Breeding practice and phenotypic characteristics of indigenous Woyito-Guji goat breeds reared in Nyangatom and Malle pastoral and agro-pastoral districts of SNNPR, Ethiopia

Mekete Girma[1]*, Sandip Banerjee[2], and Tekleyohannes Birhanu[1]

[1]Southern Agricultural Research Institute, Jinka Agricultural Research Center, Ethiopia

[2]School of Animal Range Sciences, Hawassa University, Ethiopia

Abstract

The study was carried to characterize the Woyto-Guji goats reared in two districts (Nyangatom and Malle) of South Omo and also to assess the traits used to select the bucks and does traditionally. The respondents were selected using stepwise purposive followed by random sampling method. The collected data were analyzed using statistical procedures. The qualitative traits were evaluated using non parametric tests. The results indicated that the bucks and does are selected by the community members using traditional descriptors. The traits preferred for selection were those related with adaptation and disease tolerance. The bucks were selected for traits which correlated with their abilities to fend off predators while the does were selected for their mothering and nursing abilities. Coat colors were also considered as important attributes towards selecting the does and bucks, the preferred coat colors were those with white with patchy, red and red with patchy. The selection criteria of breeding doe's were more concerned on their maternal instincts and nursing abilities while body conformation and coat color were the traits preferred for selection of the bucks. Pastoral and agro pastoral preference of coat color patterns were white with patchy, red and red with patchy which were helpful for the goats of the area for the adaptation on the existing hot environment. Therefore, based on their adaptation traits, selection and breed improvement strategies should be developed for the existing environment.

Keywords: Woyito-Guji goats; Adaptation trait; Selection criteria; South Omo; Ethiopia

Introduction

Livestock production is an integral part of Ethiopian agricultural system. Goats along with the sheep are mostly owned by smallholder farmers and are an integral part of the livestock sub-sector [1], and they are reared both for subsistence and income generation [2,3] Southern Nations and Nationalities People Region (SNNPR) of Ethiopia endowed with an approximately 5.26 million heads of goats . The region has a varied agro climate and topography, has and is the home for at least two goat breeds and many ecotypes within the breeds.

According to [4] Woyto-Guji goats are known to be related to the Arsi-Bale type of goat breed. These goats occupy a wide area extending from South Omo to Southern Sidama and Wolayita. As the breeding tract of the goats extends to the tse-tse fly infested areas it is expected that the Woyto-Guji goats are also trypano tolerant. The Woyto-Guji goats are reared for milk, meat, skins and manure production, besides playing an integral part in the socio cultural functions [5]. Due to its varied uses it is perceived that in the future this breed can also be included under the community based breeding program especially in the areas infested with tse tse flies.

However, as the breeding tract of this goat breed extends too many remote areas of the Southern region there have been very few scientific reports pertaining to understand the traits traditionally used for selection of the does and bucks by different communities. It has been observed that very little attention has been paid to study the traits of the Woyito Guji goats and thus planned intervention towards their improvement in the region is by and large lacking [6].

The Objective of the study was

To characterize the phenotypic characteristics and traditional breeding practices of indigenous Woyito-Guji goat breeds.

Materials and Methods

Description of the Study Area

Nyangatom district is located between $4^0 85'$-$5^0 67'$ N latitude and $35^0 75'$-$36^0 23'$E longitude, bordering Dasenech woreda in the south, Bench Maji and Salamago woreda's in the north, Hammer woreda in east and Kenya and South Sudan in West. The Nyangatom district with total land area of 2,652 Km^2 is situated

at about 730 km from the capital city of SNNPR, Hawassa. Similarly Malle woreda is located between $5^0 48'$-$6^0 01'$ N latitude and $36^0 30'$-37^0E longitude, bordering Uba Debretsehay woreda in the north, Kamba woreda in the north east, Derashe woreda in the east, Konso woreda in the south east, Bena-Tsemay woreda in the south west and Debub Ari woreda in the west. The Malle woreda with a total land area of 1,432 km^2 is located about 577 km from the capital city of SNNPR, Hawassa. The agro-ecology and altitudinal range of the Nyangatom and Malle district are kola/arid with of 400-450 asl and semi aride with 600-1500 asl respectively [7]. The mean annual temperature of the Nynagatom ranges between 33 and 42°c and that of Malle 18-35°c. The rainfall of Nyangatom district is erratic in nature. The mean annual rainfall ranges from 350-500 mm and 800-1200 for Nyangatom and Malle respectively [7].

