Journal of Animal Sciences and Livestock Production

ISSN: 2577-0594

Open Access Research Article

Growth and Milk Production Performance of Abergelle Goat under the Community based Breeding Program at Ziqula District, Northern Ethiopia

Yeshiwas W*, Bekahagn W, Mulatu G, Wubeneh A, Alemu D

Department of Agriculture, Sekota Dry land Agriculture Research Center (SDARC), Sekota, Ethiopia

ABSTRACT

Community based goat breeding program is becoming a new approach which is implemented nationwide in Ethiopia. The program was also being implemented in Abergelle goat breed for the last six years (2014-2019) at Bilaque village in Ziquala district, Wag himra zone of North Eastern part of Ethiopia. The objective of this study was device and implementation of community based goat breeding program for the improvement of growth and milk production performance of the breed. Goats from 33 goat keepers were monitored for the buck selection process. Best bucks were selected at yearly basis based on their indexed Estimated Breeding Value (EBV) and unselected bucks were culled out from the population through castration and sale. Generalized Linear Model (GLM) procedure of SAS (9.0) in support with descriptive statistics and micro soft excel programs were used for data analysis. Birth type, year of birth and parity had significant ($P<0.05$) effect on pre-weaning growth performances of Abergelle goat. Mean yearling weight of kids had slightly increased from 12.8 ± 0.11 Kg to 13.7 ± 0.12 Kg respectively, during the course of four round selections. Yearling weight had better correlation with six month weight ($r=0.3$) and nine month weight ($r=0.31$) at ($p<0.05$). Daily milk yield was significantly ($p<0.05$) affected by season of lactation, and selection years. Daily milk yield was increased from 300.31 ± 7.41 ml to 352.62 ± 14.33 ml during the selection years. It was concluded that, the program was found to be compatible strategy which can suit with the existing breeding practices of farmers as it can allow for the use of elite bucks and removal of inferior once from the population.

Keywords: Abergelle goat; Body weight; Community based; Milk yield; Selection

INTRODUCTION

Goats comprise 5.32% of the total tropical livestock units of Ethiopia, contribute an estimated 12 to 14% of annual meat products, 10.5% of milk production, 47% of the agricultural GDP 30% of all domestic meat consumption and 6% of all animals exported. Together with sheep, goats contribute about 90% of the live animal/meat and 92% of the total skin export trade value. Abergelle goat is one from the Ethiopian goat breeds which is under rift valley rout family has an estimated population of over 300,000. It is found along the Tekeze River in Southern Tigray (Tembien and Inderta), Waghimra, Raya Azebo, and North Gondar (Simien) and kept by the Agew and Tigray ethnic groups.

Received:	14-October-2022;	**Manuscript No:**	IPJASLP-22-14547;
Editor assigned:	17-October-2022;	**PreQC No:**	IPJASLP-22-14547 (PQ);
Reviewed:	31-October-2022;	**QC No:**	IPJASLP-22-14547;
Revised:	22-February-2023;	**Manuscript No:**	IPJASLP-22-14547 (R);
Published:	01-March-2023;	**DOI:**	10.36648/2577-0594.7.3.40

Corresponding author: Yeshiwas W, Department of Agriculture, Sekota Dry land Agriculture Research Center (SDARC), Sekota, Ethiopia; E-mail: walleyeshiwas@gmail.com

Citation: Yeshiwas W, Bekahagn W, Mulatu G, Wubeneh A, Alemu D (2023) Growth and Milk Production Performance of Abergelle Goat under the Community Based Breeding Program at Ziqula District, Northern Ethiopia. J Anim Sci Livest Prod. 7:40.

Goat together with other livestock species contributes about 75% of the cash income sources of smallholder farmers at the mid and lowland areas of Waghemira. According to the result from established Community Based Breeding Programs (CBBP) works on the breed, the average flock size was 27 heads per household. Under the traditional management condition, the breed is characterized by its lower body weight, longer kidding interval, and lower litter size with better meat quality and temperament in comparison to other indigenous goat breeds of Ethiopia. As a result of this, community based selective breeding program has been developed and implemented for the improvement of growth and production performance of the breed. The approach is truly participatory, which considers the active involvement of communities in design, implementation and ownership of the scheme/ system. This innovative approach clearly takes account of farmers needs, views, decisions, active participation, genetic choices and overall execution of the system instead of building central breeding facilities. The experiment was designed with the objectives of devise and implementation of a selective breeding scheme for the improvement of body weight and milk production performance of Abergelle goats that can be applied under village conditions [1-5].

