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Original article

Preliminary analysis of Dawuro sheep growth performance managed under community-based breeding programs in south Ethiopia

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ABSTRACT

A preliminary Performance analysis of Dawuro sheep from the ongoing Dawuro sheep community-based breeding program (CBBP) was made. Data for this study were collected over a period of 3 years (2017-2019). Studied traits were birth weight (BWT), weaning weight (WWT), 6-month weight (6WT), average daily gain from birth to weaning (ADG0-3), and average daily gain from weaning to 6-month age (ADG3-6). The analyses were carried out using SAS software. The least square means for BWT, WWT, and 6WT, ADG0-3, and ADG3-6 were 2.55±0.04 kg, 13.95±0.14 kg, 19.88±0.044, 125.68±1.55 gm and 70.35±4.7 gm respectively. Phenotypic progress for most of studied traits has shown promising improvements. The preliminary result suggests that selection based on 6WT can be effective in improving performance of Dawuro sheep. Thus, strengthen the cooperatives and continuation of selection therefore recommended for bringing further improvements. Estimation of genetic parameter and genetic trend is required for more information and optimization. Analysis of correlated traits also suggests for more efficient selection program.

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1. Introduction

Genetic improvement has been a major responsibility of agricultural research organization. Today community-based breeding program (CBBP) has being widely applied as an alternative strategy for sheep genetic improvement program. The program has been designed to ensure involvement of farmers' (target groups) in all steps of the breeding program (Duguma et al., 2009; Mueller et al., 2015). In Ethiopia CBBP, for the first time was initiated for improvement of Bonga, Menz, Afar and Horro sheep breeds. Later the program was expanded to Atsbi, Doyogena, Abergelle, Konso and few other sites, in different parts of the country with the support of ICARDA, Federal government and their respective regional governments. The aim of CBBP was to improve the productivity and income of small-scale resource-poor sheep producers by providing access to improved animals that respond to improved feeding and management, facilitating the targeting of specific market opportunities.

In 2016/17, Ethiopian Agricultural Research Institute partnership with Southern Agricultural Research Institute (SARI), Areka Agricultural Research Centre (AARC) adopted CBBP in Dawuro zone to improve Dowro sheep. The program was adopted after promising result reported from prevesly established Doyogena, Bonga Menz and Horro sites. The Dawuro sheep was known by their fattening potential, twining rate, short lambing interval and resistance to disease (Amelmal, 2011). According to Zewdu (2008), Dawuro sheep population were resembles with Bonga sheep breed.

For the implementation of Dawuro sheep CBBP, two districts and one Keble per district were selected. Accordingly, on-farm data collection of economically important traits focusing on quantitative traits has been recorded. Birth weight, birth date, sex of lamb, weaning weight (at three months age), six months weight, dam parity and type of birth are major variables being recorded. The achievements were shown with field day and attracted the attention of participants. However, the data generated under CBBP needs to be evaluated to unravel the actual progress of the programme (Haile et al., 2019b). Thus, there was a need to evaluate the data generated on the ongoing data collection to know the genetic improvement trend of this breed under CBBP. We report preliminary results from the breeding program whose objectives were:

- ✓ Evaluate the progress in implementation of Dawuro sheep community-based breeding program
- ✓ Evaluate the growth performance of Dawuro sheep population kept under CBBPs;
- ✓ Study the effects of non-genetic factors on performance of sheep.

2. Materials and methods

2.1. Description of the study area

Dawuro sheep CBBP has been undertaken in Tocha and Kechi districts located in Sothern region Dawuro Zone, found at a distance of 258 km to the Southwest of Addis Ababa (national capital) and 171 km from Hawassa (the regional capital). Dawuro zone is bordered by Hadiya zone in the North, Kemebata-Tembaro zone in North east, Wolayita zone in the East, Gamo-Gofa zone in the west and Konta special woreda and Jimma (Oromiya) zone in the west. Dawuro is situated at an altitude ranging from 800 to 2850 m.a.s.l., longitude 37°09'E and latitude 7°08 'N. The capital of Dawuro zone is Tarcha, which is located at about 507 km from Addis Ababa and 282 km from Hawassa (the capital city of SNNPR).

