IJAS Iranian Journal of Applied Animal Science

Breeding Objectives, Selection Criteria and Breeding Practices of Indigenous Goat Population in Ethiopia: A Review

Review Article

K. Tilahun[1,2*], S. Betsha[2] and A. Melesse[2]

[1] Department of Animal Science, College of Dry and Agriculture, Kebri Dehar University, Kebri Dehar, Ethiopia
[2] School of Animal and Range Science, Hawassa University, Hawassa, Ethiopia

Received on: 14 Sep 2022
Revised on: 11 Nov 2022
Accepted on: 8 Dec 2022
Online Published on: Sep 2023

*Correspondence E-mail: info@kdu.edu.et

Online version is available on: www.ijas.ir

ABSTRACT

Breeding objectives and selection criteria are the main component in small ruminant production and these parameters should be identified to formulate sustainable breeding programs. Farmers select breeding stock to be parents of the next generation by using various criteria in different agro ecologies and production systems. However, selection is practiced by livestock keepers without having knowledge of heritability of traits, repeatability and genetic and phenotypic correlation among traits. Selection is practiced by giving more emphasis for qualitative traits such as color and appearance, which are less relevant to production characters. Under smallholder subsistence production system, goats are mainly kept for multipurpose roles and there is no definite breeding goal. The objectives of keeping goats varied based on production system, socio economic factors, and cultural role. The breeding system that is dominantly practiced by farmers is uncontrolled mating which leads to mating of related animals that in turn may cause loss of fitness and reproductive traits due to the occurrence of inbreeding. The main factors that attributed to uncontrolled mating are the presence of communal grazing land, lack of awareness on the consequence of inbreeding, and lack of sufficient breeding bucks in the flocks. To improve the productivity of the indigenous goat population, farmers should identify the breeding objectives and breeding goal traits and selection should be practiced towards those identified traits based on the recorded performances. The objective of this review is thus to highlight the breeding objectives, selection criteria and breeding practices of indigenous goat types in a wide range production systems of Ethiopia by carefully reviewing recently available literature sources.

KEY WORDS breeding objective, breeding practice, constraints, Ethiopia, goat, selection criteria.

INTRODUCTION

Small ruminant production is an important farming activity (Kosgey *et al*. 2006),which contribute as source of wide range of products and services for rural farming communities by providing food and income (Kurnianto *et al.* 2013). Small ruminant provides both tangible (income, meat, milk, skin) and intangible (social, tradition, insurance) benefits for both pastoral and agro-pastoral communities (Kosgey, 2004; Gebreyesus *et al*. 2012). They are suitable for smallholder agriculture due to their ability in adapting unfavorable tropical climate and their short generation interval (Nigussie *et al.* 2013; Melesse *et al*. 2022), their different nutritional regimes, their productivity, small size, and non-competitiveness for food with human (Aziz, 2010). They are also considered as the poor man's cow because maintaining dairy cow is not affordable by many rural poor farmers (Aziz, 2010).Goat farming is practiced worldwide, with goat products having a favorable image (Gooki *et al.* 2019; Mohammadabadi, 2019a). The number of goats has increased globally, even in countries with high and intermediate incomes, despite major changes in agriculture due

to industrial mergers, globalization, and technological advances in developed countries (Gholamhoseini *et al*. 2018; Mohammadabadi, 2019b). Goat production is one of the key elements contributing to the economy of farmers living in the arid and semi-arid regions (Barazandeh *et al*. 2012). The most important goat breeding continents are Asia and Africa (Mohammadabadi and Tohidinejad, 2017). In developing countries, about 96% of the milk and meat producing goat populations are found while 4% are found in developed countries (Mohammadabadi *et al*. 2021). Increasing meat production using scientific, accurate, and precise selective programs are one of the most important goals for genetic improvement of goats (Moghbeli *et al*. 2013; Mohammadabadi and Asadollahpour, 2021). This could be achieved by identifying the genotype of reproductive and productive traits of animals and their relationships, through determining the polymorphism and finding the phylogenetic relationships of domestic animals (Nassiry *et al*. 2005; Norouzy *et al*. 2005; Mohammadabadi, 2021).

Ethiopian goat population is estimated to be 50 million heads (CSA, 2020). Despite, the large population and diversity, their productivity and contribution to the national economy of the country is by far below their potential (Legese and Fadiga, 2014; Solomon *et al*. 2014; Melesse *et al*. 2022). In other hand, the human population is continually increasing which in turn increases the demand for animal products (meat, milk and eggs). To meet the growing demand for animal products, improving the productivity per individual animal is essential rather than increasing the number of animal, which would lead to shortage of grazing areas and increases the environmental degradation by over grazing. However, the productivity of indigenous goat populations were limited by many factors, such as lack of feasible and sustainable breeding program

(Abraham *et al*. 2018; Melesse *et al*. 2022) and uncontrolled mating and negative selection by selling of good performing young animals (Gizaw *et al*. 2013). Absence of clear strategies to improve productivity (Molla, 2020), poor genetic performance and low input traditional production system (Gizaw *et al*. 2008) are also additional limiting factors. Thus, to overcome, these challenges cross breeding to combine the adaptive traits of indigenous breed with the productive potentials of exotic breeds (Alemu, 2004) and selective breeding were recommended as suitable options to improve the poor genetic potentials of the local goat population. Moreover, designing and establishment of any genetic improvement programs needs clear understanding of the farming system and evaluation of the existing constraints in that particular areas (Sani *et al*. 2003). In addition, evaluation and assessing of the farmers selection criteria is a tool to design sustainable genetic improvement program that enables to develop suitable genotype that match with the existing environmental conditions (Bett *et al*. 2011). Moreover, designing and implementation of genetic improvement scheme needs considering the difference in production systems, farmers priority in utilizing tangible and intangible benefits as well as the breeding objectives of the communities (Dea *et al*. 2019). The knowledge of breeding objectives and selection criteria are important to the success and sustainability of breeding programs. Therefore, evaluation and understanding of these parameters are essential to create a common understanding and facilitate the formulation of sustainable breeding programs (Haile *et al*. 2018). Thus, the objective of the present review is to highlight the overall characteristics of the breeding objectives, breeding practices and selection criteria of the indigenous goat population by providing a comprehensive information from the available literature.