The districts were selected for the study because they are situated in the breeding tract of the Woyto-Guji goats. According to [8]), some households in South Omo zone had reported that the Woyto-Guji goats in the studied districts were brought in from Malle and Gofa. The rearers also were in opinion that the Malle goats are superior to the goats from the lowland pastoral areas in terms of body size, milk production and prolificacy [8].

Human and Livestock Demography

The Malle woreda is inhabited by 97,339 people and has a 67.9 people per sq.km. While the Nyangatom have 7.6 people per sq. km [7] . According to [9], South Omo zone have a population of 1.75 million cattle, 2.89 million goat and 1.56 million sheep. According to the [7] there are three ethnic groups residing in the Nyangatom woreda viz. Nyangatom, Kuwegu and Murule; while in Malle woreda is inhabited mainly by the Malle ethnic group.

Data Collection and sampling techniques procedure

The studied woreda's were selected purposively based on the information provided by the relevant authorities and also from secondary sources. Stepwise purposive sampling was carried to select the kebeles based on the presence and distribution of the Woyto-Guji goats. The people who had a flock of more than ten Woyto-Guji goats and residing on the vicinity of the all-weather roads and who were willing to cooperate with the researcher were identified. Based on these criteria 6 kebeles from Malle woreda and 4 kebeles from Nyangatom woreda were selected. Thereafter, among the identified rearers fifteen potential respondents were selected randomly from each of the identified kebele, i.e. a total of 150 households.

A total of 610 goats were used in the present study for phenotypic character evaluation. Goat management related information was collected using a semi structured questionnaire which was pretested and then translated in to the local language. In addition to the above, secondary data on socio-economic traits, agricultural production, livestock population, farming practices and description of the woreda were collected from published and unpublished sources.

Informal and formal survey tools were employed to obtain information on goat production and husbandry details.

Discussions using checklists were held with zonal and woreda livestock experts, development agents and key informants in all the selected PA's to collect relevant information on almost all aspects of livestock (goat) production in the two woreda's. A structured questionnaire was prepared and pre-tested before administration and some re-arrangement, reframing and correcting in accordance with respondents perception made. The questionnaire was administered to randomly select household heads to collect breeding practices: breed and mating type, goat production objectives, selection criteria, culling and castration practices.

Data Management and Analysis

The data were analyzed using statistical software (SPSS v 19 for Windows). Qualitative data from the questionnaire and physical description of the sample goats was done using non parametric tests, frequency procedure of chi-square test (χ^2) and spearman rank correlation. Means were compared using one way ANOVA.

Indices were calculated for all ranking data according to the formula:

Index = sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason (attribute) divided by the sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reasons.

Results and Discussions

Livestock Holding and Flock Structure

The findings as presented in Table 1 indicate that different species of livestock are reared in both the districts. There was however difference (P<0.05) in livestock holding/density of most of the species was observed between the two districts. The households in Nyangatom district preferred to rear cattle, goats and sheep and less number of poultry when compared to those residing in the Malle district (Table 2).

Flock demography of the goats as presented in Table 3 indicated that irrespective of the two studied locations, the numbers of breeding does accounted for a higher proportion when compared to other classes of goats. However, the proportion of the does varied across the studied locations with

Table 1: Livestock holding per household in the study districts.

Livestock type	Nyangatom	Malle
	Mean± SD	Mean± SD
Cattle	22.7±16.8^a (0-93)	7.6±5.7^b (0-30)
Goats	59.6±32.2^a (16-200)	19.5±9.2^b (7-44)
Sheep	47.1±32.9^a (10-200)	2.5±1.5^b (1-8)
Donkey	1.9±1.0 (0-4)	1.4±0.9 (0-3)
Poultry	7.1±3.7^b (0-15)	10.4±4.3^a (0-20)

^{a,b}(P<0.05); Values across the rows are significantly different ; Values in the parenthesis indicate range

Table 2: Flock demography of goats in the study areas.

