop production as compared to the crop–livestock production systems. Producers under this system have a permanent residence and their movement is limited in terms of both distance and duration. The system is characterized by a high degree of dependence on milk and meat production. Some crop agriculture is practiced around the permanent homestead. This is also a low input / low output system. The system is usually practiced below 1500 m.a.s.l. but with higher rainfall to support short-season crops compared to the pastoral system (Solomon et al., 2008). In the sub moist/moist lowlands, agro-pastoralism is the main mode of production. Crop and livestock production are both important activities (Tsegaye et al., 2013).
Table 2: Major sheep production systems in Ethiopia

<table>
<thead>
<tr>
<th>Production systems</th>
<th>Environment</th>
<th>Geographic regions</th>
<th>Characteristic features of production systems</th>
<th>Scale of production and management†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subalpine sheep–cereal system</td>
<td>Subalpine (&gt; 3000 m)</td>
<td>Menz area, Wag Himra, parts of North Gondar (Debark, Dabat, Janamora, Wegera), South Gondar, North and south Wollo zones of Amhara state, and Tigray State</td>
<td>Meat, fiber, manure, skin; unreliable, long season barley</td>
<td>Medium scale sheep production; Semi intensive/extensive, low-input</td>
</tr>
<tr>
<td>Highland cereal–livestock system</td>
<td>Highlands (2000–3000m)</td>
<td>Most of Oromia; West and East Gojam and Agew Awi zones of Amhara state; Central Tigray</td>
<td>Mainly cereal cropping; meat, manure, skin</td>
<td>Small-scale sheep production; semi intensive, low-input</td>
</tr>
<tr>
<td>Highland perennial crop system</td>
<td>Highlands (1500–2000m)</td>
<td>Coffee, Inset and fruit growing areas of Southern and Oromia</td>
<td>Mainly perennial cash crops (coffee, Inset, khat); meat, skin</td>
<td>Minor sheep production; semi-intensive, low input; some practice tethering</td>
</tr>
<tr>
<td>Lowland crop–livestock system</td>
<td>Sub-moist/moist lowland (≤1000 m)</td>
<td>Benishangul-Gumz, lowlands of Amhara, Oromia</td>
<td>Cereals, sesame, cotton; meat, skin</td>
<td>High level of livestock keeping; extensive/semi intensive, low-input</td>
</tr>
<tr>
<td>Pastoral system</td>
<td>Semi-arid/arid (≤1000m)</td>
<td>Pastoral regions in Somali, Afar, Oromia and southern states</td>
<td>Meat, milk, skin; minimal or no cropping</td>
<td>Rangeland-based large scale sheep production; extensive, low-input</td>
</tr>
</tbody>
</table>

† Based on feeding, veterinary care, housing practices Adapted from Gizaw et al. (2008).

Ranching

Ranching is a range-based system of livestock production similar to the pastoral systems but with different production parameters, livestock functions and management. Ranching can be considered as a modern land-use system. It is a labor-extensive system focusing on the production of marketable commodities from one or two selected species. This is mainly in the form of producing live slaughter animals for meat. The main function of the system is to generate cash income. Management of livestock is characterized by grazing within defined borders and an individual tenure system with possibilities of intensified feeding and watering of animals. The form of ownership in ranching could be parastatal, cooperative or private (companies or individuals). Ranches can be differentiated by targeted livestock species and product: Although the most common system is cattle ranching, sheep and goat ranching for the production of skins (Karakul), wool (Merino), and meat (Dorper sheep and Boer goats) exist in various parts of the world, intensity and level of development: this system of ranching works with a minimum of fixed investments and extensive management practices (Solomon et al., 2008).

This system requires heavy investment and improvement practices and well-planned and executed livestock management and grazing systems and stratified system: In this case, ranches could be specialized to produce weaned lambs or kids for fattening or finishing by other production systems (Solomon et al, 2008). The ranch system of production is important in arid and semi-arid zones of Africa, particularly in eastern and southern Africa (Kenya, Tanzania, Zambia, Zimbabwe, Botswana, Namibia and South Africa). Ranches are also found in some highland areas. Both highland and arid/semi-arid ranching can be undertaken in Ethiopia. Sheep ranching can be established in the highland sheep–barley system, where there is very little crop cultivation, with targeted production objectives of either meat, coarse wool or both. Extensive ranching can also be established in the arid/semi-arid areas of the lowlands or pastoralist areas for market-oriented sheep or goat meat production using specialized breeds such as the Dorper sheep or Boer goat and their crosses with local stock. It is possible to produce sheep and goats that are more uniform and targeted to satisfy the increasing export and domestic market if such systems could be introduced into the pastoral, agro-pastoral and the highland sheep–barley production systems (Solomon et al, 2008).

Urban and peri-urban (landless) sheep and goat production system

This system involves the production of sheep and goats
within and at the boundary of cities. Quantitative data is not available on the importance of urban and peri-urban production systems but it is not uncommon to observe sheep and goats in urban areas including the capital Addis Ababa (Solomon et al., 2008). Feed resources are usually household wastes, market area wastes, mill leftovers, by-products and roadside grazing (particularly in the peri-urban system). Besides, small-scale sheep fattening is emerging as an economic activity in many growing cities. The viability of this activity depends on its acceptance into the formal extension services. It could either be a high input / high output or low input / low output system (Solomon et al., 2008). In most cases, the type of sheep and goats available from this system is meant for local consumption, being well-finished, fatty animals demanded by the local Ethiopian market (Solomon et al., 2008).