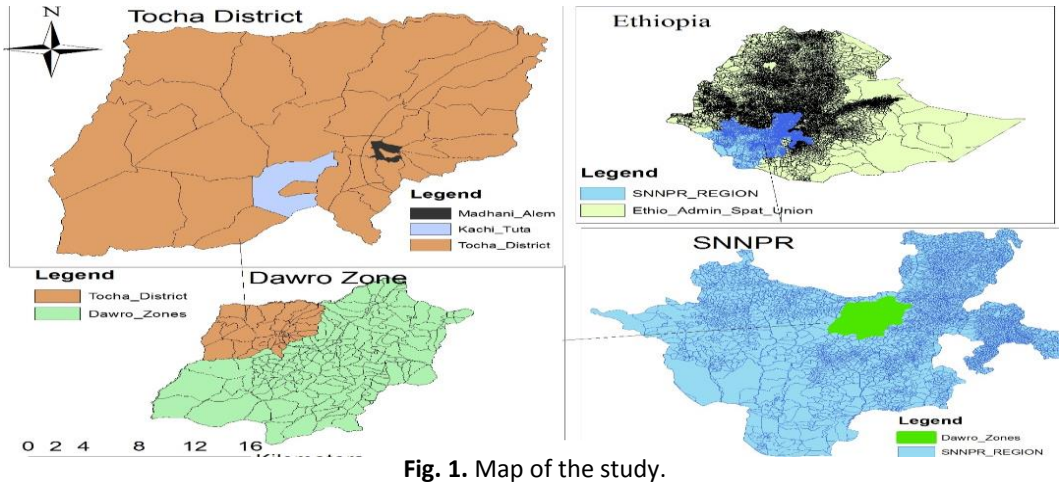

Fig. 1. Map of the study.

The annual mean maximum and minimum temperature of Dawuro zone is 18^0C and 29^0C, respectively (http://climexp.knmi.nl/select.cgi?field=cru4_tmp). The annual mean rainfall of the zone ranged from 1200 to 1800 mm (http://climexp.knmi.nl/select.cgi?field=cru4_pre). The main rainy season of the zone is between June to September (long rainy season), short rainy season from March to April, and dry season lasts from October to February and May (Agricultural office of Dawuro zone).

Table 1
Basic information of study area.

Location (latitude and longitude)	7°20' N latitude and 37°50' E
Altitude	800 to 2850 m.a.s. l
Agro ecology	Highland ≥2300 m.a.s.l., 44.1% of area; Midland >1500 to < 2300 m.a.s.l., 19.5 % of area; and Lowland ≤1500 m.a.s.l., 36.4% of area.
Total area	74671 ha
Species-wise livestock population	1. Cattle; 131277 2. Sheep; 77480 3. Goat; 22988 4. Donkey; 2007 5. Mule; 2424 6. Horse; 2107 7. Chickens; 131267
Temperature	18oc (minimum) and 29oc (maximum)
Major crops grown	Ensete ventricosum, barley, wheat, teff, sorghum, maize, fababeen, pea, taro.
Total human population	154409 a) Male; 75660 b) Female; 78749

Source: (Tocha district office of agriculture, 2018)

2.2. Sources of data and data management

For this study empirical data were obtained from the ongoing Dawuro sheep community, based breeding program (CBBP) implemented in Tocha and Kechi Tuta districts for the last three year 2017-2019. The program was initially established with 840 base flock and 35 breeding rams. Reproductive, productive and healthy related data is collected and keep in each site and, soft copy in excel in Areka agricultural research Centre. The type of data collected for productive traits are birth weight (BWT), weaning weight (WWT) and 6-month weight (6WT).

Table 2
Number of households (HH) and mean flock size in the different locations from baseline record.

Districts	Sites	Total number of household	Total Number of participants	Average flock size	Range
Kechi Tuta	Kechi	608	82(Female 11)	10	3-16
Tocha	Medhani Alem	149	45(Female 5)	9	2-12

2.3. Effects of non-genetic factors

Data used for analysis included birth weight, three-month weight, and 6-month weight. Before conducting the main analysis, data were coded and entered into the computer for analysis and preliminary data analysis; like homogeneity, test and normality test were employed. Then, data were analyzed using the Generalized Linear Model (GLM) procedures of SAS version 9.2 (SAS, 2009). The non-genetic factors used in the model included year of birth (2017 to 2019), season (long rainy season, small rainy and dry season), sex (male and female), parity (1, 2,

3, 4, ≥5), birth type (single, twin, and triplet) and site (Medehani_Alem, Keche Tuta). The Tukey-Kramer test was used to separate least squares means with more than two levels.