MATERIALS AND METHODS

Description of the Study Area

The program was implemented at Bilaqu village of Ziquala district, located 12°48′41.39″N and 38°43′22.02″E 775 Km North east of Addis Ababa. The district has rugged topography characterized by mountains, steep escarpments and deeply incised valleys. Mixed crop livestock system with high priority of livestock production is the major farming practice at the area. The mean annual rainfall of the area was 250-650 mm with very short and an erratic distribution from late early July to late August, mean annual temperature of 25°C-39°C and an altitude of 1308 (m.a.s.l) based on the above agro metrological data, and feed availability status at the area, from June up to November was considered as wet and the remaining months were taken as dry for indicating the birth season of kids [6-8].

Village Selection

Once the mega project entitled “harnessing genetic diversity of indigenous goat in Africa” has developed by ILRI/Beca since 2013, the program was implemented at Bilaqu village selected based on goat production potential, separate herding practice flock, accessibility of road and feed resources under irrigation and willingness of the farmers to participate in the program. About 33 goat keepers were selected and had a continuous discussion on the principle and implication of community-based goat improvement program followed by further baseline survey study like, general household characteristics, purpose of keeping goats, livestock ownership, flock structure, trait selection criteria’s of farmers, performance of goats, management and breeding practices and goat production constraints had been assessed. General information on farming systems of the study area and breeding objective identification components were used from obtained from survey report conducted at saziba village of Abergele district. Based on the report, growth and milk production traits were taken as priority traits of interest for improvement according to their respective order (**Table 1**). Reports of district office of agriculture and rural development were also considered as secondary information during site selection [9-12].

Table 1: List of preferred traits by farmers (own flock ranking method for females and group animal ranking for males), adopted from Abegaz Guangul, et al.

Sex	Traits	Percentage (%)
Female	Milk yield	20.47
	Drought resistance	14.96
	Body size	14.17
	Kid growth	11.81
	Twining	10.24
	Kidding interval	9.45
	Other cumulative traits	18.9
Male	Body size	21.03
	Color	23.86
	Body conformation	10.12
	Height	9.09

Fast growth	7.95
Other cumulative traits	27.95

Animal Management and Recording

All animals in the villages were identified using plastic ear tags. In addition, local names were provided for each individual goat which was helped full during the loss of an ear tag. Three enumerators were recruited and trained for data recording and follow up of the breeding program and to collect pedigree and performance data from the participating village flocks. Baseline information collected includes parity of the doe's using farmer recall method, age of the doe's based on their dentition and farmers information, total flock number with each age class category of the households, date of birth, milk yield of the dam, birth weight and subsequent weights of kids. The enumerators made rounds of visits to the villages every morning to record kids born and identify them by ear tags, milk data measurement and weigh the newborn. The kids were also weighed at three, six, nine and twelve months of age. Milk yield data were also recorded up to twelve weeks at a week interval [13].

Estimation of Breeding Value (EBV) and Selection

During program implementation, the overall procedure was considered the guideline protocol designed for setting up community based sheep breeding programs in Ethiopia by A one tier breeding structure was adopted and all first birth kids of the population born from unselected previous village sires were evaluated and selected as first round breeding population, after all, the growth performance of individuals and milk production performance of their respective dams were recorded. Index selection method were implemented for the first two round selections (on yearling weight and dam ADMY traits) where as for the recent three round selections, breeding value of candidate bucks were estimated by computing correction factors for the non- genetic/fixed factors like season, birth type, parity. Yearling bucks from all flocks in the project villages were evaluated together as cohorts and to be subjected further approval by farmers from phenotypic criterions like color, body conformation extra and the selection process were conducted based on the selection criteria which have been defined earlier by Solomon, et al.

Buck usage Modality and Mating

The selected bucks were assigned to buck groups with 1:15 sex ratio following an own flock mating plan due to larger flock sizes at each household by considering the previous mating history of bucks to avoid inbreeding. Unselected bucks were culled out through castration and sale as before the mating season was approaching. In cases of small flock number faced during the selection process, group mating system was used. Bucks were rotated among the individual members based on mapped rotation modality by considering the grazing corridor of flocks, settlement and previous mating history. After completion of a single breeding season bucks were rotated to other farmers by considering the preset conditions and finally at the end of service period they fattened and sold and the income used as a revolving fund and income generation for the established cooperative [14].

