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Konso Goat Performance under Community-Based Breeding Program

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ABSTRACT: The current study was aimed to evaluate Konso goat performance under community based breeding program (CBBP) in Konso zone. Konso goat performance under farmer community level management was not evaluated yet to exploit its potential. Hence, five consecutive years' data (2018-2022) from three villages (Baide, Arfayde and Jarso), a total of 283 cooperative members and 1859 goat flock size were used for the performance analysis. Means were separated by Duncan multiple range test at α 0.05. Village, month, year, sex, birth type and parity were used as fixed effects for the birth weight (BW), weaning weight (WW), six months weight (6MW), nine months weight (9MW), yearling weight (12MW) and mature weights' (MW) response variables. An overall findings revealed that goats in the study areas have showed that the BW, WW, 6MW, 9MW, 12MW and MW were 2.56, 9.48, 14.61, 18.56, 19.37 and 27.04 kg, respectively. Except WW, the rest of the growth parameters were significantly affected by Village (P<0.05). On the other side, mature weight was not affected by kidding months (P>0.05), and yearling weight was also not affected by kidding year. Kid sex was not affected 6MW and 12MW (P>0.05). Additionally, birth type hasn't affected BW, 6MW and 12MW. Finally, all the growth parameters weren't significantly affected (P>0.05) by parity. These findings have revealed that resource-poor participatory goat breeding program should be further monitored and evaluated based on the above mentioned factors' in short and long term plans for the Konso goat breed genetic improvement.

Keywords: Community-Based Breeding Program, Goat, Konso, Performance, Selection.

INTRODUCTION

Animal production systems in developed countries with high-input are supported by the state and implemented by well-organized national breeding programs. Data recording, processing methods and central decisions about the use of male breeding animals are important elements of such breeding programs (Haile *et al.*, 2020). Genetic improvement programs of indigenous small ruminants in low-input production systems contribute to improved productivity (Duguma *et al*., 2020) as well as ensuring sustain able conservation strategies (Mirkena *et al*., 2010a).

However, in developing countries, the required supportive infra- structure is largely unavailable, and attempts to repeat developed countries' approaches were little in success (Haile *et al.*, 2020). The most common approach implemented in many developing countries is centralized breeding schemes entirely managed and controlled by governments with minimal participation by farmers (Haile *et al.*, 2018). These nucleus breeding units established at a central station, are run by a government organization undertaking part of the breeding strategy roles including data recording, genetic evaluation, selection, delivery of genetic change and feedback to farmers. However, these centralized schemes have failed to sustainably provide the desired genetic improvement to small holders and the participation of the end users in the process (Haile *et al.*, 2020).

Another widely followed strategy has been the import of improved lines in the form of live animals, semen or embryos. These are usually crossbred with the local and 'less productive' breeds to upgrade them. In most cases, this is done without sufficient pretesting of the suitability and adaptability of the exotic breeds and their resulting crosses to local production systems and with no clear strategy concerning what the final genotype would be. Genetic erosion of these local populations and breeds has occurred where indiscriminate crossbreeding with local populations has been practiced (Haile *et al.*, 2018).

An alternative approach is a community-based breeding program (CBBP). Such programs consider the needs, views, decisions and active participation of farmers from inception through to implementation. Their success is based upon proper consideration of farmers' breeding objectives, available infrastructure, participation and ownership (Wurzinger *et al.,* 2011; Mueller *et al.,* 2015; Haile *et al.,* 2018).

The Arba Minch Agricultural Research Center (AMARC) under Southern Agricultural Research Institute (SARI), in partnership with the International Livestock Research Institute (ILRI) and International Center for Agricultural Research in the Dry Areas (ICARDA), have been implementing on Konso goat breed community-based breeding program (CBBP) in south Ethiopia since 2013. However, the progress status of the program has not yet been adequately reported. This paper evaluates the status of the Konso goat CBBP in south Ethiopia by using the growth and reproduction performance parameters.

