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COMPARATIVE EVALUATION OF PHENOTYPIC RANKING DECISIONS AND TRAIT PREFERENCES OF SHEEP PRODUCERS IN AMHARA REGIONAL STATE OF ETHIOPIA

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ABSTRACT: This study was aimed to investigate comparative trait preferences of farmers' and selection practices for Rutana and Gumuz sheep breeds in existing production system. Ranking method, such as direct and own-flock ranking experiment with sheep keepers were carried in smallholder and large-scale production systems. Appearance, coat colour and fast growth rate were important traits in selecting breeding rams in smallholder system where as fast growth rate, tail length and appearance were preferred in large-scale system. Mothering ability, multiple births and lambing interval were most preferred for ranking breeding ewes in both systems. The mean of all objectively measured body conformation traits and body weight varies significantly across the farmers ranking categories and in line with their selection decision. In Gumuz sheep breed the average body weight of ewes which ranked as best was superior to rank as poor (34.5 kg vs. 26.7kg); whereas, in Rutana breed it was 39.4 kg vs. 29.5 kg ($P<0.05$). The farmers' breeding objectives were improving reproduction, conformation and growth traits, which can increase net cash income per flock through increased number of marketable animals for meat production. Therefore, considering meat production traits is recommended as feasible strategy for future for Gumuz and Rutana sheep genetic improvement and conservation program.

Keywords: Breed improvement; Conservation; Gumuz sheep; Ranking experiment; Rutana sheep.

INTRODUCTION

Sheep productions in developing countries like Ethiopia is an important livestock farming activity and contributed immensely to the subsistence, economic and social livelihood of the smallholder farmers, in terms of generating income, meat, milk, skin and fiber (Hirpa and Abebe, 2008; Adem et al., 2018). Sheep production in developing countries is largely based on traditional breeds and characterized by diverse and multiple farmer breeding objectives (Solomon et al., 2008; Laouadi et al., 2018; Haile et al., 2019).

In Ethiopia, there are nine sheep breeds (Solomon et al., 2008) and 40 million sheep population (Central Statistical Agency of Ethiopia, 2020), which is distributed throughout the country. Despite the diverse sheep breeds in Ethiopia, the productivity and the contribution of sheep to the livelihood of resource poor farmers and the country economy is far below the potential. This might be attributed to the lack of appropriate indigenous breed improvement and utilization strategies (Solomon et al., 2011).

The local Gumuz sheep breed is prolific, adaptable to hot environmental condition and known for their tasty meat (Solomon et al., 2011). Previous study revealed that Gumuz sheep had diseases tolerance ability with a better survival rate compared with Rutana sheep, which is exist in the same area. However, it has been ranked poorly for its growth and body weight compared to the Rutana sheep (Solomon et al., 2008). Rutana sheep was introduced in the north western lowlands for crossbreeding with Gumuz as the breed is more preferable in the market and fetched higher price in the export market. Although, Gumuz sheep were preferred in terms of prolificacy and adaptation to the existing environment over Rutana and their crosses, the population of Gumuz sheep is considered decreasing in the study areas. As a consequence, the adapted local genetic resource of Gumuz breed which is the only thin-tailed breed of Ethiopia is losing its genetic diversity and considered to be declined (Solomon et al., 2008). A good understanding of production and breeding practices is fundamental to design a sound breeding program, which leads to sustainable utilization and conservation of the genetic resources (Hagos et al., 2018). Therefore, elucidating the updated comparative trait preferences of the local farmers on the two sheep breeds in the existed production systems has a paramount importance for designing effective breeding program. Breeding objectives and trait preferences can be identified through participatory approaches as advised by multiple scholars (Duguma et al., 2011; Königet al., 2016). Hence, the objective of the study was to identify the trait preferences and evaluating the selection decisions for Gumuz and Rutana sheep breeds under existing production system.

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border advantage and sale sheep to Sudanese traders who prefer a yearling male lamb. Hence, large scale produces needs to reared lambs, which can reach market weight sooner. Similar findings were reported by Nugussieet al. (2015) and Abebeet al. (2020) for indigenous sheep in Ethiopia, and Sheriff et al. (2021) for Arab and Oromo goat keepers in north western Ethiopia. According to their justification, the high attribute of fast growth of lambs and kids for breeding and meat production might due to high market demand and the proximity of the study areas to export market.

