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Reproductive Performance and Breeding Strategies for Genetic Improvement of Goat in Ethiopia: A Review

***[1]Zewdie B. and [2]Welday K.**

[1]Department of Animal Sciences, Assosa University, Ethiopia.
[2]Department of Animal and Range Sciences, Jijiga University, Ethiopia,
Email: kflom807@gmail.com Mob. No. +251-913-502-839

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Corresponding Author
Zewdie B.
E-mail: *zewdiebefikadu @yahoo.com*
Phone: *+251938647534/912127099*

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ABSTRACT

Economic opportunities exist for small ruminant producers to supply animals to both the export and domestic markets. The growing demands of meat products at the domestic as well as international markets also increase the importance of goat in the national economy of the country. Despite the large size of the country's goat population, the productivity per unit of animal and the contribution of this sector to the national economy is relatively low. The phenotypes of the goats have important influence socio-cultural and economic values to the Ethiopian communities; as a result, most farmers have specific consideration and choices for goat coat colors followed by body sizes. Nowadays, there is a great interest worldwide in conservation and utilization of genetic resources aiming for a more efficient use of present genetic resources of the goat species. In Ethiopia, a number of organizations attempted to evaluate performances of farm animal genetic resources at different times predominantly under on-station management in ranches and research farms. Although, performance levels, genetic parameter estimates and breeding program practices are available for limited number of breeds, indigenous goat populations have developed certain valuable genetic traits such as ability to improve the performance under low input condition and climatic stress, tolerance to infectious diseases and parasites. These genotypes can help in meeting future challenges resulting from possible changes in production systems and consumer requirements. Hence, to efficiently utilize these special features of indigenous breeds, there is a need of planning and implementing viable breeding programs that fit to the existing low input production systems.

INTRODUCTION

Livestock production is the most important agricultural activity in the majority of the Africa countries. Ethiopia harbors a huge and diverse goat population in the country, playing an important role in the livelihood of resource-poor farmers. Sale of goats and goat products (meat, skin and milk) by farming communities is the major economic source for their subsistence. In addition, goats are raised mostly to safeguard against crop failure and unfavorable crop prices in intensive cropping areas (Tesfay, 2004). Traditionally, goats have served as a means of ready cash and a reserve against economic and agricultural production hardship. However, the proximity of Ethiopia to large Middle Eastern markets demanding export quality goat carcasses with better quality and an increase in the domestic demand for small ruminant meat is leading to a change in the importance and scale of goat production. Economic opportunities exist for small ruminant producers to supply animals to both the export and domestic markets.

Small ruminants' improvement programmes in Ethiopia, however, have several constraints. The major constraints on the traditional sheep and goat production were:- feed shortage particularly in the dry and wet seasons, insufficient veterinary services, lack of improved genotypes which can thrive well in the environment and bring desirable characteristics such as good growth performance and desirable phenotypes , low price of products, weak planning, in the design and implementation of improving programmes.

The majority (95%) of the world's goat population is found in developing countries of the tropics (FAO, 1997). Of the total world population of 674.1 million goats, approximately 26.2% are found in Africa. East Africa contains 38.9 and 10.2% of the African and world goat population, respectively. According to FAO (1997), there are approximately 16.7 million goats. Goats are primarily owned by smallholder farmers and pastoralists and contribute significantly to the economy and food supply of the poorest sectors of the society. Besides of their significant contributions to the economy and food supply of resource poor farmers, their specific biological features such as feeding behavior, reproductive efficiency and small body size are important characteristics for integrating goats into pastoral and sedentary smallholder production systems.

Despite the huge number of goat population in the country, characterization of Animal Genetic Resource (AnGR) in Ethiopia has largely been limited to description of production systems and phenotypes classification of traditional breeds using multivariate morphological and recently including molecular criteria for analysis. Performance levels and genetic parameter estimates are available for limited number of breeds (Tesfay, 2004). Further detailed and specific studies are required to sufficiently explore the genetic diversity between- and within-populations, to identify strains/breeds with unique attributes and estimate genetic parameters for economically important and adaptive traits. Information obtained from past characterization studies can assist in designing and developing genetic improvement programs for sustainable utilization of the most promising and widely used breeds in the country.

Knowledge of the adapted goat genetic resources is a pre-requisite for designing appropriate breeding and utilization programs. Characterization of livestock breeds based on their morphological traits variations (Delgado *et al*., 2001) are the first step towards the use of the available Animal Genetic Resources (AnGR) (Lanari *et al*., 2003). Morphometric measurements have been used to evaluate the characteristics of various breeds of animals, and could provide information on the suitability of animals for selection (Nesamvuni *et al*., 2000; Mwacharo *et al*., 2006; Martins et al., 2009; Yakubu, 2010a) and for further characterization studies using modern molecular methods. Therefore, there is a need to design and implement the appropriate breeding strategies to improve the livelihoods of the small holder farmers and to satisfy the growing demand of meat for domestic consumption and international market. Efficiently utilize these special features of indigenous breeds, there is a need of planning and implementing viable breeding programs that fit to the existing low input production systems. Therefore, related research results and facts of indigenous goat reproductive performance and breeding strategies for genetic improvement of goat were reviewed with the aim of delivering relevant information for the breeding improvement and conservation strategy of a country.

Goat Genetic Resource in Ethiopia

The goat population of Ethiopia is estimated at 29.9 million (CSA, 2010a). It is believed that these goats have evolved through a process of natural selection that resulted in goats selected for adaptation and survival rather than production per se. (Peacock, 1996; Abegaz *et al*., 2008). Thus, most tropical goats are mainly nondescript. Domestic goats have been classified by varying criteria but four commonly used classification methods are: classification based on origin, utility, body size and shape and length of ears. Indigenous African goats are mainly categorized in two groups that are long-eared and short-eared. Based on their size, they are also classified in three types; large goat types in Sahara and South Africa, intermediate type of East and North-central Africa and the dwarf goat type of humid West Africa (Devendra, 1978).