MATERIALS AND METHODS

A. Description of the sites and breeds

Konso is a zone in the south region, Ethiopia. Located in the Great Rift Valley, 607.2 km from Addis Ababa. Konso is bordered on the south by the Oromia Region, on the west by the South Omo Zone, on the northwest by Allezone, on the north by Gardula zone, on the northeast by Kore zone, and on the east by Burjizone. Konso is located 595km away from Addis Ababa in the southwest of Ethiopia; it is located at 5°17' 36" N latitude and 37°29' 05" E longitude and lies between 600 to 2100 meter above sea level. The temperature ranges between 12 to 33°C. The annual rainfall variation is between 400 and 1000mm (Netsanet *et al.*, 2016).

The Konso goat CBBP was set up in 6 villages (Fuchucha, Baide, Arfayde, Jarso, Tebela-Kuchale and Masoya). Three villages were identified for the current study as presented in Table 1.

The Konso goat breed is judged good for traits such as growth rate, body size and disease resistance (Netsanet *et al.,* 2016). The core of this program is to get community members working together in ram selection, management and use. Buck selection occurs at 6 months of the age. All young rams were collected at one central place in each community on an agreed screening date. Selection was then performed based on the estimated breeding values and an index constructed that involved more than one trait. A breeding ram selection committee composed of 3 to 5members elected by the community was involved in the selection. The committee checked the conformation, coat color, and other criteria in their decision making. The number of bucks to be selected depended on the number of ewes available formating, with a male: female allocation ratio of 1: 30 (Mueller *et al.*, 2015). Finally, buck selection was confirmed by the researchers by estimated breeding value (EBV) selection using wombat software.

B. Data recording and analysis

Data recording formats to collect biological data from each house hold were developed. Data analysed included birth weight, 3-month weight, 6-month weight, 9-month weight, 12-month weight and mature weight. Least squares analysis (SPSS, 2011) was carried out to study performance of goat and examine fixed effects. The fixed effects fitted for the weights were: location, year of birth, kidding months, sex (two classes, male and female), birth type (three classes: single, twin and triple) and parity. A fixed effect model was fitted. The Duncan multiple range test was used to separate least squares means by using the following model.

$$Y = \mu + A_i + S_j + D_k + M_l + P_m + B_n + e_{ijklmn} \quad (1)$$

Where:

Y = the observed (body weight measurements) in the i^{th}birth year, j^{th} sex and k^{th} districts, l^{th} birth month, m^{th} parity and n^{th} birth type

μ=Overall mean;

A_i= the effect of i^{th} birth year (i= 2018, 2019, 2020, 2021 and 2022);

S_j=the effect of j^{th}Sex (j= male and female);

D_k=the effect of k^{th} location (k= 1: Baide, 2: Arfayde and 3:Jarso);

M_l=the effect of l^{th}birth month (l= Sep-Aug);

P_m=the effect of m^{th}parity (m= 1-5);

B_n=the effect of n^{th}birth type (n= 1: Single, 2: Twin and 3: Triplet) and

e_{ijklmn}=random residual error.

Stepwise regression procedure was also used to determine the best-fitted regression equation for the prediction of body weight from body measurements by the following model.

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + e_j \quad (2)$$

Where:

Y=the response variable (body weight)

α=the intercept $X1$, $X2$, $X3$, $X4$, $X5$, $X6$ and Xn= are the explanatory variables (location, year of birth, kidding months, sex, birth type and parity, respectively).

$\beta 1$, $\beta 2$, ..., βn are regression coefficient of the variables X ($X1$, $X2$, ...,Xn)

ej=the residual random error.

Table 1: Characteristics of the three study villages.