**Husbandry Practices of sheep and goats**

Smallholder farmers are performing animal husbandry in different production systems and agro ecologies. In a mixed crop-livestock farming systems, sheep and goat are confined and tethered in a wooden hut during the night and are only permitted for grazing and browsing during the day under the supervision of a herdsman, mainly young men or women (Webb and Mamabolo, 2004; Tsedeke, 2007). The enclosure of livestock in huts or kraals is done mainly to protect them from theft and predation (Webb and Mamabolo, 2004). Tethering is common during wet season until crops are harvested. 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 the wet season is reported for Goma Woreda of Oromia region (Belete, 2009). A sort of individual herding or hiring a person for an individual family or a group of families was reported for the western part of the country (Alganesh et al., 2003).

**Feed resources and feeding systems**

Lack of adequate year-round feed resources is probably the most important factor contributing to low animal production in arid and semiarid regions in the world (Ben Salem & Smith, 2008; Kawas et al., 2010). Even though huge and diverse livestock genetic resources, the economic support of the livestock sector to livelihoods of the livestock keepers in Ethiopia is very small (Adugna, 2007; Aklilu et al., 2013). Among the main factors affecting livestock production and productivity in Ethiopia, unavailability of feed both in quantity and quality is the leading problem (Adugna, 2007). Feed cost accounts for over 50% of the total production and marketing costs in any livestock enterprise (Solomon et al., 2017).

Sheep and goat production in Ethiopia suffers from feed shortages at all levels with an estimated 40% insufficiency in the national feed balance and this is aggravated by the seasonal availability of forage and crop residues in the highlands and by recurrent and prolonged drought in the lowlands (Alemu, 2008). Some authors also indicated that the feed types available and feed resource management and utilization practices of livestock keepers need to be identified and the feed balances for specific geographic regions and agro-ecological zones need to be estimated to develop suitable market oriented intervention strategies (Solomon et al., 2017).

The major feed resources for sheep and goats include grazing on communal natural pasture, private pastures, crop stubble, fallow grazing, road side grazing, crop residues, browsing, improved forages, and non-conventional feeds, including household food leftovers, weeds from crop fields, tillers from dense crop fields, fillers (crops intentionally planted on part of crop lands or around the homestead to be used as feed) and traditional brewers byproducts (Atella) and the importance of the different feed resources varies depending on the production system, farmers’ livestock management practice and the production environment (Etalem and Abera, 2018; Abraham et al., 2017; Solomon et al., 2010; Endeshaw, 2007; Tsedeke, 2007; Belete, 2009; Tesfaye, 2009 and Yenesew, 2009). Moreover, Dhaba et al., (2013) in Ilu Aba Bora zone and Shewangzaw A.et al., (2018) in Amhara region, showed that the major sources of feed for small ruminants were natural pasture grazing and browsing on communal grazing lands, road and riverside and aftermath grazing. Natural pasture is the most important source of feed during the wet season in all systems (Solomon et al., 2010).

In most production systems, agro-ecologies and geographic regions, extensive free grazing in communal grazing lands and stubble grazing are the most common practices of feeding sheep, while browsers are used for goat flocks by almost all farmers and pastoralists. It is estimated that natural pasture provides from 80–90%, and crop residues 10–15% of the total livestock feed intake in Ethiopia (Alemayehu, 2003). The form of controlled feeding includes tethered grazing on private lands and marginal lands, cut-and-carry feeding of grass, tillers, fillers and weeds (Solomon et al., 2010). Most of the farmers practicing tethering because unavailability of communal grazing lands in highly populated areas and damage by free roaming animals on perennial coffee and fruit plantations (42.6–93.4% of respondents), saving herding labour (19.5–50%), protection of animals from predators (27.8–53.6%), utilizing marginal lands (7.6–1.45%) and avoiding unwanted breeding (2.5%) (Endeshaw, 2007; Solomon et al., 2010; Tsedeke, 2007 and Belete, 2009).

According to Solomon et al., (2010) and Belete (2009), supplementary feeding of sheep and goat in most extensive production systems where large breeding flocks are kept is limited mainly to fattening/finishing castrates. Occasional crop residue supplementary feeding of certain...
classes of sheep is practiced during the dry seasons. In contrast, in areas with small flock sizes, tethering and supplementary feeding is a common practice. In wet highland perennial crop systems, 92% and 33% of the households supplement all breeding females and castrates during the dry and wet seasons, respectively. Supplemental feeds include household food leftovers, attela (residues left after distillation) from local areke and tella, grains, enset from tuber-pseudo stem to tip part of leaves, banana leaves and stem, sweet potato vine, haricot been residue, maize from early stage to postharvest, wheat bran (20% households), fruit leaves mainly avocado and banana (Musa paradisiaca), and Chat (Catha edulis) leftovers.

Goats are more selective and browse more, especially under extensive conditions, than sheep. The selectivity of goats is reduced under intensive management. Goats generally have better body condition compared to sheep under the same grazing conditions, mainly due to their ability to select a nutritious diet. Goats prefer to eat feed at a height of 20–120 cm. They can stand on their hind legs for long periods and can even climb trees to reach parts of trees they prefer. They also have mobile upper lips and tongues that enable them to consume leaves between thorns. The preference of goats for consuming browse can be used in the control of invasive species on grasslands. Keeping a mixture of browsers and grazers can maintain rangeland grazing areas rather than allowing them to become overgrown with brush. The mixed species of livestock kept by pastoralists enables the simultaneous use of vegetation at different heights (Alemu, 2008).