FARM-Africa (1996), phenotypically classified indigenous Ethiopian goats into 11 types, while a genetic characterization showed only eight distinctively different types. These are Abergalle, Arsi-Bale, Afar, Central Highland, Gumez, Hararghe Highland, Keffa, Long-eared Somali, North-West Highland, Short-eared Somali, and Woyto-Guji. However, DNA characterization

indicated that all the Ethiopian goat populations are very closely related to each other and the 11 Ethiopian populations have been grouped as 8 distinct genetic entities: Arsi-Bale, Gumez, Keffa, Woyto-Guji, Abergalle, Afar, Highland goats (previously separated as Central and North West Highland) and the goats from the previously known Hararghe, Southeastern Bale and Southern Sidamo provinces (Hararghe Highland, Short-eared Somali and Long-eared Somali goats) (Tesfaye, 2004). Moreover, Begayit, Ille, Felata, Arab, Gumuz, Agew and Oromo sub-types of the western lowlands have been recently reported.

The majority of Ethiopian goat population is found in large flocks in the arid and semi-arid lowlands where pastoralists in the South, East, and West keep them for milk and meat production and for sale. Goats in the highlands are widely distributed in the crop-livestock production systems with very small flock sizes as a means of cash earnings and meat. Despite the huge resource potential, production and export opportunities, goat production in Ethiopia is relatively undeveloped. Although there are severe environmental constraints to increase goat productivity, there is considerable potential for goat production in the country, where goat milk, meat, and skin are valued commodities (ESGPIP, 2008)

Ethiopia Goat Production Systems

There are a number of ways to classify production systems. There are three major and two minor production systems are described. The major production systems are: Highland sheep–barley system, mixed crop–livestock system, pastoral and agro-pastoral production systems. Other production systems are not currently practiced widely but have a future are: Ranching and Urban and peri-urban (landless) sheep and goat production system (ESGIGP, 2008).

Description of Production Systems

i.) Highland sheep–barley system: This system is found in the highlands above 3000 m.a.s.l. where the major crops grown are barley and pulses such as faba beans, lentils, etc. Temperature is the main factor determining productivity in the highland sheep–barley production system. At times, night temperatures fall below 0ºC and frosty nights are common, particularly between October and January. Cropping intensity in these areas is generally low. Sheep are the dominant livestock species. The main feed resource-base includes wasteland grazing, stubble and sometimes straw. Sheep flock sizes range from 30 to several hundred head. Although sheep are reared mainly for meat, skins and coarse wool production for the cottage industry of the central highlands are subsidiary products. There is, therefore, a clear possibility of establishing more formal sheep production enterprises using appropriate technology packages. Large sheep production ranches could be established where mainly meat or dual-purpose breeds could be maintained either by individual farmers or cooperatives. These highland areas are generally unsuitable for sustainable crop production. ii.) Mixed crop–livestock systems: These systems are based on cropping associated with livestock husbandry. This system is generally found in areas where the altitude ranges between 1500 and 3000 m.a.s.l. The area has adequate rainfall and moderate temperature and is thus suitable for grain production. The integration of crops and livestock is high in most areas. The integration is lower in the perennial crop–livestock system (coffee growing areas) in southern Ethiopia where animals are of minor importance. Livestock in general and small ruminants in particular play an important role in food security and food self sufficiency in this production system. In the grain-based mixed production system, livestock are the main cash source for the purchase of agricultural inputs. Livestock are used as a savings and insurance mechanism. Cattle are the dominant livestock species and are kept mainly for draft power. Sheep and goats are kept to meet small and immediate cash needs. Sheep are more dominant than goats in this production system. The major commodity is meat, while milk is a subsidiary product in some areas. Skin of hair ('Gishe') goats in the extreme highland areas has a local niche market for making saddles. The major feed resources are natural pasture and crop residues. In some areas, one-fifth to one-third of the holding is used for grazing. In most of the areas, however, livestock generally depend on grazing communal land that is dwindling in size and productivity. Sheep and goats in this system experience year-round nutritional stress due to increases in cultivated land area. This results in very high grazing pressure and subsequent shortage of feed. The system of sheep and goat production for the most part is a low input / low output system except in some cases of concentrate supplementation and use of anthelmintics for fattening sheep and goats. There is a need to intensify production because of the high population density in these areas. Potential for intensive small ruminant production through finishing activities and stratification of production exists.

ii). Pastoral and agro-pastoral production systems

Pastoral system: In general, pastoral systems are associated with agro-ecological zones (AEZ) that are too dry to sustain crop production. These are characterized by little or no crop agriculture and high mobility in search of grazing and water. Under Ethiopian conditions, pastoral systems of production are found at altitudes below 1500 m.a.s.l. and where the annual precipitation is less than 500 mm. In these systems, livestock are maintained as a principal activity. Fifty percent of household revenue comes from livestock or more than 20% of household food energy is derived directly from livestock or livestock-related activities. Rangeland is the main land resource Livestock species consist of camels, cattle, sheep, goats and donkeys. In recent years,

pastoralists have shown an increasing interest in keeping larger numbers of sheep and goats. There are more goats than sheep in this system. Milk and meat are the two outputs. In drought years, goats gain more importance as suppliers of milk to the household. Goats also help to control bush encroachment. Pastoralists depend on their livestock not only for their income but also for their survival.

