

# Farmers' Perception on the Effect of Community-Based Sheep Breeding Program for Smallholder Production System- A Case of Bonga Sheep in Ethiopia

Ebadu Areb<sup>1\*</sup>, Tesfaye Getachew<sup>2</sup>, M. A. Kirmani<sup>3</sup> and Aynalem Haile<sup>2</sup>

<sup>1</sup>Associate Researcher, Department of Animal Breeding and Genetics, South Agricultural Research Institute at Worabe Centre, PO Box 21 Worabe, ETHIOPIA

<sup>2</sup>Research Scholar, Department of Animal Breeding and Genetics, International Centre for Agricultural Research in the Dry Area, PO Box 5689, Addis Ababa, ETHIOPIA

<sup>3</sup>Ex. Professor, Department of Animal Breeding and Genetics, Collage of Agricultural and Veterinary Medicine, Jimma University. PC Depot, Rehmatatabad, Srinagar, Jammu and Kashmir-190017, INDIA

\*Corresponding Author: [ebaduaireb1@gmail.com](mailto:ebaduaireb1@gmail.com)

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## Abstract

*The study was conducted to asses' effectiveness of community-based breeding program (CBBP) in Bonga sheep. Data collected from 322 households and 43 focus group discussions of 7 communities (both CBBP participants and non-participants) and analysed by SPSS. Kruskal-Wallis test and binary logistic regression were used to analyse non-parametric and binary data set, respectively. CBBP participants got skills of importance and strategies of selection, and system and importance of record keeping. Uncontrolled breeding for CBBP non-participants resulted in inbreeding and poor productive and reproductive performance. The type of traits showing improvement of CBBP participants were growth performance, twinning rate, lamb survival, age at first lambing and lambing interval. There is a variation in income through breeding sire selling with rate of 3483.67±46.55 and 2274.64±45.20 Ethiopian birr for CBBP participants and non-participants, respectively. Generally, the evaluation revealed that response of performance improvement, better survival rate, and positive changes in income through CBBP.*

**Keywords:** Bonga Sheep, Sheep Breed Improvement, Community-Based Breeding Program, Farmer Perception, Kaffa Zone, Participant and non-participant, Record Keeping, Selection

## Introduction

Ethiopia has been endowed with nine breeds of sheep, distributed in different agro-ecologies and production systems, identified using microsatellite deoxyribonucleic acid (DNA) marker technique (Gizaw *et al.*, 2007). The breeds identified were Bonga, Horro, Simien, Gumz, Washera, Arsi, Afar, Black Head Somali (BHS) and Short Fat-Tailed sheep (Sekota, Farta, Tikur, Wollo, and Menz). They have immense potential to contribute to the livelihood of producers, namely cash income, meat, milk, skin, manure and exportable item, especially under low input, smallholder, and pastoral production systems (Solomon, 2008). Bonga sheep breed has been characterizing by long and wide fat tail with tapering, and twisted end, short and smooth hair, polled, mainly convex facial profile of male and all type of colours but predominantly red and light red. The breed is known for its docile temperament, fattening potential, fast growth and prolificacy (Duguma, 2010). Bonga sheep breed is not susceptible to changes in photoperiod and known as non-seasonal like other tropical breeds (Tera *et al.*, 2020). The breeding programs tried in Ethiopia are cross breeding, selective breeding involving central nucleus scheme and community-based breeding program (CBBP). The first two were not successful while CBBP generated genetic gain and economic benefit to small holder farmers (Haile *et al.*, 2019). Community based breeding programs are organized breeding activities that are planned, designed and implemented by smallholder farmers individually or in cooperation with technical stakeholders to effect genetic improvement within their livestock (Karnuah and Dunga, 2018). The CBBP was considered as a viable option for genetic gains that improves productivity and enhances smallholders' livelihood. Also, it can be described as a system of genetic resource and ecosystem management that helps for conservation and sustainable use of livestock sector (Tsfahun *et al.*, 2008). The program encouraged members to fully participate in each step enabling farmers to have clear ideas on the breeding objectives and also to incorporate their preferences (Gutu *et al.*, 2015). Therefore, this study was carried out to assess farmers' perception on effectiveness of CBBP in improving growth and reproductive traits, sheep management, income generation and population trend of Bonga sheep breed across years and the way forward.

