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Research Article

Review on Sheep and Goat Production System in Ethiopia

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ABSTRACT

The review aims to examine sheep and goat production system to disseminate well organized information for the beneficiaries and readers by providing different husbandry practice, (housing management), reproductive and productive performance(age at sexual maturity, age at first lambing, age at first kidding, kidding/lambing interval and litter size), feed resource, constraints and opportunities of sheep and goat. Small ruminants are the major economically important livestock in Ethiopia, playing an important role in the livelihood of resource-poor farmers. Mixed crop livestock production practice is common production system of Ethiopia across different agro ecological condition which depends up on traditional husbandry practice and indigenous breed of small ruminant with low level production and productivity. Therefore provision of strong extension services and training on sheep and goat production system, husbandry practices and potentials of existing breed for sheep and goat production in order to improve the production capacity and productivity of sheep and goat to enhance income of smallholder livelihoods/ society.

Keyword: Ethiopia; Goat; Production system; Sheep

INTRODUCTION

Livestock is an important and integral component of agriculture, which is the pillar of the Ethiopia economy and Ethiopia is believed to have the largest livestock population in Africa. The recent livestock population of Ethiopia that the country has estimates about 60.39 million cattle, 31.30 million sheep, 32.74 million goats, 1.42 million camels, 56.06 million poultries, 2.01 million horses, 8.85 million donkeys, 0.46 million mules and 6.52 million beehives and are widely distributed across the different agro-ecological zones of the country (CSA, 2018).These potentials make the country prominent repository for animal genetic diversity (Hussein et al; 2015).

Small ruminants are among the major economically important livestock in Ethiopia, playing an important role in the livelihood of resource-poor farmers and they are integral part of livestock keeping in Sub-Saharan Africa (SSA) that are mainly kept for immediate cash sources, milk, meat, wool, manure, and saving or risk distribution (Kosgey, 2004; Hagos et al., 2017 and Hagos et al., 2018). Small ruminants also have various social and cultural functions that vary among different cultures, socio-economies, agro-ecologies, and locations in tropical and sub-tropical Africa (Markos, 2006). Mixed crop livestock production practice is common production system of Ethiopia across different agro ecological condition which depends on indigenous breed of small ruminant with low level production and productivity (FAO, 2004 and Solomon et al., 2010). The small body size, broad feeding habits, resistance to disease, ability to walk long distance to search feed, highly tolerant to adverse climatic condition with endurance of drought and to low and fluctuating nutrient availability and their short reproductive cycle provide small ruminants with comparative advantage over other species to suit the circumstances of specially resource poor livestock keepers (FAO, 2004; CTA, 2007; Kosgey, 2008 and Gurmessa et al., 2011).

Despite the large number of small ruminants and their contributions to the livelihood of the farmers and the national economy small ruminants productivity in Ethiopia is low due to different factors including, weak attention from scientists, administrators and legislators (Girma et. al, 2000); low genetic potential and policy issues (Zinash et. al, 2001); market and institutional problem and problem of credit facilities (Berhanu

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et. al, 2006); shortage, seasonal unavailability and low nutritive value of feed and/or (Getahun, 2008; Tesfaye, 2009; Solomon et. al, 2010; Yenesewu et. al, 2013); prevalence of different diseases and parasites (Tesfaye, 2009; Solomon et. al, 2010; Tsegaye et. al, 2013; Yenesewu et. al, 2013). Absence of adequate baseline information about the production system is considered as one of the bottlenecks for development of strategy for breed improvement and conservation in most developing countries (FAO, 2012). Therefore, it is important to review the production system of sheep and goat in Ethiopia.

Sheep and Goat Production System in Ethiopia

Small ruminant production systems vary considerably across the world, and reflect the different local environmental conditions, which determine, to a large extent, breeds, housing, intensification level, management practices, environmental issues, and feeding systems used. The components of the production systems are considered to be most important ones in determining quality in animal production (Sepulveda et al., 2011). In several Sub-Saharan African countries including Ethiopia and many other developing countries, mixed crop/ livestock production in subsistence manner is the predominant mode of agricultural production system (Tesfaye et al., 2004). Farmers/pastoralists choice of agricultural enterprises in Ethiopia depends on the production environment (availability of resources, particularly land, water and climate), long-standing tradition of agricultural production in the community, socio-economic circumstances (awareness and skill, access to inputs and markets), and government support (inputs and services) which stems from agricultural policies. Livestock production systems are identified on the basis of contribution of the livestock sector to the total household revenue (income and food), type and level of crop agriculture practiced types of livestock species kept, mobility and duration of movement.

Getahun (2008) classified traditional small ruminant production systems into four subsystems: small ruminant in 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.

On the other hand, Solomon et al.(2008), also reported that the sheep and goat production system in Ethiopia into five sub production system based on feeding, veterinary care, housing practices(Subalpine–cereal system which is characterized as medium scale production; semi-intensive/extensive, low-input), highland cereal-livestock system which were characterized as Small-scale sheep production; semi intensive, low-input), highland perennial crop system which were characterized as minor sheep and goat production; semi intensive, low-input; some practice tethering), lowland crop-livestock system(agro pastoral) by characterizing high level of livestock keeping; extensive/semi-intensive, low-input), and pastoral system which is characterized as rangeland-based large-scale production; extensive, low-input). And also (Ermais, 2014) reported that the sheep and goat production system were about 99% of farmers practice mixed crop-livestock production system and which is the dominating system in Southern Ethiopia and similar to most parts of the central southern region.

In general, mode of livestock production system in Ethiopia is broadly classified into pastoral, agro-pastoral and mixed crop-livestock, peri-urban and urban production systems (Solomon et al., 2010). There are various factors that should be considered to categorize small ruminant production systems in Ethiopia. In mixed crop-livestock production system which mainly observed in many parts of Ethiopia, small-ruminant production is characterized by low productivity due to nutritional stress and internal and external parasites. The pastoral and agro-pastoral systems which are found in the lowlands are characterized by extensive production based largely on the rangeland (EARO, 2000).

HOUSING MANAGEMENT OF SMALL RUMINANT IN ETHIOPIA

Housing is required to protect animals from extreme temperature (rain, cold, excessive heat and wind), disease, predator, theft and to make management easier and to provide opportunity for intensive feeding and controlled breeding in Bale zone, Oromia, Ethiopia (Belete et al., 2015). According to (Belete, 2009; Sisay and Kefyalew, (2015), small ruminant owners house their sheep and goat to protect them from predators, adverse climatic condition and to provide supplement in the evening in Goma district, Jimma Zone Oromia and in Degahabur Zone, Eastern Ethiopia respectively. Similarily Hundie and Geleta (2015) also reported that respondents shelter their sheep during night time throughout the year to protect them from cold, rain, predators and theft in Horro Guduru and Eastern Wollega Zones west Ethiopia. And also Kenfo et al., (2018) reported that housing is important to protect animals from extreme temperature, rain, wind, predators and theft in Bensa district of Southern Ethiopia.