Agro-pastoral system: This system is characterized by less integration with crop production as compared to the crop–livestock production systems. Producers under this system have a permanent residence and their movement is limited in terms of both distance and duration. The system is characterized by a high degree of dependence on milk and meat production. Some crop agriculture is practiced around the permanent homestead. This is also a low input / low output system. The system is usually practiced below 1500 m.a.s.l. but with higher rainfall to support short season crops compared to the pastorals

iii.) Ranching:

Ranching is a range-based system of livestock production similar to the pastoral systems but with different production parameters, livestock functions and management. Ranching can be considered as a modern land use system. It is a labor-extensive system focusing on the production of marketable commodities from one or two selected species. This is mainly in the form of producing live slaughter animals for meat. The main function of the system is to generate cash income. Management of livestock is characterized by grazing within defined borders and an individual tenure system with possibilities of intensified feeding and watering of animals. The form of ownership in ranching could be parastatal, cooperative or private (companies or individuals).

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

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

Reproductive Performance

Evaluations of the performance of economically important traits of the livestock are very useful inputs for planning a breeding program. The most important traits of livestock are broadly classified into two categories: production and reproductive traits. Reproductive performance is an important criterion when evaluating the structure of the strength and weakness of the breeds in particular production environments (Browing *et al*., 2006). It has high impact on overall flock productivity. Mukasa Mugerwa *et al*. (2002) stated that reproduction failure is the first indicator of decreased flock productivity. Litter size (number of kids born per does), age at first kidding and kidding interval are economically important reproductive traits. A range of 1 to 1.7 litter size was reported from on station, on farm monitoring and breeds survey studies for different Ethiopian goat breeds coated by (Solomon *et al.,* 2014). The litter size is largely influenced by ovulation rate. The ovulation rate is highly influenced by the breed and improvement could be achieved by selection (Ibrahim, 1998). Age at fist kidding is an indication of the overall flock productivity. The lifetime production can be increased by decreasing first kidding age. A wide range of 375 to 854 day of age at first kidding were reported in different management and breeds of Ethiopian goats which is influenced by genotype, management, season and type of birth (Derbie, 2008; Kebede *et al*., 2012a). Kidding interval is the interval between two kidding. Individuals with long kidding interval has lower overall production index (Ibrahim, 1998).

Indigenous goats are invaluable reservoirs of genes for adaptive and economic traits (National Agricultural Marketing Council_NAMC, 2005; Ben Salem and Smith, 2008) that provide diversified genetic pool. These genotypes can help in meeting future challenges resulting from possible changes in production systems and consumer requirements (Kosgey and Okeyo, 2007). Indigenous goat breeds can tolerate local diseases such as pulpy kidney, tick-borne diseases (Webb and Mamabolo, 2004) and gastrointestinal parasite infestation. It is ideal that such breeds be utilized in the communal setting (Kosgey *et al*., 2006). Genetic potential for indigenous goats is, at times, confounded by the low standard of management under which indigenous livestock are usually kept. Nonetheless, when a productivity index, which combines fertility, survival and yield traits, is used to compare breeds, indigenous breeds raised under range conditions outperform imported breeds (Mpofu, 2002).

Major constraints of Ethiopia goat production

Despite of the large population of goats and the roles of goats at household and national level, the productivity and the contribution of goat to the country economy is far below the potential. Goat production in Ethiopia is constrained by many biological, environmental and

socio-economical factors. Important constraint are, scarcity of feed, lack of infrastructure, high prevalence of diseases and parasites, lack of record, poor market management and inappropriate breeds and high levels of inbreeding.

***i.) Scarcity of feed*:**

The feed resource base for goat production in Ethiopia is natural grazing and crop residues. The quality and supply of these resources is seasonally variable. Grazing resources in the highlands are diminishing due to increases in cropping land. Bush encroachment and overgrazing have reduced grazing resources in the pastoral areas. Poor management of rangelands, inappropriate grazing management (Quinn *et al*., 2007), rangeland fires and seasonal droughts limit the availability of fodder (Ben Salem and Smith, 2008) in the communal areas. The quality and availability of natural pastures is highly variable in the tropics with crude protein dropping below 8% in dry mature tropical grasses, especially during the dry season (Bakshi and Wadhwa, 2007; Raghuvansi *et al.,* 2007; Ben Salem and Smith, 2008). In the wet season, forage is of high quality but because of the high temperatures, rapid physiological maturation decrease, leading to early lignifications and reduced digestibility of the grasses. In the sour rangeland, which is mainly a grassveld, grass is of good quality in the hot-wet season and becomes unpalatable in the cold-dry season (Botsime, 2006).

***ii.) Lack of infrastructure*:**

The lack of infrastructure leads to the need for transport livestock or livestock products from remote rural communities, where production is concentrated, to urban markets is lacking. Sheep and goats are generally trekked long distances for marketing, often without adequate water and feed. They are also trekked similarly long distances in search of feed and water. There are very limited market centers and stock routes with the necessary facilities such as feeding and watering points (ESGPIP, 2008).

iii.) High prevalence of diseases and parasites:

Diseases and parasites are major constraints to communal goat production and safe utilization of goat products. These diseases and parasites are endemic in many regions of Africa (Githiori *et al*., 2006). The impact of diseases and parasites may be through high morbidity, mortalities, abortions and stillbirths or subclinical effects manifested as weight loser reduced gains. The negative impact of diseases and parasites may also be through the financial implications involved in controlling or overcoming the effects of disease and mortality (Mahusoon *et al.,* 2004; Sissay *et al*., 2006). Diseases and parasites have a heavy impact on kids because of their poor immunity status (Sebei *et al*., 2004). High kid mortality diminishes the benefits of the high reproductive performance of does. Lack of hygiene which allows the build-up of infective agents and use of contaminated water are major contributory factors to high kid mortality (Peacock, 2005). Poor housing negatively impacts on goat productivity as goats are exposed to extreme weather conditions (van Niekerk et al., 2006) attributed the incidence of diseases and high mortality to poor hygiene and precarious housing conditions. Incidences of diarrhea are high at the beginning of the rainy season, especially in kids. The problem of parasitism is compounded by the fact that, under the communal system, livestock are usually reared extensively (Bayer *et al*., 2001). This increases infestation and makes control measures difficult to implement. Helminths are associated with sub-clinical production losses and have profound depressive impacts upon long-term animal productivity. Helminth infestations contribute immensely to anaemia (van Wyk *et al.,* 2006).