Goat production systems in Ethiopia

Mixed crop livestock production system

Mixed production system is practiced in the highland and mid altitude areas of the country which ranges between 1500 and 3000 m a.s.l (IBC, 2004). In these areas, the importance of crop is comparable with that of livestock, which is integrated with crop production (Mekuriaw *et al*. 2016). The area receives abundant rainfall and is suitable for crop production and livestock production where the latter is considered as secondary farming activity. High importance of livestock is observed in areas where crop production is not good (Gizaw *et al*. 2010). There is free grazing system without any supplementation (Workneh, 2000). This system is mainly characterized by small flock size (Alemu, 2004) and shrinkage of grazing land (Tsegaye *et al*. 2013; Yemane *et al*. 2020). These factors lead the communities to shift from large ruminant to small ruminants, as small ruminant can thrive and reproduce on limited grazing area and crop residues (Slozhenkina *et al*. 2020). Water shortage is not a production constraint in most areas of this system (Mekuriaw *et al*. 2016). In this system, integration of livestock with crop production is highly important as the livestock manure is used as source of fertilizers for crop production (Yemane *et al*. 2020). Livestock production in this system further provides oxen as draft animal power for ploughing purposes.

Smallholders produce various crop species along with their livestock and mostly wheat, barely, faba bean, field pea, and linseed are produced (Mekuriaw *et al*. 2016). This production system is practiced in different parts of the country. Ambo, Gondar and Arsi Bale goats are produced under this system (Farm-Africa, 1996). Moreover, in mixed production system there was high soil erosion and nutrient depletion due to the expansion of cropping and shrinkage of grazing land. Milk is a subsidiary product in this areas and

skin hair (Gishe) in highland area is locally attractive for making saddle (Abegaz *et al*. 2008).

Pastoral production system

Pastoral production system is practiced in dry parts of Ethiopia at an altitude below 1500 m. This system is mainly characterized by low rainfall/precipitation, unsuitability for crop production, large land size per households, large flock size and dependency of the communities on livestock production (Abegaz *et al*. 2008). In some parts of the country, there is slightly cropping practice that helps the pastoralism to evolve to agro-pastoralism (Gizaw *et al*. 2010).

Milk production is the main purpose of goat keeping in this system (Mekuriaw *et al*. 2016). The main feeding system is browsing on natural pastor and shortage of water is the critical constraint (Gebreyesus *et al*. 2012). During drought period, pastoralists usually migrate with their livestock to search feeds. This production system is mainly practiced in north-west and eastern parts of Ethiopia (Farm Africa, 1996; Fikru and Gebeyehu, 2015).

Agro pastoral system

This system is dominantly practiced in semi-arid parts of Ethiopia. The amount of rainfall is higher than pastoralist and cropping is practiced to some extent (Abegaz *et al*. 2008). It is the mode of production in the moist low land areas where crop and livestock production is practiced. The system is characterized by transhumant (movement to search feed in dry season) or sedentary (with no movement/stable) production system (Gizaw *et al*. 2010).

Urban and peri-urban production system

Though different livestock species is observed in different towns of the country, this system is less developed. The system includes dairy production and small ruminant fattening (Gizaw *et al*. 2010). There is no reliable and satisfactory information available for this system. This system calls for action and needs investigation to clearly evaluate the value chain, contribution and their impacts on environment (Solomon *et al*. 2014). Expansion of urbanization, human population growth and shrinkage of grazing area and the presence of concentrate feed are the cause of this system. The main feed sources are household wastes, wastes around market area, mill leftovers, by products and road side grazing fallow land (Abegaz *et al*. 2008).

Goat breeding objectives

Before developing selection criteria for genetic improvement, the basis of selection needs to be identified. This facilitates the genetic improvement and help to maximize profit and return from the sector. To develop breeding objective, firstly the traits that influences the profitability of the activity needs to be considered and prioritized (Abraham *et al*. 2018). Under smallholder subsistence farming system of Ethiopia, farmers have multiple breeding objectives and there is no definite breeding goal to be achieved (Yemane *et al*. 2020). In different parts of the country, goats were kept for milk production, meat production, and reproduction. Farmer's intention was to maintain breeding goat that are adaptive to the available environmental conditions with higher milk productivity, good appearance and large body frame, fast growing and better reproducing ability (Kebede *et al*. 2012). During defining and setting breeding objectives particularly in areas where the participatory analysis of the priority problems and the role of goats to overcome these problems need to be evaluated. Moreover, farmers breeding goal is to ensure milk production through increasing daily yield per individual animals and increased fertility per flock through increasing marketable (Gebreyesus *et al*. 2013). In different areas where goat milk used for human consumption, the farmers' breeding objectives is mainly to increase milk production. However, in different areas consumption of goat milk is not common due to different cultural taboo and religious issue. In these areas, the objectives of goat breeding should be to attain animals with high growth rate.