Data Analysis

Descriptive statistics and Microsoft excel program were used to perform simple population characteristics and graphical presentation of data. Productive performance (quantitative) data were analyzed using the GLM procedures of SAS version 9.0. Birth type, sex, season of birth, parity and year were fitted as fixed effects for body weight variables whereas season of birth, parity and year were fitted as fixed effects for milk production traits. Least square mean with respective standard error was separated using Tukey-Kramer test. Person correlation was employed to investigate associations among weight at different age and dam post-partum weight. The following models for body weight and milk yield variables with the fixed effects were used [15].

For growth parameter;

$$Y_{ijklm}=\mu+B_{ti}+S_j+S_{bk}+P_l+Y_m+e_{ijklm}$$

Where,
Yijklm=the observed growth performance of the goat,
μ=overall mean,
B_{ti}=effect of i^{th} birth type (Single, twin and triplet),
S_j=effect of j^{th} sex,
S_k=effect of k^{th} birth season (wet and dry),
P_l =effect of l^{th} parity (first to ninth),
Y_m=effect of the m^{th} year (2013-2018)
e_{ijklm}=random residual error

For milk parameters;

$$Y_{ijk}=\mu+S_{bi}+P_j+Y_k+e_{ijkl}$$

Where,

Y_{ijk}=the observed milk yield,

μ=overall mean,

S_i=effect of i^{th} birth season (wet and dry),

P_j=is the effect of j^{th} parity,

Y_k=effect of k^{th} year

e_{ijk}=random residual error

RESULTS AND DISCUSSION

Population Structure and Off Take Rates

The current study confirmed that from the whole monitored goat population during the base line data recorded in the village, about 51.7% of the population was covered by does, 40.2% weaned kids, 2.1% kids, 5.2% bucks and about 0.6% castrated bucks as indicated in **Figure 1**. The flock composition was fairly normal with its higher number of breeding does followed by weaned kids. The current result on the total proportion of does from the population was slightly lower than the reports of and who reported 56.6% and 51.8% respectively in the same breed. Lower number in this study might be due to smaller number of household used in comparison to the above reports and the study period difference. Death (22%), sale (44%), share (5.5%) and slaughtering (8%) were the major off take reasons recorded from the study in the flock. The result also revealed that sale was recorded as the highest proportion for goat disposal. Kids with their dams and weaning male kids were leaving the flock with the highest proportion which might be directly linked with the reason that goat keepers were mostly took either male kids or old does to the market (**Figure 2**).

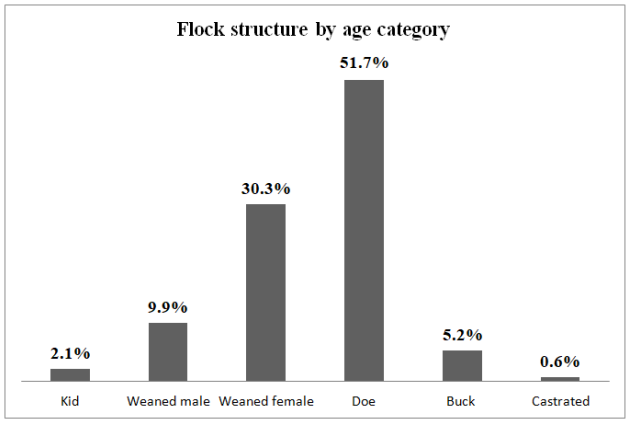

Figure 1: Population structure by age category.

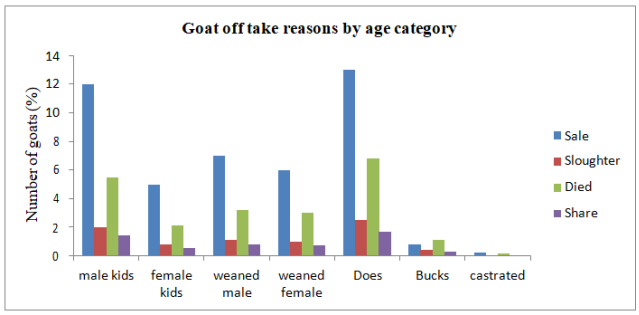

Figure 2: Goat off take reasons by age category at the study village.