Sr. No.	Village	Participant household	Flock size	Altitude (m.a.s.l)	North	East	Production system	Goat use
1	Baide	150	1011	1202	$05^0$28’15’’	$037^0$26’00’’	Mixed lowland	Meat type
2	Arfayde	108	610	1565	$05^0$24’49’’	$037^0$19’35’’	Mixed midland	
3	Jarso	25	236	890	$05^0$19’31’’	$037^0$36’42’’	Agro-pastoral	
Total		**283**	**1857**					

RESULTS AND DISCUSSION

A. Performance of the goat in the study villages

The mean growth performance of the Konso goat in the study areas were presented in Table 1 and figure 1. The mean birth, weaning, six months, nine months, yearling and mature body weights (kg) were 2.56, 9.48, 14.61, 18.56, 19.37 and 27.04 kg, respectively. Generally, the above mentioned body weight categories were significantly affected ($P<0.05$) by village, month, year, sex and birth type whereas parity of the does hadn't affected ($P>0.05$) the corresponding traits.

The current finding revealed that birth weight was significantly affected ($P<0.05$) by village, month, year and sex whereas birth type and parity not affected ($P>0.05$). Kids in Arfayde village exhibited higher values than Baide followed by Jarso villages. Kids born in December and May showed higher birth weight whereas kids born in January showed the lowest kid birth weight. Its value also varied from year to year. Male kids showed higher birth weight than females. Finally, birth weight was not significantly affected by both birth type and parity of the does. The current result was a higher value than the 2.30kg birth weight reported for the Borana goat breed by Hulunim *et al.* (2019). But the current result was lower than the birth weight of Bati goats reported by Hulunim *et al.* (2019) (2.71 kg).

Weaning weight was also significantly affected by month, year, sex and birth type. Village and parity haven't affected weaning weight. Kids weighed better during November and December whereas lowest during June. Weaning weight during 2018 followed by 2019 and 2022 years' were better weighed. Male and twin goats indicated better weaning weights than the other contemporaries. The current result was less than the 9.38 and 9.04 kg reported for 3MW for the same breed by Temesgen *et al.* (2019); Netsanet *et al.* (2016), respectively, and higher than the 7.44kg 3MW reported for Abergele goat breed by Temesgen *et al.* (2019). The present result was also less than the 9.42 kg reported for the Central highland goat (CHL) by Zergaw *et al.* (2016). The higher 3MW reported in the current study may be attributed to the breed improvement effort and the lower result was from different management practices of the farmers (Ermias, 2022).

Six moth weight was significantly affected by village, month and year. Kids born in Baide and Jarso; on May and year 2018, 2019 and 2022 have revealed better growth performance. The current result was a higher value than the report of Zergaw *et al.* (2016) (11.49kg) for the same breed. The higher result in the current study might be due to the breed improvement efforts done for the last years.

Nine month weight was significantly affected by village, month, year, sex and birth type. Kids born in Baide and Arfayde; on May; 2018 and 2019 followed by 2021 1nd 2022; male sex, and twin and triplet were relatively good performed than the rest of the corresponding parameters. The present result was higher than what was reported by Minister *et al.* (2018) for Abergele goat (11.40) and Dereje and Ermias (2018) (15.89) for the same breed. The higher result reported in the current study might possibly be from the breed improvement effort done and the management practices of the farmers.

Yearling weight was significantly affected by both village and month. Kids born in Baide and November indicated superior body weight. The current result was higher than the values reported by Dereje and Ermias (2018) (18.89 kg) for the same breed. The higher 12MW reported in the present study were the result of the breed improvement efforts done for the ongoing CBBPs and another possible reason might be the management practices of the farmers.

Finally, goat mature weight in the study areas was statistically significantly affected by village, year, sex and birth type. Goats in Baide site; born during 2018; male sexed and twins have showed higher mature weight. Similar factors were reported on Tellicherry goats (Thiruvenkadan *et al.*, 2009).

