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Herd management and breeding practices of sheep owners in a mixed crop-livestock and a pastoral system of Ethiopia

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An exploratory survey was undertaken to understand sheep production system, breeding practices and selection criteria for Ethiopian Menz and Afar sheep breeds in their home tract as a step towards developing sustainable sheep breeding strategies. The mean sheep flock size was 31.6 in Menz and 23.0 in Afar area. Half of the pastoralists (Afar) and one-fifth of smallholder farmers (Menz) do not have a breeding ram. Mating was predominantly uncontrolled. Higher chance of mixing sheep flocks was reported in most of the seasons. Menz and Afar rams were castrated at 1.7 and 1.5 years old, respectively. Castrates were kept for longer period of time, on average for 1.9 years in Menz and 3.1 years in Afar. Appearance/conformation was the most important trait in choosing a breeding ram for both Menz and Afar sheep owners. Breeding ewes are chosen based on lambing interval and mothering ability in both crop-livestock and pastoral systems; and milk yield in pastoral system. Afar ewes produce mean daily milk yield of 224 ml. In Menz area sheep are kept for income, meat, manure, coarse wool and as means of saving, in that order. In Afar area, sheep are kept for milk, meat and income. Livestock improvement programs targeting smallholder farmers need to incorporate existing traditional herding and breeding practices, trait preferences and the multiple roles of sheep.

Key words: Afar sheep, indigenous selection criteria, low-input production systems, menz sheep.

INTRODUCTION

Ethiopia is home for an estimated 25 million sheep (CSA, 2007) and about 14 traditional sheep populations (Gizaw et al., 2007). Their multipurpose role of sheep as source of income, meat, skin, manure and coarse wool or long hairy fleece, means of risk avoidance during crop failure

and their cultural function during festivals are well documented (Kosgey et al., 2008). Despite low level of productivity due to several technical (genotype, feeding and animal health), institutional, environmental and infrastructural constraints (Tibbo, 2006) indigenous sheep breeds have great potential to contribute more to the livelihood of people in low-input, smallholder crop-livestock and pastoral production systems (Kosgey and Okeyo, 2007). It is important to the currently low producti-vity in order to satisfy the large and ever-increasing

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population of Ethiopia estimated at 79.2 million in July 2007 with an annual growth rate of 2.5% (CSA, 2007). Unfortunately, attempts to improve small ruminants in the Tropics so far faced several constraints mainly due to weak planning, poor involvement of livestock owners and implementing livestock improvement programs without taking into consideration all the needs of farmers (Sölkner et al., 1998; Tibbo et al., 2006). There is, therefore, a need for new thinking and developing breeding programs with the consultation and involvement of all stakeholders from the planning to implementation phase. Sölkner et al (1998) propose a new approach, which is a community-based breeding program.

This work is part of an on-going project, initiated jointly by the International Center for Agricultural Research in the Dry Areas (ICARDA), International Livestock Research Institute (ILRI), Austrian University of Natural Resource and Applied Sciences (BOKU), and Agricultural Research Systems in Ethiopia to design community-based sheep breeding strategies. Detailed and up-to-date information on production system, indigenous knowledge of managing the breed, identification of important traits for selection with full participation of farmers are prerequisites (Sölkner et al., 1998; Kosgey et al., 2006). Unfortunately, this information is not readily available for Ethiopian sheep breeds (Ayalew et al., 2004) and available information so far has been based on on-station managed flocks. Thus, this study was aimed at assessing traditional sheep breeding practices and herding systems and identifying trait preference of smallholder farmers and pastoralists in Menz and Afar region. Based on this information breeding programs for Menz and Afar sheep can be jointly developed with sheep keepers.

MATERIALS AND METHODS

Study sites

The survey was conducted in the cool highlands (Menz) and arid and semi-arid lowlands (Afar) of Ethiopia, representing one mixed crop-livestock and one pastoral production systems. Two villages in Menz and one village in Afar were selected based on their suitability for sheep production, market and road access and willingness of the pastoralists to participate on the program. A total of 228 households (120 in Menz and 108 in Afar) were randomly sampled for the survey. In Menz, the survey was conducted at an altitude ranging from 2800 to 32000 m.a.s.l. based on the meteorological data obtained from Debre Berhan Research Centre for the years 1985 to 2004, the annual rainfall at Mehal Meda town (the capital of the Menz Gera district) was about 900 mm and the minimum and maximum average temperatures was 6.8 and 17.6°C, respectively. The production system of Menz can be characterized as a mixed crop-livestock system.