## Materials and Methods

### Description of the Study Area

The study was conducted in four districts, namely Adiyo, Gesha, Shishonde and Tello, in Kaffa zone of Southern Nations, Nationalities, and Peoples Regional State of Ethiopia. The period considered during data collection extends from the year of 2012 to 2019. The area is characterized by mixed crop-livestock production system. It has one major rainy season that extends from May to October, and a dry season that lasts from October to April (Mirkena *et al.*, 2012). The altitude ranges from 1600 to 3348 meter above sea level, with minimum and maximum temperature of 14 and 32°C and an average of 24°C. Minimum and maximum rain fall within period of data collection were 1079 and 2032 mm per year with an average of 1617 mm.

### Breeding Program and Flock Management

This study was undertaken on seven randomly selected CBBP cooperatives (Table 1). Animal identification, data recording, selection and mating management have been routine practices of the breeding programs. In all CBBP cooperatives, one of the participating farmers was recruited and trained as an enumerator. These enumerators make round of visit to the community and record specified biological data on newly born lambs and their parents (sire and dam). All founder stock and new born lambs were identified using plastic ear tags. Data recorded included CBBP cooperative name, farmers name, sire and dam identification numbers, parity of dam, birth date, birth type, sex, coat-colour of the lamb, and body weight of the lamb at birth, weaning, six months, and twelve months of age.

**Table 1:** Establishment year and participant numbers in each Bonga sheep CBBP

District	Sampled CBBP cooperatives	Establishment year	Initial members		Total	Current members		Total
			Male	Female		Male	Female	
Adiyo	Alargeta	2014	28	2	30	119	15	134
	Meduta	2014	34	0	34	79	7	86
Shishonde	Wanabolla	2014	12	9	21	47	18	65
Gesha	Abeta	2012	39	2	41	73	4	77
	Didifa	2014	43	4	47	51	8	59
Tello	Dacha	2012	28	4	32	72	13	85
	Yama	2014	23	6	29	91	14	105
Total			207	27	234	532	79	611

## Data Collection

A survey by interview using structured questionnaires, focus group discussion, and direct observation were carried out to collect data from two groups of farmers, namely CBBP participants involved in the program and non-participants who were not involved in the programs. The explanatory variables were CBBP cooperatives, sex and educational level of respondent. The dependent variables collected were type of acquired management skills due to participation, record keeping status, system of using breeding sire, type of improved traits, population trend, selling price difference between the two groups, major constraints of CBBP participants, interest to continue within the program for participants and interest to join CBBP for non-participants. The number of household samples for the study was determined according to Yamane (1967) as follows:

$$n = \frac{N}{1 + N(e^2)}$$

Where: n is the sample size, N is the total population size, and e is the level of precision.

Thus, the sample size for a precision of 7% (based on the observed variability within each group during preliminary survey) was as under:

$$n = \frac{611}{1 + 611(0.07^2)} = 152.983 = 153 \text{ farmers}$$

A total of 161 respondents (22 respondents from each of the 7 CBBP and their respective enumerators (7)) were considered representing CBBP participants. Similarly, 161 respondents were selected randomly from non-CBBP participating farmers of those seven communities. Besides 43 households participated in focus group discussion by forming seven groups from both CBBP and non-CBBP members.

## Data Analysis

The collected data from both CBBP participant and non-participant farmers were analysed by the SPSS version 20 (IBM, 2011). Chi - square ( $X^2$ ) test was used to test the significant differences of the explanatory variables. Binary logistic regression model was designed to test the hypothesis that there is a significant difference between CBBP participants and non-participants for the following parameters: involvement of managing breeding sire, performance improvement difference between CBBP participants and non-participants, sheep selling price difference, interest to continue with the program for CBBP participants and to join the program for non-participants. The Kruskal-Wallis test was designed to test significance of non-parametric test for selling price of sheep at different age and sex for CBBP participant and non-participant community members. Rank data were subjected to index calculation to identify the most improved traits and major constraints of sheep breeding as perceived by the respondents.