Class of species	Nyangatom	Malle
	Mean± SD	Mean± SD
Doe	26.2±17.7[a] (6-120)	9.3±5.0[b] (3-26)
Buck/intact males	6.0±4.0[a] (2-30)	2.7±1.9[b] (0-7)
Castrate	3.2±3.1 (1-20)	2.5±1.8 (1-6)

[a,b]($P<0.05$); Values across the rows are significantly different ; Values in the parenthesis indicate range.

a higher ($P<0.05$) number of does and bucks were observed in Nyangatom district when compared to those of the Malle district.

The average numbers of intact males as were observed in the study was higher than those reported by Alayu et al., [10]. This may be because the respondents in the area prefer to rear the intact males to see their breeding abilities and thereafter those performing the best are retained and the others castrated, the observations are in close accordance with those of [8,11].

Selection Criteria for Doe's in the areas Studied

It transpires from Table 4 that selection of does is prevalent among all the respondents. The selection goes in tandem with the objective of rearing the does, while the primary objective varied across the locations, it was for traits associated with dairy traits (milk production) which was important for the respondents from Nyangatom district while on the other hand in Malle district the primordial trait associated with the selection of the does was body conformation, does with deeper chest and long length (traits associated with high body weight were preferred). This was followed by good body conformation, in Nyangatom district preferred does with good body conformation, while does with good mothering ability were preferred in Malle district. The results further indicated that the pastoralist at Nyangatom preferred mothering ability as the 3rd most preferred trait while in Malle it was high milk production potential.

The finding of selection habit of doe's for breeding in the districts based on survival of kids and milk production potential of the dam was in agreement with [12] in which Dire Dawa area goat rearers select their doe based on traditional criteria such as conformation, behaviour and adaptation [10,13] as important as most production traits in selecting breeding animals. Goats in some pastoral area of South Omo are also selected highly for adaptation traits such as tolerance to drought and resistance to diseases above growth performance trait and also long and wide tail [8].

Selection Habit and Criteria for Bucks

Traits considered for the selection of bucks in the studied districts are presented in Table 5. It transpires from the table that bucks with a high body weight and good skeletal structure (conformation) was preferred in both the studied locations. This is generally followed by selection based on coat color. While red with patchy and white colors with patchy was preferred by the respondents in the Nyangatom district while the preferred coat color as reported by the respondents in the Malle district was red and white with patchy colors.

The study showed that bucks were selected based on criteria's such as body conformation and color. Available buck in the surrounding also used for breeding. In agreement with this study; color, mother history and body size were mentioned in Dire Dawa area as reasons for selecting first preferred male goats [12]. Male goats in Bench Maji zone are also selected based on body size [14] Horn presence is also used as selection criteria for bucks in Bati, Borena and Shinile area of Ethiopia [13], which corresponded with this study. In line with this study in many areas of the country, body size was used for selection of breeding buck [15,10,16,11].

Buck utilization and management of goats

The results as presented in Table 6 indicate that most of the bucks were home born at Nyangatom district while the

Table 3: Criteria for selecting a doe in Nyangatom and Malle district.

Criteria of selecting a doe	Study districts with rank and index											
	Nyangatom						Malle					
	1st	2nd	3rd	4th	Index	Rank	1st	2nd	3rd	4th	Index	Rank
Appearance or good body conformation	16	17	7	1	0.21	2	65	17	5	1	0.36	1
Pedigree	-	-	-	1	0.001	10	2	8	-	-	0.036	6
Prolificacy	4	11	-	-	0.08	5	8	16	11	8	0.12	4
Good mothering ability	1	13	17	5	0.14	3	4	17	39	22	0.19	2
High milk production potential	28	9	5	10	0.27	1	3	20	14	14	0.13	3
Coat color	-	3	10	3	0.053	7	8	8	13	20	0.113	5
Wide tail					-		-	4	6	3	0.03	7
Kids who grow fast	1		4	5	0.03	9	-	-	-	22	0.024	8
Disease resistance	-	4	7	19	0.075	6	-	-	-	-		
Adaptability or survival ability	10	2	2	11	0.10	4	-	-	-	-		
Fast growth of the dam	-	1	8	5	0.04	8	-	-	-	-		
Regular breeder					-		-	-	2	-	0.004	9