The breeding objective that is prioritized by the communities and the market demand for that products need to be match for the sustainability of the current objective and to achieve long term economic benefits (Haile *et al*. 2018). However, identifying breeding objectives is more difficult since it is influenced by social and cultural factors (Gebreyesus *et al*. 2013). However, setting breeding objective traits is important to increase the profitability of the sector (Abraham *et al*. 2018). Goat is a multipurpose livestock, which is kept and bred for different purposes; and the breeding objectives varied with production environment and cultural settings. For instance, farmers in Erob district of Tigray region, goats are kept for meat production, income generation, milk production, and breeding purpose as main objectives. The breeding objectives of Abergelle goat breeders were body size, milk yield and mothering ability (kids survival rate) whereas while the breeding objectives of western lowland goat keepers were promoting twining rate, mothering ability, body conformation, and kid growth (Abegaz, 2014). In different parts of Ethiopia, the breeding objectives of farmers and pastoralists are cash income, saving, and meat production for household consumption (Gizaw *et al*. 2010; Fantahun *et al*. 2016).

Purpose of keeping goats

Farmers and pastoralists keep goat for various purposes in different production system. Milk production for household consumption, as source of cash income and meat produc-

tion are the primary reasons in which goats are kept in pastoral and agro pastoral production system (Gebeyehu *et al*. 2013; Abraham *et al*. 2017; Gebre *et al*. 2020; Yemane *et al*. 2022). In pastoralist area, the lives of the communities is culturally attached with livestock production and they used them for different social purposes including different religious and cultural ceremonies (Fantahun *et al*. 2016; Tesfahun *et al*. 2017). Goat is also an option to generate income through the sale of live and slaughter animals and there is also high contribution for household consumption through milk and meat (Abegaz, 2014; Takele, 2016). Goat has many roles in the communities and they serve as a means of regular cash income, source of manure for crop production, insurance against crop failure, skin, as a form of gift for different cultural and ceremonial benefits in different parts of Ethiopia (Kebede *et al*. 2012; Zergaw *et al*. 2016).

The purpose of goat production in Ethiopia considerably varies from one location to the other as well as based on the production system. Farmers in the Bale zone, for example, rear goat for generating income, meat production, and cultural importance, manure (Asefa *et al*. 2015; Diriba and Kebede, 2020) and income, meat and cultural role in Bench Maji (Fantahun *et al*. 2016). Maefur goats in Erob district of Tigray region are kept for income generation, skin production, breeding and manure (Weldeyesus and Rohotash, 2018). Cash income, milk production and meat were the main purpose of goat keeping in Kafta and Setit Humera districts (Abraham *et al*. 2017). In south Omo zone, Benatsemay and Hamer districts the main purpose of goat production by farmers were to promote social status (Tesfahun *et al*. 2017). In pastoral and agro pastoral areas, goats are primarily kept for income, milk and meat production whereas goats reared in mixed farming system of Arsi Negelle and Adami Tulu area are mainly kept for income, meat, festival, and ceremonies (Gebeyehu *et al*. 2013). Income, meat for home consumption, saving asset (live animal bank) are the main purposes goat raising in Homosha and Bambis districts of Benishangul Gumuz. However, goat production for milk is not reported in these districts (Sherif *et al*. 2020). Income generation and milk production were the main purpose of goat production in Borena and Bati areas. In Siti/Shinile areas of Somali region, milk production is the primary reason for keeping goats followed by income generation, cultural value, and as identity of wealth status (Gatew *et al*. 2017). Milk production, income and meat are priority purpose in Aba'ala district of Afar region (Gebre *et al*. 2020). In Dawro zone, goats reared in Esera district are kept for the purpose of meat, income generation, insurance in case of crop failure, expression of wealth status and manure (Figure 1; Beyene *et al*. 2018).

Goats were reared for the purpose of income, meat and saving in east Gojam (Chanie *et al*. 2014) income and milk production in Asossa zone (Wendimu *et al*. 2018).

Figure 1 Use of goat skin as water container (Gatew *et al*. 2017)

Selection criteria of goat

Selective breeding is a long-standing and sustainable genetic improvement methods for various communities involved in livestock production. Identifying the indigenous selective breeding practices of farmers and pastoralists facilitate and help to transform to modern breeding methods. Improving the traditional selection practices is more imperative and feasible than introducing a completely new approach for genetic improvement of indigenous breeds (Gizaw *et al*. 2013). Selection of breeding stock for future generation has been practiced by farmers by giving more attention for appearance and color traits. However, these traits are less relevant to productivity of the animals. Selection for parent of the next generation is based on the recorded performance and visual appraisal (Gatew *et al*. 2017).

Body size and performance of goat were the main criteria in which farmers in Abergelle and western lowland were used to select replacement animals (Abegaz, 2014). In south Omo zone however, body size and reproductive performance traits have been prioritized by farmers to select breeding animals among their flocks (Berhanu *et al*. 2012). Goat genetic improvement endeavors needs selection within breeds/types. To understand the genetic potential of animals, selection should be undertaken within breed. However, to undertake such selection practices, the knowledge of heritability, repeatability, genetic and phenotypic correlation among traits is essential to be able to identify which traits need to be included in selection criteria (Melesse *et al*. 2022).

