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Indigenous Sheep Populations Production System in Agarfa Woreda, Bale Zone, Oromia Regional State, Ethiopia: Inference for Sustainable Utilization of Genetic Resources

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ABSTRACT

This study was designed to generate organized information on production system of indigenous, sheep types, major constraints of sheep husbandry and traits preferences of sheep types in three Agro ecological zones. The study was performed based on household survey. Two kebeles from each Agro ecology and 30 households from each kebeles were sampled using purposive sampling techniques. For household survey, 180 households (60 from each agro ecology) were participated. Data were collected through semi structured questionnaire, participatory focus group discussion, secondary information. Data were analyzed by using statistical analysis system (version, 9.4, 2012) and SPSS; Version, 22. The results showed that the major purpose of sheep rearing in the study area were for income, saving, meat, wealth, manure and socio-cultural uses. The major constraints of sheep husbandry across the study areas were feed shortage, disease prevalence, water shortage and predator. The most important trait of preferences by the farmers in all the three agro ecologies were body conformation/appearance, tail type and color. Improving the management and seasonal shortage of feed should be considered in any intervention activities.

Keywords: Agarfa Woreda, Indigenous Sheep Types, Agro Ecology, Production System, Trait Preference.

INTRODUCTION

Background of the study

Ethiopia's sheep population, estimated to be 42.9 million heads, is found widely distributed across the diverse agro ecological zones of the country [1]. According to [2], approximately 75% of the sheep are kept in small scale mixed farms in the highland regions 1500 altitude receiving greater than over 700 mm of annual rainfall the remaining 25% are found in the lowlands. Ethiopia has diversified indigenous sheep populations which are parallel to the diversity in agro ecology. This diversity grouped into

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9 breeds and 14 traditional sheep populations [3], inhabited in the lowland, midland and highland agro ecologies of the country [4].

Despite low level of productivity due to several factors such as feed shortage, disease, genotype, environmental and institutional constraints [2] indigenous sheep breeds have a great potential to contribute more to the livelihood of people in low input, small holder and pastoral production systems [5]. Evaluating the production system, indigenous knowledge of selection, management, identification of breeding goals, describing morphological characters and productivity level of sheep populations in their habitat are prerequisites to set up a genetic improvement program at the smallholder and pastoral levels [6].

Agarfa Woreda sheep is locally recognized indigenous sheep type in Bale zone, Oromia region. Information on production system of this sheep type is insufficient in spite of its contribution and role as source of cash income and improving food security. For example, [7] conducted research on the phenotypic characterization of sheep in Bale zone; particularly Dinsho, Agarfa, Goba, Sawena and Dawekechan Woredas. However, information on production system of Agarfa Woreda sheep based on agro ecological zone is limited. In addition to this study, if there are previous works evidently done, updating of previous results is vital since genetic resources and production systems are not static, routine inventories and continuing monitoring is needed [8]. Therefore, this study was under taken to evaluate sheep production systems, major constraints of sheep husbandry and trait preferences of farmers in Agarfa Woreda.

MATERIALS AND METHODS

Description of the study area

Agarfa Woreda is one of the Woredas found in Bale zone of Oromia regional state, south eastern Ethiopia. It is located at a distance of about 460 km from the capital city Addis Ababa and is situated at 7°17' up to 80 N' North Latitude and 370 up to 39°49' east Longitude.

Sampling Size and Sampling Techniques

Multi- stage purposive sampling was used to select Agarfa Woreda from the total of18 districts found in Bale Zone. The sampled sheep populations were selected using multi-stage purposive sampling method by classifying the district in to three agro ecological zones namely Dega, Woinadega and Kolla in order to get potential sheep producing peasant associations and villages/farmers from the district. Then, potential sheep producing PA's (Peasant association) representing each agro-ecological zone were identified by purposive sampling procedure for morphological characterization and administration of semi structured questionnaire. Two PA's from each agro ecological zone were selected. Households that possess a minimum of 5 sheep were identified from each PA and then, numbers of households from each selected PA were determined according to proportionate sampling technique as indicated below: **W= [A/B] x No;** Where: W= Number of households calculated from single selected PA's; A=Total number of households per PA's; B= Total number of households in all PA's; and No = the calculated sample size. The sample size 180 household was determined according to the [9] as under: N0=0.25/SE2; Where: N0= Sample size; and SE= Standard error (0.0373) with 95% confidence level. Accordingly, 30 households (HHs) were randomly selected with a total of 180 HHs.