According to assessment undertaken in Eastern Ethiopia, about 61.1% of the respondents kept their sheep in kraal without roof houses, while 35.5% kept their sheep in house with roof and 3.3% of respondents kept their sheep with in main house with family members (Helen et al ., 2016).

Table 1: Different housing system of sheep and goat in Ethiopia

Housing system	Percent	Animals kept	Place done	Source
Main house	58	Sheep	Burie district North western Ethiopia	(Yenesewet.al., 2013)
Attached to main house	33			
Separate house	9			
Main house	16.67	Sheep	Horro Guduru and East	Hundie and Geleta, 2015

Separate house	83.33		Wollega zones	
Family house with roof	75.76	sheep	Bensa district , Southern Ethiopia	(Kenfo et al., 2018)
Separate house with roof	24.24			
Kraal	45.55	goat	Bale zone Oromia Ethiopia	(Belete et al., 2015)
Separate house	28.1			
Yards	25.28			
Main house	26.4	Sheep and goat	Degahabur Zone, Eastern Ethiopia	(Sisay and Kefyalew, 2015)
Grazing area	8.9			
Separate house	64.4			
Main house	22.5	Sheep and goat	Gome district, Jimma Zone Oromia, Ethiopia	(Belete, 2009)
Adjoin house	39.4			
Separate house	38.1			
Main house	98.6	Sheep and goat	Alaba Southern, Ethiopia	(Tsedeke, 2007)
Separate house	0.7			
No house	0.7			
Main house	82.8	Sheep	Doyogena district Southern, Ethiopia	(Taye et al., 2017)
Separate house	10.3			
Open barn	6.8			
Main house	62	Sheep and goat	Jijiga and Shinile Zones of Somali Regional State, Ethiopia.	(Sisay et al., 2006)
House attac hed to main house	10.9			
Separate	27.1			
Family house	12.6	Sheep and goat	Illubabor zones of Oromia regional state	(Dhaba et al., 2012)
Partition to family house	45.9			
Separate house	41.5			
In family house	39.4	Sheep and goat	Ada Barga and Ejere Districts of West Shoa Zone	(Yadeta, 2016)
Separate house	29.4			
Veranda (extend of building)	31.2			

FEED RESOURCES AND FEEDING SYSTEM OF LIVESTOCK

Livestock feed resources in Ethiopia are mainly natural pasture, crop residues, improved pastures, forage crops and agro-industrial by products (Alemayehu, 2004). 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). According to Hagos et al. (2018) small ruminant feed resource in Ethiopia are mainly natural pasture, crop residue, fallow land and locally available brewery product (Atela) and salt in central zone of Tigray, Northern Ethiopia. Similarly the feed resource for small ruminant in Ethiopia are mainly grazing on communal natural pasture, crop stubble, fallow grazing, road side grazing, crop residues, browses, and non-conventional feeds (household food leftovers, weeds, crop tillers and fillers), improved forages and crop residues (Tsedeke, 2007) and according to IPMS(2010), the major feed resources for small ruminants were natural pasture grazing and browsing, crop stubble, fallow land grazing and browsing, crop residue, non-conventional feeds, brows species and improved forage feed sources and also Assen and Aklilu (2012) identified the major feed resource for small ruminants as natural grazing land, crop aftermath, hay, crop residue, agro-industrial by product, improved forage species and weeds in in different agro-ecological zones in Tigray, Ethiopia, and Tegene et al. (2015), reported that the major feed resources of small ruminant feed as natural grazing land (private, communal and hired), crop residue(private and purchased), hay (private and purchased), fodder trees and industrial by product in Shebedino district, Sidama Zone, Southern, Ethiopia

On the other hand, Shewangzaw and Adis (2016) reported that the main feed sources for small ruminant were natural pasture and crop residue with supplementary feed sources of food left over, atela, salt, nuge cake, dashen brewery by product and multiple feed which in north Gondar Zone of Amara Region, Ethiopia.

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

The feeding systems include communal or private natural grazing and browsing, provision of crop residues and cut-and-carry feeding. The feeding system practiced for small ruminants include free grazing and browsing, partly tethered grazing or browsing, fully tethered grazing or browsing and confined grazing in Gedio Southern Ethiopia (Selamawit and Matiwos, 2015), Free grazing and browsing in dry season , tethered grazing and browsing at wet season and cut and carry system of feeding in Illu Abba Bora Zone of the Oromia regional state (Dhaba et al., 2012), Herding, tethering and free grazing of small ruminant feeding system were practice in western and South Western Ethiopia (Zawudu et al., 2012) and only free grazing system of small ruminant feeding practiced in Western Tigray, North Ethiopia (Hagos et al., 2017). Livestock are grazed on permanent pastures, fallow land and cropland aftermath (Alemayehu, 2004).

NATURAL PASTURE

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

The herbage yield and nutritional quality of natural pasture is generally low (Adane and Berhan, 2005) due to poor management and utilization. Natural pastures would be adequate for live weight maintenance and weight gain during wet seasons, but would not support maintenance for the rest of the year (Zinash et al., 1995). The energy (ME), crude protein (CP) and dry matter (DM) contents of these natural pastures in most cases have been reported to be below the maintenance requirement of the animal in Bale highlands (Solomon, 2004). Average pasture yield for the highland areas is estimated to be 4 tons/ha. In many areas, natural pastures are invaded by species of low palatability (Solomon and Alemu, 2009).

CROP RESIDUES

Crop residues are fibrous materials which are the by-products of cultivated crops. This is a basic limitation in residues such as straw and stover with crude protein contents around the borderline level of 6-7%. Most residues are deficient in fermentable energy and minerals. Crop residues have low palatability and digestibility that leads to poor intake, particularly when fed as the sole roughage. In the mixed cereal livestock farming systems of the Ethiopian highlands, crop residues provide on average about 50% of the total feed source for ruminant livestock. The contributions of crop residues reach up to 80% during the dry seasons of the year (Adugna, 2007).

According to Gasheet al. (2017), major crop residues available for livestock feeding in the area were cereals (teff, oat, maize, wheat and barley), pulses (horse bean and chickpea) and oil seeds (linseed and niger seed), the annual total dry matter (DM) feed produced from crop-residues was 5.2 tons per household and teff and wheat straw and maize stover are the major crop residue source contributing annual DM production in East Gojjam Zone, Amhara Region, Ethiopia.

The availability of crop residues is closely related to the farming systems, the type of crop produced and the intensity of cultivation. Teff, wheat and barley straws are the major residues available in the highlands while maize and sorghum are common in the lowlands. Crop residues are often left in the field or accumulated in places where the crop is threshed. Transportation of crop residues, even over short distances, can become difficult and costly because of their bulk. The production of crop residues is also seasonal, available in very large quantities just after harvest and less available thereafter (Solomon and Alemu, 2009).

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

IMPROVED PASTURE AND FORAGE CROPS

Improved forages yield is higher than the naturally occurring swards and have higher nutritional value. In addition, the length of the productive season is longer for cultivated pastures than for the native pastures, which provide an opportunity for livestock (mainly large and small ruminant) production to develop and use pasture and forage at a large scale. Over the past two decades, several forages have been tested under varying ecological zones for their adaptability. As a result, a number of useful forages have been selected for different zones.

