IJAS Iranian Journal of Applied Animal Science

Indigenous Sheep Production in Ethiopia: A Review

Review Article

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Received on: 23 Sep 2011
Revised on: 7 Nov 2011
Accepted on: 24 Nov 2011
Online Published on: Dec 2012

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Online version is available on: www.ijas.ir

ABSTRACT

Research results and facts of indigenous sheep production were reviewed with the aim of delivering relevant information for the beneficiaries. The common production system used in Ethiopia was the extensive type, which was characterized by small flock sizes and the flock being periodically devastated by diseases. Some indigenous sheep groups of the country were characterized and their names were designated from their commonest niche areas. There are large variations in phenotypic characteristics of indigenous sheep in the country. Social cultures and beliefs of most of the community have been highly attached and attracted by these morphological variations of indigenous sheep in Ethiopia. Consequently, those sheep endowed with attractive coat-colors have always exceeded market values of their counterparts. There is also a genetic variation between and within sheep populations of the country. Moreover, there is also a generation response for selection. Although indigenous sheep producers have many opportunities, they have also many constraints that affect productivity. It can be concluded that breeding and improved production programs for the local sheep should incorporate the production objectives and trait preferences of the society. Presence of diversified phenotypic appearances of local sheep shows the genetic potential for improvement. Hence, this huge gene pool should be used for improvement through good management and traditional selection together with genomic technology.

KEY WORDS Ethiopia, indigenous sheep, production systems.

INTRODUCTION

Ethiopia has around 25 million sheep (CSA, 2007) and they may be grouped into about 14 traditional sheep populations (Gizaw *et al.* 2007). They are also found widely distributed across the different agro-ecological zones of the country (EARO, 2000). Moreover, sheep production in Ethiopia is based on indigenous breeds except Awassi-Menz cross-breds that contribute less than 1% of the population. Despite low level of productivity due to several technical (genotype, feeding and animal health), institutional, environmental and infrastructural constraints (Tibbo, 2006), indigenous sheep breeds have great potential to contributing more to the livelihoods of the people in low-input, smallholder crop livestock and pastoral production systems (Kosgey and Okeyo, 2007). The annual off-take rate for sheep is estimated to be 33% (EPA, 2002) with an average carcass weight of about 10 kg, which is the second lowest of the sub-Saharan African countries (FAO, 2009). Carcass weights of sheep, therefore, need to be improved to the demands of the market.

Indigenous sheep in Ethiopia have a multipurpose role for smallholder farmers as sources of income, meat, skin, manure and coarse wool or long hairy fleece. They are also a means of risk avoidance during crop failure. Thus, increasing the current level of productivity of sheep is essential to meet the demands of the ever-increasing human population. On the other hand, by improving the productiv-

ity of sheep, export earnings as well as the income of the household will be improved. There are however, a number of constraints that affect the productivity of sheep such as mortality, feed scarcity and inadequate indigenous breed utilizations to production. Various scholars from different corners of the world have been advising that the performance of indigenous sheep could be improved through management and there is also potential for genetic improvement through selection.

Moreover, sheep production provides an opportunity for smallholder farmers that requires low initial capital and is able to use the marginal land as well as crop residues for feeding; additionally, care-taking of sheep can be carried out by any family members. Similarly, Getachew *et al.* (2010) stated that sheep enterprise in Ethiopia is being used as a cash income and provides social security in the bad crop years. In general, there are many scientific findings that have been conducted by various researchers on the biological and socioeconomics of indigenous sheep. However, a comprehensive review of such results has yet to be executed.

Therefore, reviewing such previous works of sheep production in the country and also some related findings from other countries seems to be crucial to deliver information to the beneficiaries. Based on this outlined background, the objective of this paper was to review the research findings and facts and thereby to deliver relevant information to the beneficiaries.

Most of the related research findings of indigenous sheep in Ethiopia and some related issues from other countries were reviewed.

Sheep production was described. Various reports of research findings that focused on characterization of indigenous sheep were also reviewed. Reviewing was based on the production systems on which sheep were reared at times of the original data collections. Findings of morphological characteristics of indigenous sheep and their distribution were also reviewed, depicted and sourced. Moreover, research findings on genetics of indigenous sheep that have been reported by various scholars were also reviewed and synthesized.

RESULTS AND DISCUSSION

Outlined description of the indigenous sheep

Indigenous sheep in Sub-Saharan Africa are described as the poorest in population growth and performance in the world (Abassa, 1995). They are diversified in breed types and have an association of specific breed types with particular ecological zones (Peters and Thorpe, 1989). Ethiopia has a diverse sheep population and its distribution is paralleled with its diverse ecology.