Data collection procedure

From each sampling site, farmers were briefed about the objective of the study before the beginning of the data collection and random open ended discussion was done. Data were collected by administering semi-structured questionnaire, organized group discussions and secondary sources.

Questionnaire survey and group discussion

General information list of [10] and Oromia livestock breed survey were used as checklist in designing the questionnaire as suggested by [11]. These include existing socio economic characteristics of farmers, flock size and structure, reproductive performances, breeding management, selection criteria, trait preferences, culling and marketing age, sheep production constraints, sheep production system and husbandry practices. Participatory focus group discussions with sheep owners, elders, village leaders and model farmers, women and extension agents who had known to have better knowledge on the present and past socio economic status of the study area were made. Through these discussions, information on the existing sheep types, trait preferences of the farmers and major constraints of sheep production were collected. Such discussions were also used to confirm information collected from the individual farmers.

Animal Care and Ethics

After carefully inspecting ethical and animal welfare concerns, the experiment was permitted by the School of Animal and Range Sciences Hawassa University ethics committee (1956ET-18/2017). The European Union's (2010) recommendations on the treatment and utilization of animals in experiment and development have been followed.

Data management and statistical analysis

Questionnaire data collected during the study period was checked for any error, coded and entered into computer for further analysis. Data gathered through questionnaire were analyzed by [12]. Chi-square test was employed when required to test equal probability assumptions. Indices were calculated to provide ranking of the purpose of keeping sheep, selection criteria and major constraints of sheep production according to the following formula: Index = Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] given for particular qualitative variables divided by Σ of [3 for rank 1 + 2 for rank 2 + 1 for rank 3] for all qualitative variables considered.

RESULTS

Composition of livestock species

The mean numbers of various livestock species per households in the three agro ecologies are summarized in Table 1.

Table 1. Mean (±SD) of livestock holding per household in the study area

Species	Dega	Woina Dega	Kolla	Overall Mean
Ox	2.27±0.7^{b}	2.65 ±0.7^{a}	2.4 ±0.7^{ab}	2.44 ±0.7
Cow	1.67±0.97^{b}	2.38 ±1.22^{a}	2.2 ±0.91^{a}	2.1 ±1.1
Bull	1.17±1.06^{b}	1.75±1.27^{a}	1.03 ±0.7^{b}	1.32 ±1.1
Heifer	0.8 ± 0.86^{a}	0.82 ±1.05^{a}	0.37 ± 0.55^{b}	0.66±0.87
Calves	0.48 ± 0.8^{a}	0.57 ±0.87^{a}	0.22 ±0.45^{b}	0.42±0.75
Sheep	8.27 ± 2.57^{a}	7.3 ± 2.74^{b}	6.12 ±1.12^{c}	7.23 ± 2.42
Goat	0.75 ±1.27^{c}	2.78 ± 3.77^{b}	4.33 ±4.05^{a}	2.62 ±3.58
Donkey	0.52 ±0.65^{c}	1.27 ± 1.4^{b}	3.33 ±1.86^{a}	1.71±1.83
Horse	1.47 ±1.49^{a}	1.32 ±1.28^{a}	na	0.93±1.31
Mule	0.33 ± 0.6^{a}	0.22 ± 0.42^{a}	0.01 ±0.01^{b}	0.19±0.44
Chicken	5.8 ± 3.48^{ab}	6.97 ± 3.79^{a}	5.52 ±3.12^{b}	6.11±3.51

$^{a-c}$Means with different superscript letters with the same raw are significantly different

SD = standard deviation; na = not available

Flock size and structure

Flock size and structure of sheep in Dega, Woina dega and Kolla agro ecologies of Agarfa woreda is presented in Table 2. The overall mean flock size per household in the study area was higher for breeding ewes (3.2; 44.3%) followed by females 6 months to 1 year (1.39; 19.22%), male lambs less than six months (0.87; 12%), female lambs less than six months (0.79; 10.9%), breeding ram (0.53; 7.3%), male six months to one year (0.35; 4.8%) and castrated (0.12; 1.7%).