In Afar, the study was conducted at an altitude ranging from 750 to 812 m.a.s.l. based on the meteorological data from Werer Research Centre for the years 1965 to 2006, the annual rainfall was 588 mm, and average daily temperature was about 27.6°C with a maximum approaching 38°C in June and a minimum of 15.4°C in November. In Afar, pastoralists are found who exclusively depend on livestock for their livelihood.

Data collection and analysis

A questionnaire was designed to obtain information on general household information, purpose of keeping sheep, flock size and structure, herding and breeding practices and selection criteria of breeding rams and ewes. The questionnaire was tested before the survey started to ensure that all questions were clear for the interviewees. Data were entered into Statistical Package for Social Sciences (SPSS 13.0 for window, release 13.0, 2004). The same statistical package was used to summarize the data and results are presented mainly in the form of descriptive tabular summaries for the two farming systems. Chi-square or t-test was employed when required to test the independence of categories or to assess the statistical significance. Indices were calculated to provide ranking of selection criteria and the reasons of keeping sheep; and calculated as Index = Sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual reason divided by the sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) for overall reasons.

RESULTS

Household characteristics

The average household size in the crop-livestock system of Menz (5.97) was lower (p < 0.01) than in the Afar pastoral production system (6.24). Average land holding of farmers in Menz area was 1.1 ha, of which 0.3 ha is for grazing. Out of the total crop land about 64% was used for main season cropping and the remaining 36% was used for short rain cropping. Sheep are the predominant species of livestock and accounted for 84.81% of the total population owned, followed by cattle (9.85%). Goats were found in larger proportion in Afar followed by sheep, cattle, camels and donkeys with proportion of 41.26, 23.92, 21.55, 12.19 and 1.08%, respectively. With regard to family food, in Menz area, food crops received the highest ranking with an index of 0.57 followed by sheep (0.30) and cattle (0.13). Whereas, for income generation sheep contributed more than any other farming activities with a total index of 0.63 followed by cattle with index of 0.29. In Afar, pastoralists depend almost entirely on livestock as means of income and food source for the family. The highest importance for family food and as source of income was given to goats, then to cattle, sheep and finally camel.

Reasons for keeping sheep

Table 1 shows the ranks of the sheep production objectives by smallholder farmers and pastoralists. The

Table 1. Ranking of sheep production objectives by smallholder farmers and pastoralists.

Production objective	Production system							
	Menz, crop-livestock				Afar, pastoral			
	Rank 1	Rank 2	Rank 3	Index	Rank 1	Rank 2	Rank 3	Index
Income	109	4	0	0.47	10	35	43	0.23
Meat	5	49	40	0.22	1	50	47	0.24
Manure	1	27	34	0.13	-	-	-	-
Hair	1	16	26	0.09	-	-	-	-
Saving	1	20	10	0.07	-	-	-	-
Ceremony	0	2	3	0.01	2	1	0	0.01
Wealth	1	0	1	0.01	6	6	2	0.05
Religious	0	0	1	0.00	-	-	-	-
Skin	0	0	3	0.00	1	0	1	0.01
Milk	-	-	-	-	84	12	7	0.45

primary reason for keeping sheep in Menz was income generation. Other reasons mentioned by farmers and their respective indices were meat consumption (0.22), manure (0.13), wool (0.09) and sheep as means of saving (0.07). However, in Afar the primary reason of keeping sheep was milk production followed by meat consumption and to generate income with an index of 0.45, 0.24 and 0.23, respectively.

Flock size and structure

The total number of livestock kept was higher in the pastoral system (96) than in the smallholder system of Menz (37). On the contrary, the size of sheep flocks was higher in Menz with an average of 32 animals (range of 7 to 69) than in Afar with an average flock size of 23.0 animals (range of 5 to 80). In Menz, breeding ewes formed the largest proportion (46.8%) of the flock, followed by male lambs (19.2%) and female lambs (14.3%). Similar results were obtained in Afar where breeding ewes were dominant (49.2%), followed by male lambs (23.6) and ewe lambs (18.1).