Body Weight Changes at Different Ages across Selection Years

From the current study it was confirmed that, the body weight of kids at all ages (birth, weaning, six month, nine month and yearling weight) indicated in **Table 2** was significantly ($p<0.05$) affected by selection years.

Nevertheless, the body weight changes across selection years were very slight which might be due to the area was very fragile, feed scarce and prolonged drought prone area which lets the animal for survival instead of producing more. The overall mean of weight at birth, three, six, nine and twelve months were 2.09 ± 0.01 kg, 6.99 ± 0.03 kg, 8.61 ± 0.04 kg, 11.4 ± 0.12 kg and 14.1 ± 0.1 kg, respectively. The body weight changes revealed in the present study was lower than some of Ethiopian indigenous goats for instance, (2.71 ± 0.04 kg), (2.36 ± 0.05) kg for birth weight of Bati and Borana goats, respectively under traditional management system reported by Hulunim and comparable with (1.91), (6.84), (9.13) and (14.25) Kg for birth weight, weaning weight, six month weight and yearling weight, respectively for same breed under traditional management condition reported by Belay D and Taye M. Zeleke reported higher value of birth weight (3.19 kg) for Somali goats in extensive management system at Alemaya university as compared with the result found in the present study. Sex of kids had not produced any pronounced effect on the body weight changes across different ages. The result of the present study was in line with the result of Hulunim who reported in significant ($p>0.05$) difference observed between males and females for their daily weight gain for both Borana and short eared Somali goats. However, the author also reported sex of kids affected significantly ($p<0.05$) the total daily weight gain (birth 90 days) of Bati goats thus males had the heavier daily weight gain (86.82 ± 3.05 g/day) as compared to their female counterparts (78.17 ± 3.37 g/day). Six month and yearling weights of Abergelle goats were larger than mid Rift Valley (7.87 ± 1.62 and 12.85 ± 2.55 kg) reported by Tesfaye, et al., and lower than 13.61 ± 0.40 and 20.15 ± 0.67 of the central highland goats at Debre Berhan area. In the present study, single birth kids had significantly ($p<0.05$) higher body weight at birth with insignificant body weight changes for the remaining ages. Kids which were born during wet season show significantly ($p<0.05$) better body weight changes across all ages except the nine month weight (**Table 3**). The reason might be allied with the favored feeding management as the wet season can produce relatively ample of feeds unlike the dry season (**Figure 3**).

Table 2: Least square means (± SE) of live body weights at different age (Kg) of Abergelle goats at Bilaqu village.

Variables		BWT		TMWT		SMWT		NMWT		YWT
	N	LSM ± SE	N	LSM ± SE	N	LSM ± SE	N	LSM ± SE	N	LSM ± SE
Over all	1607	2.09 ± 0.01	1370	6.99 ± 0.03	1306	8.61 ± 0.04	1072	11.4 ± 0.12	771	14.1 ± 0.1
CV%		13.5		17.6		16.2		35.5		16.9
Sex		ns		ns		ns		ns		Ns
Male	852	1.92 ± 0.01	723	6.96 ± 0.05	692	8.8 ± 0.05	562	11.7 ± 0.07	368	15.2 ± 0.15
Female	755	1.88 ± 0.01	647	6.92 ± 0.05	614	8.6 ± 0.06	510	11.5 ± 0.25	403	14.7 ± 0.13
Birth type		*		ns		ns		ns		Ns
Single	1542	2.15 ± 0[a]	1323	7.04 ± 0.03	1262	8.62 ± 0.04	1035	11.7 ± 0.13	753	14.8 ± 0.10
Twin	56	2.01 ± 0.03[a]	47	6.84 ± 0.18	44	8.78 ± 0.21	37	11.5 ± 0.33	18	15.1 ± 0.79
	9	1.63 ± 0.09[b]	0	-	0	-	0	-	0	-
Birth season		*		*		*		ns		*
Dry	466	1.91 ± 0.01	416	6.74 ± 0.04[b]	380	8.51 ± 0.06[b]	253	11.4 ± 0.5	181	14.5 ± 0.23a
Wet	1141	1.95 ± 0.00	954	7.14 ± 0.04[a]	926	8.9 ± 0.05[a]	819	11.8 ± 0.05	590	15.4 ± 0.11b
Year		*		*		*		*		***
2014	400	1.94 ± 0.01[b]	350	7.51 ± 0.08[a]	315	9.36 ± 0.10[a]	265	11.1 ± 0.1[b]	241	12.8 ± 0.11d
2015	243	1.97 ± 0.01[b]	239	6.74 ± 0.06[b]	221	8.19 ± 0.07[c]	128	13.2 ± 0.97[a]	90	16.9 ± 0.30[a]
2016	239	1.86 ± 0.0[c]	222	6.81 ± 0.05[b]	213	8.26 ± 0.07[c]	175	10.6 ± 0.1[c]	105	15 ± 0.27[b]
2017	266	1.81 ± 0.01[c]	261	6.19 ± 0.06[c]	260	8.60 ± 0.06[b]	226	11.8 ± 0.11[ab]	190	16.3 ± 0.22[a]
2018	312	1.94 ± 0.01[b]	298	7.45 ± 0.08[a]	297	9.12 ± 0.08[a]	278	11.3 ± 0.07[b]	145	13.7 ± 0.12[c]
2018	147	2.06 ± 0.02[a]	-	-						