Selection criteria of breeding bucks

Farmers select best performing animals from their flock, which become parents of the next generation by using their own criteria. The criteria may vary with the knowledge of livestock owners and production system. In Aba'ala district of Afar region, the most preferred trait to select breeding bucks were coat color, appearance (conformation and body size) and pedigree (dam history for milk). The most preferred color is light brown while the most desired color is black and black-gray (Gebre *et al*. 2020). In Konso and Borena pastoralist areas, traits like body size, long body frame and white and brown colors were considered as selection criteria of their buck. White, red and brown colors were mainly preferred while black was reported the least preferred color (Abegaz, 2014). The reason why goats with black color discouraged is that consumers usually hesitate to pay better prices due to cultural related beliefs and taboos (Getachew *et al*. 2018; Melesse *et al*. 2022). Among the breeding flock, breeding male is important and contributes 50% of the genetic makeup of the next generation and it determine the overall pregnancy rate in the flock. Since one buck can mate to a large number of females at the same time, his genetic makeup is widely transferred to the flocks. Due to this fact, the choice of good buck is a critical issue in goat breeding practices. Farmers in Bati, Borena and Siti areas consider traits like conformation, growth rate, cot color, libido and maternal history (Gatew *et al*. 2017). Goat owners in Ziquala, Tanqua Abergelle and Lay Armachiho have been practicing selection of breeding bucks by giving high emphasis for coat color, body conformation and growth rate (Alemu, 2015). Similarly, growth rate, conformation and color type are considered in order of importance in Wollega zone (Seid *et al*. 2015). In Dire Dawa, pedigree and appraisal were important criteria for selecting of bucks for breeding purposes (Gebreyesus *et al*. 2012). The most important criteria for the selection of breeding male in Bale zone were appearance and coat color (Asefa *et al*. 2015) while libido, growth rate and prolificacy are criteria used to select breeding bucks in central rift valley of Ethiopia (Kebede *et al*. 2012). Body size and growth rate were the most prioritized selection criteria in Kafta and Setit Humera districts (Abraham *et al*. 2017) while body size and conformation were important criteria to select breeding bucks in Loma district of south Ethiopia (Yaekob *et al*. 2017).

Selection criteria of breeding does

Farmers select breeding does to be parents of the next generation by applying different criteria. The emphasis given to each criteria varied based on the importance of traits in farming communities. In agro pastoral and pastoral system, milk yield was the most preferred trait while coat color and appearances were considered as second criteria (Gebre *et al*. 2020). In Konso and Borena pastoralists, breeding does were selected based on body size, milk yield, frequency of kidding, prolificacy and coat color (Getachew *et al*. 2018). In Erob district of Tigray region, milk yield, performance, size, conformation, temperament and color were considered as the main selection criteria (Weldeyesus and Rohotash, 2018). Litter size, growth rate and age at first kidding were mostly considered in Wollega zone of western Ethiopia (Seid *et al*. 2015).

In pastoral area, milk yield is mainly considered as a selection criterion while in agro pastoral area, body conformation is emphasized to select breeding does (Alemu, 2015). In pastoralist area, goat milk was used as a source of food thus farmers mainly emphasize milk production as the main criteria to select breeding does as reported in Asayita district of Afar region (Feki *et al*. 2015). Breeding females were selected by the criteria of milk, body size and litter size in Siti Pastoralist area. However, goats reared in Borena area, body size and milk yield are mainly considered (Gatew *et al*. 2017). Physical appearance, coat color and milk yield are the criteria considered by farmers in Bale zone to select their breeding does. However, in this area, twin birth is less preferred due to the reason that twins will compute with amount of milk required for human consumption. Adaptation, mothering ability and short kidding intervals are important characters to select breeding does in Loma district of south Ethiopia (Yaekob *et al*. 2017).

Goat breeding practices

Mating system practiced by farmers in different parts of Ethiopia is dominantly uncontrolled. In Meanit district of Bench Maji zone goat owners practiced uncontrolled mating. Some controlled breeding practices was observed in Sheko and Shey Bench districts (Fantahun *et al*. 2016). In Konso and Meta Robi districts, uncontrolled mating was practiced because of different flocks are mixed at grazing areas and lack of awareness on the consequence of inbreeding (Zergaw *et al*. 2016). Similarly, uncontrolled mating was practiced by farmers in Bale zone (Asefa *et al*. 2015) and in Horro, Amuru and Guduru districts of Wollega zone (Seid *et al*. 2015). Farmers in Bati, Borena and Siti areas, those who had not breeding buck were using neighbor bucks or mating at random with available bucks at communal grazing area and watering point.

In Oromia region, farmers practice uncontrolled mating by allowing their breeding male to mate to its close relatives including daughters, dam and sibs. These practices are not be deliberately performed by goat owner rather there were different factors beyond the control of farmers for example flock graze together in communal grazing areas and lack of awareness to the consequences of inbreeding (Workneh and Rowland, 2004; Asefa *et al*. 2015; Abraham

et al. 2017). Housing the flock together at night, lack of sufficient bucks and shortage of grazing land also reported as contributing factors to uncontrolled mating (Kebede *et al*. 2012; Seid *et al*. 2015).

Goat castration practices

Farmers and pastoralists practice male goat castration for multiple objectives. Castration is one of the methods of restricting male animals with undesired trait from mating females. It is also used as a means of fattening practice to enhance the body weight for increased market value (Getachew *et al*. 2018). For example, farmers in various parts of the country castrate their bucks to improve fattening. Different research works conducted in Bench Maji zone (Fantaun *et al*. 2016), in Aba'ala district of Afar region (Gebre *et al*. 2020) in Gojam Enebse Sar Midir district (Chanie *et al*. 2014), in Jimma zone (Gebrechristos and Dugma, 2013), in Konso zone (Getachew *et al*. 2018), and in Erob district of Tigray region (Gebre *et al*. 2020) reported the practice of buck castration for improved body weight as a means of income generation. Many households also practice castration in order to control undesired breeding of bucks with does (Seid *et al*. 2015; Beyene *et al*. 2018).

The methods of castration and the age at which castration is applied varied from place to place with respect to knowledge of the farmers. Farmers and pastoralist for instance in Siti and Borena area castrate bucks by traditional methods using bend wooden material locally known as "Wormatume" by Somali people and "Tuma" by Borena people (Gatew *et al*. 2017). In Ziquala, and Abergelle districts, traditional castration is practiced by all goat keepers (Alemu, 2015).