Table 2. Average sheep flock size per household and structure in each agro ecology

Flock Size and Structure	Dega		Woina dega		Kolla		Overall	
	Mean	%	Mean	%	Mean	%	Mean	%
Male lambs <6 months	0.37	4.47	0.88	12.05	1.37	22.39	0.87	12.03
Female lambs <6 months	1.15	13.91	1.1	15.07	0.12	1.96	0.79	10.93
Breeding ram	0.7	8.46	0.66	9.04	0.23	3.76	0.53	7.33
Breeding ewe	3.6	43.53	2.89	39.59	3.1	50.65	3.2	44.3
Male 6 months to 1 year	0.37	4.47	0.45	6.16	0.22	3.59	0.35	4.84
Female six months to 1year	1.93	23.34	1.2	16.44	1.03	16.83	1.39	19.23
Castrated	0.15	1.81	0.12	1.64	0.05	0.82	0.12	1.66
Total size	8.27		7.3		6.12		7.23	

Purpose of keeping sheep

Table 3. Purpose of keeping sheep in the study area as prioritized by the respondents

Purpose	Dega				Woina dega				Kolla			
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I
Meat	nr	39	9	0.24	12	3	42	0.23	8	7	37	0.21
Income	54	3	3	0.47	40	27	4	0.49	45	7	4	0.43
Wealth	nr	nr	22	0.06	8	13	11	0.17	nr	4	4	0.03
Ceremonies	3	5	nr	0.05	nr	3	nr	0.02	nr	nr	4	0.01
Saving/banking	3	9	20	0.13	nr	6	3	0.04	7	42	11	0.32
Manure	nr	4	6	0.04	nr	8	nr	0.04	nr	nr	4	0.01

Index = sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) given for each variable divided by sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for all variables; I = index; R = rank; nr = not ranked.

Feed Resources

According to the interviews made, the main feed resources for sheep in the study area were natural pasture and crop residues during dry and wet season (Table 4).

Table 4. Major feed resources during the dry and wet seasons as measured by index values

Feed resources	Dega		Woina dega		Kolla		Overall mean	
	WS	DS	WS	DS	WS	DS	WS	DS
Natural pasture	0.44	0.42	0.45	0.44	0.45	0.39	0.45	0.42
Established pasture	0.13	0.2	nr	0.02	nr	nr	0.04	0.07
Crop residues	0.29	0.38	0.3	0.32	0.23	0.34	0.27	0.35
Fallow land	0.04	Nr	0.26	0.21	0.32	0.21	0.21	0.14
Concentrates	nr	Nr	nr	nr	nr	0.06	nr	0.02

WS = wet season; DS = dry season; nr = not ranked

Housing

This study demonstrated that 59.4% of the households in the study area housed their sheep within the family house with roof, 11.7% separate house with roof and the rest 28.9% housed their sheep attached with the family house. According to the survey results, 72.8% of the households used corrugated iron sheet, 22.2% grass/bushes and 5% plastic materials for construction of roof, while 53.9% of households used grass/bushes, 23.3% straw, 8.3% wooden paved, 8.3% small sized stones and 6.1% mud /earth for the construction of floor.

Breeding practices

Selection criteria for breeding animals

According to the survey result, the most important criteria for selection of both breeding rams and ewes were body size or appearance/conformation, tail shape and coat color (Table 5).

Selection criteria for breeding rams

Selection criteria for selecting breeding rams as ranked by households in the study area have been presented in Table 5. Rams were selected for breeding at 9.7, 10.4 and 11.5 months of age in Dega, Woina dega and Kolla, respectively (Table 5). From the selection criteria considered, body size or appearance/conformation was ranked first by sheep owners in Dega, Woina dega and Kolla with index values of 0.34, 0.45 and 0.39, respectively. In Dega, tail shape, color, pedigree, age and growth were ranked second, third, fourth, fifth and sixth with index of 0.28, 0.19, 0.07, 0.05, 0.03, respectively. In Woina dega, tail shape, color and growth were ranked second, third and fourth with index of 0.34, 0.17 and 0.03, respectively. Similarly, in Kolla tail shape, color, adaptability, growth and age were ranked second, third, fourth, fifth and sixth with index of 0.3, 0.15, 0.07, 0.04 and 0.04, respectively. Most of the time large body size, red coat color, and white color, long fat tailed were the usual preferred traits to select breeding rams.

Selection criteria for breeding ewes

Selection criteria for selecting breeding ewes as ranked by households in the study area are presented in the Table 5.