Index = sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3+1 for rank 4] for particular purpose divided by sum of [4 for rank 1 + 3 for rank 2 + 2for rank 3+1 for rank 4] for all purpose; Appearance (good body conformation) includes good physical characteristics such as size and leg length.

Table 4: Criteria for selecting a buck in the studied districts.

Criteria of selecting a buck	Study districts with rank and index											
	Nyangatom						Malle					
	1st	2nd	3rd	4th	Index	Rank	1st	2nd	3rd	4th	Index	Rank
Appearance(good body conformation)	44	13	2	1	0.37	1	67	22	1	-	0.37	1
Color	5	22	8	18	0.20	2	16	24	22	23	0.23	2
Any buck available in the area	1	10	39	4	0.19	3	1	39	32	10	0.22	3
Fast growth	10	14	7	5	0.17	4	-	-	1	43	0.05	5
Activeness/libido	-	1	4	32	0.07	5	-	-	20	6	0.05	6
Wide tail							-	-	6	5	0.02	7
Thick horn							6	5	8	3	0.06	4

Index = sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3+1 for rank 4] for particular purpose divided by sum of [4 for rank 1 + 3 for rank 2 + 2for rank 3+1 for rank 4] for all purpose; Appearance (good body conformation) includes good physical characteristics such as size and leg length.

Table 5: Buck source in the last 12 month.

Parameters	Nyangatom (N=60)	Malle (N=90)
Source (%)		
Own buck home born	100	32.2
Not known buck	-	2.2
Neighbors and communal buck	-	65.6
Mating practice (%)		
By letting the buck all year round	100	83.3
By allowing the bucks to mate with the desired does during the breeding season		8.9
Taking the buck to the does when does are at estrus		6.7
When the goat are free of tether at off crop season		1.1

n, number of respondents, %, Percentage

respondents in Malle area selected good bucks from the vicinity and if not available used the best buck from their own herd. In Nyangatom district most of the herders (young boys of the pastorals) pay attention and kept their herd in seclusion, so that there is no mixing of the flocks and hence out crossing can be minimized. However, if a mating (with some other flocks) does occur, it may not be taken sportingly and there are often quarrels and skirmishes with the owners of the animals. This is because individual pastoralists take pride in their uniquely identified flocks which they do so either by their coat color, appearance and shape of the horn, many of the goats respond when called by their names. In both the districts the bucks are allowed to mingle with the flocks the year round. Some of the bucks are tethered and then taken to the does in estrus; this is carried out for the purpose of selective breeding.

In Malle district panmectic breeding is often encountered during after the crops have been harvested and the does and bucks have enough access to the crop aftermaths. But during the cropping season, matings are common in the pastures. The respondents in Nyangatom also indicated that they identify three to four bucks for siring their flock, once the buck is old it is

replaced by another buck of equal or better merit. Once the buck is replaced the elder buck is then castrated and sold off. There is also a practice of hemi-castration in early age of kids to make the buck calm (do the mating only on his own flock) and to make him bear only female kids in Nyangatom district.

Purpose of rearing a buck

The results as presented in Table 7 indicated that the primordial reason for maintaining a buck is to use it for the purpose of breeding followed by socio cultural purposes (Nyangatom district) while it is reared for breeding and source of income generation in the Malle district. The study also indicates that in both the study areas, bucks are also reared for chevon and blood as used for home consumption.

Culling and castration practice

The finding as presented in Table 8 indicates that culling is practiced in both the study areas and for both sexes. Castration too was practiced in both the study areas, with all the undesirable bucks being castrated at Nyangatom district. The reasons for culling of the doe's and bucks are low weight, poor fertility, old age and poor health. Bucks with undesirable appearance and conformation/small body size are slaughtered and consumed. In both the studied areas the bucks culled are castrated and sold as a source of income.

