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Evaluation of Productive and Reproductive Performances of Gumuz, Felata and Agew Goat Breeds in Metekel Zone, Benishangul Gumuz Ethiopia

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Abstract

Goat production is one of the key practices of livestock farming mainly in the lowland of the country. This study was undertaken to evaluate the production and reproduction potential of the Agew, Felata and Gumuz goat breeds in Metekel zone of Benishangul-Gumuz Regional State. Thirty goats from each of the three breeds making a total flock size of 90 were purchased from the local markets and kept on-station under uniform management conditions for performance evaluation during the period of 2016 to 2022. The appropriate flock management and health care were employed throughout the study period. Growth and reproductive performance data were collected for six consecutive years and the data were subjected to analysis using the General Linear Model Procedures of the Statistical Analysis System (SAS). Average birth weights recorded for Felata, Gumuz and Agew were 2.22±0.03, 2.01±0.02 and 2.03±0.02kg, respectively. Breed, birth year, season of birth, birth type, and sex had significant effect (P<0.001) on birth weight of kids. The overall least square means of birth weights of single, twins and triplets were 2.18±0.02, 2.01±0.02, and 1.78±0.05 kg, respectively. Breed, birth year, and season had significant effect on litter size of goats. The highest average weaning weight was attained by Felata goats (7.38±0.25 kg) and the lowest being for Agew goats (6.27±0.13 kg). The average yearling weight reached at 18.01±0.57 kg for Felata goats, 17.01±0.32 kg for Gumuz goats and 16.77±0.31 kg for Agew goats. The average age at first service for Felata, Gumuz, and Agew goats were 258.36±3.82, 231.05±2.11 and 240.20±2.70 days respectively. Similarly, the average age at first kidding was 413.84±10.63 days for Felata, 378.89±7.04 kg for Gumuz and 394.47±7.44 days for Agew goats. Thus, it can be concluded that under the same management condition in most performance parameters of Gumuz goat breeds was higher than Agew and Felata Goats. Therefore, Gumuz goats should be improved by establishing a community-based breeding program.

Keywords: Gumuz goat, Felata goat, Agew goat, body weight, reproductive performance

Introduction

Ethiopia has about 52.2 million goats (CSA, 2021), and they play an important role in sustaining the livelihoods of resource poor farmers (Solomon et al., 2014). Ethiopia is endowed with varied ecological zones and possesses diverse goat genetic resources. Research studies that evaluate the performance of goats, such as their growth and prolificacy, are typically carried out on farms that have different management conditions. However, to obtain accurate results, these traits should be measured under similar management conditions on a research station. In the Metekel zone, goats have a considerable impact on the livelihoods of households as they serve as a source of income and are used in festivals. On average, each household in the area owns 11.37 goats.

Indigenous goats make valuable socioeconomic contributions especially to the poor in the rural areas. They are important sources of meat, milk, manure, skin, and satisfy various cultural and religious functions (Tesfaye, 2004; Aziz, 2010). The importance of this valuable genetic resource is, however, underestimated and the contribution to the livelihood of the poor is inadequately understood (Kosgey and Okeyo, 2007; Aziz, 2010).

In Ethiopia, there are 14 different goat breeds that are characterized using their physical features and some have been reasonably documented (FARM-Africa, 1996). According to Getinet (2001), in the Benishangul Gumuz region, five goat breeds were identified based on the multivariate analytical technique and farmers' identification criteria, namely the Arab, Gumuz, Felata, Agew, and Oromo of which two of them are found to be dominant (Arab and Gumuz). The three goat breeds namely Agew, Gumuz and Felata are thought to be abundant in Metekel. However; the on-station performance of these goat breeds has not been studied under similar management conditions. It is, therefore important to evaluate the production and reproduction potential of the Agaw, Felata, and Gumuz goat breeds at on-station and to point out future strategies for further exploitation of the breeds.

Material and Methods

Description of the study area

The experiment was conducted at Pawe Agricultural Research Centre (PARC), Metekel Zone, Benishangul Gumuz Region, and Ethiopia from 2016 to 2022. PARC is located at a latitude of 11° 19’ North and a longitude of 36° 24’ East at an altitude of 1120 m above sea level. It is found 572 km west of Addis Ababa. The mean minimum and maximum temperatures of the study area are 17.2 and

32.8 °C, respectively. The mean annual rainfall is 1574.7 mm with the main wet season from June to September, which can sometimes extend to November (National Meteorology Agency weather data base, 2009-2019).

Animal management

On-station performance evaluation study was carried out on goats of three breeds viz. Felata, Agew and Gumuz for a period of 6 successive years from 2016 to 2022. A total of 90 goats were purchased from the nearby local markets with each breed represented by 30 goats. All goats were vaccinated for common disease occurred in the area and treated against internal parasites, drenched and ear tag was given. Natural mating system was practiced and herding was based on breed groups. The buck was herded together at daytime and isolated at night, while one male assigned to 25 does. A raised bed housing type was used to for avoid the contamination of urine and faeces. The flocks were allowed to graze outdoor at on-station for 5 h a day and they had free access to drinking water. Pregnant does at late gestation and lactating does in early lactation were supplemented with concentrate mixture prepared from maize and soybean grain. All the other flocks were also supplemented with concentrate mixture on return from grazing. Newly born kids were kept together with their does during the first 3-5 days of parturition. Following these days of duration they were isolated and allowed to suckle three times per day in the morning, midday, and evening until weaning age (3month). After weaning, all the kids were kept together with the flock. Routine culling was practiced in the flocks for different culling reasons.