B. Kidding Months of the Konso Goat in the Study Areas

Konso goats in the study areas give birth year round (Fig. 1). However, higher frequency of the kidding was observed in May, February and April months. December, March and June months were the lowest kidding occurred in the current study. Majority of the goat breeds are non-seasonal in breeding activity. The breeding of goats can be carried out throughout the year at and the kids are obtained in all the months of the year (Sastry *et al*., 2019).

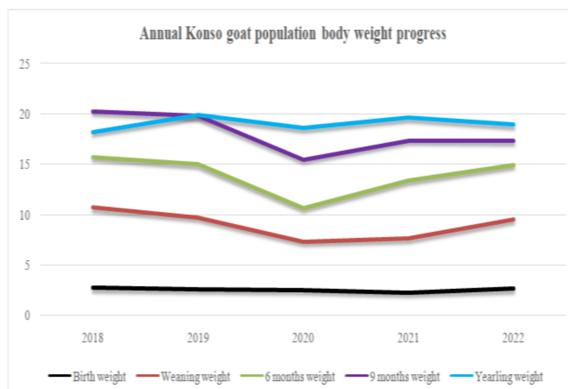

Fig. 1. Konso goat annual body weight progress in the study areas.

C. Prediction of the Konso Goat Live Body Weight

General regression coefficient and graph were observed to predict BW, WW, 6MW, 9MW, 12MW affected by the village, month, year, sex, birth type and parity of the Konso goat in three villages (Table 1 and Fig. 2). BW and 12MW were estimated by sex of the goat whereas weaning weight was more predicted by village, month, year and sex of the goat. Furthermore, 6MW was more predicted by year and sex of the goat. Finally, 9MW was better estimated by village, year and sex of the goat. Almost similar results were reported for the same breed (Ermias, 2022).

Table 2: Birth, weaning, six month, nine month, yearling and mature weights in terms of village, month, year, sex, birth type and parity.

