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Original Research

Implementation of Community-based Sheep Breeding Programs in Different Production Systems in Ethiopia

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Abstract

This paper presents implementation process of community-based sheep breeding schemes selected by different communities among alternatives simulated following breeding objective traits identified through participatory approaches in Ethiopia. Four study areas: Afar (pastoral), Bonga and Horro (crop-livestock), and Menz (sheep-barley) were considered. Three measureable traits that were most preferred by the respective communities were selected as objective traits and used for simulation of alternative breeding schemes. The alternative schemes were presented to communities and jointly discussed upon with scientists focusing on the advantages and disadvantages of the different scenarios. Equipped, with this information, the project members finally made a decision as to which scheme(s) they liked and therefore want to implement. Prior to implementation, baseline information was collected for benchmarking and evaluation of the changes that will be realized from the improvement intervention. A total of 1364 in Afar, 1074 in Bonga, 2248 in Horro and 2411 in Menz sheep were ear-tagged. Recording formats were developed and enumerators were employed for communities to assist households in the measurements and recording. Monitoring of the breeding activities was done fortnightly by research team. Two stages of selection were applied to select breeding rams: initial screening at 6- and final selection at 12 months of age. A committee composed of 5 members from each community was actively involved in the selection process. A total of 14, 21, 36, and 50 rams have been selected and distributed for use in Afar, Bonga, Horro and Menz, respectively in two rounds of selection. Seed money was provided by the project to purchase the selected rams for the community; and different ram-groups were formed based on number of breeding ewes, settlement and communal grazing areas.

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INTRODUCTION

Genetic improvement programs of indigenous livestock in low- and medium-input production systems contribute significantly to improved livestock productivity (Olivier *et al*., 2002) as well as ensuring sustainable conservation strategies (Gizaw *et al*., 2008; Mirkena *et al*., 2010a). Livestock also contribute to the economy of the communities depending on them (Mueller, 2006). Research on production systems and local and indigenous knowledge systems during the last 10 to 15 years has yielded ample evidence that in many cases, indigenous breeds and their locally available derivatives would be the "best fit" in terms of adaptability to the physical and animal husbandry environments (FAO, 2010).

For production systems characterized by unfavorable environmental conditions, and poor infrastructure and weak organizational set up at farmers and national level, community-based breeding programs have been suggested as an alternative to governmental breeding programs (Valle Zárate and Markemann, 2010). However, for such programs to succeed, a careful analysis of information on all aspects of production systems should first be undertaken to elaborate a set of appropriate breeding objectives which normally varies from one production system to another so that the needs and aspirations of target groups are taken into account (FAO, 2010). A number of breeding programs have failed simply because preferences of target communities were not considered (e.g., some sheep crossbreeding programs in Ethiopia due to color and tail type deviation from the local breeds (Tibbo, 2006; Gizaw and Getachew, 2009; Rege *et al*., 2010); goat crossbreeding in Republic of Korea due to color difference of Boer from the local black goats (FAO, 2010)). Mueller (2006) summarized some examples of breeding programs in communities for sheep in Mexico and Peru, alpacas in Peru, llamas in Bolivia and goats in Argentina. Often only the outcomes of breeding programs are reported in literature; the specifics of the implementation process and lessons learnt from this process are not reported even though this information would be extremely important for repeating community-based breeding in other locations. A recent example of a comprehensive description of the concept, research results and implementation strategies taking as example pig breeding in Northern Vietnam is the paper by Valle Zárate and Markemann (2010). Thus, in this paper, we present the implementation process step by step for a community-based breeding program under smallholder conditions in four different production systems in Ethiopia.