Improved pasture and forages have, therefore, been grown and used in government ranches, state farms, farmers' demonstration plots and dairy and fattening areas (Alemayehu, 2002). Forage crops are commonly grown for feeding livestock with oats and vetch mixtures, fodder beet, elephant grass mixed with siratro and desmodium species, rhodes/lucerne mixture, phalaris/trifolium mixture, hedgerows of sesbania, leucaena and tree-Lucerne being common ones (Alemayehu, 2006). Due to unprecedented population increase, land scarcity and crop dominated farming, there has been limited introduction of improved pasture and forages to smallholder farming communities and the adoption of this technology by smallholder mixed farmers has been generally slow (Abebe et al., 2008).

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

In Ethiopia, most improved tropical species can be grown in the lowlands (1,500-2000 meters) except temperate species, which can grow in areas between 2,100 to 3,000 meters above sea level (Alemayehu, 2002). Pasture establishment is relatively difficult in the highlands compared to the humid, warmer and lower areas because of the types of soil and climate.

Besides producing high amount of better quality forage, they have a number of other benefits in the farming system including improvement of soil fertility through biological Nitrogen fixation or when used as mulch (legumes), erosion control when established as conservation structures, fuel wood supply, bee forage and control of weeds, pests and diseases when integrated in crop rotation as break crops. Generally Improved forage crops have diversified functions and play an important role in sustaining the livelihoods of farmers, mainly as a result of their positive effects on livestock production and contribution to economic and environmental sustainability.

AGRO-INDUSTRIAL BY-PRODUCTS

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

Agro-industrial by-products have special value in feeding livestock mainly in urban and peri-urban livestock production system, as well as in situations where the productive potential of the animals is relatively high and require high nutrient supply. The major agro-industrial byproducts commonly used are obtained from flour milling industries, edible oil extracting plants, breweries and sugar factories. The current trends of increasing urban population has a significant effect on the establishment of agro-industries due to the corresponding increasing demand for the edible main products. Agro-industrial by-products are rich in energy and/or protein contents or both. They have low fiber content, high digestibility and energy values compared with the other class of feeds (Zinash and Seyoum, 1991). Alemu et al. (1991) also reported more than 35% CP and 50-70% in vitro organic matter digestibility (IVOMD) for oil seed cakes and 18-20% CP and more than 80% IVOMD for flour milling by-products. Supplementing ruminants fed low quality feeds with agro-industrial by-products enables them to perform well due to higher nutrient density to correct the nutrient deficiencies in the basal diet.

FACTORS AFFECTING FEED QUALITY

Freshness, mold, spoilage, taste, moisture and temperature all have an effect on the feed quality and the palatability of a particular feed. High neutral detergent fiber (NDF) in individual feeds and the total diet will restrict the cow's ability to consume a high intake (Azage et al., 2013).

Forage testing is necessary because forage quality varies considerably due to several factors, including differences in forage genotype, maturity, season, and management. An understanding of factors affecting forage quality will help producers anticipate and plan for changes in forage quality. When forage quality is low, forages alone may not support desired rates of animal performance. In such cases, it is necessary to provide livestock with supplements for protein and energy (Adesogan et al., 2012).

Animal performance, whether growth or milk production, depends upon the animal's potential for production, as well as on how much DM the animal eats and the nutritive value of the DM the animal consumes. Therefore, the two forage-related factors that determine animal performance are forage intake and forage nutritive value. Collectively, these factors determine the quality of the forage. When forage is fed without restriction as the sole feed, forage quality can be an excellent predictor of animal performance (Adesogan, et al., 2012).

Forage nutritive value is primarily determined by concentrations of crude protein (CP) and "available" energy in the forage. For many years total digestible nutrients (TDN) has been used as an overall measure of available energy in forages. In the past 20 years, however, measurements of digestible forage, metabolizable energy, and net energy of forage have increasingly been used. However, TDN is still an acceptable and easily understood measure of nutritive value, particularly for beef cattle. Forage quality is affected most by variations in forage genotype, maturity, season, and management. Other "anti-quality" factors may be encountered occasionally.

GENOTYPE

According to Tesfaye (2008), Grass species have high content of DM, ash, ADF and NDF than fodder tree species and fodder tree species have also high content of CP and ADL than that grass species inMetema district of North Gondar Zone, Ethiopia. Legumes generally have a higher quality than grasses. Legumes have higher CP concentrations and a higher intake by livestock due to a higher percentage of rapidly digestible leaves. However, TDN concentrations of legumes and cool-season grasses are similar. Generalizations about quality of grasses are risky, but temperate or cool-season grasses, such as rye and ryegrass, often have higher quality than tropical or warm-season grasses, such as bermuda grass and bahia grass. However, there is much variation in forage quality within and among grass genera (Adesogan et al., 2012). Similarily Deribe et al.(2013), also indicated that the DM, ash and CP content of indigenous browse were higher than indigenous grass species and the ADF and NDF content of indigenous browse species was lower than indigenous grass species in mixed farming System of Southern Ethiopia and according to Emana et al. (2017), the average CP and DM content of Browse species was higher than grass species while the average DM, ash, ADF and ADF content of Grass species was higher than browse species in Abol and Lare Districts of Gambella Region, Ethiopia.

MATURITY

The stage of forage regrowth at the time of utilization whether as hay, haylage, or grazing has a major influence on forage quality. Forage-regrowth stage is determined by the number of days between harvests for hay or haylage and by the rest period in rotational grazing. Forage quality begins to decline as soon as forages start to regrow due to the accumulation of stems and deposition of poorly digested lignin in both leaves and stems. Therefore, forage quality generally declines with increasing length of the interval between harvests of stored forages or with longer rest periods in rotational grazing. Maturity of legumes and cool-season grasses can be assessed by determining the reproductive stage of growth. For warm-season grasses, however, weeks of regrowth are a better indicator of maturity because flowering may begin shortly after regrowth begins (Adesogan et al., 2012). The CP content and IVDMD were reduced by 30.2% and 17.8%, respectively with the delay in harvesting from mid-October to late November (Fekede, 2013).

SEASON

According to Sisay(2006), the ash, ADF, NDF, ADL and DM content were higher in October than August and CP content were lower in October than August fornatural pasture grass species. According to Yayneshet (2010), the ADF, NDF and ADL content were higher and CP content were lower in dry season than rainy or wet season of the year for both grass and browse species in Tigray region, northern Ethiopia. The CP content Cynodon dactylon reported by Gelayenew (2012), were 9.3 and 7.4% for the wet and dry seasons, respectively. Teka et al. (2012) also reported that the CP contents of C. dactylon were 11.67% and 6.94% in the early and late rainy seasons, respectively; while for Panicum maximum the corresponding values were 7.93 and 5.11 %, respectively. Seasonal effects on forage quality have been noted in grazing trials in Florida, where forage regrowth intervals were kept constant. A "summer slump" was observed in that gains of grazing livestock were less during the summer than in spring and fall. That this slump in cattle weight gain during the summer is an effect of environment on forages and not due to the effect of the environment on animals. Spring harvests are made generally after short re growth periods, while summer harvests are made after long re growth periods because of heavy summer rainfall that delays harvests. Therefore, the quality of Bermuda grass hay is highest when harvested in the spring or early summer (Adesogan et al., 2012).