As the respondents in Nyangatom area mentioned that the practice of hemi castration was carried in order to make the buck efficiently mate their does. Study by [17] indicate that hemi-castration leading to improve semen characteristics with increase in semen volume, mass motility, individual motility and percentage of live sperm in semen of animal without any differences between left and right hemi-castrated animals. The study further indicated that testicular circumference in left hemi-castration was higher than that in right hemi-castration. Result also showed partially castration leads to enhanced growth performance and meat production in goats than full castration [18].

Qualitative characters

The results pertaining to the qualitative traits of the goats reared in the two districts are presented in Table 8. It transpires

Table 6: Rank of respondents for rearing bucks.

Purpose of rearing bucks	Study districts with rank and index											
	Nyangatom						Malle					
	1st	2nd	3rd	4th	Index	Rank	1st	2nd	3rd	4th	Index	Rank
For breeding	56	2	2	-	0.42	1	61	28	1	-	0.44	1
For socio-cultural purpose	3	55	2	-	0.33	2	1	1	28	10	0.10	3
For income source	2	3	44	9	0.21	3	28	60	2	-	0.40	2
For meat and blood	-	-	9	9	0.05	4	-	1	12	16	0.06	4

Index = sum of [4 for rank 1 + 3 for rank 2 + 2 for rank 3+1 for rank 4] for particular purpose divided by sum of [4 for rank 1 + 3 for rank 2 + 2for rank 3+1 for rank 4] for all purpose

Table 7: Culling and castration practice of goats which are unsuitable for breeding.

	Nyangatom (n=60)	Malle (n=90)	Total(n=150)
Do you cull undesirable buck and doe's (%)			
Yes	78.3	88.9	84.7
No	21.7	11.1	15.3
Do you practice castration of buck? (%)			
Yes	100	74(82.2)	89.3
No	0	16(7.8)	10.7

n, number of respondents, %, Percentage

Table 8: Some qualitative traits of the Woyito-Guji goats in the studied districts.

Trait	Character	Nyangatom (%)	Malle (%)	Total (%)
Coat color	White	12.7	11.5	12
	Red	18.3	19.7	19.2
	Black	4.8	10	8
	White with patchy	19.7	18.9	19.2
	White with spots	3.1	3.4	3.3
	Red with patchy	21	15.7	17.7
	Red with spots	2.6	2.1	2.3
	Black with patchy	14.8	17.1	16.2
	Black with spots	3.1	1.6	2.1
Color pattern	Plain	38.4	45.4	42.8
	Patchy	52.4	47.2	49.2
	Spotty	9.2	7.3	8
Ear orientation	Semi pendulous	0	2.6	1.6
	Carried horizontally	100	97.4	98.4
Hair length	Medium	99.1	96.9	97.7
	Long	0.9	3.1	2.3
Hair type	Glossy, smooth hair	99.1	96.9	97.7
	Straight long hair	0.9	3.1	2.3
Head profile	Straight	87.3[a]	4.2[b]	35.4
	Concave	12.7[b]	95.8[a]	64.6
Horn presence	Present	98.7	96.1	97
	Absent	1.3	3.9	3
Horn orientation	Lateral	0.9[b]	3.4[a]	2.5
	Obliquely upward	99.1[a]	88.2[b]	92.3
	Backward	0	8.4	5.2
Horn shape	Scurs/rudimentary	0.9[b]	3.4[a]	2.5
	Straight	99.1[a]	85.3[b]	90.5
	Curved	0	11.3[a]	7
Presence of beard	Present	31.4	34.9	33.6
	Absent	68.6	65.1	66.4
Presence of ruff	Present	35.4[a]	7.1[b]	17.7
	Absent	64.6[b]	92.9[a]	82.3
Presence of wattle	Present	3.9	3.9	3.9
	Absent	96.1	96.1	96.1

[a][b]Values across rows differ significantly,*P<0.05;

from the table that most of the goats had patchy coats with red background in Nyangatom district while most of the goats in the Malle district had a red color and white with patchy. The most uncommon coat color in both the districts was red coat color with spots and black coat color with spots in the Nyangatom and Malle districts respectively.

