

Small Ruminant Production System, Productivity and Their Role in Ethiopian Economy: Review

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Abstract

In Ethiopia, small ruminants are raised under mixed crop-livestock and pastoral/agro-pastoral production systems. To date, number of sheep and goat are greater than 42.92 and 52.46 million heads, respectively. Small ruminants play a crucial role in terms of generating employment opportunities, income generation, improving family nutrition, ensuring household food security and for foreign exchange earnings at national level. Despite the wide distribution and large size of small ruminant population, their productivity is low; they grow slowly and lamb/kid mortality is high and meat production potential also low. For the last twenty years the average annual meat consumption per capita from small ruminant is slightly increase with some fluctuations and the current small ruminant meat consumption was 2.48 kg/year. Apart from their contribution for the smallholders, small ruminant plays a vital role for foreign exchange earnings at national level. In 2020, Ethiopia earns 66.59 million US\$ with the share of 64.20 and 2.39 million US\$ from the export of small ruminant meat and live shoat export, respectively.

Keywords

Small Ruminant, Meat, Production, Consumption

1. Introduction

Small ruminants (sheep and goats) are among the major economically important livestock in Ethiopia. The country has around 42.92 and 52.46 million heads of sheep and goats, respectively [1], playing an important role in the livelihood of resource-poor farmers [2]. [3] noted, small ruminants have become steadily more important in the livestock production of rural households. This is due to farmers recognizing that small ruminants provide alternative opportunities to increase their incomes. A comparative economic analysis of smallholder cattle and small ruminant production systems showed that in terms of efficiency of resource use, cattle and small ruminant production are almost equally efficient.

Small ruminants are produced under mixed crop-livestock production system and pastoral and agro-pastoral production systems characterized by low input and technologies, feed and disease [4]. The average holding of sheep and goat per household was 5.3 and 4.5 in West Shoa zone of Oromia Region [5] and 2.96 and 3.28 in southern of Ethiopia [6], respectively.

The genetic characteristics of the Ethiopian sheep and goat populations are the results of interactions between historical patterns of migration and geographic isolation and interbreeding, while their phenotypic traits are primarily determined by ecological patterns [7]. The purpose of this paper is, therefore, to review and document the current status of small ruminant production, productivity and consumption in Ethiopia.

2. Current Status of Small Ruminant Production in Ethiopia

In Ethiopia, the term small ruminant is synonymous with shoats and it includes sheep and goat. Small ruminant production offers considerable opportunities in terms of generating employment opportunities, income generation, improv-

ing family nutrition, ensuring household food security and for foreign exchange earnings at national level [8].

2.1. Small ruminant population in Ethiopia

Total small ruminant population increases from 21.06 million in the 2001 year with the contribution of 11.44 million sheep and 9.62 million goats to 95.38 million with the share of 42.91 and 52.46 million, respectively in 2020 (Figure 1). The figure shows that population of sheep and goat increase with some fluctuation within the last twenty years.



Source: FAOSTAT, 2022

Figure 1. Sheep and goat population in Ethiopia.

2.2. Geographical distribution of small ruminant in Ethiopia

Table 1 shows the distribution of the total sheep and goat population among the different regions of Ethiopia in 2021. The figures indicate that Somale region has the largest number of sheep and goat, followed by Amhara and Afar region in sheep and goat numbers, respectively. Afar, Amhara, Oromia and Sidama region together represent 94 percent and 88 percent of the total national sheep and goat population, respectively. The remaining 6 percent of sheep and 12 percent goat are mainly distributed among Benishangul-Gumuz, Dire Dawa, Harari, Gambella, Southern Nations, Nationalities, and People's and Tigray regions (Table 1).