MATERIALS AND METHODS

Study areas and Community Identification

Four study areas in different agro-ecological zones (Figure 1) were targeted for the design and implementation of community-based indigenous sheep improvement schemes in Ethiopia. These were: Afar (pastoral/agro-pastoral), Bonga (mixed crop-livestock), Horro (mixed crop-livestock) and Menz (sheep-barley). In each area, a research center is mandated to monitor the day to day implementation activities. Descriptions of the study areas are given elsewhere (Edea, 2008; Getachew, 2008). Briefly, Afar is located at about 250km east of Addis Ababa on the highway to Djibouti. Livestock rearing is the main stay of the area, except along the Awash River where cotton cultivation is practiced. The Afar sheep, which is used for milk and meat, is a hardy breed adapted to arid and semi-arid areas of the middle Awash valley which includes the coastal strip of the Danakil depression and the associated Rift Valley in Ethiopia (Galal, 1983; Wilson, 1991). Bonga and Horro are situated in the South Western and Western parts of Ethiopia at about 450km and 315km from Addis Ababa, respectively. Mixed crop-livestock production is the predominant production system in both areas. Both breeds are fat-long-tailed sheep and are highly valued for meat production. The areas have one major rainy season that extends from March to mid October (Denboba, 2005; Olana, 2006; Edea, 2008). Menz is located at about 280km North of Addis Ababa. The area is characterized as a low-input sheep-barley production system. Menz is a fat-tailed breed raised for meat and coarse wool production. Menz area is characterized by a bi-modal rainfall pattern where the main rainy season is from June to September and erratic and unreliable short rainy season in February and March (Getachew, 2008).

Participating communities in each area were selected by a team composed of researchers, development agents and local government officials following syntheses of secondary information and diagnostic surveys conducted to determine major sheep producing areas. In total, eight communities each with 60 households were organized based on sheep population, presence of communal grazing land, accessibility, and willingness of the community members to get involved in the improvement program. For individual households, possession of at least four breeding ewes was the requirement to enroll as a member in the community-based breeding program.

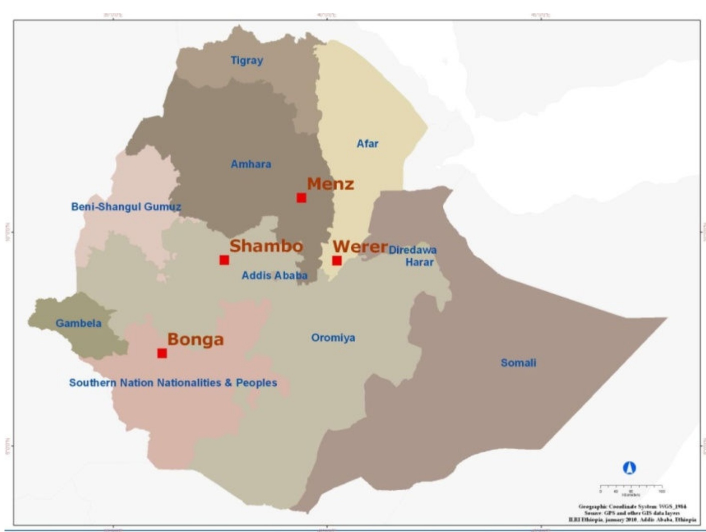


Figure 1: Study areas

Objective Traits Determination

Objective traits were determined for the different breeds through various approaches: production system studies (Edea, 2008; Getachew, 2008), choice experiments (Duguma *et al*., 2011), own-flock and group-animal ranking experiments (Mirkena *et al*., unpublished). The various approaches were employed so as to cross-check the validity of preferences from independent sources and to ensure that all the important traits were captured. Results from the different studies were combined and weighted traits rank was computed.

In order to keep things simple, and for ease of implementation under smallholder farmers'/pastoralists' circumstances, only three measureable traits that were most preferred by communities were selected as objective traits. These were: body size and lamb survival for all production systems; twinning rate for the mixed crop-livestock system; milk yield for the pastoral/agro-pastoral system and wool yield for the sheep barley system (Mirkena *et al*., 2010b).

Simulation Studies

Four alternative breeding schemes were simulated using a deterministic approach (Mirkena *et al*., 2010b). The schemes varied in the proportion of breeding rams selected and duration of ram use (in years). These were: 10% selection proportion and 2 years of ram use for breeding (Scheme 1), 10% selection proportion and 3 years of ram use for breeding (Scheme 2), 15% selection proportion and 2 years of ram use for breeding (Scheme 3) and 15% selection proportion and 3 years of ram use for breeding (Scheme 4). Details of simulation procedures, predicted genetic gains and economic returns achievable under the different scenarios were reported by Mirkena *et al*. (2010b).