Table 5. Selection criteria of breeding ram and ewes

Selection criteria	Dega				Woina dega				Kolla			
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I
Breeding ram												
Size/appearance	34	7	7	0.34	46	12	2	0.45	35	10	15	0.39
Color	3	7	46	0.19	2	nr	54	0.17	5	5	29	0.15
Adaptability	nr	nr	nr	nr	nr	nr	nr	nr	nr	11	5	0.07
Growth	4	nr	nr	0.03	4	nr	nr	0.03	5	nr	nr	0.04
Age	4	4	nr	0.05	nr	nr	nr	nr	5	nr	nr	0.04
Libido	4	nr	nr	0.03	nr	nr	nr	nr	nr	nr	nr	nr
Tail shape	3	42	7	0.28	8	48	4	0.34	10	34	11	0.3
Pedigree	8	nr	nr	0.07	nr	nr	nr	nr	nr	nr	nr	nr
Breeding Ewe												
Body size	35	13	3	0.37	50	5	nr	0.44	38	13	9	0.41
Colors	4	4	36	0.16	5	nr	51	0.18	4	nr	38	0.14
Lamb growth	8	3	nr	0.08	nr	nr	nr	nr	10	nr	nr	0.08
Tail shape/length	4	35	16	0.27	5	50	5	0.33	4	47	9	0.32
Pedigree	9	5	5	0.12	5	4	nr	0.06	4	nr	4	0.04

Index = sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for each selection criteria divided by sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for all of the selection criteria; I = index; R= rank; nr = not ranked

Traits of preference by farmers

In the study area, body size/conformation, tail type/long fat tailed, coat color, disease tolerance, growth rate and fertility/prolificacy were among the reported preferred traits by the farmers (Table 6).

Table 6. Traits of preference as reported by the farmers in the study area

Traits	Dega				Woina dega				Kolla			
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I
Size/conformation	35	12	28	0.44	36	14	5	0.39	36	7	7	0.36
Color	3	6	11	0.09	nr	5	28	0.11	6	10	39	0.21
Disease tolerance	nr	nr	3	0.008	9	nr	nr	0.07	3	nr	3	0.03
Growth rate	5	3	3	0.07	5	2	nr	0.05	5	6	nr	0.07
Tail type/fat tailed	12	35	15	0.34	10	31	14	0.29	11	37	11	0.33
Fertility/prolificacy	5	4	nr	0.06	nr	8	13	0.08	3	nr	nr	0.02

Index = sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for each trait divided by sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for all of the traits preferred by farmers; I = index; R = rank; nr = not ranked

Disease and health management

According to the farmers, the type of disease which frequently occurred in Dega were internal parasites, ecto-parasites, pneumonia and foot and mouth disease. In Woina dega internal parasites, ecto- parasites, pneumonia, foot and mouth disease, faciolosis, listeriosis and Anthrax were mentioned by the farmers, Whereas in Kolla internal parasites, ecto- parasites, pneumonia, foot and mouth disease, Anthrax and sheep pox were common (Table 7). From the listed diseases and parasites in the study area, ecto-parasites are common health problems that were reported by the majority (46.6%) of the farmers (Table 7). According to the respondents, 82.8% received veterinary services from government, 7.2 % from private veterinary, 7.2% both government and private veterinary and 2.8 % from open market. In Kolla, all (100%) farmers received drugs / veterinary services from government.

Table 7. Reported sheep health problems in the study area (in %)

Suspected diseases and parasites			Agro ecology			Overall (N=180)
Local name	Common name	Reported symptoms	Dega (N=60)	W/dega (N=60)	Kolla (N=60)	
Sombe	Pneumonia	Coughing	16.67	10.5	6.33	11.17
Masaa	Foot and mouth disease	Blisters in their mouth and feet	23.33	7.5	3.67	11.5
Moorulla	Faciolosis	Swelling around neck and tongue	na	2	na	0.67
Martoo	Listeriosis	Rotating by them self	na	1.5	na	0.5
Abbaa sangaa	Anthrax	Sudden death with bleeding	na	3.5	6.5	3.33
Dolla	Sheep- pox	Swelling around teat	na	na	8.5	2.83
Mxxantuu qaamaalaa	Ecto-parasites	Restless , irritation of skin	40	48.33	51.33	46.55
Albaatii	Internal parasite	Loss of appetite diarrhea	20	26.67	23.67	23.45