**Water sources and watering**

The main sources of water for sheep and goat during the dry season in most parts of the country are rivers, springs, streams, ponds, deep well, tap water, dam as well as rain water harvest (Berihu, 2016; Abraham et al., 2017; Solomon et al., 2010 and Solomon et al., 2017). The major water sources in Ilu Aba bora zone for small ruminant production in the wet and dry seasons were river and river and tap water. According to the study of (Dhaba et al., 2013) in West Shoa and South Wollo Zones, the major water sources in wet and dry seasons were river and river and tap water, respectively. Watering frequency varies with season and agro-ecology and sheep are commonly watered every three days and goats every 3–5 days during the dry season as nearby water sources dry-up.

In the report of Dhaba et al., (2013), in West Shoa and South Wollo frequency of water was shown to be once in a day and once in 3 days in dry season, and twice a day and once in a day in wet season, respectively. Animals are watered once in two days in moist lowlands and once a day in moist highlands and time taken to watering points range from 7.7–9 minutes in Gomma to 0.33–5 hours in Alaba, and distance ranges from 1.0 km (wet season) to 2–5 km (dry season) in Metema to 1.0–10 km in Dale (Solomon et al., 2010) and during dry season, the average distance from home to the water source was less than 1 km (45%) and 23% and 32% of the respondents got water from with no distance and 1–5 km, respectively in Amhara regions (Shewangizaw Addisu, 2018). Water shortage is a limiting factor in most lowland areas and to a limited extent in mid altitudes (Mesay et al., 2013; Yedeta, 2016; Abraham et al., 2017). In eastern, north-eastern and south-eastern part of the country there is also a critical shortage of water; however, there are breeds adapted to lowland agro ecologies through their physiological adaptation mechanisms (Belete, 2009).

Limitations of water may result in poor nutrition and digestion, because there is a relationship that exists between water intake and feeding of roughages, particularly during dry season. Long distance travel of small and large ruminants in search of water was another problem whereas, during the rainy season pond and dams filled by the rainy water were the main sources of water and some farmers and pastoralists reported that they also use tap water during the rainy season (Mesay et al., 2013). It can be noted that there is a wide variation in time spent to get to water sources and watering frequencies. In Menz area, smallholder farmers get water at a distance of less than 1 km and about 92.5% sheep owners in Menz and 33.6% in the Afar area watered lamb with adults (Tesfaye, 2008).

**Housing system**

Housing can be very necessary for determining by reducing stress, disease hazards and making management easier. According to Etalem and Abera (2018) in Hadya zone Misha Woreda and Alemitu and Abera (2018) in Sodozuria, Wolyta Zone showed that, majority of the respondents keeps sheep and goats in the main house together with the family except for newborn lambs and kid until weaning. According to Berihu (2016), most of the small ruminant holding households responded that they housed their livestock (small ruminants, cattle and poultry) separately but all animal groups (females, males and young animals) were kept in the same house regardless of the species, age, and health status. However, Tesfaye (2008), showed that majority of sheep are housed separately from other livestock; whereas, the study of Alubel (2015) in Ziquala and Tanqua Abergele districts reported that majority of farmers confine their goats without roof and a minority of them confine their goats in the family house. Whereas, almost all farmers in the western Amhara provide shelter for their goats and almost all respondents housed their goats together with other livestock species. Most of the respondents housed kids together with adults during night time (Damitie et al., 2015).

Different farmers living in different agro-ecological settings, take up different housing practices. This implies that being a resident in highland agro-ecological zone, as
compared to that of midland or lowland increases the probability of having crossbred animals and implementing shading management and to feed their sheep and goats at home (Fikermayam et al., 2016). None of the respondents in western Tigray had provision for accommodating different age groups only sick ones and newly born kids/lambs were retained alone in sheds (Abraham et al., 2017). Sheds were constructed of locally available materials and were not permanent as animals migrate from place to place in search of feed and water. However, farmers in urban areas used permanent houses separated from or attached to their homesteads (Abraham et al., 2017).

**Common Diseases and Parasites of sheep and goats**

Diseases can affect the productivity and reproductivity of sheep and goats. The major diseases of sheep and goat in different ecological regions of Ethiopia are Pasteurellosis, Fasciolosis, Sheep pox, Dermatophilosis, Coenonosis, Respiratory problem, Orf, Anthrax, Blackleg, Endoparasitosis, GIT disorder, Ectoparasitosis/tick/lice, Mange mites/skin diseases, Enzootic ataxia, Lameness, Eye problem, Enteritis, Heartwater, Diarrhea, Goat pox, Trypanosomiasis, PRR like disease, Pneumonia, Abortion (Abraham et al., 2017; Asfaw et al., 2008; Endeshaw, 2007; Tsedeke, 2007; Belete, 2009; Tesfaye, 2009; Solomon et al., 2010 and Yenesew, 2009).

**Herding practices**

These are very important for planning genetic improvement programs and introducing improved sheep and goats management such as strategic health interventions at village level and the flock herding practices of the smallholder and large scale farmers reflects the breeding management and has an impact on the flock size (Yohannes et al., 2017). Separate herding of does and kids was dominant in Bale Zone and the reason is that milk is the main product for the society, which causes competition with kids (Belete et al., 2015).