Parasites also reduce voluntary feed intake, efficiency of feed utilization and increase the endogenous loss of protein in the gastrointestinal tract (Alexandre and Mandonnet, 2005). Prevalence of goat diseases and parasites in communal areas is largely unknown. It is crucial to investigate the prevalence and type of different helminths affecting goats prior to devising control strategies against gastrointestinal parasites in the communal areas. There is little government support for control programmes and research on diseases and parasites in goats in many African countries. Veterinary and goat improvement programmes are minimal (Alexandre and Mandonnet, 2005). About one-half of all lambs/kids born die due to various causes. This is a very important constraint limiting productivity. Annual mortality in all classes of stock averages 23% for sheep and 25% for goats in the central highlands (Adane and Girma, 2008).

iv.) Poor marketing management:

There are insufficient national investments on marketing inputs and services, research and support on marketing of goats and their products, in most developing countries. Formal goat marketing, in most communal areas, is characterized by absent or ill-functioning markets (Kusina and Kusina, 1999; Moll *et al.,* 2007). Smallholder households are often located in marginal areas with poor infrastructure and poor access to the market; thereby limiting goat farmers' capacity to transport goats to the few available slaughter facilities (Bayer *et al*., 2001). Communal farmers, therefore, resort to the informal way of marketing their goats where pricing is based on an arbitrary scale, with reference to visual assessment of the animal. Intermediaries in most countries (Kusina and Kusina, 1999; Simela and Merkel, 2008), purchase live animals from farmers for resale in other areas, such as towns and schools. All these transactions are not captured in official statistics leading

to underestimation of production and consumption of chevon in Sub- Saharan Africa (Sebei *et al.,* 2004; Simela and Merkel, 2008). Wealth for goat-keepers can be boosted significantly by adding value to goat products, identification of niche markets and by alerting the population about the health benefits associated with consumption of goat meat (Peacock *et al*., 2005) through promotion and advertisement. Because of the small flock sizes of most communal farmers, hiring vehicles for transporting their goats to the auction floors is not economically viable. Producers do not have access to market information. The system lacks market orientation, which would have been an important driving force for increased production**.** Certain disease conditions are also causing Ethiopian animals and products to be banned from export markets.

v.) Lack of records:

Farmers rarely keep records on goat production. The maintenance of records is indispensable for improving goat production. Such records should capture information such as age of the goat, animal weights and diseases that each goat might have suffered from. In addition, female goats should also have records that indicate age at first kidding, kidding interval(s) and whether it produces twins, triplets or singles. By using records, farmers can also rank goats in each class, a useful tool in culling. Records should also capture goat numbers and breed(s). Other important records that can be kept by farmers include costs incurred, for instance in buying drugs and vaccines and cash obtained from sale of goats and/or their products. In addition to lack of records, there is poor management of goats and/or their products.

***vi.) Inappropriate breeds and high levels of inbreeding*:**

A crucial component of any production system is the utilization of appropriate and adapted goat breeds. Exploitation of suitable, well adapted breeds is important, if feed resources are to be optimally utilized. To fulfill the function of savings, for example, it is important that the type of goats being kept does not require much management input and veterinary care and can be kept at a low cost (Bayer *et al*., 2001). This invites communal goat farmers to consider traits other than fast growth but hardiness. In addition, goats of a particular color may be preferred for cultural or ceremonial purposes. These are rational, non-commercial objectives that are of great importance to the resource-poor farmers where breeds are chosen to suit production objectives. Regardless of the different objectives farmers might rear goats for, in communities of most countries in Southern Africa, there are no structured breeding seasons and, therefore, does and bucks run together all year round (Tefera *et al.,* 2004). Inbreeding is a challenge for many communal goat flocks. It results in poor growth rates (Saico and Abul, 2007) and abortions among other negative effects. Inbreeding, a manifestation of mating closely related individuals, is exacerbated by the small flock sizes, confinement of goats during the cropping season and the long periods that bucks stay in the flocks before they are culled (Masika and Mafu, 2004). Exchange of bucks between farmers from different villages can reduce inbreeding. It, however, is imperative to investigate the inbreeding levels in communal goats. Apart from inbreeding, limited availability of feed has a negative impact on the productivity of goats.

Vii.) Change in natural Environment:

The Millennium Ecosystem Assessment concludes that, the degradation of ecosystems could become significantly worse during the first half of this century, and be a barrier to achieving the Millennium Development Goals. Recent changes in climate, especially warmer regional temperatures, have already affected biodiversity and ecosystems, particularly in dry land environments such as the African Sahel. Global climate change is likely to have significant impact on the world's environment. In general, the faster the changes, the greater will be the risk of adverse effects. A study is made in the effect of climate change on animal genetic diversity, Ethiopia has limited capacity and resources for designing and implementing conservation programs to its domestic animal genetic resources at risk. On the other hand, changes in climate, particularly increase in temperature affects a diverse set of physical and biological systems in many parts of the world in turn breeds often possess unique genetic traits that enable their survival in a diverse range of production environments with intense stresses, such as severe feed and water shortages, and diseases and drought. Indigenous goat populations generally dominate the goat flocks in Ethiopia and have developed certain valuable genetic traits such as ability to perform better under low input condition and climatic stress, tolerance to infectious diseases and parasites (Philipsson *et al*., 2006; Kosgey and Okeyo, 2007).