Index = {Sum of (3 X number of households ranked first + 2 X number of households ranked second + 1 X number of households ranked third) for an individual improved trait} / [Sum of (3 X number of households ranked first + 2 X number of households ranked second + 1 X number of households ranked third) for overall improved traits]

The data collected from focus group discussion and direct observation were summarized by narrative in the discussion.

## Results and Discussion

### Farmers Developed Animal Management Skills

On average, 561 households were found in each kebele which is the lowest administration unit in Ethiopia (Kebele office information), and on average 87 households were participated in CBBP. This indicated that 15.6% of kebele members were included in the program. Community-based breeding program participants revealed that they acquired different sheep breeding skills, which include record keeping, visual appraisal of selection candidates, management and use of breeding sires. Non-participants had interest to establish own CBBP cooperatives in their village and buy breeding sires from CBBP participants.

### Status of Record Keeping

Records were always maintained by all CBBP cooperatives (ranging from 60.9% in Didifa to 100% in Meduta and Wanabolla) whereas 4.3% of farmers failed to maintain records in Didifa cooperative (Table 2). The entire educated respondents (secondary, high school, and diploma) maintained the records. Perusal of this table showed that record keeping differed significantly among the CBBP cooperatives whereas both sex and educational level of respondents did not influence record keeping significantly.

**Table 2:** Percentages of flock record keeping by Bonga sheep CBBP participants

Explanatory variables	How often data record? (N=161)			X <sup>2</sup> value
	Always	Mostly	Rarely	
CBBP cooperative				26.036**
Abeta	95.7	4.3	0	
Alargeta	82.6	17.4	0	
Dacha	82.6	17.4	0	
Didifa	60.9	34.8	4.3	
Meduta	100	0	0	
Wanabolla	100	0	0	
Yama	78.3	21.7	0	
Sex				0.273 <sup>NS</sup>
Male	86	13.3	0.7	
Female	83.3	16.7	0	
Education level				7.06 <sup>NS</sup>
Diploma	100	0	0	
High school	100	0	0	
Secondary	100	0	0	
Primary	78.6	17.9	3.6	
Write and read	86.5	13.5	0	
Illiterate	85.9	14.1	0	

\*\* $P < 0.01$ ; NS = not significant; X<sup>2</sup>-value = chi-square value

### Status of Use of Breeding Sire

The results on use of breeding sire by CBBP participants are presented in Table 3. Perusal of these results showed that CBBP cooperative effect significantly influenced use of breeding sires among cooperatives, whereas effect of both sex and educational level of farmers were non-significant. The frequency of use of breeding sires for "Always" category ranged from 60.9% (Dacha cooperative) to 100% (Didifa and Meduta cooperatives). Frequency for "Sometimes" category ranged from 0.0% (Abeta, Didifa and Meduta cooperatives) to 39.1% (Dacha cooperative). However, two cooperatives, namely Dacha and Yama, showed an alarmingly 39.1 and 21.7% of respondents using breeding sires "sometimes" and the possible reason ascribed failure of farmers to detect heat in ewes and commitment of CBBP farmers and enumerators. Such type of poor commitment of CBBP farmers and enumerators

result poor data accuracy in addition to on and off of using breeding sire (Tera *et al.*, 2021).