According to Tesfaye (2010), who reported that about 52% of goats in the Shalla district were mixing kids with adults? About 45.8% of the respondents run their flock individually, while 54.2% of respondents mix their goats with their neighbor (Belete et al., 2015). Similarly, the common herding management in western Tigary was free grazing where farmers herded their goats together with sheep (Abraham et al., 2017). Because of their feeding habit, farmers prefer to manage sheep separately, but the majority of the smallholder farmers keep sheep with other livestock because of the shortage of labor (Getachew et al., 2010). Hassen et al. (2014) described that sheep and goats are herded together in Afar pastoral and agro pastoral system whereas, about 62% of the large scale farmers herd sheep separately and 38% rear sheep and goats flock together. According to report of Mekoya et al., (2000), sheep in the central highlands of Ethiopia are herded separately for grazing all year round using family members.

**Breeding practices and selection criteria**

Livestock production is affected by a multifarious interaction of the genetic potential of the livestock breed kept, the production system and the production environment. Sheep and goat breeds reared in Ethiopia are almost exclusively indigenous breeds. Most of these breeds have not been systematically improved and have evolved in marginal environments with adaptation to the natural environment and are thus less 'productive' in certain production traits such as growth traits when compared to other breeds. However, the productivity of livestock breeds should be evaluated within the context of the production environment (the climatic conditions, availability of feeding, disease load, etc.). Besides, the mode of production determines the level of productivity and production through the farmers' production objective, such as choice of crop or livestock production. The production objectives in turn determine the farmers' management skills and the level of input used to meet these objectives (Niftalem, 1990; Solomon et al., 1995; Tsedeke, 2007; Getahun, 2008; Mengistie, 2008; Solomon et al., 2008; Solomon et al., 2008 and Solomon et al., 2010).

Sheep breeds in the subalpine region are lighter in weight at birth, yearling, and at maturity compared to breeds in the wet highlands and lowlands. They also have less reproductive capacity, especially in litter size. The goat breeds identified in Ethiopia (Tesfaye, 2004) include Afar, Abergelle, Arsi, Hareruge highland, Short-eared Somali, Long-eared Somali, Western highland, Western lowland, Central highland, and Keffa. Reproductive and growth performance are important measures of productivity in meat animals. Sheep and goat productivity in Ethiopia, and in general in Africa, is considered low as compared to productivity levels in developed livestock industries of the world. Reproduction levels in sub-Saharan African breeds are 17.5–16.4 months for age at first parturition (Otte and Chilonda 2002), 230–437 day for lambing intervals (Wilson 1989), and 1.0–1.5 for litter size [140] (Ibrahim 1998). The growth rate of sheep and goats in Ethiopia is slow ranging from 100 g/day at an early age to less than 50 g/day after weaning, resulting in small carcass weights (10 kg) and annual meat production (3–3.5 kg/year per animal) (EARO 2000).

Flock monitoring studies showed that there is a loss of body weight in most classes of animals in sheep and goat flocks (Belete, 2009) ensuing in smaller animals at slaughter age (18–20 kg for sheep and 16–18 kg for goats) and thus low meat yield. Farmers have their benchmarks for selection of breeding sheep or goats and the selection criteria used for male sheep and goat is different (Yadeta,
for males, tail type, color and height is given the most emphasis on selection. Tesfaye (2008) in Menz and Afar area reported that appearance is a primary ram selection criterion in both crop-livestock and pastoral production system. Likewise, Zewudu et al., (2012) in Adiyo Kaka district of Kaffa zone of Southern Nations, Nationalities of Ethiopia reported ram selection based on body size. The most common way of selecting goats as parents for the coming generations is to use the offspring of a chosen parent (buck and/or doe) and body size, growth rate and libido prioritized selection criteria (Abraham et al., 2017). For breeding males, black colored, poor conditioned and small sized sheep are not preferred and culled at a young age (sold or slaughtered at home) (Helen et al., 2013). Furthermore, farmers in different production systems may have different trait preferences (Roessler et al., 2008) and they may also follow as diverse strategies as the agro-environments within which they perform (Solomon et al., 2010; Tadele, 2010). Farmers who had no breeding males, purchase buck from local markets or got buck service from their neighbors (Abraham et al., 2017).

Tesfaye et al., (2011) and Fsahatsion et al., (2013) reported that the majority of farmers reared their ram and high degree of inbreeding expected in dega and weyna dega. Helen et al., (2013) in eastern Ethiopia reported the level of inbreeding might be high in a mixed crop-livestock system where communal grazing is becoming less and less important. Understanding farmers’ trait preferences provide insights into which traits are particularly important in their agro-ecosystem and how these can be incorporated in the design of sustainable breeding programs (Yadeta, 2016). Farmers also have different criteria in the selection of female sheep and goats. Appearance, coat color and lamb survival were used in ewe selection in eastern Ethiopia (Helen et al., 2013). However, liter size and lamb growth were more important selection criteria in pastoral and agro-pastoral systems than in the mixed crop-livestock system which was considered highly associated with mothering ability (Gemeda et al., 2011). For breeding females, black colored, old aged, poor conditioned and those ewes which have long lambing intervals are culled (Zewudu et al., 2012; Yenesew et al., 2010).

**Marketing system of sheep and goats in Ethiopia**

Sheep and Goats are supplied to markets based on the age and sex structures of the type of animals Tesfaye (2009). According to Solomon et al., (2010) stated that, yearlings are the first class of animals to be sold to cover immediate cash needs and also, bucks including buck kids and young intact males constitute the largest percentage of marketed goats in Dale(53.3%) and Alaba PLW (32.0%). A typical sheep and goat marketing structure/chain based on a typical livestock market structure identified in Metemaby Ayele et al. (2003) and sheep and goat marketing structure in Alaba PLW (Tsedeke 2007).