Age at which castration practiced also varied with production system. In Erob district of Tigray region, castration is practiced at the age about two and half years old in both pastoral and agro-pastoral production system (Gebre *et al*. 2020). In another parts of the country, castration is undertaken at earlier age (12-18 months) (Fikru and Gebeyew, 2015; Yemane *et al*. 2020).

However, castration is not a common practice in Kafta and Setit Humera and bucks are allowed to run with does until they become five years old (Abraham *et al*. 2017). Other scholars in Dire Dawa areas reported that bucks could run with females until they become five and a half years old (Gebreyesus *et al*. 2013). In most of the areas, traditional castration is dominantly practiced by farmers. However, about 55% of farmers in Jomma zone apply modern castration at the veterinary clinic by using Burdizo castrator (Figure 2; Yemane *et al*. 2020).

Figure 2 Traditional castration methods (Alemu, 2015)

Constraints of goat production

There is a need to identify the existing constraints that hamper goat production and productivity to design appropriate intervention strategies (Alemu, 2015; Seid *et al*. 2015). Many factors and challenges hamper the goat production and productivity in Ethiopia. Climate change is one of the severe challenges that affect the productivity of pasture and animals (Gizaw *et al*. 2010). Livestock production in the country is climate sensitive, which is affected by recurrent drought. Goat production was further affected by the prevalence of diseases, feed shortage, predatory, lack of appropriate market, labor and water shortage (Gebreyesus *et al*. 2012; Gebeyehu *et al*. 2013; Gebreyesus *et al*. 2013; Abraham *et al*. 2017). Moreover, cost and quality of feed, lack of sufficient extension service, lack of concentrate feed and its high price were the constraint that hinder back goat production (Diriba and Kebede, 2020). Under traditional free range production system, different diseases and parasites, and predators were reported as critical constraints of goat production (Weldeyesus and Rohotash, 2018). In Madda Walabu and Sawena districts of Bale zone, abortion, kid mortality, poor growth and repeated services to conceive are the limiting factors in goat production (Asefa *et al*. 2015). In addition, lack of appropriate breeding program in the country is one of the limiting factor, which affect long term and sustainable genetic/breed improvement (Solomon *et al*. 2014).

In pastoralist areas, mobility, recurrent drought, erratic rainfall and lack of supportive infrastructure are the challenges that attribute to poor goat production (Getachew *et al*. 2018). Besides, the occurrence of diseases (liver fluke, and contagious caprine pleuropneumonia and skin diseases), feed shortage both in quantity and quality and lack of appropriate market also observed to affect the productiv-

eity of goat in the country (Fikru and Gebeyehu, 2015; Beyene *et al*. 2018; Getachew *et al*. 2018; Ambel *et al*. 2021). Furthermore, poisoning (Tsegaye *et al*. 2013), lack of improved genotype, shortage of labor, working capital and absence of extension as well as veterinary services services were limiting factors in goat production (Abegaz, 2014; Abraham *et al*. 2017; Yemane *et al*. 2020). The presence of different forms of theft and the incidence of predators are also reported as prominent constraints in goat production (Tsegaye *et al*. 2009; Chanie *et al*. 2014; Wendimu *et al*. 2018).

Goat production and improvement opportunities

Despite several constraints and challenges, there are different opportunities that enable farmers and goat owners to expand and even to improve their flocks. To establish breeding program for genetic improvement, identifying the available opportunities is essential element. The involvement of different institutions, population growth, urbanization and raising income and the presence of abattoirs in indifferent locations are few of the opportunities to expand goat production in the country (Fikru and Gebeyew, 2015; Mekuriaw *et al*. 2016). Moreover, establishment of goat production requires small space, low initial capital and low labor. Goat production is also attractive due their short generation interval, high prolificacy and their nature of adaptability in harsh environments which enabled them to thrive and reproduce efficiently as compared to other farm animals (Beyene *et al*. 2018). The presences of different NGOs that support improvement of the livestock sector are further some of the opportunities in the enhancement of goat production at a larger scale (Gebeyehu *et al*. 2013).

The country's wide agro ecological environments and research work conducted by different universities, research institutes and non-governmental organizations that provide insight for the improvement could further contribute to the expansion goat production in Ethiopia (Diriba and Kebede, 2020). Moreover, the availability of large land that is not utilized for crop production, the growing demand for meat, presence of abattoirs and establishment of slaughtering and meat processing facilities are the promising opportunities for the growth of goat production in different parts of Ethiopia (Chanie *et al*. 2014).

CONCLUSION

Goat is preferred animal and kept by different communities in wide agro climatic conditions due to its unique specialization for smallholder poor farmers. They mainly serve as a source of milk for home consumption, meat for sell and home consumption, cash income and manure production. Selection is practiced by farmers by using many criteria among which coat color, appearance, body conformation and reproductive traits are considered as the main preferred ones for both male and female goats. Uncontrolled mating is the dominant breeding strategy the most of the households. Castration of buck is performed mainly by traditional methods using locally available materials. It is mainly practiced to promote fattening and to control undesired breeding. Prevalence of diseases, parasites, feed shortage, lack of extension services, occurrence of recurrent drought, lack of appropriate market outlet, absence of feasible breeding program and uncontrolled mating are the most inherent constraints of goat production in Ethiopia. On the other hand, there are noticeable opportunities that could be the basis of goat expansion and improvement in Ethiopia of which the existence of increasing demand for goat products, their adaptation potential to wide range of environments coupled with their high prolificacy and their broad feeding habit are the main promising features.