Table 1 - Selection criteria for ranking of breeding rams in smallholder and large-scale system

Selection Criteria	Smallholder system				Large scale system				Overall
	R1	R2	R3	I	R1	R2	R3	I	I
Body conformation	44.4	17.2	21.7	0.32	15.0	26.7	13.3	0.19	0.26
Coat color	9.4	30.6	35.0	0.21	13.3	10.0	25.0	0.14	0.17
Growth rate	22.8	16.1	7.8	0.18	26.7	20.0	21.7	0.24	0.21
Libido	5.6	15.0	7.2	0.09	13.3	16.7	13.3	0.14	0.11
Age at 1st mating	3.9	8.3	10.0	0.06	10.0	8.3	10.0	0.09	0.08
Tail length	13.9	12.8	18.3	0.14	21.7	18.3	16.7	0.20	0.17

R = Rank; I = Index

Selection criteria for ranking of breeding ewes

As indicated in Table 2, body conformation was reported as the first selection criteria of breeding ewes in both production systems. Multiple births, mothering ability and lambing interval were ranked descending as the next three selection criteria of breeding ewes in large scale production system. Whereas mothering ability, multiple births and coat color were orderly ranked in smallholder production system. Previous study reported that mothering ability increases the chance of survival of young goats (Snyman, 2010; Tesema et al., 2020) and mainly given high emphasis by farmers in selecting breeding ewes, which is in support of the current study. The main reason why sheep farmers selecting ewes with good mothering abilities is by considering of the caring and nourishing potential of ewes for better growth and survival of lambs. This result is in agreement with Dugumaet al. (2011) reported that there was a high choice preference for good mothering ability of ewes in four indigenous sheep breeds of Ethiopia by anticipating a healthy and good-sized lamb in their flock. Hence, the high preference of ewes mothering quality might be the indication sheep producers are trying to be profitable by obtaining market demanded and large sized lambs in early ages. In agreement to this, Abebeet al. (2020) indicated that one possible reason of smallholder farmers for selecting of ewes with sound mothering abilities could be selling lambs for income generation, thus well-nourished lambs are expected to fetch a better price. In large scale production system of this study, twining ability was the second most important trait for ranking of breeding ewes. The higher preference for twinning was consistent with the reports of Edea et al. (2012) for Bonga sheep and Nziku et al. (2016) for dairy goats in Kenya.

Table 2 - Selection criteria for ranking of breeding ewes in smallholder and large-scale system

Selection Criteria	Smallholder system				Large scale system				Overall
	R1	R2	R3	I	R1	R2	R3	I	I
Body conformation	23.3	21.7	8.3	0.20	33.3	10.0	20.0	0.23	0.22
Coat colour	13.3	16.1	22.2	0.16	6.7	10.0	8.3	0.08	0.12
Mothering ability	20.6	16.1	20.6	0.19	3.3	16.7	30.0	0.12	0.16
Age at 1st lambing	5.0	7.2	3.9	0.06	11.7	15.0	10.0	0.13	0.09
Twinning ability	12.2	22.2	16.1	0.16	15.0	28.3	13.3	0.19	0.17
Lambing interval	18.9	8.9	8.3	0.13	25.0	18.3	5.0	0.19	0.16
lamb growth	6.7	7.8	20.6	0.10	5.0	1.7	13.3	0.05	0.08

R = Rank; I = Index

Evaluation of farmers ranking decision

As indicated in table 3, there was a significant difference ($P<0.001$) in the mean values for morph-metric conformation traits across the established ranking groups. Among all ewes and rams studied within the two production systems, those selected as best were highest for all traits than those grouped as poor.