2.4. Growth traits and daily weight gain traits

$Yijklmn = \mu + P_i + S_j + bt_k + yr_l + Se_m + Sx_n + e_{ijklmn}$

Where:

Yijklmn = growth trait for each animal

μ = overall mean,

$p_i = i^{th}$ parity (i=5; 1, 2, 3, 4, ≥5)

$S_j = j^{th}$ site (j= 2; Medehani_Alem, Keche Tuta)

$bt_k = k^{th}$ birth type (k =3; single, twin, triplet)

$Yr_l = l^{th}$ year (l=3; 2017 -2019)

$Se_m = m^{th}$ season (m=3; main rainy season, Small rainy, dry season)

$Sx_n = n^{th}$ sex (n = male, female)

eijklmn = random error

2.5. Community participation

In the first phase, consultation and meeting was made with zonal and district experts, representative of sheep producers, elders (women and men sheep producers) and youth group. All the households were recorded based on the number of flocks keep in their household. The program was started with 128 male and 11 female household in two cooperative. Training was given for participants on using top ram, importance of selection, keeping elite flock; avoid negative selection, system and importance of record keeping, culling system, selection mechanism and effect of inbreeding. In the second phase, baseline data collection was made.

3. Preliminary results

The ANOVA showed that the effect of site/cooperative, birth type, birth year and sex were highly significantly affected ($p<0.01$) on BWT, WWT and 6WT, whereas the effect of parity and season were significant effects ($P<0.05$) on BWT, season of birth have also a significant effect on birth weight and 6 month weight (Table 3).

In the preliminary analysis study, the overall least square mean of birth weight, weaning weight and 6 month weight were 2.55±0.04 kg, 13.95±0.14 and 19.88±0.4 respectively with CV of 15.29,13.95 and 17.02 percent respectively. The least square means (LSM ± SE) of birth weight, weaning weight and 6 month weight among the two cooperatives (Site) were 2.58±0.01, 14.16±0.11, 18.13±0.16 and 2.52±0.01, 13.75±0.7, 21.63±0.43 for Medehani_Alem and Keche Tuta respectively. The higher weaning weight and lower 6 month weight were recorded from Medehani_Alem cooperative. The reverse is true for and Keche Tuta breeder cooperative.

The variation in the BWT over cooperatives (Site), observed in present study, may be due to variations in management practice, availability of feed/fodder and efficiency of data enumerators.

Table 3
Least square mean (Mean±S.E) for growth traits of Dawuro sheep.

	BWT(Kg)		WWT(Kg)		6WT(Kg)	
Source of variation	**N**	**LSM ±SE**	**N**	**LSM ±SE**	**N**	**LSM ±SE**
Overall	1813	2.55±0.04	973	13.95±0.14		19.88±0.44
CV%		15.29		13.95		17.02
Parity		**		NS		NS
Parity 1	518	2.36±0.01^{ab}	338	13.89±0.1	181	19.83±0.23
Parity 2	642	2.49±0.01^{b}	381	13.72±0.1	170	19.79±0.24
Parity 3	296	2.62±0.02^{a}	155	14.22±0.16	58	19.72±0.4
Parity 4	176	2.61±0.03^{a}	46	14.04±0.29	4	21.06±1.6
Parity ≥5	181	2.49±0.03^{b}	53	13.91±0.27	22	19.0±0.6
Cooperative		*		**		**
Medehani_Alem	625	2.58±0.01	298	14.16±0.11	54	18.13±0.16
Keche Tuta	1188	2.52±0.01	675	13.75±0.7	381	21.63±0.43

Birth type		**		**		*
Single	655	2.96±0.01[a]	341	14.78±0.1[a]	112	20.64±0.3[a]
Twin	1069	2.67±0.01[b]	587	14.29±0.08[b]	33	19.17±0.5[b]
Triplet	81	2.35±0.04[c]	45	12.8±0.29[c]	290	19.82±0.18[b]
quadruplets	8	2.22±0.01[c]	-			
Sex		**		*		**
Male	945	2.6±0.01	503	14.1±0.08	197	23.22±0.22
Female	868	2.5±0.01	470	13.81±0.09	238	20.59±0.25
Season of birth		**		NS		**
Long rainy season	629	2.51±0.01[b]	369	13.74±0.1	145	19.64±0.26[b]
Short rain season	288	2.66±0.02[a]	128	14.06±0.17	94	19.24±0.33[b]
Dry season	896	2.48±0.01[b]	476	14.07±0.09	196	20.75±0.22[a]
Birth year		**		**		**
2017	201	2.59±0.02[a]	90	13.82±0.2[ab]		NA
2018	893	2.46±0.01[b]	406	13.78±0.09[b]	192	19.5±0.23
2019	719	2.59±0.01[a]	477	14.26±0.09[a]	243	20.25±0.20

Note: Mean values with different superscripts across columns are significantly different (P<0.05); LSM-Least Square Means; SE-Standard Error; N number of observations; BWT-birth weight; WWT-weaning weight; 6WT-six-month weight; kg-kilograms; NA- data not available; ** highly significant (p<0.01), *significant (p<0.05) and; NS -non-significant (p>0.05).