N = number of respondents; na = not available

Lambing pattern in the study area

Table 8. Reported months of lambing in Agarfa district

Months	Dega				Woina dega				Kolla			
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I
September-November	42	8	6	0.41	53	3	4	0.47	38	12	10	0.41
December-February	4	46	2	0.29	7	49	4	0.34	15	37	8	0.35
March-May	8	2	48	0.21	nr	4	48	0.16	3	4	34	0.14
June- August	6	4	4	0.08	nr	4	4	0.03	4	7	8	0.09

Index = sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for each season divided by sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for all of the seasons reported by farmers; I = index; R = rank; nr = not ranked.

Major constraints of sheep production

According to the respondents, feed shortage, disease, water shortage and predators were among the reported constraints of sheep production in the study area (Table 9). Feed shortage and disease have been reported by the majority of the respondents in the three agro ecologies as the common constraint and ranked first and second. During the focus group discussion, shortage of feed was due to the increment of human population, which led to shrinkage of communal grazing areas due to expanded crop cultivation. Genotype and labour were among the different constraints given to the respondents in the three agro ecologies to rank but none of the respondents listed them as a major constraint. At the same time, market and drought were not major constraints in Dega and Woina dega.

Table 9. Major constraints of sheep production in the three agro ecologies of the study area

Constraints	Dega				Woina dega				Kolla			
	R1	R2	R3	I	R1	R2	R3	I	R1	R2	R3	I
Feed shortage	15	43	19	0.42	43	13	11	0.46	30	17	8	0.37
Water shortage	12	7	20	0.22	5	nr	16	0.09	8	6	37	0.2
Disease	30	10	21	0.36	12	38	33	0.4	11	34	8	0.3
Drought	nr	nr	Nr	nr	nr	nr	nr	nr	2	3	3	0.04
Market	nr	nr	Nr	nr	nr	nr	nr	nr	3	nr	nr	0.02
Predator	3	nr	Nr	0.02	nr	9	nr	0.05	3	nr	3	0.03

Index = sum of (3 X number of household ranked first + 2 X number of household ranked second + 1 X number of household ranked third) for each constraint divided by sum of (3 X number of household ranked first +2 X number of household ranked second + 1 X number of household ranked third) for all of the constraints reported by farmers; I = index; R = rank nr = not ranked

Reproductive performances

According to the respondents, the overall age at puberty/ sexual maturity/ in male Agarfa woreda sheep was 10.1months, while it was 9.23, 9.39 and 11.61 months in Dega, Woina dega and Kolla agro ecologies, respectively (Table 10). In the study area, the overall age at puberty in female was 11.7, while it was 10.2, 10.47 and 12.83 months in Dega, Woina dega and Kolla agro ecologies, respectively (Table 10). Based on the response of the farmers, the overall estimated mean age at first lambing was 13.23 months, while it was 12.44, 12.47 and 14.78 months in Dega, Woinadega and Kolla agro ecologies, respectively (Table 10). The overall estimated mean lambing interval for Agarfa Woreda ewes was 7.5 months with 6.75, 7.4 and 8.4 months of age for Dega, Woina dega and Kolla agro ecologies, respectively (Table 10). According to the survey result, the average overall reproductive lifespan of ewes was 8.44 years. The corresponding values for Dega, Woina dega and Kolla agro ecologies were 9.51, 8.98 and 6.83 years, respectively (Table 10). Based on the survey result, in the study area on average an ewe can produce 5.45 lambs, while in Dega, Woina dega and Kolla an ewe can produce 6.77, 5.45 and 4.13 lambs in her life time, respectively. The overall average number of lambs born per lambing in this study was 1.36, with 1.73, 1.25 and 1.08 lambs in Dega, Woina dega and Kolla agro ecologies, respectively (Table 10).