**Table 3:** Percentages of breeding sire using by Bonga sheep CBBP participants

Explanatory variables	Breeding sire using frequency (N=161)				X <sup>2</sup> value
	Always	Mostly	Sometimes	Rarely	
CBBP cooperative					53.55***
Abeta	91.3	8.7	0	0	
Alargeta	87	8.7	4.3	0	
Dacha	60.9	0	39.1	0	
Didifa	100	0	0	0	
Meduta	100	0	0	0	
Wanabolla	90.5	0	9.5	0	
Yama	66.9	2.7	21.7	8.7	
Sex					3.43 <sup>NS</sup>
Male	83.7	2.8	12.1	1.4	
Female	100	0	0	0	
Education level					8.19 <sup>NS</sup>
Diploma	100	0	0	0	
High school	100	0	0	0	
Secondary	71.4	0	28.6	0	
Primary	96.3	0	3.7	0	
Write and read	78.4	2.7	16.2	2.7	
Illiterate	85.7	3.6	9.5	1.2	

\*\*\* $P < 0.001$ ; NS = not significant; X<sup>2</sup>-value = chi-square value

From randomly selected sample of interviewee from CBBP participants up to 98.13% were satisfied by their breeding sire that full fill their trait preference. This is due to participation of the community during selection and every participant knows the criteria of selection. But the remaining 1.88% participants have complained that related with lower body size and coat colour when compared with others' breeding sires. A similar participation technique was reported from Menz sheep breeding program that selection of the best young rams based on their six-month weight and subject to farmers criteria (Gizaw *et al.*, 2014).

The results on maintenance of breeding sires by the participant farmers are presented in Table 4. The odds ratio [Exp (B)] showed that educated participants (1.329) and cooperatives established earlier (0.933) were willing to maintain breeding sires but they are non-significant. Poor interest in maintaining breeding sires by the participants was due to (i) fear of theft of these animals, and (ii) difficulty in their control/handling by rope.

**Table 4:** Maintenance of breeding sires by Bonga sheep CBBP participants

Effect	B	SE	Wald	Df	P-value	Exp(B)
Constant	-2.59	1.285	4.066	1	0.044	0.075
CBBP cooperative	-0.07	0.101	0.473	1	0.491	0.933
Sex	-0.332	0.681	0.237	1	0.626	0.718
Educational level	0.285	0.22	1.677	1	0.195	1.329

B = regression coefficient; SE = standard Error; Wald = test statistics; Df = degree of freedom; and Exp (B) = odds ratio

### Status of Flock Performance for Non-participants

Most of the CBBP non-participant respondents (66.7%) (Table 5) had shortage of breeding sires because CBBP members are not allowed to share the sires outside of their group. According to focus group discussion, negative selection was a problem of CBBP non-participants as they used to sell fast growing animals in better price compared

to the inferior ones at their younger age. This was in agreement with report of Gizaw *et al.* (2014) that farmers usually sell off fast growing sires that are potentially best breeding sire and this resulted in negative selection and shortage of breeding sire. Additionally, Haile *et al.* (2013) several households prefer to sell male lambs early for immediate case income. To alleviate this problem, CBBP non-participant community members wanted to participate in the program.

**Table 5:** Status of using breeding sire for non-participants from Bonga sheep CBBP

Use of breeding sire		Frequency	Percent
Opportunity to use selected sire	No	106	66.7
	Yes	53	33.3
	Total	159	100
Availability of own breeding sire	No	64	40.5
	Yes	94	59.5
	Total	158	100

Oppositely in pastoral production system of Ethiopia like Afar, sire is considered as property of a given community. Denying others to use breeding sire is culturally prohibited. Such norms facilitate use of only selected breeding sires in common (Haile *et al.*, 2013). According to respondents, uncontrolled breeding was common, which resulted in inbreeding, causing lower reproductive and productive performance of their flocks in comparison with CBBP participants.

### Perception on Improvement of Trait Performance

Respondents verified improvements on animal performance during interview. Up to 96.9% of CBBP participants agreed that there have been improvements on productive and reproductive traits across years. But the remaining 3.1% of respondents of CBBP participants did not agree the presence of improvement. Farmers ranked improved traits from the time of starting of the breeding program. The results showed that indices for improvement in growth, twinning rate, lamb survival, lambing interval, age at first lambing and coat color were 0.56, 0.15, 0.11, 0.08, 0.08 and 0.01, respectively and their corresponding rank was I, II, III, IV and V, respectively (Table 6).