FEED MANAGEMENT

Pre-harvest and post-harvest management determine the quality forage. Pre-harvest management for maximum quality of hay or silage involves weed control and frequent cutting. Some producers harvest every four or five weeks throughout the season, making either hay or silage, depending on rainfall (Adesogan et al., 2012).

The quality of hay or silage will never increase during harvesting and storage, but post-harvest decreases in quality can be minimized by careful management. Post-harvest management requires avoiding rain damage, as well as proper curing of hay to less than 15% moisture or wilting of silage to 60%–70% moisture, promptly sealing silos and wrapping haylages and minimizing losses during storage. Leaching of nutrients from weathering decreases forage nutritive value. Therefore, hay bales should be stored under a barn or a tarp whenever possible (Adesogan et al., 2012)

REPRODUCTIVE PERFORMANCE OF SMALL RUMINANTS IN ETHIOPIA

Reproduction determines several aspects of sheep and goat production and an understanding of reproduction is crucial in reproductive management. A high rate of reproductive efficiency is important for herd expansion and replacement, production of (meat, milk, skin and fiber and replacement of breeding stock and reproductive performance is a prerequisite for any successful livestock production system (Merkle and Alemu, 2008).

Assessing of the productive, reproductive and economic performance of small ruminants and their existing level of integration with crop production and other livestock keeping is required to capture a full picture of their contribution and thereby verifying possible intervention areas (Getahun, 2008).

AGE AT SEXUAL MATURITY/PUBERTY

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 and Girma, 2008) and also according to Merkel and Alemu (2008), age at puberty can be influenced by nutrition, body weight, breed, season of birth and growth rate and Zewudu et al. (2012), reported that the age at of puberty of male and female Bonga sheep was 7.5±2.1 and 9.3±2.2 months and that of Horro sheep was 7.1±3 and 7.8±2.4 months respectively in Western and South-Western Ethiopia.

Table 2: Age at puberty of male and female lambs and kids (months)

Age at puberty of lambs		**Source**	**Age at puberty Of kids**	**Source**		
Male	Female	Male	Female			
8±2.75	8.06±2.61	(Taye et al., 2016)	7.6±0.14	7.9±0.13		Belete et al., 2015
--- 8.99±2.5------		Assen andAkililu, 2012	--- 8.90±2.5---	Assen and Akililu ,2012		
5.4±0.2	5.5±0.2	(Belete , 2009)	4.9±0.2		4.9±0.2	(Belete , 2009)
8.91±0.04	---	(Yadeta, 2016)	8.39±0.06		---	(Yadeta, 2016)
7.63±0.14	7.24±0.11	(Helene et al., 2015)	11.1±2		12.7±2.1	(Woldeyesus and Rohotash, 2018)
			7.4±1.95		8.2±1.64	(Tesfay, 2009)

AGE AT FIRST LAMBING OR KIDDING

Age at first lambing or kidding (AFL/K) can be recorded easily in farmers stock and it is an economically important trait because it determines rate of genetic progress and population turnover rate. It is also good indicator of early sexual maturity in does and ewes. FAO (2002) reported age at first lambing ranges between 16.2 and 16.9 months in mixed farming systems of sub-Sahara African countries.

Table 3: Age at first Lambing/kidding of doe and ewes (months)

Age at first lambing	Source	Age at fist kidding	Source
12.7	(Tsedeke,2007)	12.1	(Tsedeke,2007)
14.6	(Getahun,2008)	14.88±0.3	(Endeshaw, 2007)
12.43±0.1	(Deribe, 2009)	12.9	(Getahun,2008)
13±0.3	(Belete, 2009)	12.5±0.3	(Belete, 2009)
13.46±2.18	(Belay and Aynalem, 2009)	11.95±0.13	(Deribe, 2009)
13.8±0.14	(Helene et al., 2015)	15.01±2.39	(Assen and Akililu, 2012)
13±3.1	Selamawit and Matiwos,2015	12.94±2.6	(Selamawit and Matiwos, 2015)
14.29±0.08	(Yadeta, 2016)	13.85±0.12	(Yadeta, 2016)
13.72±2.34	(Taye et al., 2016)	21.1±2	(Woldeyesus and Rohotash, 2018)

LAMBING AND KIDDING INTERVAL

Lambing or kidding interval is the interval between two parturitions that determines reproductive efficiency in small ruminant production. Kidding interval is one of the major components of reproductive performance that has significant influences on production systems. It contributes largely to the productive efficiency and it has been reported to be affected by nutrition, suckling, parity (number of times kidded/lambed) and breed (Banerjee et al., 2000). Also according to Ibrahim (1998), the long kidding/lambing interval has lower reproductive efficiency and commonly arises from long post-partum anestrus intervals, repeated cycles of service intervals without conception, embryo death or abortion. Mengistie et al. (2013) also reported that the kidding interval of goat was affected by season and litter size per kidding, kidding interval was shorter for does that kidded during cool season and single litter and multiple bearing does and those kidded in the hot season had larger reproductive rate.

Table 4: Lambing/kidding interval of doe and ewe (months)

Lambing interval	Source	Kidding interval	Source
7.84	(Tsedeke,2007)	6.9	(Tsedeke,2007)
8.04	(Belete, 2009)	7.84	(Belete, 2009)
9.19±0.08	(Deribe, 2009)	9.05±0.08	(Deribe, 2009)
8.73±1.78	(Belay and Aynalem, 2009)	13.8±0.03	(Mengistie et al.,2013)
8.93±1.42	(Hundie and Geleta, 2015)	8.41±2.35	(Assen and Akililu, 2012)
8.01±2.2	Selamawit and Matiwos,2015	8.3±1.6	(Selamawit and Matiwos, 2015)
8.83±0.44	(Yadeta, 2016)	8.23±0.52	(Yadeta, 2016)
10.94±2.47	(Taye et al., 2016)	7.1±0.6	(Woldeyesus and Rohotash, 2018)
8.58±0.14	(Helen et al., 2015)		

LITTER SIZE OF DOE AND EWE

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 and Girma, 2008). According to Mengistie et al. (2013), litter size was also affected by parity and season of kidding, does kidded in the hot season and those with higher parities had larger litter. The effect of season on litter size and other traits indicates that the need for supplementation of does during the dry season when the grazing condition is very poor for better reproductive efficiency.