Selection among Alternative Schemes

Simulation results of the alternative schemes were presented to communities and jointly discussed upon. The discussions between the scientists and the communities focused on the advantages and disadvantages (i.e. the consequences) of the different scenarios. Equipped, with this information, the community members finally made a decision as to which scheme(s) they liked and therefore want to implement. Communities in the mixed crop-livestock and the sheep-barley systems opted for strong selection pressure and use of rams for short durations (**Scheme 1**). However, the pastoral/agro-pastoral communities favored and opted for strong selection pressure and use of breeding rams for longer periods (**Scheme 2**). All the project communities favored strong selection intensities (10% best candidates) in view of possible superior genetic gains. Similar reasons were given by the communities in the mixed crop-livestock and the sheep-barley systems for choosing shorter duration of ram use. The reasons were: fear of increased risk of inbreeding and poor response of older rams to conditioning or fattening for sale. In the pastoral/agro-pastoral system, extended use of breeding rams was favored despite the communities' awareness of the associated inbreeding problems. Sato (1980) also reported that the Rendille pastoralists of Northern Kenya use breeding rams for 3 to 4 years. In the pastoral/agro-pastoral system, lambing is controlled to synchronize with seasons of feed availability making difficult frequent replacement of rams. This control results in longer lambing intervals than are found when breeding is allowed year round (Wilson, 1988). In addition, control leads to only one lamb crop per year while the uncontrolled breeding results in shorter lambing intervals enabling approximately three lamb crops to be obtained in two years. Thus, longer intervals coupled with litter size of about 1.06 for Afar flocks may lead to shortage of breeding rams for frequent replacement as compared to other sheep breeds found in the mixed crop-livestock system where lambing is year round and litter size is relatively high (1.34) and sheep-barley system where lambing is year round. Also, breeding males are generally considered as property of the clan where traditional laws inhibit individual owners the right to sale breeding rams once raised for breeding. Fattening is also not widely practiced in the pastoral areas.

RESULTS AND DISCUSSION

The general procedures followed in implementing the current community-based sheep breeding programs (CBBP) were indicated in Figure 2.

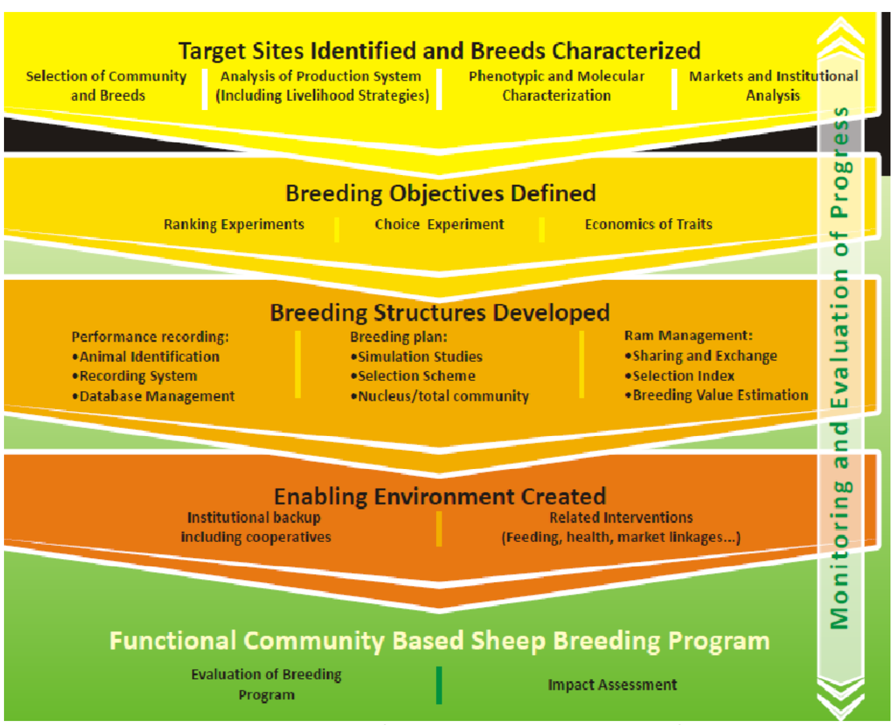


Figure 2: Procedures followed in implementing the CBBP

Animal Identification

Unique identification/numbering system (5-digit) per community was decided by the research team. Plain plastic ear tags were procured. Identification numbers were hand-written using indelible markers. All sheep belonging to project member households were ear-tagged. A total of 7097 animals (1364 in Afar, 1074 in Bonga, 2248 in Horro and 2411 in Menz) were covered. It was not possible to identify all animals in Afar due to reasons discussed below. Animal identification, performance and pedigree recording are the most essential management tools in genetic improvement and the development of sustainable selection decisions (Olivier *et al*., 2005; Bett *et al*., 2009). Based on practical experience of the sheep genetic improvement project in the Peruvian highlands, Mueller *et al*. (2002) reported that lack of performance recording prohibited accurate selection decisions.