In both the studied locations it was observed that most of the goats had ears which were horizontally oriented. It was also observed that predominantly the goats in both the districts had coat neither short or long and glossy and smooth hair. The head shape of the goats varied (P<0.05) across the two districts, with straight head being observed in Nyangatom while it was concave in the Malle district. The horn of most of the goats irrespective of the districts was obliquely upward and straight. Beards, ruffs and wattles were absent in most of the goats in the two districts.

The results as presented in Table 8 indicate that goats in the two districts have several coat colors while the preferred coat color of goats reared at Nyangatom district was Red with patchy, followed by white with patchy and red coat, while those reared at Malle district was Red followed by White with patchy coat color. The variability in coat color may be due to the indiscriminate crossing existing among indigenous goat populations [19].

The respondents also indicated that coat color was an important criteria for selection of the bucks and does. Selection of goats based on coat color is primarily aimed for identification purpose followed by minimizing thermal load. Studies by [20] indicated that selection of livestock based on coat color can be successful because the trait is highly heritable. Besides coat color, thermal load in goats is also influenced by coat length and condition of the hair [21]. The animals with short and glossy coat can help in minimizing thermal load; the observations are in close accordance with those of [10,22].

Studies by [20,23] Peters et al. (1982), and Odubote (1994) indicate that the absorption of solar heat is correlated with the degree of coat pigmentation and thus coat pigmentation could be of importance in tropical climate and under intense solar radiation. The study further indicates that the heat absorption increases from white, brown to black coat color.

The orientation of the ears in most of the goats are horizontal, which may be associated with alertness to protect them against predators and also long ears can help in dissipating heat from the animals [24]. The presence of horizontal orientation of the ears have also been reported for several Ethiopian goat breeds [25,26,10] also reported that in Loma district of SNNPR some of the goats had pricked ears (Figure 1).

The results also indicate that the head profile of the goats in both districts are different, while it was straight at Nyangatom district and was concave at the Malle district. The differences as observed may be attributed to differences in the strains of the animals, which need further studies to ascertain the differences. The presence of concave head shape in goats from the country has also been reported by other authors [25,27]. The goats are horned which may be a breed character and may be preferred as a selection criteria as horned animals are able to protect themselves better from predators, besides it may be also a socio cultural preference, the observations are in accordance with other authors [19,14,10,13]. Most of the goats in the country are horned indicating that the respondents preferred horns in the small ruminants which may be attributed to defensive mechanism of the goats. The absence of ruff and beard in the breed may be a deliberate selection procedure especially in the hot climate of the region of study [26].

The respondents select the goats which are devoid of wattles, this may be of socio cultural importance, however studies by [23,28] Odubote (1994) and Adedeji (2012) indicate that among the West African Dwarf goats those with wattles had significantly lower rectal temperature and respiration rate indicating that goats with wattle are able to tolerate the hot and humid climate and hence could be associated with thermo regulatory function of the tropically adapted animals.

Summary and Conclusion

The study was carried to characterize the Woyto-Guji goats physically and to study their traits used for selecting them by the tribal societies at Nyangatom and Malle district. Goats of the study area were selected for traits such as tolerance to drought and tolerance towards diseases while the production came from sheer numbers of goats reared by the community members.

The results indicated that the bucks and does are selected by the community members using traditional descriptors. The traits preferred for selection were those related with adaptation
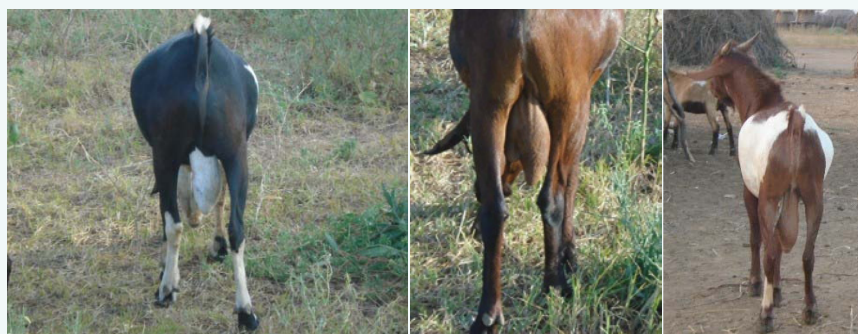