The Ethiopian live animal and meat export marketing system is operating in an environment characterized by several constraints that need the attention and action of the government and other non-governmental development organizations (Hailemariam et al., 2008). Despite the contribution of livestock to the economy and smallholders’ livelihood, the production the system is not adequately market-oriented. There is little evidence of strategic production of livestock for marketing except some sales targeted to traditional Ethiopian festivals (Ayele et al., 2003). Smallholder farmers and pastoralists are the main suppliers of small ruminants to domestic consumers and meat export slaughter houses; where, animals are kept under low input and output systems (Getahun, 2008; Hailemariam et al., 2008; Belete et al., 2010). The lack of market oriented production of the livestock sector is reported to significantly affect the quantity and quality of marketable livestock for both domestic and export market (Belete et al., 2010; ESGPIP, 2011).

According to Ayele et al. (2003), the livestock marketing structure in Ethiopia follows a four level system. The main actors of the 1st tier are local farmers and rural traders who transact at farm level with very minimal volume, 1-2 animals per transaction irrespective of species involved. Those small traders from different corners bring their livestock to the local market (2nd tier). Traders purchase a few large animals or a fairly large number of small animals for selling to the secondary markets. In the secondary market (3rd tier), both smaller and larger traders operate and traders and butchers from terminal markets come to buy animals. In the terminal market (4th tier), big traders and butchers transact larger numbers mainly slaughter type of animals. From the terminal markets and slaughterhouses, meat reaches consumers through a different channel and a different set of traders/businesses. Livestock are generally traded by ‘eye-ball’ pricing that means there are no objectively set standards for selling and buying animals, except measuring the live weight of sheep and goats in Borena area and visual observation of the animals, in most other areas (Hailemariam et al., 2008). Under such circumstances, the price of an animal will reflect not only the bargaining skills of both buyers and sellers but also the buyer’s preference for the characteristics of animal and the seller’s willingness to sell, sometimes leading to transaction failure (EARO, 2000; Ayele et al., 2003). Potential production and market opportunities for small ruminant meat has not been exploited because of scant knowledge of small ruminant demand patterns (Ehui et al., 2000). Almost all export abattoirs are complaining about the shortage of sheep and goats supply for the export market. Some of them were even unable to meet the already requested quantity by their customers, let alone searching new markets for sheep and goat meat. Thus, government and non-governmental organizations have to provide with technical
and financial supports, and small ruminant producers should be aware of these opportunities and be engaged in market-oriented production practices (Tsedek, 2007; Belete et al., 2010). Associated with the production to consumer markets is the need for a proactive agribusiness orientation (Devendra, 2007).

Reproductive performance of sheep and goats

Reproductive performance is a prerequisite for any successful livestock production programme. Where farm resources are severely limited as it is often the case in SSA, reproduction failure is the first sign of decreased productivity (Mukasa Mugerwa et al., 2002). Reproductive traits are difficult to measure and are strongly influenced by management decisions, but are also of paramount economic importance (Notter, 2000). Flock reproductive rate also affects selection intensity and consequently the rate of genetic improvement in all traits under selection. The reproductive rate can be influenced by conception rate, litter size, young mortality and interval between parturitions (Ndlovu and Simela, 1996).

The traditional free roaming management system allows year round breeding, with minimal purchased inputs (Kosgey et al, 2008). This creates a good environment for bucks and rams to service does or ewes any time, which is not a case in a controlled system under on station. On the contrary, uncontrolled breeding is complicated by diseases transmission and inbreeding when the bucks and rams are small in number. Poor reproductive performances of Ethiopian sheep and goats can be associated with genetic factors, poor management, seasonal fluctuations in feed resources and diseases (Mukasa-Mugerwa et al., 2002). The Season had significant effect on most reproductive traits including fertility, lambing rate and weaning rate. Age at first mating (puberty) affects reproductive efficiency. The age at which puberty is attained is determined largely by genotype and environmental factors like nutrition, season and climate (Getahun, 2008; Girma, 2008). Most sheep and goat breeds, achieving 40-70% of the mature body weight is satisfactory for the attainment of puberty. There are large variations in mean age at puberty between and within breeds, resulting from the genotype and post weaning nutrition.

Age at First Parturition (AFP)

Age at first parturition (AFP) can be 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 (Getahun, 2008; Girma, 2008). Abegaz et al. (2002) reported age at first lambing of Horro ewes at 64.6-85% of their mature body weight. Most scholars, however, reported age at first parturition in months.

Parturition Interval (PI)

Parturition Interval (Lambing/ kidding interval) refers to the number of days between successive parturitions. Reproductive efficiency is related to the length of parturition interval; i.e. doe/ewe with long kidding/lambing interval has lower reproductive efficiency (Ibrahim, 1998). At least three times kidding or lambing is expected per two years under normal circumstances (Adane and Girma, 2008). To attain this lambing or kidding interval should not exceed 8 months (245 days). There are reports on the possibility of attaining three parturitions from indigenous small ruminants in two years (IBC, 2004 and Getahun, 2008) though PI of the traditionally managed sheep was influenced by various factors including previous litter type, parity and lambing season (Dibissa, 2000).