Table 10. Reported reproductive performances in the three agro ecologies (Mean ± SD)

Reproductive parameters	Dega	Woina dega	Kolla	Overall
Age of males at sexual maturity	9.23±0.48[b]	9.39±1.06[b]	11.61±1.61[a]	10.1±2.58
Age of females at sexual maturity	10.2±0.55[b]	10.47±1.12[b]	12.83±1.4[a]	11.17±2.24
Age of ewes at first lambing	12.44±0.62[b]	12.47±0.86[b]	14.78±0.49[a]	13.23±1.55
Lambing interval	6.75±0.37[c]	7.4±0.71[b]	8.4±1.1[a]	7.5±1.04
Reproductive life time of ewes	9.51±1.25[a]	8.98±1.23[b]	6.83±0.9[c]	8.44±1.62
Number of lambs per ewes life time	6.77±9.15[a]	5.45±1.03[ab]	4.13±0.7[b]	5.45±5.41
Number of lambs per lambing	1.73±0.45[a]	1.25+0.44[b]	1.08±0.28[c]	1.36±0.48

[a-c]Means with different superscript letters within the same raw are significantly different (p<0.05); SD = standard deviation

DISCUSSION

There was significant difference (P < 0.05) in flock and herd size between agro ecologies for all of the major livestock species in the study area. Respondents of the Kolla owned higher number of donkey and goat than households of Dega and Woina dega. Similarly, higher number of households in Dega owned sheep as compared to the other agro ecologies. The results also indicated that the highest numbers of calves, horse and mule were found in Dega. Because of the fact that this study involved farmers who owned sheep as major criteria, all respondent (100%) across the study area had sheep. However, the proportion of farmers who owned sheep was different in the three agro ecologies. The average holding of sheep per household in Dega, Woina dega and Kolla were 8.27, 7.3 and 6.12, respectively. The average holding of sheep per household (7.23) in this study was lower than the average holding of Gumuz sheep (16.02) at Metema [13] and black head Somali sheep breed (19.19) in Somali region [14]. It is also lower than 11.3 reported for Adiyo Kaka sheep [15] and 8.2 reported for Horro sheep [13]. On the other hand, it was higher than the average holding of Wolaita sheep (2.77) reported by [16] and 5.7 reported for Hararage highland sheep [17]. In this study there was higher proportion of breeding ewes which is important for the production of larger number of lambs. The proportion of breeding ewes obtained from this study is in agreement with that of 49.2% reported for Afar breeding ewes [18] and higher than 30% reported for Keffa and Bench Maji ewes [19]. The proportion of breeding rams was 7.3%. The ratio of breeding ram to ewe in this study was 1:6.1. This ratio is close to the report of 1:6.7 for Gumuz sheep [13], While it is higher than 1:7.7 for Hararage highland sheep [17] and 1:17.4 for Afar sheep [18] and lower than the report of 1:1.98 of Dawuro and Konta sheep [20] and 1:5.21 for Keffa and bench maji [19]. Maintaining the proper ratio of fertile rams and ewes is important as it can affect the overall reproductive efficiency [21]. According to the survey result, from the different purpose of keeping sheep, income from sales ranked first. Similarly, [17] and [18] reported that income generation was the main purpose of keeping sheep in Hararage and Menz area, respectively. The income/cash obtained is used for buying clothes for families, household materials, and school items for children, reducing risk of financial problems and other household financial needs. Sheep meat is a favorite food in festivities/ceremonies/ such as Easter, Chris-mass, Moulid, Arafat and Weeding ceremonies. Among the purpose of keeping sheep manure and socio cultural received relatively lower ranks in the study area. The main feed resources for sheep in the study area were natural pasture and crop residues during dry and wet season. This is in line with the results of previous studies [18,22-24]. However, their contribution varied between seasons with the contribution (an index value of 0.42 for natural pasture and 0.35 for crop residues) in the dry season but higher for natural pasture during the wet season (index of 0.45 natural pastures and 0.27 for crop residues). The major crop residues used in this area include barley, wheat and noug. The availability of feed in this area shows seasonality. Mostly feed shortage occurred during the dry season. During focal group discussion, sever seasonal feed shortage experienced for a