In general, the ewes and rams grouped as average had mean values that were in between the best and poor groups. For instance, in smallholder system, the difference between the best and poor group in live weight for Gumuz sheep was 8.2kg at two years age. Rams ranked as best in both breed groups were higher in all measured traits compared with rams classified as poor qualities (Table 3). For instance, in Gumuz rams the magnitude difference between the best and inferior rams in live weight, body condition and scrotal circumference were 12.7kg, 0.9 and 3.2cm, respectively. In Rutana ram, the differences between the two groups were 13kg of live weight, 1.8 body condition and 1.9 cm scrotal circumferences.

In the present study, there was significant difference between breeds and ranks for all objectively measured traits, which were in accordance with those reported by Gemeda et al. (2010) and Königet al. (2016). Rutana ewes and rams had higher mean values for all traits compared with Gumuz rams and ewes. In addition, in both breeds ewes and rams

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selected as best significantly superior than with that of ranked as poor in all of measured body conformation traits. Inline to this, Sheriff et al. (2021) for Arab and Oromo goat keepers in north western Ethiopia and Getachewet al. (2020) for indigenous goat of the pastoral communities in Ethiopia justified that the mean values of does ranked as best and poor quality, there were clear and logical differences in most of the attributes considered. At the same time, a recent study on Simien sheep breed showed that the best ranked ewes had significantly higher values than the other ranked groups (Solomon et al., 2020). In general, there was a clear trend for the different traits of ewes and rams ranked from best to inferior. Therefore, using of farmers knowledge for selecting the best animals is possible option to start the breeding program where performance recording totally lacking.

Table 3 - Least squares mean (± SE) of objectively measured traits by breed types and rank categories

Trait	Breed	Rank	LS (mean ± SE) Ewes	LS (mean ± SE) Rams
Body Weight (kg)	Gumuz	Best	34.5±3.3^{a}	40.1±6.1^{a}
		Average	30.2±4.0^{b}	30.2±4.5^{b}
		Poor	26.7±4.7^{c}	27.4±2.6^{c}
	Rutana	Best	39.4±5.7^{d}	41.4±8.2^{d}
		Average	35.1±5.0^{e}	34.5±4.1^{e}
		Poor	29.5±6.2^{f}	28.4±5.4^{f}
Significance level	***	***		
Heart Girth (cm)	Gumuz	Best	77.1±3.3^{a}	78.5±4.3^{a}
		Average	74.2±3.4^{b}	73.2±3.9^{b}
		Poor	71.4±3.1^{c}	73.1±5.1^{c}
	Rutana	Best	82.5±4.1^{d}	86.4±7.3^{d}
		Average	79.1±3.9^{e}	78.7±4.9^{e}
		Poor	76.2±4.2^{f}	75.1±5.6^{f}
Significance level	***	***		
Body Length (cm)	Gumuz	Best	68.8±2.7^{a}	69.0±3.9^{a}
		Average	66.3±2.9^{b}	65.6±4.0^{b}
		Poor	63.7±3.1^{c}	65.4±3.5^{c}
	Rutana	Best	71.1±3.6^{d}	73.0±5.4^{d}
		Average	67.7±3.4^{e}	67.3±4.7^{e}
		Poor	64.9±3.7^{f}	64.6±4.3^{f}
Significance level	***	***		
Wither Height (cm)	Gumuz	Best	68.9±3.4^{a}	73.4±8.5^{a}
		Average	64.7±4.8^{b}	68.1±6.1^{b}
		Poor	61.6±5.1^{c}	69.3±4.0^{c}
	Rutana	Best	77.6±4.8^{d}	79.5±5.5^{d}
		Average	73.9±3.8^{e}	72.7±4.8^{e}
		Poor	71.6±3.2^{f}	69.5±5.1^{cf}
Significance level	***	**		
Body Condition Score	Gumuz	Best	3.2±0.4^{a}	3.2±0.8^{a}
		Average	2.4±0.5^{b}	2.7±0.5^{b}
		Poor	1.6±0.4^{c}	2.3±0.3^{c}
	Rutana	Best	4.0±0.6^{d}	3.7±0.8^{d}
		Average	3.0±0.4^{e}	2.6±0.5^{e}
		Poor	2.3±0.4^{f}	1.9±0.6^{f}
Significance level	***	***		
Scrotal Circumference (cm)	Gumuz	Best		26.1±3.4^{a}
		Average		22.7±3.1^{b}
		Poor		22.9±2.5^{b}
	Rutana	Best		25.5±3.2^{d}
		Average		23.7±3.7^{e}
		Poor		23.6±2.6^{e}
Significance level	*	*		