Parity		*		Ns		ns		*		Ns
1	363	1.80 ± 0.01[b]	311	6.6 ± 0.07	292	8.46 ± 0.08	242	11.12 ± 0.1[b]	157	14.11 ± 0.21
2	288	1.86 ± 0.01[b]	240	6.83 ± 0.08	230	8.62 ± 0.09	178	11.34 ± 0.13[a]	130	14.33 ± 0.25
3	256	1.91 ± 0.01[a]	217	6.71 ± 0.09	213	8.46 ± 0.09	175	11.21 ± 0.13[a]	116	14.23 ± 0.25
4	308	1.90 ± 0.01[a]	259	6.78 ± 0.08	247	8.57 ± 0.104	218	11.31 ± 0.12[a]	166	14.72 ± 0.24
5	219	1.93 ± 0.01[a]	195	6.89 ± 0.09	186	8.54 ± 0.11	150	11.03 ± 0.12[b]	116	14.2 ± 0.23
6	117	1.94 ± 0.02[a]	103	6.73 ± 0.13	94	8.44 ± 0.14	74	12.72 ± 1.67[a]	60	14.47 ± 0.38
≥ 7	40	1.94 ± 0.04[a]	33	7.13 ± 0.23	32	8.51 ± 0.22	26	11.66 ± 0.34[a]	19	15.07 ± 0.71

Where BWT=birth weight, TMWT=three month weight, SMWT=six month weight, NMWT=nine month weight, YWT= yearling weight, N= total population, LSM=least square means and SE=standard error, '*'=p<0.05, '**'=p<0.01, '***'=p<0.001 and ns=no significant difference, a=data in the first delivery, b=data in the fifth delivery, c=significance between nulliparous and multiparous female

Table 3: Person correlation among weights at different ages.

	BWt	TMWt	SMWt	NMWt	Ywt
BWt	1*				
TMWt	0.16762	1***			
SMWt	0.09739	0.80393*	1**		
NMWt	0.00725	0.16263*	0.26482**	1**	
Ywt	-0.07668	0.10141	0.30367	0.31093	1

Where: '*': significantly associated at p<0.05; '**': significantly associated at p<0.001; '***': significantly associated at p<0.001

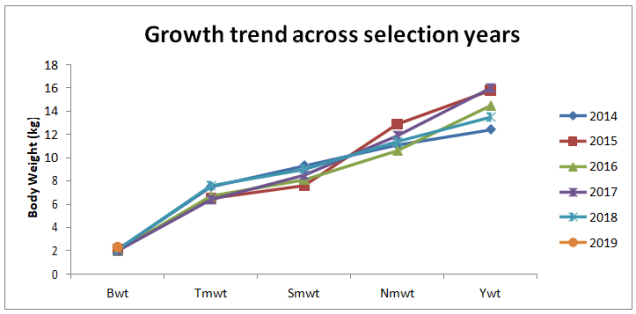

Figure 3: Body weight changes across selection years.