Parameters (N)	BW (μ±sd)	WW (μ±sd)	6MW (μ±sd)	9MW (μ±sd)	12MW (μ±sd)	MW (μ±sd)
Overall (1857)	2.56±0.47	9.48±2.72	14.61±3.63	18.56±3.45	19.37±2.24	27.04±5.63
Village	*	NS	*	*	*	*
Baide(1011)	2.54±0.34^{b}	9.35±2.96	14.90±4.10^{a}	19.05±3.85^{a}	19.55±2.36^{a}	31.72±7.01^{a}
Arfayde(610)	2.65±0.65^{a}	9.52±2.39	13.89±2.89^{b}	18.80±2.44^{a}		25.90±4.98^{b}
Jarso(236)	2.36±0.48^{c}	9.94±2.14	14.59±2.51^{a}	16.38±2.37^{b}	19.01±1.96^{b}	
Month	*	*	*	*	*	NS
Sep (130)	2.60±0.55^{abc}	9.56±2.38^{bc}	15.35±3.26^{abc}	18.83±3.49^{abc}	19.00±1.48^{b}	30.70±8.05
Oct(141)	2.56±0.52^{abcd}	9.52±2.77^{bc}	14.69±3.08^{bcde}	18.98±3.46^{abc}	18.94±1.57^{b}	29.67±3.85
Nov(155)	2.59±0.39^{abcd}	10.99±2.69^{a}	15.57±3.26^{ab}	19.57±3.14^{ab}	21.72±3.66^{a}	26.50±6.30
Dec(104)	2.65±0.34^{a}	10.57±2.86^{a}	15.13±3.71^{abcd}	18.58±4.45^{bcd}	17.77±1.63^{b}	20.00±0.00
Jan(138)	2.43±0.43^{d}	9.52±2.41b^{c}	14.60±2.85^{bcdef}	19.31±3.38^{abc}	19.25±1.28^{b}	35.94±11.84
Feb(203)	2.48±0.46^{bcd}	8.93±2.75^{bcd}	13.46±3.26^{ef}	18.16±3.17^{cde}	19.12±1.86^{b}	29.85±2.94
Mar(112)	2.58±0.44^{abcd}	9.52±2.51^{bc}	14.18±3.45^{cdef}	17.34±2.68^{e}	18.16±0.87^{b}	31.90±8.95
Apr(190)	2.45±0.51^{cd}	8.66±2.02^{cd}	13.37±3.58^{f}	17.34±2.67^{de}	19.28±1.90^{b}	29.14±6.39
May(281)	2.67±0.51^{a}	9.61±3.31^{b}	16.27±4.26^{a}	20.12±4.25^{a}	19.23±1.61^{b}	25.52±4.75
Jun(113)	2.64±0.45^{ab}	8.55±2.59^{d}	14.05±4.58^{def}	18.98±3.56^{abc}	18.30±1.74^{b}	29.28±8.47
Jul(127)	2.53±0.41^{abcd}	9.55±2.30^{bc}	13.94±2.76^{def}	18.07±3.33^{cde}	18.00±1.00^{b}	27.43±3.41
Aug(163)	2.56±0.49^{abcd}	8.73±2.41^{bcd}	14.42±4.19^{bcdef}	18.16±3.52^{cde}	18.91±1.43^{b}	26.32±5.62
Year	*	*	*	*	NS	*
2018(446)	2.66±0.37^{a}	10.66±2.69^{a}	15.70±3.46^{a}	20.29±3.15^{a}	18.25±1.77	39.84±6.74^{a}
2019(276)	2.57±0.49^{ab}	9.70±2.57^{b}	14.96±3.61^{ab}	19.78±2.93^{a}	19.83±0.52	33.17±6.74^{b}
2020(223)	2.48±0.56^{b}	7.28±1.43^{c}	10.65±2.01^{d}	15.43±2.15^{c}	18.61±1.50	27.99±6.35^{c}
2021(439)	2.24±0.35^{c}	7.57±2.03^{c}	13.37±3.79^{c}	17.37±3.27^{b}	19.61±2.49	26.85±4.74^{bc}
2022(473)	2.58±0.57^{ab}	9.49±2.37^{b}	14.92±2.67^{ab}	17.29±3.20^{b}	18.91±1.52	25.87±5.24^{bc}
Sex	*	*	NS	*	NS	*
Male(959)	2.61±0.47^{a}	9.81±2.71^{a}	14.94±3.50	19.06±3.42^{a}	19.82±2.25	31.22±8.58^{a}
Female(896)	2.49±0.47^{b}	8.95±2.64^{b}	14.04±3.79	17.73±3.35^{b}	19.04±2.18	27.10±5.23^{b}
Birth type	NS	*	NS	*	NS	*
Single(1520)	2.56±0.47	9.36±2.64^{b}	14.44±3.64^{b}	18.36±3.45^{b}	19.36±2.16	27.88±6.18^{b}
Twin(334)	2.56±0.48	9.92±2.94^{a}	15.24±3.55^{a}	19.30±3.40^{a}	19.42±2.64	29.76±7.97^{a}
Triplet(3)				19.83±0.58^{a}		
Parity	NS	NS	NS	NS	NS	NS
1(243)	2.53±0.47	9.39±2.54	14.30±3.39	17.64±2.72	19.09±1.69	25.27±4.95
2(272)	2.58±0.48	9.59±2.53	14.41±3.59	18.36±3.63	18.78±2.02	25.78±4.55
3(288)	2.60±0.47	10.26±2.86	15.09±3.76	19.36±3.64	18.15±1.37	26.93±4.72
4(227)	2.61±0.49	10.49±2.88	15.40±3.35	19.52±3.41	18.60±1.58	29.48±6.83
5(131)	2.61±0.43	9.83±2.45	14.95±3.53	18.74±3.75	18.55±1.11	26.28±6.82
6(76)	2.60±0.51	10.02±2.14	14.68±2.78	18.04±2.48	19.58±1.02	26.36±7.06
7(40)	2.70±0.44	9.50±2.38	14.68±2.26	19.61±3.24	19.00±2.00	29.50±5.62
8(17)	2.73±0.22	10.10±1.82	15.88±1.03	18.67±3.21	19.00±2.00	28.83±6.59
9(8)	2.43±0.10	11.00±1.27	18.00±1.00	22.00±1.73	19.00±2.00	
10(6)	2.18±0.46	11.00±0.00	13.50±0.00	16.00±0.00	19.00±0.00	