The proportion of breeding rams and castrates in Menz were 5.7 and 3.9% and in Afar 2.8 and 0.8%, respectively. Therefore, the ratio of breeding ram to breeding ewe was 1:8.3 and 1:17.4 in Menz and Afar flocks, respectively.

Herding practice

Table 2 shows the percentage of households mixing their sheep flock with other species and other sheep flocks within a village in the mixed crop-livestock and the pastoral production system. About 44% of the sheep owners in Menz area herd sheep together with other

species (cattle, equines and goat), 41.7% keep the sheep flock separately and 14.2% of the farmers keep them sometimes separately and sometimes with other livestock species depending on the availability of labor. In pastoral areas, sheep were grazed with goats throughout the year. In both systems, children are usually responsible for herding sheep. There is always the possibility of mixing with other adjacent sheep flocks within a village. During the rainy season, 62.5% of the sheep owners stated that their sheep flock had a possibility of mixing. Immediately after the rainy season (September to November) and during crop harvesting time (November to January) more than 85% of the smallholder farmers in Menz area herd their sheep on their private land in order to exploit natural pasture and crop aftermath. After the crop aftermath was depleted from the cultivated land, sheep are free to graze everywhere. All pastoralists stated that they practiced transhumance and moved around with their animals in search for feed and water.

Pastoralists settled in a village are usually relatives and mostly move to new places together and settle there. In Afar area, during the main rainy season sheep graze on relatively upland areas and 64.8% of pastoralists explained that their animals mix with other flocks. Whereas during the dry season, only 33.6% of the interviewees reported that their sheep flock mixed with others.

Ram ownership and purpose of keeping ram

Over 20% of the sheep owners in Menz had no breeding ram, 17.6% owned one ram and 61.8% owned more than one breeding ram. Whereas, 51.7% of Afar sheep breeders did not have breeding ram, 36.7% owned one ram and 11.6% had more than one breeding ram. The majority of the breeding rams (90%) in Menz were born in

Table 2. Percentage of households mixing their sheep flock with other species and other sheep flocks.

Sheep herding	Production system	
	Crop-livestock (n=120)	Pastoral (n=108)
	(%)	(%)
With other species		
Herded with other species (cattle, equines and goat)	44.1	-
Herded separately	41.7	-
Separately and with other species	14.2	-
With goat	-	100.0
Season of herding		
During the rainy season	62.5	64.8
After the rainy season	14.7	-
During crop harvesting time	11.8	-
Dry season after crop aftermath was picked up	81.7	33.6

the flock and 7.1% were purchased from the market. In Afar area all the breeding rams originated from within the flock.

The majority (65.5%) of the farmers in Menz keep rams for breeding and for later fattening, 24.1% for breeding only, 3.5% for breeding and socio-cultural benefit and 6.9% of the interviewees stated that all the four aspects are important to them. In Afar, almost half (49%) of the pastoralists keep rams for breeding only, 32% for breeding and fattening, 7.0% for breeding and socio-cultural benefits and 11% for breeding, fattening and other socio-cultural benefits. Menz farmers had more interest to keep rams for both purposes (breeding + fattening) than the Afar pastoralists.

Castration

The majority of the Menz (96.7%) and Afar (97.2%) sheep owners practice castration using traditional method (use of knives). Castration is usually done at age of 1.7 years in Menz and 1.5 years in Afar sheep. In both areas it was reported that castrated sheep were kept for an extended period of time (1.9 and 3.1 years, respectively). In Menz farmers gave the following reasons for castration: improve fattening (61.1%), to avoid unnecessary mating (15.0%), to improve the fattening potential and behavior of the ram (14.2%) and for all of the above reasons (9.7%). The reasons of castration mentioned by Afar sheep owners were similar: to avoid unnecessary mating and improve fattening (30.6%), to improve fattening only (30.8%), to avoid unnecessary mating only (10.6%), to improve ram behavior (2.9%) and for all of the above cases (23.1%).

Breeding practices

Breeding was generally uncontrolled in both areas. Only in Afar sheep owners reported that they try to avoid dry season lambing and indiscriminate mating. Methods like ram isolation, castration and tying of a cord around the neck of the scrotum and looped over the prepuce to prevent extrusion of the penis of the ram were used to control mating in Afar. About 63% of farmers in Menz area and 77% of pastoralists in Afar area claimed that they were able to identify the sire of the lamb by relating lamb with the color and appearance/conformation of rams.