Table 4

Least square mean (Mean±S.E) for daily weight gain traits of Dawuro sheep.

	ADG0-3(g)		ADG3-6(g)	
Source of variation	**N**	**mean ±SE**	**N**	**mean ±SE**
Overall	973	125.68±1.55	475	70.35±4.7
CV%		16.88		65.59
Parity		NS		NS
Parity 1	338	124.69±1.18	177	65.95±2.57
Parity 2	381	124.38±1.11	168	67.23±2.64
Parity 3	155	128.07±1.7	56	66.04±4.57
Parity 4	46	125.58±3.2	44	88.33±17.11
Parity ≥ 5	53	125.69±2.98	22	63.96±7.29
Cooperative		**		**
Medehani_Alem	298	123.44±0.8	54	90.26±4.6
Keche Tuta	675	127.93±1.2	373	50.35±1.7
Birth type		**		NS
Single	341	131.54±1.17[a]	109	72.85±3.27
Twin	587	129.32±0.89[a]	285	67.93±2.02
≥Triplet	45	116.20±3.2[a]	33	70.12±3.95
Sex		NS		*
Male	503	126.70±0.9	192	66.03±2.4
Female	470	124.66±1.0	235	74.57±2.23
Season		NS		**
long rainy season	369	123.39±1.1	449	64.29±2.84
Short rainy season	128	126.62±1.9	87	68.77±3.66
Dry season	476	127.05±0.9	195	77.84±2.45
Birth year		*		NS
2017	90	124.28±2.2[b]		NA
2018	406	124.82±1.07[b]	192	71.79±2.47
2019	477	127.95±0.99[a]	235	68.82±2.23

Note: Mean values with different superscripts across columns are significantly different (P<0.05); LSM-Least Square Means; SE-Standard Error; N number of observations; **highly significant (p<0.01), *significant (p<0.05) and NS -non-significant (p>0.05; ADG0- 3 daily weight gain from birth to Weaning, ADG 3-6-daily weight gain from weaning to 6-month age, NA=data not available.

The least square means of birth weight for single, twin, triplet and quadruplet were significant. Single born sheep had heavier weights at all ages and gained more weight than multiple births. Berhanu and Aynalem (2009) have reported the same results. The possible reason for these trends may be explained by limited uterine space during pregnancy among twins/ ≥Triplet/or quadruplet, singles, nutrition of dam especially during the last trimester of pregnancy. In the present study male were heavier than female lambs and this may be due to the influence of hormones in the two sexes.

The least squares mean (LSM ± SE) of birth weight for the consecutive three years was 2.59±0.02, 2.46±0.01, 2.59±0.01kg in 2017, 2018 and 2019 respectively. The corresponding weaning weight was 13.82±0.2, 13.78±0.09, 14.26±0.09 respectively. 6-month weight in 2018 and 2019 were 19.5±0.23 and 20.25±0.20 kg respectiely. The pair-wise comparison of birth weight and weaning weight means showed pair-wise differences among selection 2017 and 2019 were non-significant. Except for birth weight, which had unclear increasing trend, 6-month weight and weaning weight had exhibited in increasing trend.

The year-wise variation in the BWT may be due to variation in the management and environmental conditions including feeding. Another possible reason could be the absence of sufficient number of records in the initial stage of CBBP and poor data quality. However, after, the enumerators gained experience and large number of data collected; the quality of the data collected may be improved. A similar situation was reported from Bonga and Menz site by Haile et al. (2014) and Gizaw et al. (2014a).

The present results indicated that birth weight increased as parity advanced from 1 to ≥5. The increase in the birth weight with advancing parity may be due to the fact that ewes attain physiological maturity with advanced age (Mengiste et al., 2010). These preliminary results are not consistent and in some cases they are unexpected. The breeding programs we set up are new approaches and we are still learning some of the operations.

4. Implication of the result

The preliminary genetic improvement result reported in the present study have provided the first information on the ongoing Dawuro sheep community based breeding program. Growth traits result indicated that Dawuro sheep could be improved by selections. Preliminary 6-month weight trait for Dawuro sheep is higher than other indigenous sheep breed of Ethiopia except Doyogena and Bonga sheep and comparable with Horro breed. Therefore, there is an opportunity to out scaled to new site and strengthen the existing sites for further improvements. The next step should be producing higher quantity of rams with better growth performance/ marketable body weight in the study areas.

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