Possible Breeding Improvement Strategy

Goat production in Ethiopia is constrained by many biological, environmental and socio-economical factors. Among them, lack of systematic breeding programs is an important constraint. Therefore, there is a need to design and implement the appropriate breeding strategies to improve the livelihoods of the small holder farmers and to satisfy the growing demand of meat for domestic consumption and international market. However, there is no systematic goat breeding program is in place and goat is the most neglect livestock species in research and development endeavors (Tsegahun, *et al*., 2000). There have been a few attempts of genetic improvement program of goats through upgrading the exotic genetic blood levels. The noticeable example is the FARM-Africa dairy goat development project in south and eastern part

of the country. The aim of the project is to improve the milk yield of the local breeds through crossing with exotic Anglo-Nubian goats (Gebremeskel, 2000). However it was reported that crossbred goats did not perform better than indigenous goats if both groups were kept in similar management levels (Ayalew *et al*., 2003). In general, many small ruminants cross breeding programs in tropical country were not successful because of the incompatibility of the genotype with the farmers breeding objectives, management methods and the prevailing environment of the tropical low input production systems (Ayalew *et al*., 2003; Wollny, 2003; Kosgey *et al*., 2006). Thus, selective pure breeding of the adapted indigenous breeds is the best possible option of genetic improvement in the tropical countries.

In Ethiopia, a number of organizations attempted to evaluate performances of some farm animal genetic resources at different times predominantly under on-station management in ranches and research farms. In Ethiopia, only limited activities on genetic characterization have been conducted on some breeds of cattle, goats and chicken. Reproductive and productive performances and limited genetic parameter estimates have been documented for some indigenous breeds of livestock. In the case of goats, breed evaluation studies have only been attempted for Afar, Arsi-Bale and Somali goat breeds (ESGPIP, 2008). Besides, a major problem with agricultural programs in Ethiopia is maintaining the strength of activities after implementation periods. Unfortunately, often programs terminate before full potential is realized (Gebremeskel, 2000).

Indigenous breeds in harsh tropical environmental conditions have special adaptive features such as tolerance of a wide range of disease, water scarcity tolerance and ability to better utilize the limited and poor quality feed. This makes them survive and be productive in the prevailing environment (Baker and Gray, 2004; Kosgey and Okeyo, 2007). To efficiently utilize these special features of indigenous breeds, there is a need of planning and implementing viable breeding programs that fit to the existing low input production systems. In developing countries where livestock production is still mostly subsistence-oriented and livestock fulfill manifold functions (Wurzinger *et al*., 2011; Roessler *et al*., 2007), a considerable number of livestock breeding programs have failed (Roessler, *et al*., 2007). Sustainable breeding programs for developing country can only succeed if breeding objectives incorporate preferences of the livestock producers (Amer *et al*., 1998; Kosgey *et al*., 2006) efforts to develop local breeds should always take into consideration the multiple breeding goals of the communities and should fully respect cultural preferences of the people.

In the past, most breeding programmes were designed by scientists and implemented by development agents without taking into consideration all the needs of the farmers and the long-term impact of their actions (Kosgey *et al*., 2006), as a result, a number of programmes in developing countries have failed. Climatic zone is also a determinant factor as there are distinct breeds and breed groups suitable for diverse purposes in the different ecological zones. Farmers in different production systems may have different trait preferences (Roessler *et al*., 2007). The strategies followed by resource-poor farmers are as diverse as the highly variable agro-environments within which they practice. Thus, no matter how much effort is put into financial and technological support, the eventual survival of improvement programmes depends on whether the farmers understood and agreed with the objectives of the projects (Donkin, 2005; Kahi *et al*., 2005). Trait preferences of pastoralists and farmers were studied using different approaches: production system studies (Edea, 2008), hypothetical choice experiments (Duguma *et al.,* 2010), own-flock and group-animal ranking experiments (Mirkena *et al.,* 2012).

The recent approach of establishing community based breeding programs is advocated for low input traditional smallholder farming systems (Sölkner *et al*., 1998; Kahi *et al*., 2005; Haile *et al*., 2009, Wurzinger *et al*., 2011). This is because community based breeding programs take into account the indigenous knowledge of the communities on breeding practices and breeding objectives (Gizaw *et al*., 2013).The community-based breeding strategies also consider the production system holistically and involve the local community at every stage, from planning to operation of the breeding program (Baker and Gray, 2004). Breeding programs involve the description and decisions about a series of interacting components. Among them the most important components to be considered in breeding program design are: description of production environment and production system, characterization of the available local genotype, definition of breeding objectives, identification of traits to be selected, decision about breeding methods and breeding population and understanding of structure and organization of people involved (Iñiguez, 1998; Sölkner *et al.,* 2010; FAO, 2010).

Design of sustainable genetic improvement schemes under smallholder situations requires indigenous knowledge on traditional breeding practices which is structured differently from scientific knowledge (Mbuku *et al*., 2006; Duguma 2010). Lack of such knowledge leads to the setting up of unrealistic breeding goals and the consequence of which can put in danger the conservation of indigenous animal genetic resources (Zewdu *et al.,* 2006). Pastoralists or smallholder farmers have very valuable knowledge about animal management and desirable traits but less knowledge on how genes are transmitted to the next generation and how to use information from relatives (Mbuku *et al*., 2006). Currently, community-based genetic improvement strategies are being advocated for pastoral production (Kahi *et al*., 2005). These strategies would require a good understanding of the community's indigenous knowledge of their animals.