Baseline Information

Information on the current husbandry practices (i.e. baseline breeding, feeding, health, etc.) is essential for benchmarking and evaluation of the changes realizable from the improvement intervention. Separate workshops were held with the respective communities to document the current husbandry practices in addition to the in-depth production system studies undertaken by Edea (2008) and Getachew (2008). Complete census of flocks owned by project members was done along with ear tag application to determine flock size and flock structure. Bodyweight measurement was also taken from each animal.

Selection of breeding rams in all areas is generally based on phenotypic appearance such as tail type, coat color, body size, conformation and libido. Within-flock selection is practiced but ewes may be bred by unwanted/unselected rams during grazing, given that village flocks share common grazing pastures and watering points. Ram borrowing is common among all the communities, but the extent varies from one community to another. In Afar, all breeding males are considered properties of a clan. Ewes are mainly culled for poor fertility and mothering ability. These two parameters were monitored for each ewe during the first 2 to 3 parities and the observations/ewe performance in these traits over such periods are assumed to be indicative of her performance in later life. Lee and Atkins (1996) also reported that early life fertility is an indicator of both fertility and the rearing ability of ewes in later life.

Availability of breeding rams in sufficient numbers differs among the production systems. In the pastoral/agro-pastoral system, though some male lambs are sold early, the communities indicated that adequate number of breeding rams is available. In the two mixed crop-livestock systems, male lambs are sold at as early as three to four months of age resulting in acute shortage of breeding rams in the flocks. Such early disposal of young animals culminates into unintentional negative selection because the fast growing animals with good genetic potential for growth are continuously eliminated before they pass their good genes to the subsequent generations, while the genetically inferior ones remain in the flocks and thus contribute the relatively less desirable genes to the next generation. In the sheep-barley system several rams are kept in the flock because marketing is mainly after fattening the castrated animals at about 2 to 3 years of age; castration is normally at about 1.7 years of age on average. Here too, genetically inferior males are left to stay intact and thus have chance to breed until such age that the owner considers appropriate for fattening and sale.

Feeding is entirely pasture based on private and/or communal grazing lands. In Horro and Menz, both communal and private grazing lands are available whereas there is only private grazing land in Bonga. Grazing lands are entirely communal properties among the Afar pastoralists and no exclusive rights are vested in individuals or groups and they can choose freely the pastures they wish to use.

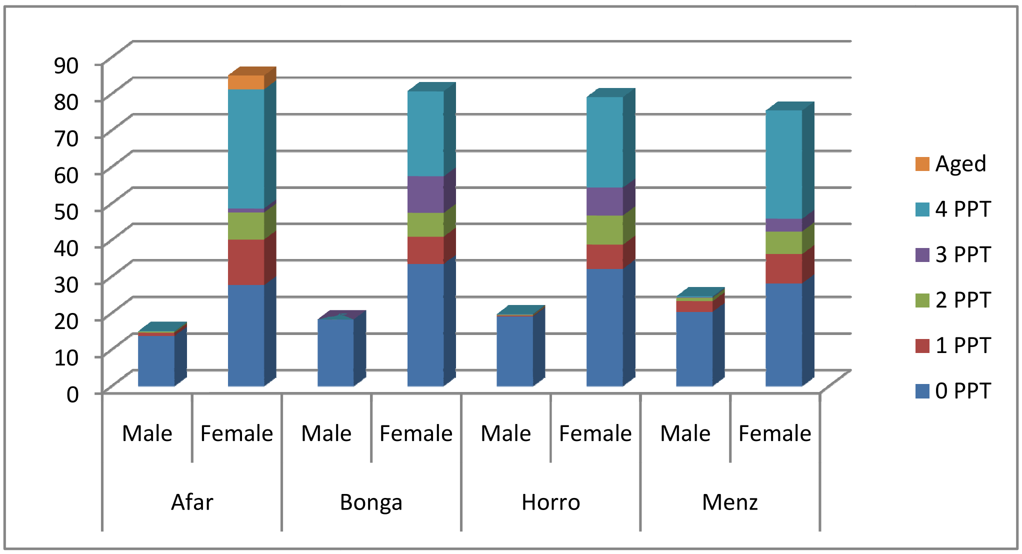
Severe land degradation has occurred and continues to do so in the Menz area, while moisture stress is observed during significant parts of the year, during which forage availability and quality become severely limiting. The shrinkage of communal grazing lands due to human population pressure leading to crop land encroachment mainly by the younger and emerging farming households, and lack of responsibility regarding the management and development of communal grazing lands in Horro and Menz, frequent drought and invasion by *Prosopis juliflora* in Afar are the major obstacles that limit communal land utilization. Moreover, the communal grazing lands are usually located near marshy river banks that are infested by gastro-intestinal parasites leading to huge flock productivity losses due to high morbidity and mortality of sheep.