The country has around 25 million sheep (CSA, 2007) and this again grouped into about 14 traditional sheep populations (Gizaw *et al.* 2007). The average holding of sheep per household in Ethiopia ranges between 3.7 (Abebe, 2010) to 31.6 (Getachew *et al.* 2010). This all makes Ethiopia's sheep population the second in Africa and sixth in the world (Demelash *et al.* 2006). Ethiopian indigenous sheep are not exhaustively described breeds, but have distinguished morphological differences that are found in every corner of the country.

There is variation in morphology and genetics. Moreover, there is enough evidence that such sheep types of a country have genetic variation that may allow for selection.

In most of the native flocks, adaptation is a pronounced phenomenon. There is also a strong relationship between sheep types, ethnic groups and production systems of a country. Generally, this huge resource of the country should be properly utilized by implementing the headway options and experiences across the world.

According to Gizaw *et al.* (2008), a nationwide and comprehensive characterization of Ethiopian sheep populations was initiated in 2005. It is confirmed that there are large variations in morphological appearances, body conformation and matured bodyweights, coat colors and tail types of native sheep. These groups are short-tailed, long-tailed, fat-rumped and thin-tailed types. Moreover, the morphological variations may be due to the variations of qualitative genes in the indigenous gene pool of the flocks.

Similarly, different scholars agreed that every qualitative trait of an animal is affected by a single gene. Consequently, coat colors, wattle, horn, beardless and extra variations between and within indigenous sheep of Ethiopia are common and diversified.

Based on reports of various scholars, there are productivity and performance variations of indigenous sheep breeds. Milan *et al.* (2011) from Serbia reported also that environmental factors have important impacts on performances of sheep.

The variations in performances of sheep in Ethiopia are also aroused from within and between breeds, and across the agro ecologies. Therefore, it shows that there is a genetic potential and the poor performances also be improved by management of indigenous sheep. The details of reviewed data of indigenous sheep production and productivity traits were collected and depicted containing their parallel reference sources in Table 1.

Moreover, the genetic variation for indigenous sheep may be basically attributed by a geographical situation of a country. Isolation, natural and artificial selections may also contribute for this variation. As a result, some indigenous sheep groups were characterized and their names are also designated from their commonest niche areas.

Generally, the characterized indigenous sheep breeds (types) of Ethiopia and their designated names are Horro, Menz, Arsi-Bale, Simien, Tikur, Wollo, Afar, Black Head Somali, Farta, Bonga and Adilo. The details of genetic characteristics of indigenous sheep are shown in Table 2. Some productivity parameters of sheep and goat are also shown in Table 3.

Gizaw *et al.* (2010), who studied genetics of indigenous sheep in Ethiopia, stated that there was genetic variation between and within all pairs of sheep populations in the country.

They have adaptive divergence in morphological characters. Yakubu *et al.* (2010), on the contrary, who studied indigenous sheep in Nigeria described that the genetics of indigenous sheep types haven't been purified through artificial breeding and the estimates of genetic distance between them is closely related. However, Kunene (2010), from South Africa reported that there is a genetic variation and polymorphism within the Zulu sheep breeds. Major indigenous sheep breeds of Ethiopia, unique, features and distributed niche areas with number sheep per household are depicted in table 4 below.

Traits and productivity of indigenous sheep

Although Ethiopia is the second in Africa and sixth in the world in sheep populations (Demelash *et al.* 2006), indigenous sheep are poor in performances. Ethiopian indigenous sheep are characterized by slow growth, late maturity and low production performances. The mean carcass production of such sheep is estimated as around 10 kg (FAO, 2009), which is low as compared to the average of sub-Saharan countries with annual off take rates of around 33% (EPA, 2002). The productivity of local sheep is low with high mortality of lambs (Tibbo, 2006). The low productivity of indigenous flocks can partially be attributed to the low management standards of the traditional production systems. However, provision of vaccination, improved feeding, clean water and night time enclosure relatively improves the production performance of indigenous sheep. In addition, skins of sheep are important by-products of small ruminants in sub-Saharan Africa (Wilson, 1992) and contribute to national revenue in most countries.

Indigenous sheep have various unique traits, of which, those having an economic importance were reviewed. In this review, the maximum age at 1st parturition (months) of sheep was 23.77 (Alexandre *et al.* 2008) at Martinik-Guadeloupe and the minimum was reported as 12.7 (Tsedeke, 2007) in Ethiopia.