Table 1. Geographical distribution of small ruminant populations

N ^o	Geographical area	Sheep	Goats
1	Tigray	2,097,619	4,838,969
2	Afar	4,476,845	8,843,082
3	Amhara	10,391,582	7,045,305
4	Oromia	9,752,385	8,425,727
5	Somale	11,013,491	16,464,505
6	Benishangul-Gumuz	61,335	446,323
7	Sidama	4,561,504	5,518,806
8	SNNP	467,858	308,903
9	Gambella	27,789	135,494
10	Harari	5,497	110,499
11	Dire Dawa	59,320	325,922
	Total	42,915,225	52,463,535

Source: CSA, 2021

2.3. Genetic diversity of small ruminant in Ethiopia

In Ethiopia, there exists a great variation in climate and topography, harboring diversified livestock species which also have variability among themselves. The country is home to large and diverse small ruminant and attractive production environments. To date, there are more than 42.92 million heads of sheep and 50.46 million heads of goats [1]; six breed groups and nine breeds of sheep [9] and four families and twelve breeds of goats [10] are kept in diverse production systems and different agro-climates ranging from the hot arid and semiarid areas to the cold humid highlands. Estimates show that 99.52% of the sheep and 99.90% of the goats are exclusively indigenous breeds [1] that are evolved to survive in harsh environments at the expense of all other factors. According to [7], most of these breeds have not been systematically improved and have evolved in marginal environments (for instance the Menz sheep in afro-alpine ecologies) with adaptation to the natural environment and are thus less 'productive' in certain production traits such as growth traits when compared to other breeds.

2.3.1. Indigenous sheep breeds in Ethiopia

In 2021, indigenous goats represented about 99.52 percent of the total national sheep population. Sheep found in Ethiopia could fall into different breeds and types whose distribution ranges from midland to highland environments. Sheep were domesticated as dual-purpose animals to produce wool and meat, early people would have valued sheep milk as well.

As in many African countries, the indigenous sheep of Ethiopia actually comprises goat with a wide range of morphologic or genetic diversity. Currently, six breed group and nine breeds of indigenous sheep in Ethiopia named based on their physical characteristics, genetic differences at the DNA level, tail type/shape and fiber type [11].

Table 2. Indigenous sheep breed groups and breeds in Ethiopia

Breed group	Breed	Population	Tail type/shape	Fiber type
Short-fat tailed	Simien	Simien	Fatty and short	fleece
	Short-fat tailed	Sekota, Farta, Tikur, Wollo, Menz	Fatty and short	fleece
Washera	Washera	Washera	Fatty and short	hair
Thin-tailed	Gumuz	Gumuz	Thin and long	hair
Long-fat tailed	Horro	Horro	Fatty and long	hair
	Arsi	Arsi-Bale, Adilo	Fatty and long	hair
Bonga	Bonga	Bonga	Fatty and long	hair
Fat-rumped tail	Afar	Afar	Fat rump/fat tail	hair
	Blackhead Somali	Blackhead Somali	Fat rump/tiny tail	hair

Source: Compiled from Gebremichael, 2008

2.3.2. Exotic sheep breeds

The proportion of exotic and crossbred sheep populations in Ethiopia remains low, only 0.49% [1], indicating that research and development efforts of sheep crossbreeding in Ethiopia did not deliver the anticipated benefit to smallholder farmers so far. However, there is still a growing interest of the government and of farmers in sheep crossbreeding. To date, some selected exotic breeds like Awassi, Corriedale, Dorper and Hampshire are under production in the country. These selected breeds can play important role in the development of Ethiopian indigenous breed productivity are introduced to the country [11].

2.3.3. Indigenous goat breeds in Ethiopia

Indigenous goats represented about 99.90 percent of the total national goat population of Ethiopia in 2021. As in many African countries, the indigenous goat of Ethiopia actually comprises goats with a wide range of morphologic or genetic diversity. Currently, four families and twelve breeds of indigenous goats in Ethiopia based on their physical characteristics and genetic differences at the DNA level [12, 13].