Selection criteria

Majority of the farmers (90%) and pastoralists (80%) reported that they recognize the importance of selection. Ranking of selection criteria of farmers and pastoralists for their breeding rams and ewes are presented in Table 3. In selecting a breeding ram, appearance and/or conformation ranked first for both Menz and Afar sheep owners with an index of 0.29 and 0.35, respectively. In Menz fast growth, coat color, tail size and shape, and mating ability were ranked high with indices of 0.24, 0.20, 0.18, and 0.04, respectively. In Afar area, tail size and shape, fast growth, coat color and mating ability were ranked second, third, fourth and fifth important traits with indices of 0.20, 0.17, 0.15 and 11, respectively. Afar pastoralists claim that they treat human diseases such as malaria, constipation and other abdominal problems using the fat in the tail of Afar sheep and believe that the causative agent of the disease will be expelled with diarrhea after drinking the fat from the tail.

Table 3. Selection criteria for breeding rams and ewes in crop-livestock and pastoral production systems.

Class and selection criteria	Production system							
	Menz, crop-livestock				Afar, pastoral system			
	Rank 1	Rank 2	Rank 3	Index	Rank 1	Rank 2	Rank 3	Index
Breeding ram								
Appearance/conformation	47	26	18	0.290	63	11	17	0.350
Colour	17	30	30	0.200	3	30	29	0.150
Horn	0	7	8	0.030	0	0	4	0.006
Ear	1	2	7	0.020	0	0	3	0.005
Fast growth	38	24	13	0.240	17	24	11	0.170
Fleece yield	0	1	1	0.004	-	-	-	-
Mating ability	2	4	11	0.040	6	22	10	0.110
Tail size and shape	15	26	32	0.180	18	21	32	0.210
Breeding ewe								
Appearance/size	9	6	16	0.080	11	24	8	0.150
Coat colour	11	14	19	0.120	1	16	28	0.100
Mothering ability	18	34	29	0.220	16	16	17	0.160
Age at first lambing	4	5	1	0.030	4	2	2	0.030
Lambing interval	42	33	17	0.310	11	14	12	0.120
Twinning	25	13	9	0.160	10	10	2	0.090
Tail size and type	4	4	15	0.050	4	10	21	0.090
Milk yield for family	-	-	-	-	43	1	1	0.220
Ear size	0	2	3	0.010	0	0	8	0.000
Longevity	1	3	3	0.020	1	6	2	0.040

Menz sheep breeders consider lambing interval, mothering ability, ability to give multiple birth and coat color type as the four most important reasons for selecting breeding ewes with an index of 0.31, 0.22, 0.16 and 0.12, respectively. On the other hand, Afar sheep breeders consider milk yield, mothering ability, appearance or ewe conformation and lambing interval as the four most important traits.

Milking and shearing practices

All of Afar pastoralists milk their ewes twice a day and use the milk for home consumption. The only exception when ewes are not milked is when they are in poor condition at lambing or lambing occurred during the dry season. The pastoralists stated that the lactation length ranged from 1.5 to 6.0 months depending on the parity and condition of the ewe, and availability of feed. Sheep milk is commonly used for preparation of a local drink known as *'hashara'*, which is prepared by boiling sheep and/or goat milk in water and roasted coffee hulls. Pastoralists prefer sheep milk for butter making due to the perceived higher fat content. Milking is not practiced in Menz area.

In Menz area, shearing of sheep was common and is done twice a year. The first shearing usually occurs between August and October and the second between April and June. The wool was utilized by farmers for manufacturing local blankets and carpets or is sold for income generation.

DISCUSSION

A good understanding of a production system is important for initiating any genetic improvement program (Kosgey et al., 2006). In this study we provide information on breeding practices, ram management and production objectives of sheep production in one crop-livestock and one pastoral production systems of Ethiopia. Many reports on sheep flock size, other than the two extreme environments (cool highland and arid lowland), of the country are in a range of 3.5 to 16 (Tekle, 2003; Abegaz et al., 2005; Abegaz, 2007; Kocho, 2007; Taye, 2008). Larger flock size (19.2) was reported in Ethiopian Somali pastoralists (Ferew, 2008). The result obtained in this study and previous reports on sheep flock size have shown that sheep flock size is higher in both cool highlands and the lower arid areas compared with the