Mean flock size and flock structure by age and sex for the different breeds are presented in Table 1 and Figure 3, respectively. The largest flock size was 20 sheep (ranging from 4 to 64) and was recorded in Menz, while the smallest flock was 9 sheep (ranging from 4 to 23) and was in Bonga. Getachew (2008) reported higher flock sizes per household for both Afar (23.0 ± 16.5 with range of 5 to 80) and Menz (31.5 ± 15.2 with range of 7 to 69). Edea (2008) also reported higher flock size for Bonga (11.3 ± 1.3 with range of 1 to 50) but smaller size for Horro (8.2 ± 2.1 with range of 2 to 50). The likely reasons for the disparity between these results and those obtained in the earlier studies may be attributed to the fact that the former studies covered wider areas and sampled respondents, while the current studies were based on complete census of flocks owned by target communities. The other likely reason for the observed differences was that some households in Afar and Bonga (one of the two communities) were not willing to disclose their respective correct flock sizes for cultural reasons as well as due to suspicions related to ear tag application.

From the baseline data, about 85%, 81%, 79% and 75% of the flocks were females in Afar, Bonga, Horro and Menz, respectively (Figure 3). The flocks comprised of about 32.6 and 27.6% in Afar, 23.3 and 33.4% in Bonga, 24.8 and 32.1% in Horro and 29.4 and 28.1% in Menz adult ewes and ewe-lambs (milk teeth females), respectively. In Afar about 4% of the ewes were aged animals older than 5 years, with one or more pairs of erupted permanent incisors. Proportionally fewer younger males than females (< 1 year of age) of the same age were found in all flocks. They were lesser by 13.9% in Afar; 14.8% in Bonga; 12.9% in Horro and 7.8% in Menz. Such disparities may arise from early disposal of male lambs. Breeding rams with one or more pairs of permanent incisors (1 to 5 year old) were only about 1.3%, 0.28%, 0.68% and 4.3% of the respective total flocks in Afar, Bonga, Horro and Menz, respectively. This clearly indicates that there is critical shortage of breeding rams in Bonga and Horro flocks and confirms the findings of Edea (2008) who reported that there was critical shortage of breeding rams in both flocks. The absence of enough number of breeding rams in the flocks may negatively influence reproductive performances of breeding ewes.

Table 1: Number of households (HH) and mean flock sizes and standard deviations (SD) in the different locations

Location	Community	№ of HH	Average flock size (SD)	Range
Afar	Halaydegi	46	15.8 (9.22)	4 – 42
	Bonta	53	11.6 (10.29)	4 – 73
	Mean		13.5 (9.99)	4 – 73
Bonga	Boqa	63	9.4 (4.98)	4 – 23
	Shuta	64	7.5 (3.85)	4 – 21
	Mean		8.5 (4.53)	4 – 23
Horro	Kitlo	59	18.4 (14.24)	3 – 72
	Lakku-Iggu	63	16.5 (10.01)	4 – 50
	Mean		17.4 (12.23)	3 –72
Menz	Mehal-Meda	64	22.7 (12.95)	4 – 64
	Molale	58	16.5 (9.67)	4 – 41
	Mean		19.8 (11.87)	4 – 64



Aged=older sheep above 5 yr of age; 4PPT=full-mouthed sheep; 3PPT=sheep with 3 pairs of permanent incisors; 2PPT=sheep with 2 pairs of permanent incisors; 1PPT=sheep with 1 pair of permanent incisor; 0PPT=sheep with milk teeth