Table 5: Average litter size of doe and ewe

Litter size of doe	Source	Litter size of ewe	Source
1.7	(Tsedeke,2007)	1.75	(Tsedeke,2007)
1.14	(Mugrewa et al., 2000)	2.07	(Endeshaw, 2007)
1.57±0.52	(Hundie and Geleta, 2015)	1.16±0.04	(Mengstie et al., 2013)
1.4	(Belete, 2009)	1.7	(Belete, 2009)
1.08-1.75	(Wilson., 1989)	1.02-1.43	(Wilson, 1989)
1.58±0.14	(Helene et al., 2015)	0.3±0.05	(Belete et al., 2015)
1.78±0.5	Selamawit and Matiwos,2015	1.7±0.63	Selamawit and Matiwos, 2015
1.19±0.42	(Yadeta, 2016)	1.28±0.33	(Yadeta, 2016)
1.42	(Getahun, 2008)	1.24	(Getahun 2008)
1.51±0.04	(Deribe,2009)	1.6	(Hailu et al., 2008)

	1.7	(Webb and Mamabolo., 2004)
	1.47±0.04	(Deribe,2009)

CONSTRAINTS OF SHEEP AND GOAT PRODUCTION

Different studies showed that despite the large potential of small ruminants in the country their productivity is low. There are various factors that contribute for low productivity of sheep and goat such as health constraints, feed shortage both in quality and quantity, poor feeding and health management (Markos, 2006; Tsedeke, 2007).According to Yenesewu et al. (2013), the major constraints of small ruminant production were Lack of adequate vet service, diseases, feed shortage, theft, labour shortage, shortage of capital, water shortage and marketing problem in In Burie District, North Western Ethiopia.

In generally, the major constraints that hinder the production performance of small ruminant production are feed and water scarcity, disease and predator, lack of infrastructures and long marketing channels and climatic condition.

FEED AND WATER SHORTAGE

Feed shortage problem was 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 availability, quality and cost of feeds have been identified as the major constraints to acceptable livestock productivity across the various regions and agro- ecological zones of Africa (Devendra, 1986 and Ademosun, 1988). The deficiency of good quality and quantity feeds observed in lowlands; which were highly exacerbated by seasonal variation and recently by bush encroachment which become significantly important factors, while pasture land remains abundant. In central rift valley, feed shortage was reported as one of the limiting factors in small ruminant productivity (Abule, 1998).

According to Sisay (2006);Getahun (2008) ; Deribe (2009); IPMS (2010) and Yenesewu et al. (2013) inBurie District, North Western Ethiopia), Tegegn et al. (2015) in Shebedino District, Sidama Zone of Southern, Ethiopia reported that lack of adequate feed resources is the main constraint of livestock production across different agro ecology in different parts of the country mainly in mixed crop livestock production system and being serious in high human population and animal population areas where land size is diminishing due to intensive crop cultivation and soil degradation.

Water is the most critical of all nutrients required by sheep and goats, but it is yet often received a little attention. Inadequate water supply will dramatically decrease the production of livestock. They eat less, digest feedstuff poorly and are more prone to digestive and metabolic problems (Alemu, 2008). In eastern, north-eastern and south-eastern part of the country there is critical shortage of water; however, small ruminants are somehow adapted to these agro-ecologies through their physiological adaptations (Belete, 2009). According to the report of Tsedeke (2007) the long distance travelled by small and large ruminants for searching of water was complicated the productivity of the flocks.

DISEASES AND PREDATORS

Diseases are one of the serious constraints of small ruminant production in Ethiopia. Annual disease losses amount to 8-10%, 14-16% and 11-13% of the cattle, sheep and goat populations, respectively (Sileshi and Kasahun, 2008). Similarly, Markos (2006) pointed that approximately 700 million Ethiopian Birr is lost annually due to helminthes (internal parasite) infestation of domestic animals. High disease prevalence amongst kids and lambs heighten the mortality rate and diminishes the benefits of their high reproductive performance. Further, losses are caused by abortions and stillbirths (Getahun, 2008) and other diseases that limit the productivity of small ruminants in Ethiopia include Pneumonia, Contagious Caprine Pleuropneumonia (CCPP), Ecthyma, Caseous Lymphadenitis and Brucellosis.

According to Adane and Girma (2008) about one-half of all lambs/kids born were dyeing due to various causes and annual mortality in all classes of stock averages 23% for sheep and 25% for goats in the central highlands. Also Zemede (2017), indicated that diseases and parasites as the major constraints to small ruminant production by causing high mortality of small ruminant due to inadequate veterinary service delivery and shortage of drugs in Tahtay Adyabo district, Tigray, Ethiopia.

According to Gurmesa et al.(2011) and Assen and Akililu (2012); predators are also the main constraints of small ruminant production in East Showa Zone and different agro-ecological Zones in Tigray, Ethiopia and also Belete (2009) reported that Predators such as foxes and hyenas are also contributing for the losses of young stocks.

LACK OF INFRASTRUCTURES AND LONG MARKETING CHANNELS

According to Adane and Girma (2008) infrastructures necessary to transport livestock or its products from remote rural communities, were lacking and sheep and goats were generally trekked long distances for marketing, often without adequate water and feed. There are very limited market centers and stock routes with the necessary facilities such as feeding and watering points. The same author reported that the producers do not have access to market information.

CLIMATIC CONDITION

Climate fluctuation particularly increase in ambient temperature affect livestock production by both direct and indirect means and the production loss of the direct impact of climate change on livestock production mostly comes from the heat stress. Direct impacts include increased ambient temperature, through heat stress by reduction of milk production, reproductive efficiency, feed intake of animal and animal health and indirectly through reduction of feed and water resource availability, increasing disease occurrence by decreasing environmental adaptation mechanism of livestock through this climate change affect the livestock production and productivity which directly affect the farmers that depends up on livestock and use the livestock resources for source of food; wealthy and social well-being. Climate fluctuations can adversely affect productivity, species composition, and quality, with potential impacts not only on forage production but also on other ecological roles of grasslands (Giridhar and Samir, 2015). Due to the wide fluctuations in distribution of rainfall in growing season in several regions of the world, the forage production will be greatly impacted. With the likely emerging scenarios that are already evident from impact of the climate change effects, the livestock production systems are likely to face more of negative than the positive impact.

Also, climatic factor influences the water demand, availability and quality. Changes in temperature and weather may affect the quality, quantity and distribution of rainfall, snow melt, river flow and groundwater. Climate change can result in a higher intensity precipitation that leads to greater peak run-offs and less groundwater recharge. Longer dry periods may reduce ground water recharge, reduce river flow and ultimately affect water availability, agriculture and drinking water supply.

OPPORTUNITIES FOR SHEEP AND GOAT PRODUCTION

RISING DEMAND FOR SHEEP AND GOATS

High demand of the small ruminants in the local market as a result of population increase, urbanization and increase in income are appreciated for the small ruminant producers in the country (Belachew and Jamberu, 2003) and also all household member involvement in their management can be considered as an opportunity for the small ruminant production (Tsedeke, 2009). Based on the export data of 2009/10, Ethiopia exported about 3.4 and 1.4 % of the meat and live small ruminant demand of the Middle East market, respectively (Solomon et al., 2010). These are indicating large potentials in expanding animal and animal product exports to the Middle East countries if the value chain actors of Ethiopia meet export market standards. There is also a drastic increase in domestic demand for small ruminant meat, particularly during religious festivals (Amaha, 2011). Increased involvement in small ruminant production is positively supported by the existing government policies that targets production and export of more live animals, meat or mutton and livestock products like skins, hides and leather (Getachew and Jane, 2014).