2.3.4. Exotic goat breeds in Ethiopia

The share of exotic and crossbred goat populations in Ethiopia remains less than 0.1% [1], indicating that research and development efforts of goat crossbreeding in Ethiopia did not deliver the anticipated benefit to smallholder farmers so far. However, there is still a growing interest of the government and of farmers in sheep crossbreeding. According to [11], from many types of meat and dairy exotic goat breeds some selected breeds like Anglo-Nubian, Beetal, Boer, Damascus or Shami, Jamnapari, Saanen and Toggenburg have been introduced to Ethiopia with the main aim of cross-

ing with local goats to improve milk production in areas where goat milk is known to be consumed.

Table 3. Indigenous goat families and breeds in Ethiopia

Family name	Breed name	Other local names
Nubian family	Nubian	
	Afar	Adal, Danakil
Rift valley family	Abergelle	
	Arsi-Bale	Gishe, Sidama
	Woito-Guji	Woyto, Guji, Konso.
Somali family	Hararghe Highland	
	Short-eared Somali	Denghier or Deghiyer
	Long-eared Somali	Large white Somali, Degheir, Digodi, Melebo
Small East African family	Central Highland	Brown goat
	Western Highland	
	Western Lowland	Gumuz
	Keffa	

Source: Compiled from Hamito, 2009

2.4. Small ruminant production system in Ethiopia

In Ethiopia, livestock production is secondary to crop production and it usually comprises of small ruminants with very small flock sizes in mixed crop-livestock [14] and it is characterized by low productivity due to recurrent drought, nutritional stress, severe resources degradation and internal and external parasites [15].

Like all other livestock species, small ruminants are kept under traditional extensive systems with no or minimal inputs and improved technologies, which results in characteristically low productivity. Small ruminants are largely produced in mixed crop-livestock and pastoral and agro-pastoral production systems mainly based on the rangeland in pastoral and agro-pastoral areas of the country [7]. But, [16] noted four small ruminant production systems as annual crop-based systems (northern, northwestern and central areas), perennial crop-based systems (mainly southern and southwestern highlands), cattle-based systems (agro-pastoral and arid areas), and small ruminant dominated systems (pastoral and arid eastern and north eastern areas) in the country. Another author, [4], classified small ruminant production systems in Ethiopia as mixed crop-livestock and pastoral and agro-pastoral based on the level of the small ruminant production, their contribution to the community and the type of crop production enterprises.

The mixed crop-livestock production system is often found in the highland agro-ecological zones where livestock production is secondary to crop production. The system comprises of very small flock sizes due to shrinkage of grazing areas per household, limited feed availability and land degradation [12]; [17]. Pastoral and agro-pastoral production system are found in the arid and semi-arid agro-ecological areas where the majority of small ruminants (40% of sheep and 40% of goats) are concentrated [18] and kept under extensive systems which make them major sources of livestock products for the Ethiopian export market [19]. The pastoral system is based on a wide range communal grazing area primarily using natural vegetation where thorny enclosures are common while the agro-pastoral system is characterized by a combination of pastoral and mixed crop-livestock production systems with periodic use of crop residues [20].