Figure 3: Flock structure by age and sex of the different breeds

Breeding ewes with one or more pairs of permanent incisors (1 to 5 year of age) constituted about 57.4% in Afar and 47.0% each in the other three breeds. Abegaz *et al*. (2005) also reported that breeding females of Horro sheep older than one year of age constituted about 47.0% of the total flock. Proportion of Menz ewes with at least one pair of permanent incisors (above 1 year old) reported in the current study is within the range (42 to 52.5%) of on-farm survey results reported by Agyemang *et al*. (1985), Mukasa-Mugerwa *et al*. (1986), Wilson (1991) and Mekoya *et al*. (2000) for same breed. Similar results are not available for Afar and Bonga breeds for comparisons. From Figure 3, it is clear that the proportion of older ewes (older than 5 year) which are generally past their most productive stage was higher in all the flocks than the more productive middle aged ewes. This warrants management decisions/interventions that favor the retention of large proportion of middle-aged ewes. It can also be observed from the proportions of ewe lambs (those younger than 1 year) and those of between 1 and 2 year of age, that a relatively high off-take rates are practiced for those younger than 1 year of age (i.e. only a small proportion of ewe lambs are retained for replacement and most of them are disposed before they reach breeding age).

Least squares means and standard errors of live weight of young ewe lambs and male lambs of about 1 year of age and adult ewes older than 4 to 5 years of age for the different breeds are presented in Table 2. The lack of an adequate number of breeding rams in the flocks of all breeds prevented the estimation of liveweight at older ages. Significant differences (P<0.001) were observed in liveweight among adult ewes of the different breeds. Bonga ewes were the heaviest followed by the Horro ewes, with Menz ewes, especially at Molale being the lightest.

Table 2: Least squares means (±SE) of live weight (LWt) of young animals of about yearling age and adult ewes of about 4 or more years old of the different breeds

Breed	Category	Number	LWt (kg)	LWt range (kg)
Afar				
	Yearling male	12	21.8±0.86	16.8 – 26.0
	Yearling female	167	21.0±0.23	12.8 – 30.2
Bonga				
	Yearling male	5	38.2±1.20[a]	36.0 – 40.0
	Yearling female	80	31.0±0.47[b]	20.0 – 41.0
Horro				
	Yearling male	5	31.2±1.70[a]	25.0 – 35.0
	Yearling female	148	26.5±0.31[b]	20.0 – 39.0
Menz (Mehal Meda)				
	Yearling male	43	24.4±0.63[a]	14.6 – 38.5
	Yearling female	105	20.8±0.42[b]	12.8 – 32.4
Menz (Molale)				
	Yearling male	26	20.4±0.57[a]	13.4 – 25.6
	Yearling female	87	18.1±0.31[b]	11.8 – 29.0
Afar	Adult ewes	449	24.9±0.23[a]	13.6 – 38.6
Bonga	Adult ewes	357	36.3±0.26[b]	25.0 – 55.0
Horro	Adult ewes	727	33.4±0.18[c]	21.0 – 56.0
Menz (Mehal Meda)	Adult ewes	497	23.6±0.16[d]	15.0 – 35.0
Menz (Molale)	Adult ewes	298	21.3±0.20[f]	13.6 – 29.0

Different super scripts indicate statistically significant differences ($P<0.001$)

There were also significant differences between the two Menz flocks located at Mehal Meda and Molale. The likely reasons may be both genetic and environmental factors. Menz flocks in Mehal Meda are mixtures of crossbred animals having unknown blood levels of Awassi. Sex had significant influences ($p < 0.001$) on liveweight of younger animals of about one year of age (1 pairs of permanent incisors), except in Afar flocks. Yearling Bonga, Horro, Menz (Mehal Meda) and Menz (Molale) rams were heavier by about 7.2, 4.7, 3.6 and 2.3kg than their respective female counterparts, respectively (Table 2).

Record formats, Recording and Data Management

Performance recording is an essential element in a breeding program. Development and use of simple, flexible and cost-effective performance recording and evaluation system is crucial. A performance recording systems or structure provides breeders with a uniform set of performance recording guidelines (Wilson and Morriecal, 1991) and allows for feedback from centrally managed and analyzed data to farmers on which areas/traits improvements should be made. Three record formats were developed for each location: two for ewe and a lamb record (Annexes A, B and C). Major traits considered were weight (birth, weaning, 6 months and yearling) and number of lambs weaned for all breeds. In addition, milk yield for Afar, number of lambs born (twinning) for Bonga and Horro and wool yield for Menz were included. Traits of economic importance that encompass reproduction, growth, milk, and wool production mainly focusing on objective traits were recorded in priori-discussed and agreed formats that were developed by the research team after a thorough discussion.