LOW START-UP COST

Low start-up cost is another factor that creates an opportunity for the development of a small ruminant production system by a small-scale farmer with limited resources. Start-up cost for meat goat producers is considerably lower than that of cattle producers (Okpebholo and Kahan, 2007). Similar authors reported that sheep and goats requires lesser space than cows and also they can easily kept on low quality forage and thrive in harsh season than cow.

LOW LABOR REQUIREMENT

Small ruminant production is less labor intensive when compared to the production of larger animals. According to Belete (2009), sheep and goats due to their smaller size women and children in the family can easily handle them. Most sheep and goats are good tempered and the chances of children and women getting injured are limited. Similarily Tsedeke (2007) and Zawudu et al. (2012) in western and south-western Ethiopia, reported, gender participation is another sheep and goat production opportunities.

PROLIFICACY

A mature doe/ewe can be bred and successfully give birth three times every two years (Girma, 2008). Moreover, sheep and goats have more reproductive cycles than cattle within the same period of time (Okpebholo and Kahan, 2007). The same author reported that, in a period of two years, it is possible for a doe/ewe to give birth to six kids/ewes because of its high twinning rate, whereas a cow is most likely to produce two calves for the same period. This quick turn over rate is an advantage to the producer in terms of cash flow and the buildings up his/her herd size.

CONCLUSION

Livestock is an important and integral component of agriculture, which is the pillar of the Ethiopia economy and Ethiopia is believed to have the largest livestock population in Africa. Small ruminants are among the major economically important livestock in Ethiopia, playing an important role in the livelihood of resource-poor farmers and they are integral part of livestock keeping in Sub-Saharan Africa (SSA) that are mainly kept for immediate cash sources, milk, meat, wool, manure, and saving or risk distribution.

However, the productivity of small ruminant did not match their number due to prevalence of diseases, lack of breed improvement program, shortage of feed and water, traditional production system, lack of infrastructure, long market channels, climatic condition and poor reproductive performance. Production practice needs to involve farmers, stakeholders in the sector, government policy, the existing breeding practices, production system, management systems and their trait preferences to upgrade the reproduction and production traits of sheep and goat.

Most of the small ruminant’s production system in Ethiopia is traditional based management and indigenous breed of both sheep and goat with low production potential. Therefore, farmers should train different aspects of improving sheep and goat productivity by considering the management, reproductive and productive traits for improvement of sustainable production.

REFERENCE

1. Abebe M, Oosting J, Fernandez-Rivera S, Van der Zijpp J, 2008. Multipurpose fodder trees in the Ethiopian highlands: Farmers' preference and relationship of indigenous knowledge of feed value with laboratory indicators. Agri. Syst. 96: 184- 194.
2. Abule, E (1998) Role and decision making power of women in livestock production around Adami Tulu. In6th ESAP Proceedings, Addis Ababa, Ethiopia, August 14-15, 1998. Pp. 95-102

3. Adane K, Birhan, T.2005. Effect of harvesting frequency and nutrient levels on natural pasture in the central highlands of Ethiopia.Tropical science, 45(2), pp.77-82.
4. Adane Y, Girma A (2008) Economic significance of sheep and goats. In Sheep and Goat, Production Handbook for Ethiopia. ESGPIP, Addis Ababa, Ethiopia. Pp. 2-4
5. Ademosun AA, H.G. Bosman and H.J. Jansen, 1988. Nutritional studies with West African Dwarf Goats in the humid tropics. Proc. Goat production in the Humid Tropics- (Eds. Smith, O.B. and Bosman H. G.)PudocWageningen, pp: 51-61.
6. Adesogan, T., Sollenberger, E., Newman, C. and Vendramini, B., 2012.Factors Affecting Forage Quality.
7. Adugna T, 2007. Feed resources for producing export quality meat and livestock in Ethiopia (Examples from selected Weredas in Oromia and SNNP regional states
8. Alemayehu, M. 2002. Forage Production in Ethiopia: A case study with implications for livestock production, Ethiopian Society of Animal Production (ESAP), Addis Ababa, Ethiopia, p106.
9. Alemayehu, M., 2004. Rangelands Biodiversity: Concepts, Approaches, and the Way Forward. Addis Ababa, Ethiopia
10. Alemu, Y., Zinash, S. and Seyoum, B., 1991. The Potential of Crop Residues and Agro- Industrial By-Products as Animal feed. In: proceedings of ESAP, 3rd National Improvement Conference. 24-26 May 1989. IAR, Addis Ababa, Ethiopia.Pp: 57-63.
11. Ameha, S. (2011): Export requirements for meat and live small ruminants. AlemuYami, R.C. Merkel and T. A.Gipson (eds). In 47th technical bulletin. March, Addis Ababa, Ethiopia. Pp. 2-3
12. Assen E and Aklilu H 2012: Sheep and goat production and utilization in different agro-ecological zones in Tigray, Ethiopia. Livestock Research for Rural Development. Volume24,Article#16. Azage, T., Berhanu, G., Dirk, H., Berhanu, B. and Yoseph, M., 2013. Smallholder dairy production and marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development, Improving Productivity and Market Success of Ethiopian Farmers Project (IPMS) International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia Pp: 14-15, 17 and 22.
13. Banerjee, A.K., Animut, G. and Ermias, E., 2000. Selection and breeding strategies for increased productivity of goats in Ethiopia. In: Merkel, R.C., Abebe, G. and Goetsch, A.L. (Eds.), The opportunities and challenges of enhancing goat production in east Africa, pp. 70-79. Debub University, Awassa, Ethiopia, 10-12 November, 2000
14. Belachew, H. and Jemberu, E. (2003): Challenges and opportunities of livestock marketing in Ethiopia. YilmaJobre and GetachewGebru (eds). In 10thproceeding of ESAP, August 22-24, Addis Ababa, Ethiopia.Pp. 4-6
15. Belay B and Aynalem H 2009: Reproductive performance of traditionally managed sheep in the south western part of Ethiopia. Livestock Research for Rural Development. Volume 21, Article #154.Retrieved June 19, 2018, Belete, A., Kefelegn, K. and Kefene, E., 2015. Assessment of production and reproduction system of indigenous goat types in Bale Zone, Oromia, Ethiopia. Academia Journal of Agricultural Research, 3(12), pp.348-360
16. Belete, S. (2009): Production and marketing systems of small ruminants in Goma district of Jimma zone, western Ethiopia. Msc. Thesis.Hawassa University, April, Awassa, Ethiopia. Pp. 38-54.
17. Berhanu, G. Hoekstra, D. and Azage, T.2006. Improving the Competitiveness of Agricultural input Markets in Ethiopia: International Association of Agricultural Economics (IAAE), August 12 – 18, 2006, Gold Coast, Australia
18. Central Statistics Agency (CSA, 2018): Agricultural sample survey. Livestock and livestock characteristic report (Private Peasant Holdings). April, Addis Ababa, Ethiopia
19. CTA, 2007.The ACP-EU Technical Centre for Agricultural and Rural Cooperation CTA Practical Guide Series, No. 1.Wageningen.Netherlands,pp: 1873-8206
20. Deribe G, Abubeker H, Tsedeke K,Tekleyohannes B, Zekarias Band Addisu., 2013. Chemical composition and digestibility of major feed resources in mixed farming system of southern Ethiopia.World Applied Sciences Journal, 26(2), pp.267-275.
21. Deribe G., 2009. On-farm performance evaluation of indigenous sheep and goats in Alaba, southern Ethiopia (Doctoral dissertation, Hawassa University)
22. Devendra, C., 1986. Feeding systems and nutrition of goats and sheep in the tropics.In Improvement of small ruminants in Eastern and Southern Africa.(Eds. Adeniji K.O. and Kategile J.A.) OAU/STRC/IBAR, NAa.rnbi Kenya, pp: 91-109.
23. Dhaba U, Belay D, Solomon D and Taye T., 2012. Sheep and goat production systems in Ilu Abba Bora zone of Oromia Regional State, Ethiopia: Feeding and management strategies. Global Veterinaria, 9(4), pp.421-429.
24. Emana M, Ashenafi Mand Getahun, A., 2017. Nutritional Characterization of Selected Fodder Species in Abol and Lare Districts of Gambella Region, Ethiopia.J Nutr Food Sci, 7(581), p.2.
25. Endeshaw Assefa. 2007. Assessment on production system and marketing of goats at Dale district (Sidama Zone). MSc Thesis ,Hawassa University, Awassa, Ethiopia.
26. Ermias Belete, 2014. On- farm performance evaluation of dorper sheep breed crosses in wolaita and siltie zones, southern ethiopia
27. Ethiopian Agricultural Research Institutes (EARO), (2000): National Small Ruminants Research Strategy Document. EARO, Addis Ababa, Ethiopia.
28. FAO (Food and Agriculture Organization of the United Nations). 2002. Cattle and Small Ruminant Production Systems in sub-Saharan Africa - A Systematic Review. Otte, M.J. and Chilonda, P. (eds). Livestock Information Sector Analysis and Policy Branch. FAO,Rome, Italy
29. FAO, 2012.Phenotypic Characterization of Animal Genetic Resources.FAO Animal Production and Health Guidelines No. 11, Rome.
30. FAO. 2004. Livestock sector brief: Ethiopia. Food and Agricultural Organization of the United Nations.Livestock