Milk Production Changes across Selection Years

As milk is an important product that all households consumed, the production performance should be maximized. From this perspective, milk production performance (ADMY) during the selection period presented in error! Reference source not found. was signi icantly different (p<0.05) between years. It was signi icantly varied during each year in an increasing fashion. In addition, the phenotypic milk production trend across years is presented in error! Reference source not found that showed positive trend. Lactation length, average daily milk yield and total milk yields were all signi icantly affected by the season of birth and year of birth. The overall average Lactation Length (LL) (± SE), Total lactation Milk Yield (TMY) (± SE) and average daily milk yield (± SE)

were 10.5 ± 0.1 weeks (73.5 days), 25.63 ± 0.29 kg and 358.04 ± 2.97 gm respectively. However a report on milk production performance of indigenous goats are lacking in our country, the result of this study was slightly higher than a report by Mohammed Bedhane, et al., which was 86 days, 17.73 kg and 208.72 gm of lactation length, total milk yield and average daily milk yields, respectively for Arsi-Bale goat breed. On the other hand, the average daily milk yield in this study was lower than the report of Dereje, et al., who reported 450 g/day for Afar goat breed. Does that have given birth during wet seasons had relatively higher daily milk yield due to the availability of feed was good in wet season. At the same time, average daily milk yield was significantly increased across years so that it can be associated with the response to selection. Even though parity of does was not statistically affected the LL, ADMY and TMY, higher parity doe‟s producing slightly higher milk yield than the lower parity doe‟s in the fact that the higher parity does has taken the advantage of mammary gland development than those lower parity does. In some extent, there was inconsistent data recording in response to flock mobility which was the most critical problems during the peak periods of lactations as the farmers were migrated the flock to distant areas for long seasons (**Table 4 and Figure 4**).

Table 4: Least square means (± SE) of LL (weeks), TMY (Kg) and ADMY (gm) of Abergelle goats at Bilaqu village.

Variables		LL		TMY		ADMY
	N	LSM ± SE	N	LSM ± SE	N	LSM ± SE
Over all	803	10.5 ± 0.1	803	25.63 ± 0.29	803	358.04 ± 2.97
CV%		26.9		30.6		20.7
Season		*		*		*
Dry	213	11.0 ± 0.2^{b}	218	25.24 ± 0.52^{b}	213	323.27 ± 6.27^{b}
Wet	590	10.37 ± 0.1^{a}	610	26.32 ± 0.34^{a}	590	370.58 ± 3.20^{a}
Year		*		*		*
2014	190	10.9 ± 0.2b^{c}	190	21.96 ± 0.60^{c}	190	300.31 ± 7.41^{d}
2015	120	10.7 ± 0.2b^{c}	120	23.98 ± 0.66^{b}	120	328.42 ± 7.34^{c}
2016	122	10.9 ± 0.2b^{c}	122	28.10 ± 0.64^{a}	122	375.13 ± 5.87^{b}
2017	116	11.6 ± 0.1^{ab}	116	29.33 ± 0.46^{a}	116	362.56 ± 5.01^{b}
2018	255	9.7 ± 0.2^{c}	255	25.58 ± 0.57^{b}	255	389.34 ± 3.66^{a}
Parity		ns		ns		ns
1	180	10.88 ± 0.21	180	25.20 ± 0.61	180	339.77 ± 6.58
2	138	10.44 ± 0.27	138	25.55 ±0.70	138	363.12 ± 6.84
3	143	10.87 ± 0.24	143	25.83 ± 0.63	143	347.87 ± 6.13
4	145	10.88 ± 0.22	145	25.12 ± 0.68	145	348.90 ± 6.95
5	111	10.89 ± 0.27	111	26.31 ± 0.83	111	354.62 ± 8.72
≥ 6	86	10.67 ± 0.60	86	25.72 ± 1.45	86	352.62 ± 14.33

Where LL: Lactation Length; TLMY: Total Lactation Milk Yield; ADMY: Average Daily Milk Yield; N: total population; LSM: Least Square Means and SE: Standard Error; '*': p<0.05; and ns: no significant differencea=data in the first delivery, b=data in the fifth delivery, c=significance between nulliparous and multiparous female

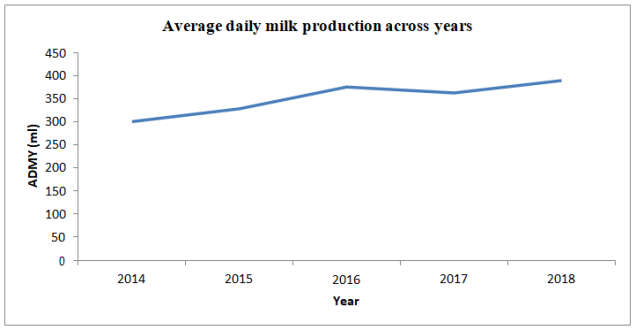

Figure 4: Trends of average daily milk yield across selection years.