3. Productivity Performance of Small Ruminant in Ethiopia

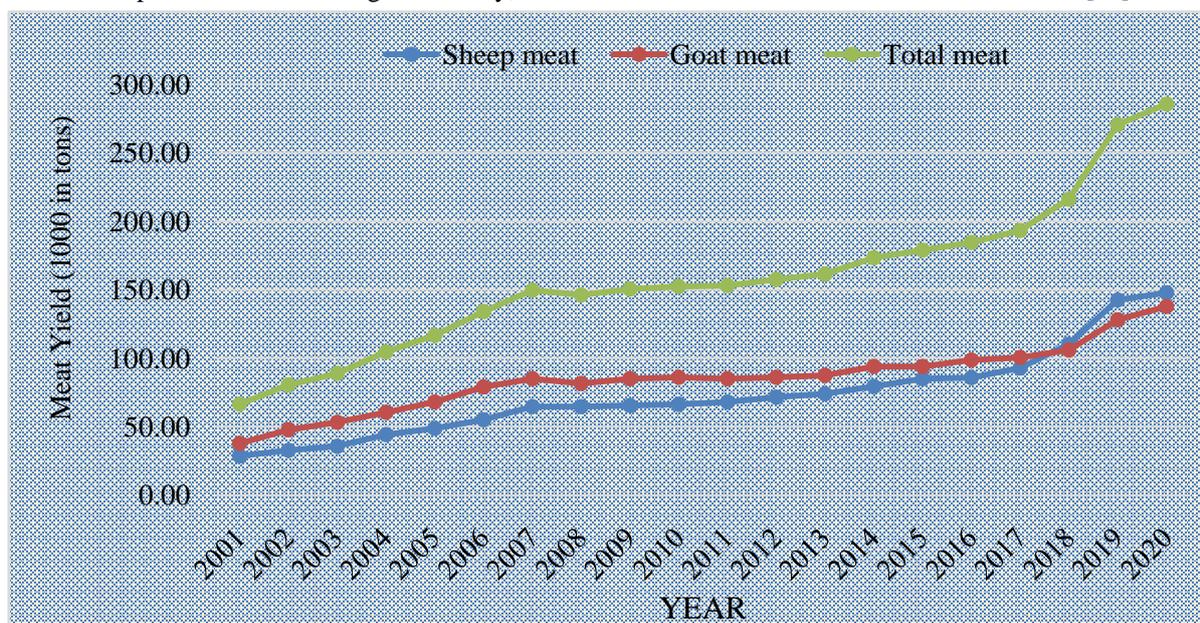
Despite the wide distribution and large size of the Ethiopian sheep and goat population, their productivity is low; they grow slowly and lamb/kid mortality is high [21]. This may be due to different factors such as poor nutrition, prevalence of diseases, and lack of appropriate breeding strategies and poor understanding of the production system as a whole [22]. There is an urgent need to increase the productivity of sheep and goats to improve household income and nutrition, and to meet the demands of the growing human population and foreign markets [21].

3.1. Meat production Potential

Meat which is defined as all animal tissues suitable as food for human consumption and includes all processed or manufactured products prepared from animal tissues [23] is the most valuable livestock product and for many people serves as their first-choice source of animal protein which provides all the essential amino acids and various micronutrients in proper proportion to the human beings. Despite the huge livestock population in the country, the production of

meat is still low and contributed to about 0.2 percent of the world total meat production, of which most is sheep and goat meat. The reasons behind low production of meat in Ethiopia are due to low off-take rates, most animals slaughtered and exported live were not produced in commercially oriented manner and sell only in need of cash or when animals get too old after serving for draft purpose and inability to fulfill minimum standard required in the international market for processed meat [24].

Meat production offers opportunity to serve a vast export market as well as Ethiopia's domestic market. The total meat production of sheep and goat from 2001 to 2020 is presented in Figure 2. The total meat production increases from 66,380 tons with 28,630 tons from sheep and 37,750 tons from goat in 2001 year to 285,490 tons with the share of 147,740 tons from sheep and 137,750 tons from goat in 2020 year (Figure 2). The trend of small ruminant meat production in Ethiopia shows it was rising moderately, of course with some fluctuations from 2001 to 2020 [25].



Source: FAOSTAT, 2022

Figure 2. Sheep and goats meat production in Ethiopia.

3.2. Reproductive Performance

The success of a small ruminant operation depends on the number of lambs and kids raised, weaned, marketed each year, age at first lambing/kidding, lambing/kidding interval and reproductive life span of female combining with other managements. Reproductive traits are responsive to environmental influences, however, and they respond to careful herd reproductive management. Some important factors small ruminant producers must carefully consider are age, weather, season, and nutrition. Reproduction levels in sub-Saharan African breeds are 17.5-16.4 months for age at first parturition [26], 230-437 day for lambing intervals [27] and 1.0-1.5 for litter size [28]. Some reproductive traits of small ruminant are indicated in Table 4.