Despite the importance of knowing the communities breeding practices, their trait preference (selection criteria), breeding objectives and herding practices such information is scanty for example for Aris Bale goat (Tesfaye K. *et al*., 2012).Therefore, assessing the production system, indigenous knowledge of managing the breed, understanding current breeding practices, definition of breeding objectives and evaluating performance levels of the breed in their habitat with full participation of the community are prerequisite to set up breeding strategy at small holder level (Kosgey *et al*., 2006).

CONCLUSION

The production of goat and its derivatives has great importance for the population in Ethiopia. Although there are severe environmental constraints to increase goat productivity, there is considerable potential for improved goat production in the country, where goat milk, meat, and skin are valued commodities. Performance levels and genetic parameter estimates are available for limited number of breeds. There is a need to increase research activities related to development of breeding programs suitable to the conditions of smallholder farmers. In Ethiopia, a number of organizations attempted to evaluate performances of some farm animal genetic resources at different times predominantly under on-station management in ranches and research farms and define the development objective of the agricultural production in the country. However, only limited activities on genetic characterization and goat breeding program practices have been conducted on indigenous goat breeds. The indigenous breeds of goat of traits enable them to cope with the stressful nature of the vast marginal lands of the region and also hardy animals and are important reservoirs of useful genes. Hence, this useful adaptive trait should be used for improvement through designing and development conservation programs that suitable to the conditions of smallholder farmers for sustainable utilization of the most promising and widely used breeds in the country.

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REFERENCES

Abegaz, S., Abebe, G. and Awgichew, K., 2008. Sheep and Goat Production Systems in Ethiopia. In: Yami, A., Merkel, R.C. (eds), Sheep and goat production handbook for Ethiopia. Ethiopian Sheep and Goat Productivity Improvement Program (ESGPIP). 27–38 pp.

Adane Hirpa and Girma Abebe, 2008. Economic Significance of Sheep and Goats. Funded by United States.

Aitken D.I (2007). Diseases of sheep. Blackwell Publishing. United Kingdom. 610 pp.

Alexandre G. and Mandonnet N (2005). Goat meat production in harsh environments. *Small Ruminant Research* 60**:** 53-66.

Amer P. R (2005). Report Meat and Wool New Zealand.

Ayalew W., Rischkowsky B., King J.M. and Bruns E (2003). Crossbreds did not create more net benefits than indigenous goats in Ethiopian smallholdings. Agric. Sys 76:1137- 1156.

Baker, R.L. and Gray, G.D (2004). Appropriate breeds and breeding schemes for sheep and goats in the tropics. In: Sani, R.A., Gray, G.D., Baker, R.L. (eds.), Worm Control for Small Ruminants in Tropical Asia, Canberra. ACIAR Monograph 113: 63–96.

Bakshi M.P.S. and Wadhwa M (2007). Tree leaves as complete feed for goat bucks. *Research* 69**:** 1-3.

Bayer W., von Lossau A. and Feldmann A (2001). Smallholders and community-based management of farm animal genetic resources. Proceedings of the workshop held in Mbabane, Swaziland, 7-11 May 2001. Food and Agriculture Organisation of the United Nations Rome, 2003.

Ben Salem H., and Smith T (2008). Feeding strategies to increase small ruminant production in dry environments. *Small Ruminant Research* **77:** 174-194.

Botsime B.D (2006). Influence of agro-ecological region on selected anthropometrical measurements of Nguni cattle in South Africa, MSc Thesis, University of Pretoria, Pretoria, South Africa.

Browning, Jr. R., Payton, T., Donnelly, B., Leite-Browning, M.L., Pandya, P., Hendrixson, W. and Byars, M., 2006. Evaluation of three meat goat breeds for doe fitness and reproductive performance in the southeastern United States. 8th World Congress on Genetics Applied to Livestock Production. Belo Horizonte, MG, Brazil.

CSA. 2010a. Summary and Statistical Report of the 2007 Population and Housing Census Result, Addis Ababa Ethiopia.

Devendra, C., 1978. In: An introduction to animal husbandry in the tropics.3rd edition. Tropical Agriculture series. Longman Publishers. London and New York. 473pp.

Delgado JV, Barba C, Camacho ME, Sereno FTPS, Martinez A, Vega-Pla JL (2001). Livestock characterization in Spain. AGRI 29:7–18.

Deribe B (2008). Growth, Reproductive Performance and Carcass Characteristics of Abergelle and Central Highland Goat types under Traditional and

Slightly Improved Management in Sekota Woreda. MSc, School of Graduate Studies of Haramaya University. 89pp.

Donkin E.F (2005). Sustainable livestock development in Africa: How do we help Africa to feed itself? In: E.F. Donkin (Ed). Proceedings of the Annual Symposium, Developing Animal Agriculture Interest Group, South African Society for Animal Science. South Africa. 27-38 Pp.

Duguma G., Mirkena, T., Haile A., Iñiguez L., Okeyo A.M., Tibbo M., Rischkowsky B., Sölkner J. and Wurzinger M (2010). Participatory approaches to investigate breeding objectives of livestock keepers. Livestock Research for Rural Development Volume 22: Article #64. Available at: http://www.lrrd.org/lrrd22/4/dugu22064.htm.

Edea Z., Dadi H, Kim S-W., Dessie T., Lee T., Kim, H., Kim J.J. and Kim K-S (2013). Genetic diversity, population structure and relationships in indigenous cattle populations of Ethiopia and Korean Hanwoo breeds using SNP markers. Front.Genet. 4:35.

ESGPIP (Ethiopia Sheep and Goat Productivity Improvement Program). 2008. Sheep and goat hand book. Ethiopia.