period of three to four months (February to May) in every year. Gizaw S, et al. [27] reported that besides feed deficit, feed shortage is expressed in terms of seasonality of feed availability, quality of the available feed and feeding practice. According to group discussion, during this period, most farmers feed their sheep household food leftovers, leaves of trees, bushes and garaba/leftovers of khat (Catha edulis), crop residues, conventional feeds like atela and local brewery by products and wheat bran. In the study area, only few numbers of respondents used concentrates (0.002%) as supplementary feeds. During group discussion, farmers at times of feed shortage, they provide supplementary feeds to lactating ewes, lambs and sick animals' priority. According to the farmers, common salt is given to sheep both in dry and wet seasons frequently, especially for rams which were kept for fattening purpose. However, salt alone does not provide any additional nutrient to the animals. In fact, excess salt to animal can cause toxicity effect if they are not properly fed. Most of the households (75.6%) housed sheep together with goat, while 24.4 % of the households housed sheep and goat in separate house. This study is in line with, [17] who reported that 66.1% Hararage households housed sheep together with goat, while 33.9% of them were housed sheep and goat together in separate house. Most farmers (82.2%) separate new born lambs (1-3 weeks) from the flock for a few days by partition to reduce physical injuries by adults. From observations made during the informal survey, most farmers do not clean sheep houses daily and majority of the houses were not ventilated. Lemma S [25], reported that poor housing favors disease and other complexes due to overcrowding in traditional production system. The most important criteria for selection of both breeding rams and ewes were body size or appearance/conformation, tail shape and coat color. This study is in agreement with that of [17] who reported for Hararage sheep that the most important criteria for selection of both breeding rams and ewes were size/appearance, tail shape and color, respectively. In contrast to this study [18] reported that reproductive traits were more important for ewes in Menz area than conformation/appearance. In all agro ecologies, body size/conformation, tail type and coat color were the most important traits for the farmers. According to the survey result, farmers in the study area preferred long fat tailed type which is cylindrical straight and twisted up at end of the tail. The reason is that this trait is the most important characteristic of their sheep type, which makes them to be preferred. The most preferred coat colors were red, white, white and red, white patchy, red patchy and black and white patchy, while unwanted color was black because of lower customers preference in the market due to various traditional beliefs. Shibabaw W [17], reported that traits like body appearance and coat color were the most considered characters in Hararage which are in line with the current findings. The survey result showed that disease was the major constraint to sheep production in the study area next to feed shortage [17]. Also reported that disease and predators were the major constraints for sheep production in Hararege and Dire Dawa area, respectively. In the study area, lambing takes place throughout the year, while peak lambing was observed from September to November. This indicates that most of the conception occurred during the short rainy season, which extends from March to June. This study is similar to Gizaw S [3] who reported that, in Agarfa district, kidding takes place all year round while, peak kidding was observed from September to November. Good reproductive performance is vital for any successful livestock production program. The age at puberty primarily depends on the nutrition supply during the growth period. Rams may reach puberty at four months under intensive management or two years under extensive management conditions [26]. The age at puberty of females also depend on management especially, on level of feeding/nutrition. Well-fed ewe lambs may reach puberty at 9 months, but when nutrition is poor, puberty may occur as late as 20 months [26], Age at puberty observed in this study for female was longer than the values reported for Gumuz (7.21 months) sheep [13] and shorter than that of black head Somali sheep which is 17.97 months [14]. The average overall reproductive lifespan of ewes was 8.44 years. However, the current findings are longer than that of reported for Wolaita sheep (7.02 years) [16] and shorter than that of black head Somali sheep (9.1 years) [14] and Hararge highland sheep (9.4 years) [17]. The overall average number of lambs born per lambing in this study was 1.36, with 1.73, 1.25 and 1.08 lambs in Dega, Woina dega and Kolla agro ecologies, respectively. Similarly, [27] and [28] reported litter size of 1.4 and 1.3 for Arsi bale and Abergelle sheep, respectively [29-32].

CONCLUSION

The present study was done to describe production systems, production constraints and to evaluate trait preferences of the sheep owners in the study area. The study was conducted in Dega, Woina dega and Kolla agro ecologies of Agarfa Woreda, Bale Zone, Oromia National Regional state. The study on description of the production system was based on survey of 180 respondents. The major purpose of sheep rearing in the study area were for income, saving, meat, wealth, manure and socio-cultural/ceremonies. The most important trait of preferences by the farmers in all the three agro ecologies were body conformation/appearance, tail type and color. The major constraints of sheep husbandry were feed and water shortage, disease prevalence and predator. The results further tell that though dealing with animals from different agro ecologies, the farmers have relatively similar production and trait preferences. Therefore, this finding was put baseline for understanding about production and traditional selection practices of sheep as first step in designing a sustainable breeding programme in the study area.

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DATA AVAILABILITY STATEMENT

Data used and analyzed for this study are available from the corresponding author on reasonable request.

DISCLOSURE STATEMENTS

No potential conflict of interest was reported by the author(s).

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