*statistically significant ($P<0.05$). ^{NS} statistically not significant ($P>0.05$), birth weight (BW), weaning weight (WW), six months weight (6MW), nine months weight (9MW), yearling weight (12MW) and mature weights' (MW)

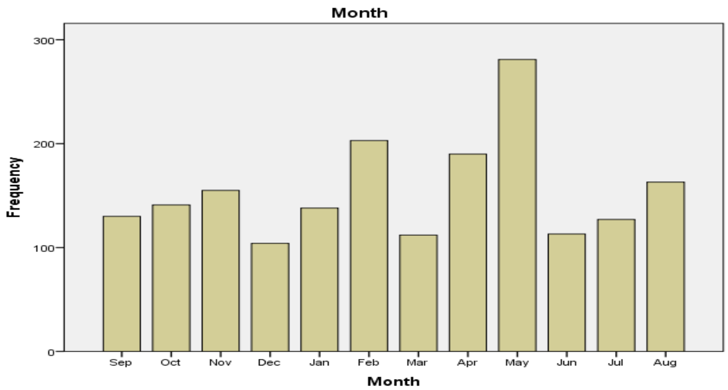

Fig. 2. Kidding months of the Konso goats in the study area.

Table 3: Regression coefficients for birth, weaning, 6 months, nine months and yearling weights in terms of village, month, year, sex, birth type and parity.

Parameters	BW	WW	6MW	9MW	12MW
Constant	70.07^{*}	1115.93^{*}	973.97^{*}	1498.25^{*}	301.69^{ns}
Village	0.02^{ns}	0.69^{*}	0.03^{ns}	-0.73^{*}	0.08^{ns}
Month	0.00^{ns}	-0.12^{*}	-0.09^{ns}	-0.08^{ns}	0.00^{ns}
Year	-0.03^{ns}	-0.55^{*}	-0.48^{*}	-0.73^{*}	-0.14^{ns}
Sex	-0.07^{*}	-0.52^{*}	-0.80^{*}	-1.26^{*}	-0.79^{*}
Birth type	-0.04^{ns}	0.09^{ns}	0.32^{ns}	0.56^{ns}	-0.18^{ns}
Parity	0.02^{ns}	0.06^{ns}	0.04^{ns}	0.04^{ns}	-0.00^{ns}
*statistically significant ($P<0.05$), ^{ns} statistically not significant ($P>0.05$)					