An enumerator was employed for each community to assist households in measurement and record keeping. A record book was prepared for each household for day to day follow up and one big record book for a community was given to the enumerator. Sample record formats were manually printed on each book. A weighing scale with 100kg capacity and accuracy of 200g, plain and printed ear tags, and permanent markers were also provided to the community. Focused trainings were given to enumerators and households on recording. Monitoring of the breeding activities, record keeping by households and the enumerator was done on a fortnightly basis by a research team from respective research center. Data is normally entered in Excel at respective research centers and copies are sent to the International Livestock Research Institute (ILRI, Addis Ababa) where data is processed. It was initially planned to develop a centralized web-based database management tool that stakeholders could access and update online; and simple indexes based on the set selection criteria for each breed are calculated to effect selection. However, the database has not been finalized by the time this paper is prepared.

Candidate Ram Selection and Animal Exhibition

Thus far ram selection was done in two rounds in each area. Screening and selection procedures were mainly based on recorded information (own and maternal) and independent culling of animals for observable defects (tail type, coat color, horns, conformation and general appearance). Two stages of selection are applied: initial screening is done at 6 months and final selection for breeding at 12 months of age. A breeding ram selection committee composed of about five members from the community was actively involved in the selection of candidate rams. All young rams were collected at one central place in each community on the screening date. A total of 14, 21, 36, and 50 rams have been selected in Afar, Bonga, Horro and Menz, respectively during the two rounds of screening activities (i.e. until end of 2010). From the inception of implementation of the breeding program to date more than 1000 breeding rams were selected from

Bonga community-based programs alone and sold to different areas (Metsafe, 2017, personal communication).

Animal exhibitions were organized simultaneously with breeding rams selection. Best animals from both sexes and the different age categories (6 month old males, year old males and those older than 2 years old; year old females, 2 to 4 years old ewes and mature ewes older than 4 years of age) were ranked from 1st to 3rd and awarded. Animal exhibitions were conducted to create awareness in communities that breeding animals have higher values than those raised for meat. It also strengthens the relationship between farmers and researchers so as to perform joint activities. A committee composed of 3 to 5 individuals from the community did the selection of the animals at each location. Members were pre-informed that best animals from each sex and age category will be identified and receive awards. All members of the community brought their animals at one central place in each community. Comparisons were made among animals in similar age category for both sexes. Committee members were asked to select and rank 10 best animals from each category of which those animals ranked from 1st to 3rd were awarded. Finally members of the committee, one at a time, were asked to give their views on why they selected and ranked an animal in that order when an animal was identified by its identity number and brought forth for award. Individuals who managed their flocks well were also selected by the community and received awards.

Management and Use of Breeding Rams

Importance of sharing rams to avoid inbreeding was well agreed upon by the community members during the various stages of discussions and consultation workshops. From the crossbreeding experience at Mehal Meda (one of the communities at Menz where rams were provided by government), there was no problem in sharing and rotating the rams among the participating farmers. Some examples among good practices at Mehal Meda include preferential supplementation of breeding rams with locally available feeds (hay, residues from pulses, and weeds) and recording weight of rams regularly to monitor differences of individual farmers in handling of breeding rams. However, when it comes to sharing and rotating rams belonging to individual households, the communities in all locations except Afar were reluctant. This was due to the fear that mismanagement of breeding rams by some members of the community may cause disappointment to the owners and subsequently may cause conflicts among them. In Afar, there is already a culture of ram sharing among the community and ram is considered as property of a given clan; denying others to use breeding rams is culturally prohibited. After repeated discussions with members, the following options that would enable smooth sharing of selected rams were suggested and discussed as alternatives:

- Sharing rams based on friendship and trust among members of the breeding group
- Exchanging rams based on written agreement
- Exchanging rams based on purchase between different breeding groups when the rams have fulfilled their services time in a given flock
- Obtain some seed money from the project or from members' contribution to purchase breeding rams in common.