ACKNOWLEDGEMENT

We would like to sincerely acknowledge Kebri Dehar University for sponsoring the first author to be able undertake his Ph D. study at Hawassa University.

REFERENCES

Abegaz S. (2014). Design of Community Based Breeding programs for two indigenous goat breeds of Ethiopia. Ph D. Thesis. Boku Univ., Vienna, Austria.

Abegaz S., Abebe G., and Awgichew K. (2008). Sheep and Goat Production Systems in Ethiopia. Pp. 27-38 in Sheep and Goat Production Handbook for Ethiopia. Ethiopian Sheep and Goat Productivity Improvement Program (ESGPIP), Ethiopia.

Abraham H., Gizaw S. and Urge M. (2017). Begait goat production systems and breeding practices in Western Tigray, North Ethiopia. *J. Anim Sci*. **7,** 198-212.

Abraham H., Gizaw S. and Urge M. (2018). Identification of breeding objectives for Begait goat in western Tigray, North Ethiopia. *Trop. Anim. Health Prod*. **50,** 1887-1892.

Alemu A. (2015). On farm phenotypic characterizations and performance evaluation of Abergelle and Central highland goat breeds as an input for designing community-based breeding program. MS Thesis. Haramaya Univ., Haramaya, Ethiopia.

Alemu T. (2004). Genetic characterization of indigenous goat populations of Ethiopia using microsatellite DNA markers. A Ph D. Thesis. Deemed Univ., Karnal-Haryana, India.

Ambel S., Bayou E. and Genzebu D. (2021). Indigenous goat husbandry practices and its production environment in case of South Western Ethiopia. *American J. Zool.* **4(1),** 1-8.

Asefa B., Kebede K. and Effa K. (2015). Breeding objectives, selection criteria and breeding system of indigenous goat types in bale zone, Oromia, Ethiopia. *Int. J. Agric. Res.* **25,** 7-15.

Aziz A.M. (2010). Present status of the world goat populations and their productivity. *Lohmann Inf*. **45(2),** 42-52.

Sani R.A., Gray G.D. and Baker R.L. (2003). Appropriate breeds and breeding schemes for sheep and goats in the tropics: The importance of characterization and utilizing disease resistance adaptation to tropical stress. Pp. 789-800 in Better Worm Control for Small Ruminant in Tropical Asia. Australian Center for International Agricultural Research, Canberra, Austria.

Barazandeh A., Moghbeli S.M., Vatankhah M. and Mohammadabadi M.R. (2012). Estimating non-genetic and genetic parameters of pre-weaning growth traits in Raini Cashmere goat. *Trop. Anim. Health Prod.* **44,** 811-817.

Berhanu T., Thiengtham J., Tudsri S., Abebe G., Tera A. and Prasanpanich S. (2012). Purposes of keeping goats, breed preferences and selection criteria in pastoral and agro-pastoral districts of South Omo Zone. *Livest. Res. Rural Dev*. Available at: https://www.lrrd.cipav.org.co/lrrd24/12/berh24213.htm.

Bett R.C., Kosgey I.S., Kahi A.K. and Peters K.J. (2011). Definition of breeding objectives and optimum crossbreeding levels for goats in the smallholder production systems. *Small Rumin. Res*. **96,** 16-24.

Beyene A., Alilo A.A. and Mola M. (2018). Assessment of sheep and goat (small ruminants) production system in Esera District, of Dawro Zone, Southern Ethiopia. *J. Adv. Dairy Res*. **6,** 4-12.

Chanie D., Mekuriaw Z. and Taye M. (2014). Husbandry Practices of Western Highland Goats in Enebse Sar Midir District, East Gojjam Zone, Ethiopia.

CSA. (2020). Federal democratic republic of Ethiopia, Central Statistical Agency, Agricultural Sample Survey. Volume II. Report on Livestock and Livestock Characteristics. Available at: https://www.statsethiopia.gov.et/our-survey-reports.

Diriba L. and Kebede T. (2020). Assessments of breeding practices, major constraints and opportunities of sheep and goat production in Sinana district, Bale zone, Ethiopia. *J. Dairy Vet. Anim. Res*. **9,** 78-83.

Dea D., Melesse A. and Mekasha Y. (2019). Application of morphometric traits and body indices in assessing the type and function of local goats reared in two districts of Gamo-Gofa Zone, South Ethiopia. *Ethiopian J. Anim. Prod*. **19,** 73-90.

Fantahun T., Alemayehu K. and Abegaz S. (2016). Characterization of goat production systems and trait preferences of goat keepers in Bench Maji zone, south western Ethiopia. *African J. Agric. Res.* **11(30),** 2768-2774.

Farm-Africa. (1996). Goat Types o f Ethiopia and Eritrea. Physical Description and Management Systems. Farm-Africa. London, United Kingdom, and International Livestock Research Institute (ILRI), Nairobi, Kenya, Africa.

Feki M., Berhanu B. and Aynalem H. (2015). Participatory definition of trait preference and pastorals' indigenous knowledge on goat breeding strategy around Aysaita district, Ethiopia. *Livest. Res. Rural Dev.* Available at: http://www.lrrd.org/lrrd27/8/misb27158.html.

Fikru S. and Gebeyew K. (2015). Sheep and goat production systems in Degehabur Zone, Eastern Ethiopia: Challenge and opportunities. *J. Adv. Dairy Res*. **3,** 134-155.

Gatew H., Hassen H., Kebede K., Haile A., Lobo R.N.B., Yetayew A. and Rischkowsky B. (2017). Husbandry practices and phenotypic characteristics of indigenous goat populations in Ethiopia. *African J. Agric. Res*. **12(36),** 2729-2741.