Litter size

Litter size is a combination of ovulation rate and embryo survival, number of lambs or kids born per parturition. There is a positive relationship between litter size and age and litter size and parity (Getahun, 2008; Girma, 2008). Litter size varies between 1.08 and 1.75 with an average of 1.38 for tropical breeds (Devendra and Burns, 1983; Girma, 2008). The average litter size of the Ethiopian goat is 1.75, it influenced by several factors including; ovulation rate, breed, level of nutrition parity or age (Getahun, 2008). Twin born ewes tended to produce more and heavier lambs than did those born single. Peak prolificacy is generally achieved between 4 and 8 years of age (Notter et al., 2000). Litter size is significantly affected by year of lambing, parity and weight of ewes at mating (Abegaz et al., 2002; Gemeda et al., 2002a; Berhanu and Aynalem, 2009).

Seasonality inbreeding

Local breeds of sheep and goats in tropical conditions are either non-seasonal breeders or exhibit only a weak seasonality of reproduction (Mukasa-Mugrewa et al., 2002; Girma, 2008). Reports indicated that 46% of sheep and 52% of goats exhibit uncontrolled mating in smallholder systems of Kenya (Kosgey et al., 2008). Conception peaks are observed in response to feeding flushes or when crop residues are available. Lack of synchrony between the supply of, and demand for, nutrients can depress ewe or doe productivity. Sheep lamb year-round with a peak in October and November in traditional sector of Ethiopian highlands. Most conceptions take place in June and July, which is the beginning of the major rainy season and most lambs are born in November and December (Agyemang et al., 1985; ILCA, 1989). Devendra and Burns (1983) reported the highest (67.3%) kidding in April and the lowest in November (17.4%). A study conducted on reproduction and productivity of Horro and Menz ewes in the highlands of Ethiopia in different seasons indicated that ewes which lambed in the wet season had a significantly higher weaning rate than those.
that lambed in the dry season (Mukasa Mugrewa et al., 2002). Mating of ewes in the dry season led to higher fertility than those mated in the wet season, probably because ewes came from the previous wet season with enough body reserves. Lambing in the subsequent wet season further enhanced their weaning rates and productivity due to better grazing during lactation. There are reports for peak conceptions of ewe/doe in response to feeding flushes and when crop residues are available (Mukasa et al., 2002; Tatek et al., 2004). Mehlet (2008) reported the lowest mating during May, July, October and November while kidding during May-Sept. May being the highest for Arsi-Bale goats. Mengistie (2008) reported the peak lambing in August and February for Washera sheep. Tsedeke (2007) identified two possible breeding seasons, between November to January (major breeding season), and between April to June (minor breeding season), when relatively adequate nutrition is available for reproduction and access to breeding males, as rams and bucks roam freely.

Growth performances of sheep and goats

Growth is an important trait for meat production which determines the overall productivity of the flock and the economic return from small ruminants’ enterprises. Growth rate of lambs or kids, particularly during the early stages of growth, is strongly influenced by breed (genotype), milk yield of the ewe or doe, the environment under which the animals are maintained including the availability of adequate feed supply in terms of both quantity and quality (Awgichew, 2000; Mengistie, 2008; Solomon Abegaz and Alemu Yami, 2009). Parity, pre-mating weight of the dam, type of birth, sex, season and month of birth also contributes to growth performances of small ruminants.

Birth weight and pre-weaning growth performances

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). Birth type and sex are sources of variation in lamb pre-weaning growth rate [167] (Taye et al., 2009). Kids or Lambs which are heavier at birth are usually singles or are those produced by ewes or does with the larger body sizes and good feeding conditions. 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 (Awgichew, 2000; Tibbo, 2006; Taye et al., 2009). Genotype showed significant difference in birth weight of lambs’ and kids.

Weaning (90-day) weight and pre-weaning Average Daily Gain (ADG)

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). Different values of weaning weight were reported by different authors. Thus, weaning weight and post-weaning growth rate of lambs is as important as the pre-weaning growth performances, mainly when the objective is producing meat through lamb and kid production. Seasonal variation in growth rate is observed in tropics because feed supply varies remarkably (Awigichew, 2000). Because of weaning shock, lower growth rate was observed at weaning time (Taye et al., 2009). Significant effect of season on post-weaning weight was reported on lamb’s growth (Tibbo, 2006; Taye et al., 2009) while there was non-significant effect of sex and birth type (Taye et al., 2009). Other studies found the significant influence of type of birth (Yilmaz et al., 2007) and sex (Awigichew, 2000; Tibbo, 2006) on post-weaning growth rate.

Survival (Mortality) rate of sheep and goats

Reproductive losses during pre-weaning period due to poor milking ability of dam, poor management and pneumonia are very high. Lamb losses before one year of age vary from 6.4 % to 45%. This could be a major influencing factor of productivity of a flock (Mukasa-Mugerwa, 1995; 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 (Mukasa-Mugerwa et al., 1994). More than half of the causes of mortality was 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).

Significant effect of season, flock size and sex of animals on survival was reported (Gemeda et al., 2002a) 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. Belete (2009) reported similar events for Keffa goats and Bonga sheep of south western Ethiopia. Birhan and Van Arendonk (2006) reported significant age and seasonal effect on mortality rate. The mortality rate was higher for lambs born in dry season, compared to those born in the wet season. ILCA (1989) reported mortality rate of 39% from on-farm monitoring of Menz sheep. There is a paucity of information on genetic variability for growth rate and mortality in indigenous sheep breeds of Ethiopia.