Information, sector Analysis and Policy Branch. FAO, Rome.

31. Fekede F, 2013. Evaluation of feed resources and assessment of feeding management practices and productivity of dairy cattle in the central highlands of Ethiopia. PhD. Dissertations, National dairy research institute, karnal-132001 (Haryana), India.
32. Gashe A, Zewdu T, and KassaA ,. 2017. Feed Resources Gozamen District, East Gojjam Zone, Amhara Region. J Environ Anal Toxicol 7: 437. doi: 10.4172/2161-0525.10004
33. Gelayenew, B. A. (2012): Assessment of livestock feed resources, seasonal chemical composition and in sacco dry matter degradability of major forage species in Abobo woreda, Gambella Regional State, Ethiopia. MSc Thesis, Hawassa University, Ethiopia
34. Getachewu, A.and Jane, W., 2014. Prospects to improve the productivity of sheep fattening in Ethiopia: Status, challenges and opportunities
35. Getahun, L. (2008): Productive and Economic performance of Small Ruminant production in production system of the Highlands of Ethiopia. Ph.D. dissertation.University of Hohenheim, Stuttgart-Hoheinheim, Germany.
36. Giridhar, K. and Samireddypalle, A. 2015.Impact of climate change on forage availability for livestock. In: Climate change Impact on livestock: adaptation and mitigation. Sejian, V,Gaughan, J., Baumgard, L., Prasad, C. S. (Eds), Springer-VerlagGMbH Publisher, New Delhi, India, pp 97-112
37. Girma Abebe. 2008. Reproduction in sheep and goats. Alemu Yami and R.C. MERKEL(eds.). IN: Sheep and goat Production Hand Book for Ethiopia. ETHIOPIA SHEEP AND GOATS PRODUCTIVITY IMPROVEMENT PROGRAM (ESGPIP), Addis Ababa, Ethiopia. pp. 57-72.
38. Girma, A., Merkel, R. C. and Sahlu, T. (2000): Enhancing food security and income generation potential of families in Southern Ethiopia through improved goat production and extension. In proceeding of a conference.Langston Univ. da la Garza Inst. for Goat Research; Debub Univ. Awassa, Ethiopia.November 10-12, Awassa, Ethiopia.
39. Gurmesa, U. Misgana, D. Feyisa, H.andMerga, M. 2011. Participatory analysis of problems limiting goat production at selected districts of East Showa zone, Ethiopia.African Journal of Agricultural Research, 6(26), pp.5701-5714.
40. Hagos, A. Solomon, G. and Mengistie, U. 2017. Begait goat production systems and breeding practices in Western Tigray, North Ethiopia.Open Journal of Animal Sciences, 7(02), p.198
41. Hagos, H.Banerjee, A.K. and Mummed, Y.Y. 2018. Indigenous breeding practices and selection criteria of sheep breed in central zone of Tigray, Northern Ethiopia. International Journal of Livestock Production, 9(6), pp. 151-159
42. Helen, N. Yoseph, M. Solomon, A., Kefelegn, K. and sanjoy, S.K. 2015. Indigenous Sheep Production System in Eastern Ethiopia: Implications for Genetic Improvement and Sustainable Use. American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS), 11(1), pp.136-152.
43. Hundie, D. and Gelata, G. 2015. Assessment on production situation and breeding practices of 'Horro sheep'under traditional management in Horro Guduru and East Wollega Zones, West Ethiopia.Global Journal of Animal Breeding and Genetics, 3(3), pp.146-
44. Hussen, M. Kechero, Y. and Molla, M. 2015. Productive and reproductive performances of ruminant livestock in Jimma Zone, Southwest Ethiopia. Journal of Reproduction and Infertility, 6 (2): 27-34.
45. Ibrahim, M. N. andSchiere, J. B. 1989. Feeding of urea-ammonia treated rice straw. A compilation of miscellaneous reports produced by the straw utilization project (Sir Lanka).PudocWageningen. pp. 1- 28.
46. Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project, 2010
47. Kenfo, H., Mekasha, Y. and Tadesse, Y., 2018. A study on sheep farming practices in relation to future production strategies in Bensa district of Southern Ethiopia. Tropical animal health and production, 50(4), pp.865-874.
48. Kosgey, I.S. 2004.Breeding objectives and breeding strategies for small ruminants in the tropics.
49. Kosgey, I.S.G.J. Rowlands , J.A.M. van Arendonk , R.L. Baker. 2008. Small ruminant production in smallholder and pastoral/extensive farming systems in Kenya. Small Ruminant Research 77:11–24, Nairobi Kenya.
50. Markos , T. 2006. Productivity and health of indigenous sheep breeds and crossbreds in the central Ethiopian highlands. Doctoral Thesis, Swedish University of Agricultural Sciences. Uppsala, Sweden
51. Merkel, R.C. and Alemu,Y.,2008. Sheep and Goat Production Handbook for Ethiopia
52. Okpebholo, F. and Kahan, T. 2007.Opportunities and Challenges for Developing Small Ruminant Production Systems. Cooperative Extension Program, College of Engineering Sciences, Technology and Agriculture, Florida A&M University, Tallahassee, Florida.The Caprine Chronicle,22: 1-4.open access environments of Sub-Saharan Africa.
53. Selamawit, D. and Matiwos, H. 2015. Sheep and goat production practice in agroforestry systems of Gedio Zone, Ethiopia. International Journal of Environment, 4(2), pp. 296-307.
54. Sepulveda,W. S. Maza, M. T. and Pardos, L. 2011. Aspects of quality related to the consumption and production of lamb meat. Consumers versus producers. Meat Science, 87, 366–372.
55. Shewangzaw, A. and Adis, K. 2016. Sheep Production and Marketing System in North Gondar Zone of Amhara Region, Ethiopia University of Gondar, Faculty of Veterinary Medicine, P.O.Box, 196, Ethiopia
56. Sileshi, Z. and Desalegn, L. 2008. Sheep and Goat flock health. In Sheep and Goat Production Handbook for Ethiopia.ESGPIP.Pp 213-272.