According to Berhanu and Aynalem (2009a), average lambing interval and annual reproductive rate of Ethiopian sheep were 262±53.4 days and 1.88±0.44, respectively.

Moreover, Tsedeke (2007) reported that the average litter size was estimated to be around 1.70 per ewe for Arsi-Bale sheep, but the litter size per ewe of Menz and Washera sheep is around 1.11 (Dibissa, 2000; Taye *et al.* 2010) in Ethiopia.

There is an average birth weight variation across the country. Mukasa and Lahalou (1995) reported that average birth weight in Ethiopia is 2 kg, but, Milan *et al.* (2011) reports the average birth weight of sheep in Serbian is about 3.37 kg. Moreover, from the reviewed data, the minimum and maximum average weaning weights of sheep were reported as 8.13 and 15 kg (Kassahun, 2000) and (Berhe, 2010), respectively in Ethiopia. The milk yield per ewe of Ethiopian Afar sheep is 224 mL per year (Getachew *et al.* 2010), but Pacinovski *et al.* (2006) reported that there was around 1.09lr for an Awassi sheep breed from the country of Macedonia.

Based on the reviewed literature, the maximum feed conversion ratio of sheep was 15.6 (Sultana *et al.* 2010) in Bangladesh; whereas, the minimum was 4.7 (Price *et al.* 2009) from South Africa. However, Mengistie (2009), from Ethiopia reported that the average feed conversion ratio and daily body weight gain were 38.40 and 1.175 kg, respectively for Washera ram lambs. Moreover, Getachew *et al.* (2011) reported that the average daily weight gains and carcass weight were also around 126 g and of 16 kg, respectively for feedlot growth and carcass performance of Washera sheep in Ethiopia. From the reviewed data, the minimum average daily body weight gains of sheep were reported as 0.07 kg (Kassahun, 2000) in Ethiopia; whereas, the maximum was 0.32 kg (Price *et al.* 2009) in South Africa, respectively.

The minimum and maximum average matured weights of sheep were also reported as 21.6±9.3 and 41.5±2.0 kg, respectively (according to Abebe, 2010) in Ethiopia.

The dressing percentage and carcass weights of Ethiopian sheep were reported to be 42.5% and 11.0 kg (Berhe, 2010) and 55.55% and 18 kg (Wood *et al.* 2010) from Bristol, respectively. Moreover, Berhe (2010) reported that average carcass weight of Ethiopian sheep was 10-12 kg and the annual mortality loss of sheep is also estimated around 14-16%. Sandip (2011) reported, from India that the dressing percentage of the Shahabadi Sheep ewes were 39%, which is low.

Distribution and improving schemes of indigenous sheep

Sheep are highly adaptable and distributed across a broad range of environments. They can utilize a wide variety of plant species and are thus complementary to cattle and camels. Sheep generally do not compete directly with these cattle and camels for feed.

Table 1 Parameters and the mean values of indigenous sheep traits

Parameters	Mean values	Rearing system	Source of references
Body weights at birth (kg)	2.5	Intensive	Mukasa and Lahalou (1995)
Body weights at weaning (kg) of sheep	14.83 Menz and 8.30 Menz	Traditional	Hassen *et al.* (2004) and Niftalem (1990)*
Body weights gained in 365 days of age (kg) of sheep	24.67	Intensive	Reviewed by Kassahun (2000)
Daily body weight gain in 365 days of age (g)	62.15	Intensive	Reviewed by Kassahun (2000)
Pre-weaning mortality rate (%)	25.3 Horro and 6.4 Washara sheep	Intensive	Tibbo (2006) and Mengistie (2008)*
Average body weights at matured age (kg)	32 (ewes) and 38 (rams)	Intensive	Kunene (2010)
	33.50	Semi-intensive	Kassahun (2000)
Age at 1st parturition (months)	15.0 Menz sheep	Intensive	Mukasa and Lahalou (1995)
	12.7 Arsi-Bale	Traditional	Tsedeke (2007)
Lambing / kidding interval (months)	8.4 Menz sheep	Intensive	Mukasa and Lahalou (1995)
	7.8 Arsi-Bale sheep	Traditional	Dibissa (2000)
Litter size	1.70 Arsi-Bale sheep	Traditional	Tsedeke (2007)
	1.11 Menz and Washara sheep	Traditional	Dibissa (2000) and Taye *et al.* (2009)*
High cause of morality (%)	53.6 (pneumonia)	Intensive	Tibbo (2006)
Morality rate of sheep up to the yearling (%)	50.50	Intensive	Tibbo (2006)
Average losses of sheep (%)	34.6	Extensive	Tsedeke (2007)
Average daily dry mater feed intake (g)	134.4 Horro and 59.10 Washara sheep	Semi-ntensive	Gojjam *et al.* (1998) and Taye *et al.* (2009)*

* Shows respectively reported data.