Figure 1 Picture of half testicle castrated breeding bucks in Nyangatom area.

and disease tolerance. The bucks were selected for traits which correlated with their abilities to fend off predators while the does were selected for their mothering and nursing abilities. Coat colors were also considered as important attributes towards selecting the does and bucks, the preferred coat colors were those with white with patchy, red and red with patchy.

The selection criteria of breeding doe's were more concerned on their maternal instincts and nursing abilities while body conformation and coat color were the traits preferred for selection of the bucks. Pastoral and agro pastoral preference of coat color patterns were white with patchy, red and red with patchy which were helpful for the goats of the area for the adaptation on the existing hot environment. Therefore, based on their adaptation traits, selection and breed improvement strategies should be developed for the existing pastoral and agro-pastoral environment to benefit them from the resource.

References

1. Workneh A. Do smallholder farmers benefit more from crossbred (Somali × Anglo-Nubian) than from indigenous goats? Goettingen, Germany: Faculty of Agricultural Sciences, George-August University of Goettingen. 2000.

2. EARO (Ethiopian Agricultural Research Organization). National Small Ruminants Research Strategy Document. EARO, Addis Ababa, Ethiopia. 2000.

3. Ehui SK, Benin S, Nega Gebreselassie. Factors affecting urban demand for live sheep: The case of Addis Ababa, Ethiopia. Socio-economics and Policy Research Working Paper 31. ILRI (International Livestock Research Institute), Nairobi, Kenya. 2000; 32.

4. FARM Africa. Goat types of Ethiopia and Eritrea. Physical description and management systems. Published jointly by FARM-Africa, London, UK and ILRI (International Livestock Research Institute), Nairobi, Kenya. 1996.

5. ESGPIP (Ethiopia Sheep and Goat Productivity Improvement Program). 2009/11. Goat breeds of Ethiopia: A guide for identification and utilization.Technical Bulletin 27. Addis Ababa, Ethiopia: ESGPIP.

6. Lombe Lorato Yakob. Characterization of goat husbandry practice in Dawuro zone, Southern Ethiopia. Global J AniSci Res. 2015; 3: 2015.

7. SOFEDB (South Omo zone Finance and Economy Development Bureau). Zonal Statistical Abstracts 2016 (2009 E C), Jinka, Ethiopia. 2016.

8. Tekleyohannes Berhanu, Jamroen Thiengtham, Sayan Tudsri, Girma Abebe, Asrat Tera & Somkiert Prasanpanich. Purposes of keeping goats breed preferences and selection criteria in pastoral and agro-pastoral districts of South Omo Zone. Livestock Res Rural Dev. 2012; 24: 2012.

9. CSA (Central Statistical Agency) 2016/17. Federal democratic republic of Ethiopia Central Statistical Agency, Agricultural Sample Survey 2016/17 Volume II, Report on livestock and livestock characteristics (private peasant holdings), Addis Ababa. Statistical bulletin. 2014; 573:13.

10. Alayu Kidane, Surafel Melaku and Ayinalem Haile 2014. Characterization of goat population and breeding practices of goat owners in Gumara-Makisegnit Watershed-North Gondar, Ethiopia. Agri J. 2014; 9: 5-14.

11. Solomon Abegaz, J. Sölkner, S. Gizaw, T. Dessie, A. Haile & M. Wurzinger 2013. Description of production systems and morphological characteristics of Abergelle and Western lowland goat breeds in Ethiopia:implication for community-based breeding programmes. Animal Genetic Resources. Food Agri Orgn United Nations. 2013; 53: 69-78.