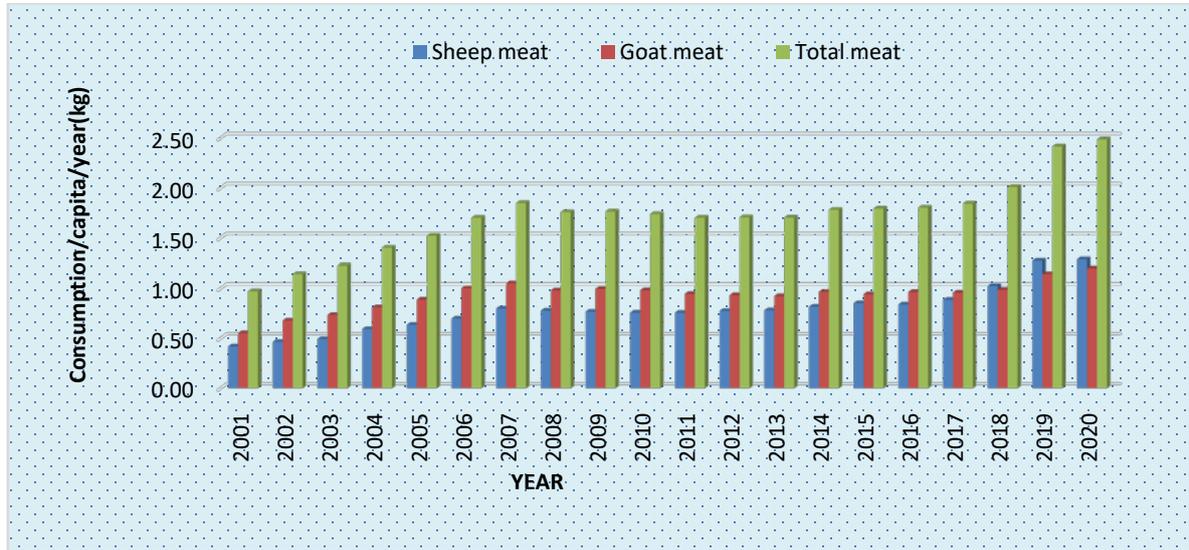
4. Meat Consumption Trend in Ethiopia

Small ruminant meat is consumed by domestic and foreign consumers. But, milk and milk products are consumed by domestic consumers. Over 90% of the meat exported to different countries is sheep and goat meat; Ethiopian sheep and goat meat is exported mainly to the Middle East and North Africa [21]. The consumption of meat was one of the factors that differentiated the society of antiquity. Cultural and religious aspects have played a major role in the processing of meat and their consumption [45]. [23] noted that, meat consumption is often an indication of economic status of a country or an individual and the domestic meat demand is believed to increase with increasing population, urbanization, and income. People with a higher social or economic status demand a greater amount of high-quality meat products. The consumption of sufficient meat is a rare extremity in most developing countries and the per capita consumption of meat in in developing country is much lower than the developed countries. In Ethiopia, for the last twenty years the average annual meat consumption per capita from small ruminant is slightly increase with some fluctuation from 0.97 kg/year in 2001 year to 2.48 kg/year in 2020 year with 1.29 and 1.20 kg/year from sheep and goat, respectively (Figure 3).