Table 2 Genetic characteristics of indigenous sheep

Traits / Parameters			Mean values	Sources of references
Genetic distances between sheep groups				
Wattle	Beard	Coat color		
0.005	0.005	0.18		Yakubu *et al.* (2010) (n=636)
The genetic diversity			21.91	Kunene (2010) (n=76)
Phenotypic diversity (%)			48.26	Kunene (2010) (n=76)
Number of alleles per sheep populations			5.87 to 7.51	Gizaw *et al.* (2007) (n=672)
Polymorphism contents			0.283 to 0.852	Niu *et al.* (2011)
Genetic differentiation			0.04 to 0.111	Niu *et al.* (2011)
Heterozygosity value			0.66 to 0.75	Gizaw *et al.* (2007)
Average heritability estimates of weights at:				
birth	weaning	Yearling	Post-waning	
0.24	0.135	0.24	0.11	Tibbo (2006)
0.068	0.18–0.26	0.20	0.22	Mandal *et al.* (2010)

Table 3 Some productivity parameters of shoat

Traits / parameters	Values
Weaning weight	15 kg
Yearling weight	22 kg
Carcass weight	40-45% of empty body weight
Annual direct losses from mortality	Sheep: 14-16% and Goat: 11-18%
Adapted from Berhe, 2010	

Table 4 Major indigenous sheep breeds of Ethiopia, unique features, distributed niche areas and holding per household

Major indigenous sheep breeds (types)	Tthe unique features	Main niche-areas / agro-ecologies	Sources
Simien, Tikur, Menz and Wollo*	Short fat-tailed	Sub-alpine (>3000 m.a.s.l)	Alemayehu, (2004)
Washera, Sekota, Horro*, Arsi-Bale* and Farta*	Long fat-tailed	Highlands (1500-3000 m.a.s.l)	Alemayehu, (2004)
Afar and Black Head Somali	Fat-rumped	Arid and semiarid (<1000 m.a.s.l)	Alemayehu, (2004)
Bonga and Adilo,	Thin-tailed	Lowlands (humid) (>1000 m.a.s.l)	Alemayehu, (2004)
Parameters	Mean values	Rearing system	
Main purpose of rearing sheep (%)	98.9 (for sale)	Extensive	Tsedeke (2007)
	7.4	extensive	Tsedeke (2007)
Average holding of sheep per household (%)	31.6 Menz and 23.0 Afar	Extensive	Getachew *et al.* (2010)
	17.77	Extensive	Gizaw *et al.* (2008)

* Symbol is to showing the possibility of finding a breed in other agro-ecologies.

Gizaw *et al.* (2008) reported that there is high morphological, ecological, ethnic and production systems diversity of indigenous sheep distributions in Ethiopia.

Compared to goats, sheep lay down more subcutaneous and intramuscular fat from surplus energy (Wilson, 1991). There has been a tendency to over-emphasise the low productivity of indigenous breeds without due consideration of some important characteristics of these breeds.

Lebbie *et al.* (1992) and Getachew *et al.* (2010) from Zimbabwe and Ethiopia, respectively reported that to improve the sheep production, selection and evaluation of the best animals should be concentrated on the traditional sector.

Generally, livestock improvement programs targeting smallholder farmers need to incorporate existing traditional herding, breeding practices, trait preferences and the multiple roles of sheep.

According to Kunene (2010), the phenotypic and genetic diversity between the indigenous sheep may indicate that there is an opportunity of genetic exploitation by selecting animals based on phenotypic as well as genetic characteristics. Improving schemes of indigenous sheep in the country should incorporate the niche areas and agro ecologies. Moreover, improvement plans for indigenous sheep should also consider socio cultural believes and ethnical interests of the country.