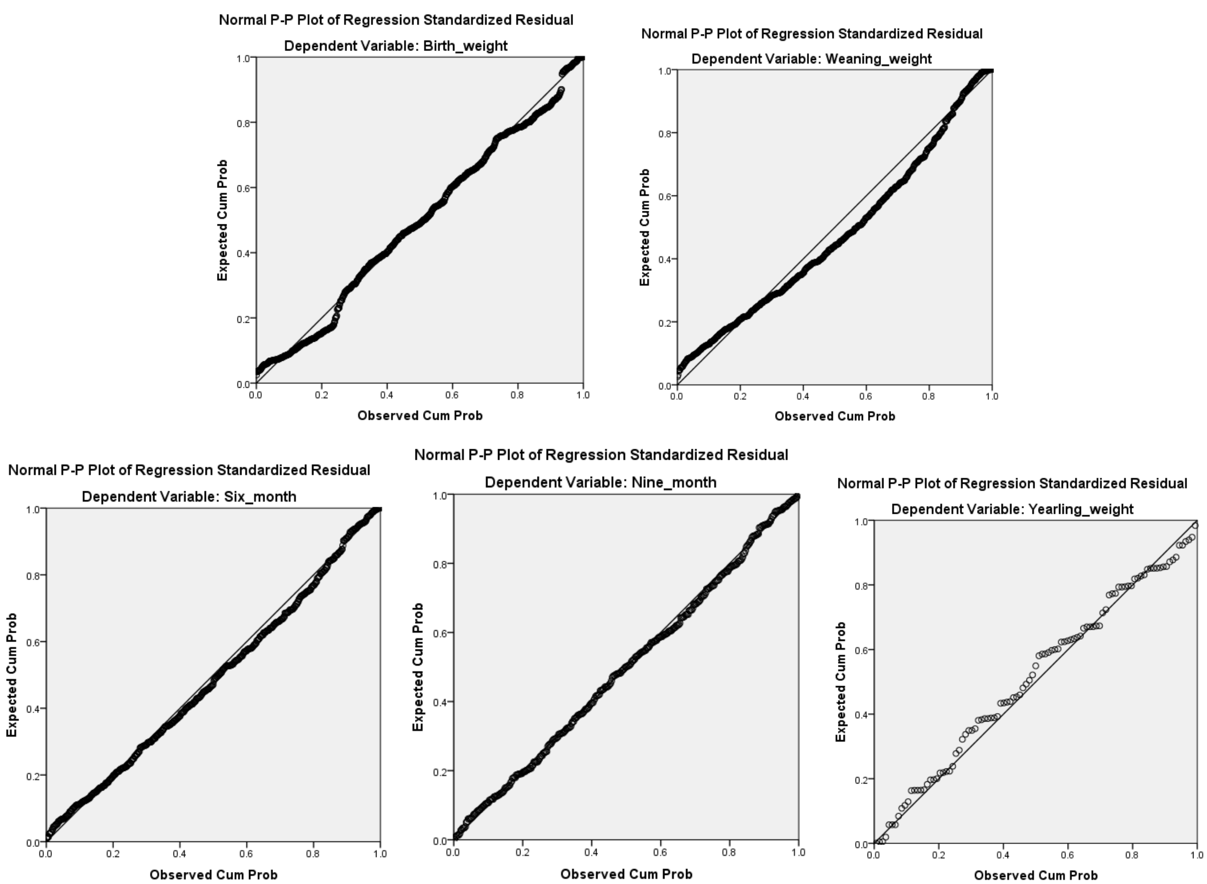

Fig. 3. Regression graph for birth, weaning, six months, nine months and yearling weights of the Konso goat in the study areas.

CONCLUSIONS

The six years' performances progress from 2018-2022 were evaluated for Konso goat community-based breeding program. The mean birth, weaning, six months, nine months, yearling and mature body weights (kg) were 2.56, 9.48, 14.61, 18.56, 19.37 and 27.04, respectively. The village, month, year and sex were affected birth weight whereas birth type and parity not affected. Weaning weight was also significantly affected by month, year, sex and birth type. Six month was significantly affected by village, month and year. Nine moth was significantly affected by village, month, year, sex and birth type. Yearling weight was significantly affected by both village and month. The higher frequency of the kidding was observed in May, February and April months.

Birth weight and yearling weight were better estimated by sex of the goat whereas weaning weight was more predicted by village, month, year and sex of the goat. Furthermore, 6MW was more predicted by year and sex of the goat. Finally, nine month weight was better estimated by village, year and sex of the goat.

These findings have shown that resource-poor participatory goat breeding program should be further monitored and evaluated based on the above mentioned factors' in short and long term plans for the Konso goat breed genetic improvement.

FUTURE SCOPE

The future scope from the current findings was to scale-out community based goat breeding programs in other villages to exploit the potential of the same and other breeds too.

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Conflict of the Interest. None.

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