CONCLUSION

Body weight of kids and milk yield were slightly increased during the selection years, though the improvement was not as such faster so that strategic supplementation of the breeder stock will become an important management step in order to catch the real genetic merit of goats as the area is poor in feed availability. The study gave some insight for its great possibility of improvement of growth and milk production traits through strategic design and implementation of selective breeding approaches. Strong consideration of the fixed factors like birth type, season of birth and parity will become an important concern during (Ebv) estimation and selection as the factors have significant effect on body weight gain of kids at different ages. Six and nine month weight had better association with yearling weight (r=0.3 and 0.31), respectively which calls for arranging the selection age from six up to nine years which can also allow the chance of maintaining elite kids. The kids born from the dams with parity of ≥ 3 had better birth and post weaning body weight, thus keeping these does as breeder stock can allow for the improvement of the population.

REFERENCES

1. Alemu A. On farm phenotypic characterization and performance evaluation of abergelle and central highland goat breeds as an input for designing community-based breeding program. MSC thesis, Haramaya University, Ethiopia. 2015. 1-147.
2. Wondim B, Gobeze M, Biresaw B (2007) Feed Resource Availability, Livestock Migration Pattern and Synthesis of Feeding Calendar at Wag-Lasta, Ethiopia. Daagu Int J Appl Res. 1(1):26-40.
3. Derbie B, Taye M (2007) Growth performance and carcass characteristics of central highland goats in Sekota District, Ethiopia. Adv Agric. 2(8):250-258.
4. Bosso NA, Cisse MF, Waaij EH (2007) Genetic and phenotypic parameters of body weight in West African Dwarf goat and Djallonke sheep. Small Rumin Res. 67(2-3) :271–278.
5. Dereje T, Mengistu UGA (2015) A review of productive and reproductive characteristics of indigenous goats in Ethiopia. Livest Res Rural Dev. 27(2):1–19.
6. FARM (1996) Goat Types of Ethiopia and Eritrea. Physical description and management systems. Published jointly by FARM-Africa, London, UK and International Livestock Research Institute, Nairobi, Kenya. 1-76.
7. Hassen H, Lababidi S, Rischkowsky B (2012) Molecular characterization of Ethiopian indigenous goat populations. Trop Anim Health Prod. 44(6):1239-1246.
8. Gatew H, Hassen H, Kebede K, Haile A, Lobo RNB, et al. (2019) Early growth trend and performance of three Ethiopian goat ecotypes under smallholder management systems. Agric Food Secur. 8(1):1-4
9. Bedhane M, Haile A, Dadi H, Tesfaye AT (2012) Estimates of genetic and phenotypic parameters for milk traits in Arsi-Bale goat in Ethiopia. Livest Res Rural Dev. 24(6):1-6.
10. Mueller JP, Rischkowsky B, Haile A, Philipsson J, Mwai O, et al. (2015) Community based livestock breeding programmes: Essentials and examples. J Anim Breed Genet. 132(2):155-168.
11. Guangul SA (2014). Design of community based breeding programs for two indigenous goat breeds of Ethiopia. BOKU-University of Natural Resources and Life sciences, Department of Sustainable Agricultural Systems, Division of Livestock Sciences, Vienna, Austria.
12. Guangul SA, Solkner J, Gizaw S, Dessie T, Haile A, et al. (2014) Optimizing alternative schemes of community based breeding programs for two Ethiopian goat breeds. Acta Agraria Kaposvariensis. 18(1)47–55.
13. Abegaz JS, Gizaw S, Dessie T, Haile A, Wurzinger M (2013) Description of production systems and morphological characteristics of Abergelle and Western lowland goat breeds in Ethiopia: implication for community-based breeding programmes. Anim Genet Resour. 53:69-78.
14. Wykes DL (2012) Robert Bakewell (1725-1795) of Dishley: Farmer and livestock improver. Agric Hist Rev. 52(1): 38-55.
15. Zeleke M (2007) Environmental influences on pre-weaning growth performances and mortality rates of extensively managed Somali goats in Eastern Ethiopia. Livestock Res Rur Dev. 19(12):1-8.