Table 4. Reproductive Performance of sheep and goat

Traits	Sheep	Goat	Source	Location(s)
Age at first mating (m)	11.00	11.00	(29)	Wolayta and Hagereselam, Ethiopia
	15.00	13.14	(30)	Kochere, Ethiopia
Age at first lambing/ kidding (m)	16.20-16.90		(26)	SSA countries
	18.10		(31)	Eastern Amhara, Ethiopia
	15.63-18.90	24.07-24.16	(32)	Jimma zone, Ethiopia
		15.01	(33)	Tigray, Ethiopia
	12.70	12.10	(34)	Alaba Zone, Ethiopia
	12.4		(35)	Gamogofa, Ethiopia
	21.00	19.50	(30)	Kochere, Ethiopia
		12.50-28.50	(36)	Sekota, Ethiopia
	13.6	13.12	(37)	Southern Ethiopia
	14.12-15.22	13.6-15.33	(5)	West Shewa, Ethiopia
Weaning age (m)	4.80	4.73-6.27	(38)	Western and South western Ethiopia
	4.40	4.70	(33)	Tigray, Ethiopia
	4.80	5.30	(29)	Walayta zone, SNNP
	6.50	6.00	(30)	Kochere, Ethiopia
	4.21	4.85	(37)	Southern Ethiopia
	3.84-4.44	3.52-4.67	(5)	West Shewa
Age at sexual maturity of male (m)	8.42-8.80		(33)	Tigray, Ethiopia
	7.10		(39)	Afar, Ethiopia
	6-70		(40)	Bako, Ethiopia
	8.30	7.42	(37)	Southern Ethiopia
	8.79-9.67	8.16-9.67	(5)	West Shewa, Ethiopia
Marketing / Slaughter age (m)	3-40		(41)	Horro and Bonga, Ethiopia
	140	11.00	(30)	Kochere, Ethiopia
	8.60	8.52	(37)	Southern Ethiopia
	6.34-7.33	6.03-6.50	(5)	West Shewa, Ethiopia
Litter size	1.08-1.75	1-1.75	(14)	Ethiopia
	1.11-1.57		(42)	Ethiopia
	1.28		(16)	Ethiopian highlands
	1-1.50		(43)	Ethiopian highlands
	1.16-1.21	1.21-1.32	(5)	West Shewa, Ethiopia
Lambing / Kidding interval (m)	7.87-8.04	7.87-8.04	(44)	Jimma zone, Oromia
	8.97	9.00	(37)	Southern Ethiopia
	8.73-9.56	8.1-9.33	(5)	West Shewa, Ethiopia
Reproductive life span of female (m)	112-129	98-120	(5)	West Shewa, Ethiopia