12. Grum Gebreyesus A Haile, T Dessie. Breeding scheme based on community-based participatory analysis of local breeding practices, objectives and constraints for goats around Dire Dawa, Ethiopia. Livestock Res Rural Dev. 2013; 25.

13. Hulunim Gatew, Halima Hassen, Kefelegn Kebede, Aynalem Haile, Raimundo Nonato Braga Lôbo, et al. Characterization of Indigenous Goat Populations in Selected Areas of Ethiopia. Am-Eur J Sci Res. 2015; 10: 287-298.

14. Tegegn Fantahun, Kefyalew Alemayehu, Solomon Abegaz. Identification and phenotypic characterization of goat ecotypes in the Bench Maji zone, Southwestern Ethiopia. Animal Genetic Resources. Food Agri Org United Nations. 2013; 53: 19-26.

15. Dhaba Urgessa, Belay Duguma, Solomon Demeke, Taye Tolamariam. Sheep and Goat Production Systems in Ilu Abba Bora Zone of Oromia Regional State, Ethiopia: Feeding and Management Strategies. Global Veterinaria. 2012; 9: 421-429.

16. Endeshaw Assefa. Assessment of Production and Marketing System of Goats in Dale District, Sidama Zone. Awassa College of Agriculture University Of Hawassa Hawassa, Ethiopia. 2007.

17. Naoman UT, Taha MB. Effect of hemi-castration on testicular growth and seminal characteristics of Iraqi male goats. Iraqi J Vet Sci. 2010; 24: 71-74.

18. El-Feel FMR. 1994. Effect of castration on growth and carcass characteristics of Egyptian local Baladi goats and their crosses with Aphine and Anglo-Nubian. Der Tropenlandwirt, Zeitschrift furdie Landwirtschaft in den Tropen und Subtropen 95. Jahrgang. 1994: 63-76.

19. Hagan JK, Apori SO, Bosompem M, Ankobea G, Mawuli A. Morphological Characteristics of Indigenous Goats in the Coastal Savannah and Forest Eco-Zones of Ghana. J Anim Sci Adv. 2012; 2: 813-821.

20. Peters KJ, Horst P, Kleinheisterkamp HH. The importance of coat colour and coat type as indicator of productive adaptability of beef cattle in a subtropical environment. Trop Ani Prod. 1982; 7: 296-304.

21. Acharya RM, Gupta UD, Sehgal JP, Singh M. Coat characteristics of goats in relation to heat tolerance in the hot tropics. Small Ruminant Res. 1995; 18: 245-248.

22. Solomon AK, Mwai O, Grum G, Haile, A, Rischkowsky BA, Solomon G, Dessie T. Review of goat research and development projects in Ethiopia. ILRI Project Report. Nairobi, Kenya. Int Livestock Res Inst. 2014.

23. Odubote IK. Influence of qualitative traits on the performance of West African Dwarf goats. Nigerian J Ani Prod. 1994; 21: 25-28.

24. Steeve D. Côté, Sandra Hamel, Antoine St-Louis, Julien Mainguy. Do mountain goats habituate to Helicopter disturbance? Journal of Wildlife Management. 2013; 77: 1244-1248.

25. Halima Hassen, Michael Baum, Barbara Rischkowsky, Markos Tibbo. Phenotypic characterization of Ethiopian Indigenous Goat Populations. Afr J Biot. 2012; 11: 13838-13846.

26. Dereje Tsegaye, Berhanu Belay and Aynalem Haile. Linear Body Measurements as Predictor of Body Weight in Hararghe Highland Goats under Farmers Environment: Ethiopia. Global Veterinaria. 2013; 11: 649-656.

27. Tsigabu Gebereselassie, Getahun Asebe, Kefelegn Kebede, Yosef Mekasha. Phenotypic characterization of goat type in Nuer Zone of Gambella People Regional State, South Western Ethiopia. Global J Ani Breeding Genetics. 2015; 3: 164-180.

28. Adedeji TA. Effect of Some Qualitative Traits and Non-Genetic Factors on Heat Tolerance Attributes of Extensively Reared West African Dwarf (WAD) Goats. Int J Applied Agr Apicultural Res. 2012; 8: 68-81.