FARM-Africa. 1996. Goat types of Ethiopia and Eritrea. Physical description and management systems. FARM-Africa, London, UK, and ILRI (International Livestock

FAO. 1997. Production Yearbook. Food and Agriculture Organization. Rome, Italy.

FAO. 2010. Breeding strategies for sustainable management of animal genetic resources. Animal Pr**o**duction and Health Guidelines. Rome, Italy.

http://www.fao.org/docrep/012/i1103e/i1103e.pdf

Gebremeskel T (2000). The experience of Farm-Africa in Goat Development Project in Ethiopia. In: Merkel, R .C., Abebe, G. & Goetsch, A. L. (eds) The Opportunities and Challenges of Enhancing Goat Production in East Africa. Proceedings of a conference held at Debub University, Awassa, Ethiopia, November 10 - 12, 2000. E (Kika) de la Garza Institute for Goat Research, Langston University, Langston..

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. ICARDA working paper, Aleppo, Syria. 47pp.

Githiori J.B.; Athanasiadou S., Thamsborg S.M (2006). Use of plants in novel approaches for control of gastrointestinal helminths in livestock with emphasis on small ruminants *Veterinary Parasitology* 139**:** 308-320.

Haile A., Tibbo M., Duguma G., Mirkena T. Okeyo M., Iniguez L., Wurzinger M. and Sölkner J (2009). *Commercialization of Livestock Agriculture in Ethiopia. In:Tamrat Degefa and Fekede Feyissa (Eds). Proceedings of the 16th Annual conference of the Ethiopian Society of Animal Production (ESAP).* Addis Ababa, Ethiopia. 329 pp.

Ibrahim H (1998). Small Ruminant Productions Techniques. ILRI training manual. ILRI (International Livestock Research Institute), Nairobi, Kenya. 192p.

Iñiguez L (1998). Community breeding programmes for small ruminants in the Andean region. In: Proceedings of sixth world congress on Genetics Applied to Livestock Production, Vol. 25 Armidale, NSW. 249-256 PP.

Kahi A.K., Rewe T.O. and Kosgey I.S (2005). Sustainable community based organizations for the genetic improvement of livestock in developing countries. Outlook on AGRICULTURE 34 (4): 261–270.

Kebede T., Haile A., Dadi H. and Alemu, T (2012a). Genetic and phenotypic parameter estimates for reproduction traits in indigenous Arsi-Bale goats. Trop Anim Health Prod .,44:1007–1015.

Kosgey I.S., Baker R.L., Udo H.M.J., and van Arendok, J.A.M (2006). Successes and failure of small ruminant breeding programmes in the tropics. A review. *Small Ruminant Research* 61: 13-28.

Kosgey I.S and Okeyo AM (2007). Genetic improvement of small ruminants in low-input smallholder production systems: Technical and infrastructural issues. Small Rumin. Res 70(1):76-88.

Kahi A. K., Rewe T. O., Kosgey I. S (2005). Outlook on Agric 34:261-270.

Kusina N.T. and Kusina, J (1999). Goat productivity in Zimbabwe: opportunities and constraints – A review. Proceedings of the Association of Institutions of Tropical Veterinary Medicine (AITVM) in association with Zimbabwe Veterinary Association (ZVA. Harare, Zimbabwe.

Lanari MR, Taddeo H, Domingo E, Centeno MP, Gallo L (2003). Phenotypic differentiation of exterior traits in local Criollo goat population in Patagonia (Argentina). Archiv Tierzucht Dummerstorf. 46:347–356.

Mahusoon M.M., Perera A.N.F., Perera E.R.K. and Perera K.A (2004). Effect of molybdenum supplementation on circulating mineral levels, nematode infection and body weight in goats as related to season. *Tropical Agricultural Research* 16: 128-136.

Masika P.J.and Mafu, J.V (2004). Aspects of goat farming in the communal farming systems of the central Eastern Cape, South Africa. *Small Ruminant Research* 52: 161-164.

Martins CEN, Quadros SAF, Trindade JPP, Quadros FLF, Costa JHC, Raduenz G (2009). Shape and function in Braford cows: The body shape as an indicative of performance and temperament. Archivos de Zootecnia 58:425–433.

Mbuku S.M., Kosgey I.S. Kahi A.K (2006). Indigenous breeding practices of pastoralist goat keepers in

northern Kenya. 8th World Congress on Genetics Applied to Livestock Production. Belo Horizonte, MG, Brazil.

Mekasha Y (2007). Reproductive traits in Ethiopian male goats, with special reference to breed and nutrition. PhD dissertation. Department of Clinical Sciences, Swedish University of Agricultural Science (SLU). Uppsala, Sweden. 56p.

Mirkena T., Duguma G., Willam A., Wurzinger M., Haile A., Rischkowsky B., Okeyo, A.m., Tobbo M. and Sölkner J (2012). Community-based alternative breeding plans for indigenous sheep breeds in four agro-ecological zones of Ethiopia. J. Anim.Breed.Genet.129:244-253.

Mpofu N (2002). Choice of genetic types for specific production environments and production systems. ZaBelo Livestock Consultancy, Zimbabwe. http://agtr.ilri.cgiar.org/Casestudy/case-mpofu-1/casestudy-Mpofu-matchingenv-1.htm.

Mukasa-Mugerwa E., Anindo D., Sovani S., Lahlou-Kassi A., Tebely S., Rege J.E.O. and Baker, R.L (2002). Reproductive performance and productivity of Menz and Horro sheep lambing in the wet and dry seasons in the highlands of Ethiopia. Small Ruminant Research 45: 261-271.

Mwacharo JM, Okeyo AM, Kamande GK, Rege JEO (2006). The small east African shorthorn zebu cows in Kenya:I- Linear body measurements. Trop. Anim. Health Prod. J. 38:65–76.