**Table 6:** Ranking of improved traits by participant in Bonga sheep CBBP

Traits	Rank 1	Rank 2	Rank 3	Sum	Index	Rank <sup>1</sup>
Age at first lambing	2	11	29	42	0.08	IV
Coat colour	1	2	0	3	0.01	V
Growth performance	114	16	7	137	0.56	I
Lamb survival	9	17	15	41	0.11	III
Lambing interval	13	1	16	30	0.08	IV
Twinning rate	15	25	8	48	0.15	II
Sum	154	72	75		1	

Rank 1 is the number of participants ranked the trait as first; Rank 2 is the number of participants ranked the trait as second; Rank 3 the number of participants ranked the trait as third; 1= order of improved traits across years

This indicated that CBBP had a pronounced effect on improving growth performance (index value of 0.56). Better improvement of growth performance was due to used it as a criterion for selection. Also, the farmers give a higher value on the traits of economic importance for higher cash returns for their efforts and investment. The least improved trait is coat colors which are red and light red (index value 0.01) (Table 6). Considering these colors are important for sustainability of the program. When looking from economic and production point of view, disregarding coat color as a criteria for selection and culling could be advantageous because under traditional system coat color is given higher value (Nguluma *et al.*, 2020). Based on focus group discussion among non-participants, 75.6% agreed that there were differences in improvement of mentioned traits of Table 6. These improvements were a result of intervention of breeding program and management option. Similarly, highland sheep under CBBP in

Atsbi Wenberta district, Tigray, Ethiopia, indicated that 58% of CBBP participant respondents thought body size of new-born lambs in their flock showed improvement as result of the intervention. According to Regassa (2018), it was also evident from interviews (52%) non-members reported they perceived improvement in body size of sheep owned by CBBP. Also Gutu *et al.* (2015) reported CBBP members observed that mostly of their 72.5% and 65% ewes had twin births compared with the ewes owned by non-participants 52.5 and 20.0% in Bonga and Horro, respectively.

### Status of Sale Price of Sheep

Income of cooperatives of Bonga sheep CBBP participant farmers was obtained from selling of breeding sire to other community, non-government and government organizations, cooperative association and private farms for breeding purpose based on body weight at 1kg/130 Ethiopian Birr (ETB). However, sires of non-participant farmers were sold in local market as usual, based on the agreement of buyer and seller. The sale price of various classes (sire lambs, ewe lambs, sires and ewes) of both CBBP participant and CBBP non-participant farmers is presented in Table 7.

**Table 7:** Differences in the sale price of Bonga sheep between CBBP participants and non-participants

Category	Participation	N	Mean	SE	X <sup>2</sup> value	P-value for Kruskal-Wallis test
Sire	Participant	147	3483.67	46.55	169	<0.0001
	Non-participant	138	2274.64	45.2		
Ewe	Participant	104	1890.38	16.02	121.35	<0.0001
	Non-participant	106	1406.6	22.24		
Sire lamb	Participant	147	1476.19	16.07	176.96	<0.0001
	Non-participant	138	1120.29	12.52		
Ewe lamb	Participant	74	1293.92	25.85	59.25	<0.0001
	Non-participant	72	972.22	26.7		

\$1USD = 44 ETB (Ethiopian birr) exchange rate July 2021; SE=standard error; X<sup>2</sup> value= Chi-square value

The results showed that average sale price of sire lambs, ewe lambs, sires and ewes for CBBP participant respondents was greater than that for CBBP non-participant farmers. The sale price differences were significant ( $P < 0.0001$ ) between these two groups of respondents. The average sale price of sires from CBBP participants and CBBP non-participants was 3483.67 and 2274.64 ETB, respectively (Table 7). The higher sale price of CBBP participants may be ascribed to higher body weights improved due to CBBP and their origin from selected breeding sire. The present result was in agreement with finding of (Gutu *et al.*, 2015), who reported that even unselected sires from the cooperatives fetch better sale price compared with other sires in the market. Also CBBP have been promoted as a tool for economic and livelihood development through livestock genetic improvement (Lamuno *et al.*, 2018). It is essential to realize that the overall vision for CBBP should be to create a financially sustainable system in which smallholders are able sustain activities of their breeding cooperatives using internally generated revenues (Kaumbata *et al.*, 2020). Private sector investment in small ruminant breeding is very limited (Haile *et al.*, 2019) but gain better income with little intervention than non-participant. Similarly, the majority of CBBP participants reported that consumption of mutton in the household had increased after introduction of CBBP. This is due to the breeding program resulted in increased productivity and income from sheep production (Haile *et al.*, 2020). This positive impact on income of participants makes interest for non participants to join the program.