Significance levels: ***= p <0.001; **= p< 0.01; *= p< 0.05; SE = Standard Error

Trait preferences of farmers

Reproduction (lambing interval and twining abilities) and mothering ability were equally the second important traits for appreciated Gumuz ewes in large scale system. The highest weighted reasons reported for Rutana ewes were for appreciating their body size and growth (0.32) in large scale system and, for mothering abilities and body size and growth (equally 0.28) in smallholder system (Table 4). Body condition and reproduction were the second and the third preferred traits in the same breed and production system. Breed behavior was the last preferred trait in both breeds and production systems.

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Reproduction, mothering ability, body size and growth were the most preferred traits for appreciating Gumuz and Rutana ewes in both production systems. This is in agreement with previous studies reported by Solomon et al. (2011) in the same area for the same breed. Inclusion of reproductive traits in designing a breeding program is, however, reasonable as the trait should reflect owners' preferences and will make them more beneficiaries from the sheep production system. Sheep owners' positive view on body size has direct effect in the production of marketable animals with good body conformation, which are later affect to their market price. Higher preference values of body size for breeding animals were reported by many previous studies in Ethiopia (Solomon et al., 2010; Duguma et al., 2011; Solomon et al., 2011). Mothering ability for Rutana sheep in both production systems also considered as the second most important trait in identifying best ewes.

Table 4 - Smallholder and commercial farmers' ewe trait preference

Breed and Trait	Smallholder						Large scale					
	Reasons			Sum	Rel. wt	Rank	Reasons			Sum	Rel.wt	Rank
	1	2	3				1	2	3			
Gumuz												
Body size and growth	10	6	4	20	0.17	2	4	3	5	12	0.20	1
Body condition	8	5	4	17	0.14	4	3	3	2	8	0.13	4
Mothering abilities	9	5	6	20	0.17	2	5	2	2	10	0.17	2
Reproduction	12	8	6	26	0.22	1	5	5	0	10	0.17	2
Drought Tolerance	4	4	7	15	0.13	5	3	2	3	8	0.13	4
Disease Resistances	11	1	6	18	0.15	3	2	3	4	9	0.15	3
Breed behavior	0	1	3	4	0.03	6	1	2	0	3	0.04	5
Rutana												
Body size and growth	14	11	8	33	0.28	1	5	7	7	19	0.32	1
Body condition	6	3	9	18	0.15	2	2	4	1	7	0.11	4
Mothering ability	8	14	11	33	0.28	1	6	4	2	12	0.21	2
Reproduction	8	4	5	17	0.14	3	4	2	4	10	0.16	3
Drought Tolerance	1	2	2	5	0.05	5	0	1	3	4	0.06	6
Disease Resistances	2	2	5	9	0.07	4	2	2	1	5	0.09	5
Breed behavior	2	2	0	4	0.03	6	1	1	1	3	0.05	7

Reasons 1,2,3= Farmers 1st, 2nd and 3rd basis for evaluating ewes.

CONCLUSION

Smallholder farmers primarily selected body conformation with ability to give multiple births and decent mothering ability whereas; multiple births and lambing interval were important selection criteria by large scale producers for breeding ewes. Physical appearance traits like body conformation and growth rate were principally considered for selection of breeding rams in both production systems. In general, traits, which have direct influence on the market price,are highly marked as a selection criterion for breeding rams and ewes. The top three preferred traits according to the weighted rank values were reproduction, body size and mothering ability. The main breeding goals for both systems have been defined as increasing meat production and marketed animals. This implies that designing sheep improvement strategy in the area should primarily target towards meat production traits.

DECLARATIONS

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Authors' contribution
All of authors contribute on idea conception, data collection and analysis, and the write up of the manuscript.

Conflict of interests
The authors have not declared any conflict of interests.

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