Gebeyehu A., Hundessa F., Umeta G., Muleta M. and Debele G. (2013). Assessment on challenges and opportunities of goat farming system in Adami Tulu, Arsi Negelle and Fantale districts of Oromia Regional State, Ethiopia. *African J. Agric. Res*. **8,** 26-31.

Gebre K.T., Yfter K.A., Teweldemedhn T.G. and Gebremariam T. (2020). Participatory definition of trait preferences and breeding practices of goats in Aba'ala, Afar region: As input for designing genetic improvement program. *Trop. Anim. Health Prod*. ***52,*** 41-52.

Gebrechristos S. and Dugma B. (2013). Assessment on goat production systems with special focus on constraints and opportunities around Jimma. American-Eurasian. *J. Agric. Environ. Sci.* **13,** 1304-1308.

Gebreyesus G., Haile A. and Dessie T. (2013). Breeding scheme based on community-based participatory analysis of local breeding practices, objectives and constraints for goats around Dire Dawa, Ethiopia. *Livest. Res. Rural Dev.* Available at: http://www.lrrd.org/lrrd25/3/grum25048.htm.

Gebreyesus G., Haile A. and Dessie T. (2012). Participatory characterization of the short-eared Somali goat and its production environment around Dire Dawa, Ethiopia. *Livest. Res. Rural Dev.* Available at: http://www.lrrd.org/lrrd24/10/gebr24184.htm.

Getachew T., Haile A. and Rischkowsky B. (2018). How to tailor community based breeding programs for small ruminants to pastoral production systems. Pp. 858-871 in Proc. Genet. Appl. Livest. Prod. Conf., Auckland, New Zealand.

Gholamhoseini F.G., Mohammadabadi M.R. and Asadi Fozi M. (2018). Polymorphism of the growth hormone gene and its effect on production and reproduction traits in goat. *Iranian J. Appl. Anim. Sci*. **8,** 653-659.

Gizaw S., Getachew T., Edea Z., Mirkena T., Duguma G., Tibbo M., Rischkowsky B., Mwai O., Dessie T., Wurzinger M., Solkner J. and Haile A. (2013). Characterization of Indigenous Breeding Strategies of the Sheep Farming Communities of Ethiopia: A Basis for Designing Community-Based Breeding Programs. International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria.

Gizaw S., Komen H., Hanotte O. and van Arendonk J.A.M. (2008). Indigenous sheep resources of Ethiopia: Types, production systems and farmers preferences. *Anim. Gent. Res. Inf.* **43,** 25-40.

Gizaw S., Tegegne A., Gebremedhin B. and Hoekstra D. (2010). Sheep and Goat Production and Marketing Systems in Ethiopia: Characteristics and Strategies for Improvement. Working Paper, Nairobi, Kenya.

Gooki F.G., Mohammadabadi M., Fozi M.A. and Soflaei M. (2019). Association of biometric traits with growth hormone

gene diversity in Raini Cashmere Goats. *Walailak J. Sci. Technol.* **16(7),** 499-508.

Haile A., Wurzinger M., Mueller J., Mirkena T., Duguma G., Rekik M., Mwacharo J., Mwai O., Sölkner J. and Rischkowsky B. (2018). Guidelines for setting up community-based small ruminants breeding programs in Ethiopia. International Center for Agricultural Research in the Dry Areas (ICARDA), Beirut, Lebanon.

IBC. (2004). Institute of Biodiversity Conservation. The State of Ethiopia's Farm Animal Genetic Resources: Country Report. A Contribution to the First Report on the State of the World's Animal Genetic Resources, Addis Ababa, Ethiopia.

Kebede T., Haile A. and Dadi H. (2012). Smallholder goat breeding and flock management practices in the central rift valley of Ethiopia. *Trop. Anim. Health Prod.* **44(5),** 999-1006.

Kosgey I.S. (2004). Breeding objectives and breeding strategies for small ruminant in the tropics. Ph D. Thesis. Wageningen Univ., Netherlands.

Kosgey I.S., Baker R.L., Udo H.M.J. and Van Arendonk J.A.M. (2006). Successes and failures of small ruminant breeding programmes in the tropics: A review. *Small Rumin. Res.* **61,** 13-28.

Kurnianto E., Sutopo S., Purbowati E., Setiatin E.T., Samsudewa D. and Permatasari T. (2013). Multivariate analysis of morphological traits of local goats in Central Java, Indonesia. *Iranian J. Appl. Anim. Sci.* **3(2),** 361-367.

Legese G. and Fadiga M. (2014). Small Ruminant Value Chain development in Ethiopia: Situation Analysis and Trends. International Center for Agricultural Research in the Dry Areas (ICARDA), Nairobi, Kenya.

Mekuriaw G., Gizaw S. and Tegegne A. (2016). Genetic-phenotypic and Production-System Diversity in Goat Populations in Ethiopia: Options for Sustainable Production. LIVES Working Paper. Nairobi, Kenya.

Melesse A., Tade B., Dea D., Yemane G., Aberra G., Keyamo K., Mekasha Y., Bitseha S. and Taye M. (2022). Multivariate characterization of morphometrical traits in indigenous goat populations reared in various agro-climatic zones of Ethiopia. *Small Rumin. Res*. **206,** 11-19.

Moghbeli S.M., Barazandeh A., Vatankhah M. and Mohammadabadi M.R. (2013). Genetics and non-genetics parameters of body weight for post-weaning traits in Raini Cashmere goats . *Trop. Anim. Health Prod.* **41,** 1519-1524.

Mohammadabadi M., Bordbar F., Jensen J., Du M. and Guo W. (2021). Key genes regulating skeletal muscle development and growth in farm animals. *Animals.* **11(3),** 835-842.