SSA=Sub-Saharan African, m=month



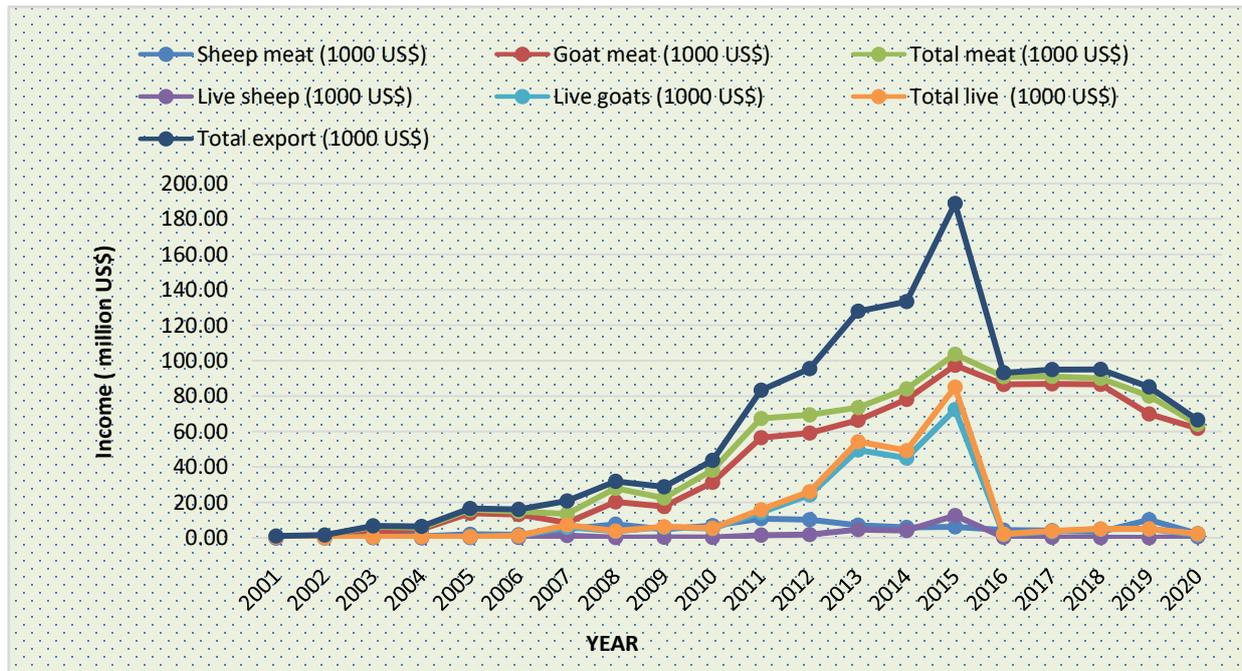
Source: FAOSTAT, 2022

Figure 3. Sheep and goats meat consumption per capita per year (kg).

5. Role of Small Ruminants in Livelihood and National Economy of Ethiopia

Small ruminants have become an important activity in livestock production in rural households and has a substantial contribution to their owner in generating income and securing food in developing countries [46] and considered as a key asset playing cultural roles. As stated by [47] and Kosgey [48], small ruminants are an important source of both tangible (income, meat, milk, skins, wool and manure) and intangible (saving, insurance against emergency, cultural and ceremonial) advantages that may vary among different cultures, locations, agro-ecologies and socio-economic.

Apart from their contribution for the smallholders, small ruminant plays a vital role for foreign earning at national level. In 2020, Ethiopia earn 66.59 million US\$ with the share of 64.20 and 2.39 million US\$ from the export of small ruminant meat and live shoat export, respectively [25]. Between 2001 to 2015 income from export of live shoat meat and meat shows increasing trend with some fluctuation. Since 2016, however the export of live shoat steadily declines and the total income of the country from small ruminant also declined (Figure 4).



Source: FAOSTAT, 2022

Figure 4. Income from meat and live animal export.

6. Conclusion

This review tried to single out the small ruminant productions systems, productivity potential, meat consumption trend and the role of small ruminant in the smallholder livelihood and national economy of Ethiopia. Small ruminant in Ethiopia are mainly raised under mixed crop-livestock and pastoral/agro-pastoral production systems. Currently, there are more than 42.92 million heads of sheep and 50.46 million heads of goats. Six breed groups and nine breeds of sheep and four families and twelve breeds of goats are kept in diverse production systems and different agro-climates ranging from the hot arid and semiarid areas to the cold humid highlands. Estimates show that 99.52% of the sheep and 99.90% of the goats are exclusively indigenous breeds that are evolved to survive in harsh environments at the expense of all other factors.

Small ruminants play a vital role in terms of generating employment opportunities, income generation, improving family nutrition, ensuring household food security and for foreign exchange earnings at national level. Despite the wide distribution and large size of the Ethiopian small ruminant population, their productivity is low; they grow slowly and lamb/kid mortality is high and meat production potential also low.

In Ethiopia, for the last twenty years the average annual meat consumption per capita from small ruminant is slightly increase with some fluctuation from 0.97 kg/year in 2001 year to 2.48 kg/year in 2020 year with 1.29 and 1.20 kg/year from sheep and goat, respectively. Apart from their contribution for the smallholders, small ruminant plays a vital role for foreign exchange earnings at national level. To date, Ethiopia earns 66.59 million US\$ with the share of 64.20 and 2.39 million US\$ from the export of small ruminant meat and live shoat export, respectively.

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