57. Sisay, F and Kefyalew, G. 2015. Sheep and goat production systems in Degehabur Zone, Eastern Ethiopia: challenge and opportunities. Advances in Dairy Research, pp.1-9
58. Sisay, T. Pravee, V. Pornsri, C. and Suwapong, S. 2006. Assessment of Small Ruminant Management Practices in Jijiga and Shinille Zones of Somali Regional State, Ethiopia.Kasetsart J.(Nat. Sci.), 40, pp.98-999
59. Solomon, A. and Alemu, Y. 2009. Shelters and housing for sheep and goats. R.C. Merkel (eds). In 32th technical bulletin. August, Addis Ababa, Ethiopia. Pp: 1-2.
60. Solomon, B. 2004.Assessment of livestock production systems and feed resource base in SinanaDinsho District of Bale Highlands, Southeast Oromia.
61. Solomon, G. Komen, H. Hanotte, O. and van Arendonk J. 2008. Indigenous sheep resources of Ethiopia: Types, production systems and farmers preferences. Animal Genetic ResourcesInformation 43:25–40.
62. Solomon, G. Azage, T. Berhanu, G. and Dirk, H. 2010. Sheep and goat production and marketing systems in Ethiopia: Characteristics and strategies for improvement. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 23. ILRI (International Livestock Research Institute), Nairobi, Kenya. pp. 58
63. Taye, M. Yilma, M. Mengistu, S. Abiso, T. Bassa, Z. Wolde, S. Rischkowsky, B. Dessie, T. Okeyo, M. and Haile, A. 2016. Characterization of production system and breeding practices of sheep producers in Doyogena district, Southern Ethiopia.African Journal of Agricultural Research, 11(52), pp.5192-5201.
64. Tegene, N. Dinku, G. and Mohammed, B. 2015. Assessment of potential of natural pasture and other feed resources in sweet potato production system of Shebedino District, Sidama Zone, SNNPRS, Ethiopia. International Journal of Livestock Production, 6(8), pp.91-98.
65. Teka, H.Madakadze I.C. Angassa, A. and Hassen, A.2012. Effect of Seasonal Variation on the Nutritional Quality of Key Herbaceous Species in Semi-arid Areas of Borana, Ethiopia.Indian Journal of Animal Nutrition, 29 (4): 324-332.
66. Tesfaye, K. Madsen J.O. and Azage T., 2004. Manure Production, Handling and Use around Holetta Agricultural Research Center. In Proceedings of the 13th annual conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia.
67. Tesfaye, T. 2009. Characterization of goat production systems and on-farm evaluation of the growth performance of grazing goats supplemented with different protein sources in Metema Woreda, Amhara Region, Ethiopia (Doctoral dissertation, Haramaya University).
68. Tsedeke, K. 2007. Production and marketing system of sheep and goats in Alaba, Southern Ethiopia.MS.c. Thesis, Hawassa University, Awassa, Ethiopia
69. Tsegaye, D. Berhanu, B. and Aynalem, H. 2013. Herd husbandry and breeding practices of goat in different agro ecologies of Western Hararghe, Ethiopia. Ethiopian journal of animal production, p.139
70. Webb, E.C. and Mamabolo, M.J. 2004. Production and reproduction characteristics of South African indigenous goats in communal farming systems.Department of Animal & Wildlife Sciences, Faculty of Natural & Agricultural Sciences, University of Pretoria, Pretoria 0002, South Africa. Peer-reviewed paper: 8th International Conference on Goats Williamson, G. and W.J.A. Payne, 1974. An Introduction to Animal Husbandry in the Tropics.Tropic Agricultural Series, Longman Group Ltd. pp. 447.
71. Wilson, R.T. 1989. Reproductive performance of African indigenous small ruminantsundervarious management systems: a review. Animal Reproduction Science. 20: 265-286.
72. Yadeta, N.B. 2016.Production and reproduction performances, producers' trait preferences and marketing system of small ruminants in Ada Barga and Ejere Districts of west Shoa Zone, Ethiopia (Doctoral dissertation, Jimma University)
73. Yayneshet, T. 2010. Feed resources availability in Tigray region, northern Ethiopia, for production of export quality meat and livestock. Ethiopia Sanitary &Phytosanitary Standards and Livestock & Meat Marketing Program (SPS-LMM) Report. 77pp
74. Yenesewu, A.Solomon, M. Azage, T. and Firewu, T. 2013.Assessment of sheep production system in Burie District, north western Ethiopia.Global Journal of Agricultural Research, 1(2), pp.29-47
75. Zewudu,E. Haile, A. Tibbo, M. Sharma, A.K. Sölkner, J. and Wurzinger, M. 2012. Sheep production systems and breeding practices of smallholders in western and south-western Ethiopia: Implications for designing community-based breeding strategies. Livestock Research for Rural Development, 24(7).
76. Zinash, S. and Seyoum, B. 1991.Utilization of feed resources and feeding systems in the central zone of Ethiopia.Proceedings of the Third National livestock improvement Conference, Addis Ababa, Ethiopia. Pp: 129-132
77. Zinash, S. Aschalew, T. Alemu, Y. and Azage, T. 2001. Status of Livestock Research and Development in the Highlands of Ethiopia. P.C.Wall (ed.). In Proceedings of Two Stockholders Workshop