Socio-economics

According to Ayele *et al.* (2003), the current knowledge on livestock market structure, performance and prices is poor and inadequate for designing policies and institutions to overcome perceived problems in the marketing systems of Ethiopia. Moreover, Gede *et al.* (2005), from Indonesia reported that farmers possess minimal marketing information and usually complain about the prices they receive for their merchandise. Small ruminants represent an important component of the Ethiopian livestock production system, providing 12% of the value of livestock products consumed at the farm level and 48% of the cash income generated (Demelash *et al.* 2006). Moreover, Ayele *et al.* (2003) reported that livelihood of smallholders in Ethiopia is highly dependent on the cash income from livestock and livestock products. However, Nwafor (2004) reported, from Gambia that the prices of sheep and goat are not determined by weight, rather by the general appearance of the animal, market site and season of the year. Moreover the same author reported also that there is no grading done and sale is by head count. Moreover, Gede *et al.* (2005), from Indonesia reported that sheep fattening on the basis of rice bran supplementation is explored as a feasible innovation for the lowlands. The trend of annual growth rate as well as the per capita consumption of sheep and goat meat production was 0.5 as compared to the total 1.3 in Ethiopia (FAO, 2009). However, Berhe (2010) presented that mutton per capita consumption is estimated to be 2.8 in the country. The Institute of Biodiversity and Conservation IBC (2004) of Ethiopia stated that sheep are playing an important role in the livelihood of resource-poor farmers, providing a vast range of products and services such as meat, milk, skin, hair, horns, bones, manure and urine for cash, security, gifts, religious rituals, medicine, etc. In the subsistence sector, farmers and pastoralists depend on small ruminants for much of their livelihood, often to a greater extent than on cattle, because sheep and goats are generally owned by the poorer sectors.

Sheep and goats are relatively cheap and are often the first asset acquired by the community.Sheep and goats contribute a quarter of the domestic meat consumption, half of the domestic wool requirements, and around 92% of the value of semi-processed skin and hide export trades (Zelalem and Fletcher, 1991). The increased domestic and international demand for Ethiopian sheep and goats has established them as important sources of Inland Revenue as well as foreign currency. This increased demand also creates an opportunity to substantially improve food security of the population and to alleviate poverty. Farmers prefer sheep that have brown coat colors and are valued as good or excellent breeds.

Sheep can naturally adapt wider agro ecologies and are hardy enough to resist harsh environment. Moreover, establishing sources of sheep is simple, compared to large animals, and needs low capital; thus, improving this huge resource will enable improvements to be made to the livelihoods of the poor farmers in Ethiopia.

A marketing channel refers to the sequence of enterprises and markets by which produce is moved from producer to consumer. Sheep and goat marketing agents, in Ethiopia include: producers, country buyers (farmers, cooperatives, small traders, butchers, etc.), big traders (wholesalers), and export abattoirs, live animal exporters, brokers/agents and consumers (ESGPIP, 2011).

Constraints and opportunities

Sheep production and productivity in Ethiopia is constrained by many factors such as scarcity of feed, lack of infrastructure, high mortality rates, inadequate veterinary coverage, poor quality products and low average reproductive rates (Ehui, 1999; Tsedeke, 2010). However, high reproductive wastage is the major constraint of sheep productivity, which also greatly reduces selection possibilities; thus, improving the frequency of lambing and reducing mortality should be the emphasized schemes of sheep production. Sheep have higher survival rates under unfavoured conditions and are widely adapted to different agro-climates. They can found in all ethnic groups and production systems.

Importantly, because of their small body sizes, small ruminants have lower feed requirements that allow integration of them into different enterprises. Moreover, in addition to requiring a small initial investment, flock numbers can be restored more rapidly because of their fast reproductive rates, and they are also suitable for meeting subsistence needs (meat and milk) of the smallholders. Furthermore, a pressure of exotic breeds on indigenous types is much less for sheep, than other species including goat, where the contribution of crossbreeding and breed substitution has been considerable (FAO, 1991).

CONCLUSION

Population growth and performances of indigenous / native sheep in Ethiopia is poor. On the other hand, small ruminants, particularly sheep are one of the expected livestock species that serve as income sources of smallholder farmers.

Therefore, emphasis should be given by researchers and development bodies to balance the indigenous sheep population dynamism and improve productivity. Ethiopia has diversified agro-ecologies and ethnic groups that may attributed for the presences of diversified phenotypes and genetic of local sheep.

Some communities from different parts of the country have been attaching their social beliefs and life-safeness with the morphological characteristics of indigenous sheep that are used at home. Such beliefs of the society on the morphological appearances of birds are creating influences on the market values of matured sheep. Thus, any breeding and improved production programs of local sheep should therefore incorporate the production objectives and trait preferences of the society. Moreover, different scholars indicated that the presence of diversified phenotypic appearances of local sheep showed the genetic potential for improvement. Hence, this huge gene pool should be used for improvement through traditional selection together with genomics technology.

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