Mohammadabadi M.R. and Asadollahpour H. (2021). Leptin gene expression in Raini Cashmere goat using Real Time PCR. *Agric. Biol. J*. **13,** 197-214.

Mohammadabadi M.R. and Tohidinejad F. (2017). Charachteristics determination of Rheb gene and protein in Raini Cashmere goat. *Iranian J. Appl. Anim. Sci.* **7,** 289-295.

Mohammadabadi M.R. (2019a). *Dlk1* gene expression in Raini Cashmere goat using Real-Time PCR. *Agric. Biotechnol. J.* **11** ,191-205.

Mohammadabadi M.R. (2019b). Expression of calpastatin gene in Raini Cashmere goat using Real-Time PCR. *Agric. Biotechnol. J.* **11,** 219-235.

Mohammadabadi M.R. (2021). Tissue-specific mRNA expression profile of ESR2 gene in goat. *Agric. Biotechnol. J.* **12,** 169-184.

Molla M. (2020). Conservation-based breeding program for indigenous sheep breeds in Ethiopia: The way forward. *Online J. Anim. Feed Res.* **10,** 17-24.

Nassiry M.R., Shahroodi F.E., Mosafer J., Mohammadi A., Manshad E., Ghazanfari S., Mohammad Abadi M.R. and Sulimova G.E. (2005). Analysis and frequency of bovine lymphocyte antigen (BoLA-DRB3) alleles in Iranian Holstein cattle. *Russian J. Genet.* **41,** 664-668.

Nigussie H., Mekasha Y., Kebede K., Abegaz S. and Kumar Pal S. (2013). Production objectives, breeding practices and selection criteria of indigenous sheep in eastern Ethiopia. *Middle East J. Sci. Res*. **21(9),** 1570-1578.

Norouzy A., Nassiry M.R., Shahrody F.E., Javadmanesh A., Abadi M.R.M. and Sulimova G.E. (2005). Identification of bovine leucocyte adhesion deficiency (BLAD) carriers in Holstein and Brown Swiss AI bulls in Iran. *Russian J. Genet*. **41(12),** 1409-1413.

Seid A., Kebede K. and Effa K. (2015). Breeding objective, selection criteria and breeding practice of indigenous goats in western Ethiopia: Implications for Sustainable Genetic Improvement. *Greener J. Agric. Sci*. **5(5),** 167-176.

Sherif O., Alemayehu K. and Haile A. (2020). Production systems and breeding practices of Arab and Oromo goat keepers in northwestern Ethiopia: implications for community-based breeding programs. *Trop. Anim Health Prod.* **52(3),** 1467-1478.

Slozhenkina M.I., Gorlov I.F., Shakhbazova O.P., Radjabov R.G., Ivanova N.V., Mosolova D.A., Knyazhechenko O.A., Poorghasemi M. and Seidavi A. (2020). Productivity of steers of different genotypes: Forecast based on interior indicators. *Arq. Bras. Med. Vet. Zootec*. **72(6),** 2279-2287.

Solomon A.K., Mwai O., Grum G., Haile A., Rischkowsky B.A., Solomon G. and Dessie, T. (2014). Review of Goat Research and Development Projects in Ethiopia. ILRI Project Report. Nairobi, Kenya.

Takele A. (2016). Phenotypic characterization of indigenous goat types and their production system in Shebelle zone, south eastern Ethiopia. *Int. J. Innov. Res. Dev*. **5(14),** 234-252.

Tesfahun B., Kebede K. and Effa K. (2017). Traditional goat husbandry practice under pastoral systems in South Omo zone, southern Ethiopia. *Trop. Anim. Health Prod.* **49,** 625-632.

Tsegaye D., Belay B. and Haile A. (2013). Prevalence of major goat diseases and mortality of goat in Daro-Labu District of west Hararghe, eastern Ethiopia. *J. Sci. Innov. Res.* **2(3),** 665-672.

Weldeyesus G. and Rohotash K. (2018). Management and breeding objectives of Maefur goat breed type in Erob district eastern zone of Tigray, northern Ethiopia. *Int. J. Livest. Prod.* **9(3),** 50-66.

Wendimu B., Oumer S. and Habtamu A. (2018). Characterization of the indigenous goat production system in Asossa zone, Benishangul Gumuz region, Ethiopia. *African J. Food. Agric. Nutr. Dev*. **18(3),** 13558-13558.

Workneh A. (2000). Do smallholder farmers benefit more from crossbred (Somali×Anglo-Nubian) than from indigenous

goats. Ph D. Thesis. Georg August Univ., Goettingen, Germany.

Workneh A. and Rowlands J. (2004). Design, execution and analysis of the livestock breed survey in Oromiya Regional State, Ethiopia. Nairobi, Kenya.

Yaekob L., Kirman M.A. and Birhanu B. (2017). Participatory identification of breeding objective traits of Woyto-Guji goat in Loma district, southern Ethiopia. *Int. J. Livest. Prod*. **8(8),** 131-135.

Yemane G., Melesse A. and Taye M. (2020). Evaluation of production systems and husbandry practices of Ethiopian indigenous goats. *Online J. Anim. Feed Res*. **10(6),** 268-277.

Yemane G., Melesse A. and Taye M. (2022). Breeding practices and reproductive performances of indigenous goat population in Southwestern Ethiopia. *Int. J. Livest. Res.* **12(3),** 25-35.

Zergaw N., Dessie T. and Kebede K. (2016). Indigenous breeding practices and selection criteria of goat owners in Konso and Meta-Robi districts, Ethiopia: Implications for designing community based breeding strategy. *Livest. Res. Rural Dev.* Available at: http://www.lrrd.org/lrrd28/7/zerg28133.html.