The last alternative was finally implemented as seed money to create a revolving fund was provided by the project. This may serve as a remedy against early sale of fast growing young rams that was found to be a major threat for the implementation of the program. Ram-group formation was based on number of breeding ewes, settlement and communal grazing areas. Social network studies in all areas and resource mapping in two locations were also conducted to aid formation of ram-groups, though not properly used until now. A ram serves in flocks of a ram-group only for one year and then will be moved to another ram-group within the community. For proper handling and management of the selected breeding rams, individuals selected by members of each ram-group must sign an agreement with respective research centers.

Related Interventions to Support the Breeding Program

For genetic improvement programs to be successful and sustainable, an integrated systems approach is required (Olivier *et al*., 2002; Rege *et al*., 2010). The authors argue that increases in productivity in the short-term through management interventions assure farmer motivation well before the first positive breeding effects become visible. Health interventions that were made by the current project include strategic vaccinations against major endemic sheep diseases prevailing in each location, seasonal mass de-worming, and treatment of sick animals. Scarcity of feeds were addressed by distributing seeds of two to three types of recommended improved forage varieties in Horro and Menz areas. However, this was not done at Bonga as feed scarcity was not reported there; and in Afar due to the migratory nature of the Afar community. In all the locations, separate trainings on animal health and feeds management were conducted. Moreover, an in-depth training on animal health was organized for four community health workers in Afar who will assist the community in providing primary aids for non-serious animal health problems and castration of unwanted rams. In two of the communities, Horro and Menz, seedlings of high-value highland fruit were distributed to interested members.

Challenges

Implementation of a sustainable breeding program requires participation of local communities in activities such as flock recording. In this regard, low level of literacy and technical ability of local sheep breeders and the community members in general was a big constraint, especially in Afar region. In the absence of accurate records, objective selection decisions would not be possible. Rege *et al*. (2010) reported that animal recording, including the recording of inputs, animal performance and breeding activities, is critical to successful livestock management and genetic improvement. Despite the project attempts to equally communicate the new ideas to all the communities, adoption greatly varied among individual members and locations. For instance, it was very difficult to convince communities at Afar and Bonga (in one of the two communities) to use ear tags (in Afar application of ear tags without abandoning the traditional identification system) during the initial stage. Afar people have a traditional way of identifying their animals, which is through branding of unique pattern that are specific to each clan and households within a clan. It was very difficult for the community to accept use of ear tags for two main reasons: a) it was considered as violation of long standing traditional norms and b) for fear of theft in case animals stray from their usual flocks. Since the clan-based identification is known to every Afar person, animals which stray be easily recognized from the clan brands and brought back to their owners. This is an established norm within the Afar people that guarantees that animals that stray are never lost. But if animals are found ear-tagged (though the traditional branding are not abandoned it is not clearly visible at a distance), they may be considered as belonging to some outsiders and may never come back to the owners. In Bonga, there has been very limited interaction and intervention from research before, consequently, some community members were suspicious and did not want to disclose their animals for tagging.

A number of problems have been associated with the communal grazing land. It is the only feed resource utilized during cropping season (from June to September in Menz and Horro). In the communally grazed lands there are no pastures protection/conservation and development at all. Disease and parasites transmission, uncontrolled mating (breeding), overgrazing due to competition, and lack of responsibilities are some of the major problems to utilize the communal grazing lands wisely.

Recurrent droughts have become a phenomenon in Afar and Menz. For instance, there was a severe and prolonged drought in 2008/09 that caused forced mobility in Afar making it impossible to trace the project animals for monitoring. There were also communication gaps (language barrier) between the researchers and communities in some locations. Staff shortage and turnover were noticed deterring implementation activities as desired in some locations. Sluggish financial flow in the national and regional research systems was also another bottleneck to implement the project activities as planned.

CONCLUSIONS

It was possible to implement the breeding schemes selected by the different communities among alternatives simulated following breeding objective traits identification. This was done mainly because:

- breeding objectives and associated traits were developed using participatory approaches
- selection strategies were designed to suit the communities' practices
- different options for selection strategies were presented clearly to the communities, discussed and the communities decided which suited them best to implement

A genetic improvement is not possible unless the environment is improved to sustain it. So it should be born in mind that such genetic improvements must be accompanied by improved feed supply and health care. Generally, the on-going improvement programs can be sustainable provided the current technical backup from research centers continues.

Conflict of Interest

None declared

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