Sheep and Goat production constraints

The low productivity of small ruminants could be attributed to multifaceted interaction of various technical, institutional and socio-economic factors such as: poor nutrition, insufficient veterinary services, persistent drought, disease, poor infrastructures, low levels of technologies,
insufficient financial services and poor genetic performance (Aklilu, 2008; Solomon et al., 2010). Along with these factors, uncontrolled mating, negative selection practices through sale of best performing young animals (Getachew et al., 2010; Mirkena, 2010; Haile et al., 2011; Gizaw et al., 2013) and inappropriate livestock development policies (Aleme and Lemma, 2015) are becoming major factors for the poor performance of small ruminants. Absence of appropriate policy on one hand and implementation of inappropriate policies on the other hand hindered the smooth progress expected of the livestock sector (Sheriff and Alemayehu, 2018).

**Feed shortage**

Lack of availability of feed resources as the main limitation to animal production which is more pronounced in the mixed crop-livestock systems, where most of the cultivated areas and high the human population is located (Sisay, 2006). Different scholars reported that both the quality and quantity of feed resources were highly varied seasonally and causes reduction in livestock productivity in most of the country (IBC, 2004; Tesssema et al., 2003; Tibbo, 2006; Tsedeke, 2007, Getahun, 2008; Yeshitila, 2008; Berhanu et al., 2006; Arse et al. 2013 and Etalem and Abera, 2018). According to Alemayahu (1998), there is excessive supply of feed during the rainy season which is usually followed by a deficit in grazing in the following dry season. Moreover, a marked seasonal variation in the quantity and quality of feed supply and the acute problem of feed supply during dry season found in Ethiopia (ILRI, 2000 and Sisay, and Kefyalew, 2015).

The problem of feed scarcity is similar all over the country, being serious in high human population areas where shrinkage of land size 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 (Yeshitila, 2008; Belete, 2009; Ameha, 2008 and Berhanu et al., 2006) to assuage the problem. Related reports proposed feed shortages in crop-livestock mixed farming areas (Endrias and Tsedeke, 2006; Tesssema et al., 2003) and rift valley areas (Abule, 1998) as a limiting factor for small ruminant productivity. The use of top feed resources during scarcity as supplementary strategies could be useful for improving nutrient utilization and production performance of small ruminants, especially fed on low-quality forage components (Patra, 2009, 2010). The supplementation of tree leaves also provides additional benefits to reduce the methane production in small ruminant production (Pal et al., 2015). Likewise, other locally available concentrate by-products such as noug, cotton seed cake, local brewery wastes and molasses can be judiciously used to boost up the local small production systems (Duguma and Janssens, 2016). To overcome the limitations, encourage private sectors in animal feeding service, To minimize feed shortage in study area the following solutions are proposed like giving advice for sheep and goat owners to enrich their way of feed preservation will solve the feed scarcity including strong extension services will be helpful in solving the problems associated with small ruminant production.

**Health constraints**

Diseases and parasites are the major constraints to improved small ruminant production and productivity in most production systems/agro-ecological zones. Hence, health problems cause high mortality and reduced reproductive and growth performances resulting in reduced output per animal and flock off-take rates (Solomon et al., 2010). Dereje et al. (2013) in Darolabu district of west Hararghe reported that, 21.7% farmers in lowland and 6.7% farmers in midland area traveled more than 10 km distance to reach government clinics. The same author also indicated that 46.7% of the total respondents travelled more than 1 km of distance in order to obtain veterinary services for treatment of diseases.

The high prevalence of diseases and parasites causes high mortality amongst kids and lambs, diminishing the benefits of their high reproductive performance (Tibbo, 2006). Sharif et al. (2005) and Girma et al. (2013) reported that kids were at higher risk of dying if they were not being separated from adult animals; this risk factor increases the accident and the contamination of the environment of neonates. Here animals with good adaptive potential are needed in these stressful environments to sustain the livelihoods of the communities (Solomon et al., 2010; Tadele, 2010; Zewdu et al., 2012; Helen et al., 2013).

Diseases and parasites are also contributing to higher production losses, particularly in young stocks (Asfaw et al., 2008). Arse et al. 2013 in Adami Tulu, Arsni Negelle and Fantale districts of Oromia Regional State and Etalem and Abera, 2018 in Haduya zone also indicated diseases affect seriously for sheep and goat production. Respiratory Disease Complex (Tibbo, 2006; Solomon and Alemu, 2009) is among the most important diseases and associated complexes in small ruminants’ husbandry and management. Poor Management is creating a favourable environment for disease incidences. Early mortalities (as high as 50% in lambs) are among the most important losses associated with managements like cold stress, starvation, miss-mothering, etc. (Tibbo, 2006). Early mortalities (as high as 50%) in are among the most important losses associated to managements like cold stress, starvation, miss-mothering, predators such as foxes and hyenas are also contributing for the losses of young stocks, i.e. kids and lambs (Ameha, 2008; Belete, 2009 and Tsedeke, 2007). Therefore, establish strong and standard quarantine services; establish animal health service centers, committed to livestock welfare improvement, massive and effective awareness creation, enhance effective control of Eco parasites for better quality of hides and skins.
Shortage of Water

Water shortages are 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 Alaba, Dale, Boricha and Kindo Koisha Woredas of Southern region. In eastern, north-eastern and south-eastern parts of the country there is also critical shortage of water; however, there are breeds adapted to lowland agro-ecologies through their physiological adaptation mechanisms (Ameha, 2008; Abule, 1998; Belete, 2009). Constraints of water may result in poor nutrition and digestion, because there is a relationship that exists between water intake and consumption of roughages, particularly during dry season (Hadjigeorgioua et al., 2000). Tsedeke (2007) reported the problem of water shortage in mixed flock and goat dominating areas of Alaba Woreda. The same author reported the long distance travel of small and large ruminants searching for water. This in turn has implications on the productivity of the flocks (Getahun, 2008).