mid-altitude areas. This might be due to the fact that highly degraded (cool and dry highland) and hot dry areas could not support crop production as well as large ruminants (Rancourt, 2006; Tibbo, 2006) and therefore small ruminants present one option to secure the livelihood of families. Additionally, subsistence farmers might also prefer small ruminants to the large ones as the risk of large animal dying and leaving family without anything is too dangerous (Sölkner et al., 1998). The relatively larger sheep flock size and higher contribution of sheep to the family income and food source, compared with other parts of the country, obtained in this study indicated that the area favors sheep (Tibbo, 2006) and shows higher dependency of farmers/pastoralist on sheep (Verbeek et al., 2007) implying the higher chance of success and acceptance of village level sheep breeding strategy if planned carefully.

The average castration age reported for Menz (1.7 years) and Afar sheep (1.5 years) obtained in this study might help to avoid/reduce the very intense form of inbreeding (sire-daughter mating). Castration and fattening practices by Afar pastoralists is not as common as for Menz farmers. They rather tend to sell more intact male sheep at their early age. The reason for selling males early was because of their social regulation that considers male sheep as the property of the tribe. This means that anybody from the tribe, who has an economic problem, has the right to sell any male sheep from any flock within the tribe. This might affect the productivity of sheep farming. The sale of ram lambs at early age might also induce negative selection as rams having good quality (fast growing male) could be sold for slaughter as they reach market weight faster than others (slow growers). In contrary to this many farmers (61.8%) in Menz area had more than one ram within a flock and this might cause indiscriminate breeding. Thus, efforts should be put on the selection and identification of breeding rams before market age to increase the proportion of breeding males in Afar pastoral system. Whereas, demonstration of early age finishing technologies and method of controlling unwanted mating using traditional apron (a flat piece of leather or plastic), which is hanged just behind the front legs around the belly and fixed in position by one rope holding the apron to the back of a ram and the other passing through the chest tied to both sides of the other preventing any slippage (http://news.bbc.co.uk/2/hi/africa/7648860.stm).

Utilization of breeding rams originated within the same flock and less knowledge of sheep keeper about inbreeding in both crop-livestock and pastoral system implies that the relationship of animals within the flock and within the village is narrow and inbreeding is increasing (Jaitner et al., 2001). However, communal herding practiced by most sheep owners in both production systems allows breeding females to mix with males from other flock and this can minimize the risk of inbreeding (Jaitner et al., 2001). Keeping breeding rams for prolonged period of time was common in Afar area and was practiced in Menz area only when the breeding ram is perceived to have special features (good appearance, preferred coat colour, large size, large and broad tail and true to breed type).

In addition to production traits, coat colour patter and type was given better attention and should be consider in decision making. A study by Ndumu et al. (2008) indicated that beauty traits like coat colour and pattern play significant role in ranking decision of Ankole cattle. Abegaz et al. (2005) also reported that farmers in east Wellega and west Shewa prefered white and brown coloured sheep. Knowledge of reasons for keeping animals is a prerequisite for deriving operational breeding goals (Jaitner et al., 2001). In crop-livestock production system the highest ranking was given for regular cash income followed by meat consumption, manure, coarse fleece and saving, whereas, pastoralists gave the highest rank for consumption (milk and meat) followed by regular cash income. The great contribution of sheep production to the diets of pastoralists is documented for Ethiopian Somali (Gizaw, 2008) and Afar (Dagen, 2007). Based on the reasons for keeping sheep, the main breeding goal has been defined as increasing meat production (improve growth rate and conformation), and fleece yield for Menz sheep and increasing milk yield and meat production for Afar pastoralists.

Conclusion

Uncontrolled mating in Menz, flock mobility and absence of breeding rams in many of the flocks in Afar are challenges which have to be tackled when implementing breeding programs. However, mixing of flocks reported by many of the farmers has a good potential in the efforts for solving absence of a breeding ram, reduce the risk of inbreeding and increase intensity of selection. Thus, strengthening the existing practice by organizing farmers/pastoralists utilizing common grazing land, based on their interests is an important prerequisite to start community-based breeding programs. Furthermore, qualitative traits like coat colour and pattern and other traits should be taken into consideration. In order to minimize the failure of breed improvement programs it is important to involve farmers and pastoralists, considering the existing breeding practices, management systems and trait preferences of the community and the multi-purpose roles of targeted animals.

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