Moll H.A.J., Staal S.J. and Ibrahim, M.N.M (2007). Smallholder dairy production and markets: a comparison of production systems in Zambia, Kenya and Sri Lanka. *Agricultural Systems* 94: 593 - 603.

National Agricultural Marketing Council (NAMC). (2005). Investigation by the Goat Working Group (a Committee of the NAMC) into the marketing potential for the South African goat industry. Report on the Investigation into the potential for the South African Goat Industry. www.nda.agric.za/docs/AAPS/NAMC1.pdf.

Nesamvuni AE, Mulaudzi J, Ramanyimi ND, Taylor GJ (2000). Estimation of body weight in Nguni-type cattle under communal management conditions. South Afr. Anim. Sci. J. 30(Supplement 1):97–98. Papachristou, T.G., Luthando, E.D., Frederick, D.P. 2005. Review article: Foraging ecology of goats and sheep on wooded rangelands. *Small Ruminant Research* **59:** 141–156.

Philipsson J, Rege JEO and Okeyo A.M (2006). Sustainable breeding programmes for tropical farming systems. In: J. M. Ojango, B. Malmfors and A.M. Okeyo (eds.). AGTR - version 2, International Livestock Research Institute, Nairobi and Swedish University of Agricultural Sciences, Uppsala, Sweden.

Peacock, C., 1996. Improving goat production in the tropics. A Manual for Development workers. Published jointly by FARM-Africa and Oxfam (UK and Ireland), Oxfam, UK. 87pp.

Peacock C (2005). Goats-A pathway out of poverty. *Small Ruminant Research* 60: 179-186.

Quinn C.H., Huby M., Kiwasila H, Lovett J.C (2007). Design principles and common pool resource management: An institutional approach to evaluating community management in semi-arid Tanzania. *Journal of Environmental Management* 84**:** 100–113.

Raghuvansi S.K.S., Tripathi M.K., Mishra A.S., Chaturvedi O.H., Prasad R., Saraswat B.L., Jakhmola R.C (2007). Feed digestion, rumen fermentation and blood biochemical constituents in Malpura rams fed a complete feed-block diet with the inclusion of tree leaves. *Small Ruminant Research* 71: 21-30.

Roessler R. Drucker A.G., Scarpa R., Markemann A., Lemke U., Thuy L.T. and Valle Zárate A (2007). Using choice experiments to assess smallholder farmers' preferences for pig breeding traits in different production systems in North–West Vietnam. Ecological economics, doi:10.

Saico S. and Abul S (2007). Socio-economic constraints on goat farming in the lowveld of Swaziland. *Journal of Sustainable Development in Africa* 9: 37-49.

Sebei P.J., McCrindle C.M.E. and Webb E.C (2004). Factors influencing weaning percentages of indigenous goats on communal grazing. *South African Journal of Animal Science* 34**:** 130-133.

Simela L. and Merkel R (2008). The contribution of chevon from Africa to global meat production. *Meat Science* 80: 101-109.

Sissay M.M., Asefa A., Uggla A. and Waller P.J (2006). Anthelmintic resistance of nematode parasites of small ruminants in eastern Ethiopia: exploitation of refugia to restore anthelmintic efficacy. *Veterinary Parasitology* 135**:** 337–346.

Sölkner J., Nakimbugwe H. and Valle-Zárate A (1998). Analyses of determinants for success and failure of village breeding programmes. In: Proceedings of sixth world congress on Genetics Applied to Livestock Production, Vol. 25 Armidale, NSW. Australia 273-280PP.

Sölkner J., Wurzinger M (2010). Implementation of community-based sheep breeding programs in different production systems in Ethiopia.

Tefera A.N., Mekala D.G., Mnisi P.E., Mukisira M., Clerkson M., Murungweni C. and Sebitloane O (2004). Goat production and livelihood systems in Sekhukhune district of the Limpopo Province, South Africa: Opportunities for commercializing goats and their by-products. Working Document Series 118, South Africa.

Tesfaye Alemu T. (2004). Genetic characterization of indigenous goat populationsof Ethiopia using microsatellite DNA markers. PhD thesis, National Dairy University, India. *Research* 70: 76-88.

Tesfaye K., Aynalem H., and Hailu D (2012).Smallholder goat breeding and flock management practices in the central rift valley of Ethiopia. Trop Anim Health Prod 44:999–1006.

Van Niekerk W.A. and Pimentel P.L (2004). Goat production in the smallholder section in the Boane district in Southern Mozambique. *South African Journal of Animal Science* 34: 123-125.

van Wyk A., Hoste H., Kaplan R.M. and Besier R.B (2006). Targeted selective treatment for worm management—how do we sell rational programs to farmers? *Veterinary Parasitology* 139: 336–346.

Webb E.C. and Mamabolo M.J (2004). Production and reproduction characteristics of South African indigenous goats in communal farming systems. *South African Journal of Animal Science* 34: 236-239.

Wollny C.B.A (2003). The need to conserve farm animal genetic resources in Africa: should policy makers be concerned? Ecol. Econ 45: 341–351.

Wurzinger M., Sölkner J. and Iniguez L (2011). Important aspects and limitations in considering community-based breeding programs for low-input smallholder livestock systems. Small Ruminant Research 98:170–175.

Yakubu A (2010a). Path coefficient and path analysis of body weight and biometric traits in Yankasa lambs. Slovak J. Anim. Sci. 43:17–25.

Zewdu W., Workneh A., Sölkner J (2006). Breeding scheme based on analysis of community breeding objectives for cattle in north-western Ethiopia. Ethiopian Journal of Animal Production 6(2): 53–66.

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