Marketing access and information

The major problems in traditional management system were that the system is not market oriented, underdeveloped marketing and infrastructure system, and poor credit facilities, etc. (Azage et al., 2006; Berhanu et al., 2006; Endrias, 2006 and Arse et al., 2013). Long market chain is an important barrier for producers and inhibits them from direct benefiting through sell of their animals without involvement of brokers (Getahun, 2008 and, Arse et al., 2013). Poor marketing information and problems of credit facilities (Endrias, 2006 and Arse et al., 2013) reduced the benefit gained by the smallholders. Inadequate infrastructure like road accessibility and marketing facilities are also contributing to the reduced benefit made from the sale of animals by the producers (Solomon Abegaz and Alemu Yami Edited, 2009).

The study of Yenesew (2010) in Burie woreda, west Gojjam, indicated that sheep sellers get market price information mainly from traders or their neighbors. There is no public market information source in the area for the producers, traders or consumers in general. This reduces system transparency and efficiency. In the sheep markets there is no weighing or grading of animals at the time of sale. Buyers and sellers judge the sheep they buy/ sell through physical observation only (Juma et al., 2010; Ramesh et al., 2012). This is a disadvantage especially for sellers. There is no precise method to know the quantity (in kg) as well as the quality (fat or lean meat) of products sold or bought. This affects the production of quality sheep and goats in the smallholder system. The role of brokers in marketing small ruminants has two views; one group describes them favorably as they facilitate transaction between buyers and sellers while others see them as problems in marketing as they are the ones who mainly decide the price (Endeshaw, 2007; Tsedeke, 2007; Ramesh et al., 2012).

The indigenous sheep and goat are year round breeders and mating is not controlled. However, the current off take rate is very low (Markos, 2006); with an average carcass weight of about 10kg, which is the second lowest amongst Sub-Saharan African countries (FAO, 2004). In Ethiopia, the marketing of livestock and livestock products is underdeveloped. The major problems are the traditional management systems which are not market oriented, underdeveloped marketing systems and poor infrastructure, poor financial facility, and presence of cross-border trade (Azage et al., 2006, Berhanu et al., 2007). A long market chain is an important barrier for producers and inhibits them from direct benefiting through the 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 to the reduced benefit made from the sale of animals by the producers (Tibbo, 2006). Therefore, provide strong institutional support services to respected actors in the subsector, improve customer satisfaction level, adopting our better marketing strategy such as strong promotional activities, improve productivity of livestock, improved the quality of meat products according to international standards, provide adequate market infrastructure, awareness creation on the importance of processed meat products, Improve and strengthen the byproduct industries linkage with meat slaughtering houses (local and export) and meat processing industries, improve the handling method of byproducts in the meat production plants, creation of consumer awareness and demand (Mengesha, 2015). Therefore, provision of strong extension services and training on sheep and goat production and management practices and the potential of existing breed for sheep and goat production etc.

Housing constraints

Good housing can determine productivity by reducing stress, disease hazards and making management easier. According to Tesfaye (2009), all farmers kept suckling goats in the house during the first 24-72 hours after which the mother joins the flock for grazing. Farmers also tended to keep kids inside for periods of up to two months during the rainy and drought periods. The same author also indicated that lack of separation of newborn kids from their dams and rest of flocks significantly affected pre-weaning kid. This may be associated with a high risk of miss mothering, injury, predators and insufficient ingestion of colostrums. The death of kids or lambs before weaning was perhaps the biggest cause of economic loss to small ruminant farmers and may be reduced by improvements in
the management and feeding of the kidding or lambing flock (Snyman, 2010; Girma et al., 2013). So, to overcome the limitations, housing sheep and goats do not tolerate mud well; therefore yards and shelters should be built only on well drained ground In areas of high rainfall it may be desirable to keep the animals off the ground.

Sheep and Goats Production Opportunities

High demand for sheep and goats in the domestic and export market as a result of population increase, urbanization and increase purchasing power of the community can be considered as an opportunity for ruminant producers (Devendra, 2007). Nowadays, many abattoirs flourish in the country; so agents and assemblers purchase small ruminants even at the farm gate. Several development partners involved in higher learning, research and development are currently committed to sheep and goat developments (Betelehem, 2009; Matawork, 2016). The study of Okpebholo (2007) showed that low start-up cost as an important factor in providing opportunity for the development of a small ruminant production system by a small-scale farmers with limited resources. Sheep and goat breeds in the lowlands of the country were also in good demand in the Middle East markets (Solomon et al., 2010). Tsedeke (2007) and Zawudu et al. (2012) in western and south-western reported, gender participation is another sheep and goat production opportunities. The support of ICARDA, IPMS under ILRI and different governmental research center in the country are sharing a good experience of community-based sheep and goat improvement programs with full participation of the beneficiaries. It also makes significant contribution to building flock ranging from production to marketing holdings targeting women and model households. Because of these developing and existing opportunities, the extension system needs to organize and guide to focus on goat production and marketing to improve income and improve smallholder livelihoods (Tsegaye et al., 2013).

CONCLUSION

Sheep and goats are essential part of livestock rearing in terms of quick source of income, milk, meat, fleece, manure, and economic growth in Sub-Saharan Africa. They are one of the major source of revenue in Ethiopia comprising about 30.70 million heads of sheep and 30.20 million heads of goat in the nation. They also play a vital role in household for rural farmers. Nonetheless, there are a lot of factors that hinders sheep and goats production yet they can be overcome on account of the uncountable opportunities which they possess.

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