### Farmers Flock Trend

For CBBP participant 78.9, 18.6 and 2.5% reported that their flock size was increasing, decreasing and undertaking no change across years, respectively (Table 8). These results were in consonance with the farmers ranking of trait improvement (Table 6), where twinning rate and lamb survival improvement ranked II and III, respectively. The decreasing trend of flock size for non-CBBP was related to shrinking of grazing land and paucity of labour.

**Table 8:** Farmers flock trend across years for Bonga sheep CBBP

Type participant	Farmers flock trend						Total
	Increasing	%	Decreasing	%	No change	%	
CBBP participant	127	78.9	30	18.6	4	2.5	161
CBBP non-participant	49	30.4	88	55	23	14.4	160

### Major Constraints of CBBP in the Study Area

The farmers ranking of major constraints by CBBP participants, in rearing of Bonga sheep is presented in Table 9. Perusal of results showed that poor interest of buyer to buy larger sire, poor human resource development (shortage of training), lack of animal health guidance with indices values of 0.150, 0.148, and 0.137, respectively were the major constraints in the area.

**Table 9:** Major constraints of Bonga sheep community-based breeding program (CBBP) participants

Constraint	Rank 1	Rank 2	Rank 3	Sum	Index	Rank <sup>1</sup>
Delay in selection	0	2	5	7	0.012	XI
Small flock size per household	7	0	2	9	0.031	IX
Poor human resource development (shortage of training)	23	13	18	54	0.148	II
Lack of animal health guidance	13	25	16	54	0.137	III
Delay in sire distribution (market)	16	21	8	45	0.128	IV
Absence of maternal line selection	9	12	3	24	0.07	VII
Poor / non-functioning of cooperative management bodies	13	19	7	39	0.11	V
Delay in replacing breeding sire	0	2	5	7	0.012	XI
Lack of supervision	6	4	9	19	0.046	VIII
Delayed auditing and profit sharing	17	6	18	41	0.106	VI
Poor interest of buyer to buy larger sire	11	37	1	49	0.15	I
Poor interest to keep breeding sire	0	0	1	1	0.001	XII
Shortage of labour	2	3	12	17	0.031	IX
Poor linkage with district and zone administration	0	4	14	18	0.029	X
Sum	117	148	119		1	

Rank 1 is the number of participants ranked the constraint as first; Rank 2 is the number of participants to ranked the constraint as second; Rank 3 the number of participants ranked the constraint as third; 1= order of constraints

Disease was a major challenge; as a result, provision of health service was among complementary interventions of the program. Important health constraints were internal and external parasites, pasteurellosis, brucellosis, sheep pox, foot and mouth disease, enterotoxaemia and Blackleg in their order of importance, respectively. Participants request to get service from health experts who live within the community.

### Conclusion

Generally, the effect of CBBP resulted that positive response of performance improvement, better survival rate, positive changes in income through breeding sire selling, developed better knowledge and skills and positive attitudes for the program. Also, population trend for CBBP participants was increasing but in decreasing manner for CBBP non-participants. These achievements of CBBP participant farmers have attracted non-participant farmers and members of the sheep breeders' CBBP cooperatives are growing. Majority of CBBP non-participants has interest to participate in the program and needs to expand the program to address majority of members. Based on the survey, poor interest of buyers for larger sires, shortage of training and lack of animal health guidance were the first three constrains for CBBP of Bonga sheep. The CBBP management team and stakeholders should strengthen efforts to address these constraints, as it will translate in better improvement of Bonga sheep.

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## Conflict of Interests

There is no conflict of interest.

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