Felata Gumuz Agew

Figure1. Three goat breeds

Data collection

Data collection were made growth data like birth weight (BW), weaning weight (WW) at 90 days, six month weight (SMW), and yearling weight (YW). Reproductive data like age at first service (the number of days counted when the female goat showed the first sign of heat in her life for received male), age at first kidding (the age at which a doe gives birth for the first time: It can be explained as a function of first pubertal age, age at first mating and conception, and successful completeness of pregnancy), kidding interval (number of days counted the time interval between successive parturitions of the same doe), litter size (the number of kids per birth) and gestation length (the period of time a foetus develops inside the womb before birth).

Statistical analysis

The data on growth and reproductive performances were analysed using general linear model procedures of the Statistical Analysis System (SAS. 1999). The effect of fixed factors considered in the model on growth and reproductive traits were analysed. The least-squares mean separation was done using Duncan's multiple range tests.

The following model was used for statistical analysis

$$Y_{ijklmn} = \mu + B_i + Y_j + S_k + S_l + LS_m + eijklmn$$

Where: Y_{ijklmn} = the response variable

μ = Overall mean

B_i = Effect of the i^{th} breed type

Y_j = Effect of the j^{th} year of birth

S_k = Effect of the k^{th} season of birth

S_l = Effect of the l^{th} sex

LS_m = Effect of the m^{th} birth type

e_{ijklmn} = Residual error

Results and Discussion

Birth season

Kidding has taken place across all the three seasons (dry, short rain, and main rain). The majority of the kidding seemed to occur in dry season for Felata goats, in main rain season for Gumuz goats and in short rain season for Agew goats (Table 1). The lowest number of kids recorded at short rain season in Felata and Gumuz goats, while dry and main rain season for Agew goat breed. High number of kidding is likely the result of adequate feed resources, and minimum environmental stress. The lower kidding percentage recorded during the main rain season for Felata and Agew breeds could be due to the presence of high rainfall that might affect duration of grazing period.

Table 1: Proportion of kids born from each breed across seasons

Birth Season	Felata		Gumuz		Agew		Overall	
	N	%	N	%	N	%	N	%
Dry	68	47.88	113	32.10	109	29.38	290	32.77
Short rain	36	25.35	99	28.12	153	41.24	288	32.54
Main rain	38	26.76	140	39.77	109	29.38	287	32.43
Total	142	100	352	100	371	100	885	100

N=number of record, Dry=October-January, Short rain=February-May, Main rain= June-September

Birth type

All the three breeds of goats have given multiple births although varied in birth rate (Table 2). Twining ability of Agew and Gumuz goats appeared to be higher relative to the Felata breed particularly in triple birth. This showed that Gumuz and Agew goat breeds are promising breeds to be considered in goat improvement program.

Table 2: Twining ability of Felata, Gumuz and Agew goat breeds

Birth type	Felata		Gumuz		Agew	
	N	%	N	%	N	%
Single	63	44.37	127	36.1	119	32.07
Twins	76	53.52	200	56.82	226	60.91
Triplets	3	2.11	25	7.1	26	7.01
Total	142	100	352	100	371	100

Growth performance

Birth weight

The overall least squares mean birth weight of goats was 2.05±0.01kg (Table 3). The birth weight of Felata goats was significantly higher than that of Gumuz and Agew goats. This could perhaps be associated with birth type where the Felata goats gave more single birth that had heavier birth weight. Breed, birth year, season of birth, birth type, and sex had shown significant effect ($p<0.01$) on birth weight of kids. Kids born in main rain and dry seasons exhibited heavier birth weight. The overall least squares mean birth weights (BW) of single, twin, and triple birth type were 2.18±0.02, 2.01±0.02 and 1.78±0.05 kg, respectively. At birth males kids were significantly ($p<0.05$) than females regardless of breed type. Our present finding is in agreement with the previous reports Netsanet et al., (2016) describing the weight of kids at birth were 2.03kg for Woyto-Guji.

Weaning weight

The average weaning weight for Felata, Gumuz, and Agew goat breeds were 7.38±0.25, 6.52±0.12, and 6.27±0.13kg respectively (Table 3).). The effect of breed, birth year, and birth type was significant ($P<0.01$) on weaning weight while season of birth and sex did not affect weaning weight of kids. This is in agreement with Bedhane et al., (2013) and Derbie and Taye, (2013) who reported that the

early stage of growth performance of kids is largely influenced by genotype and the milk yield of the does. The higher weaning weight was recorded in Felata and Gumuz breeds, whereas the lower weaning weight was recorded in Agew breeds. On the other hand the current result on weaning weight was slightly lower than that reported by Temesgen et al. (2019) describing the weights of kids at three months were 7.44, 10.96 and 9.38 kg for Abergelle, Central Highland and Woyto-Guji breeds of goats, respectively.

Six Month and Yearling Body Weight

Birth year, and sex had significant effect ($p<0.001$) on the six-month and yearling body weight of goats whereas birth type affected only six-month weight (Table 3). Body weight of male kids increased from 6.6 kg at weaning to 17.6 kg at yearling age while the female kids reached to 16.5 kg of yearling weight from similar weaning weight of 6.4 kg (Table 3). The effect of birth type on body weight of kids lasted only until six months of age in this experiment. However, kids of single birth continued to have higher body weight even after six months of age though not statistically significant. Goats born in the year 2017 had higher YW while lower YW was observed in 2020 this variation could be attributed to differences feed resource availability over the year.

Table 3: Least squares mean and standard error of growth trait measurements for Felata, Gumuz and Agew goat breeds

Classes	N	LS	N	**BW**(kg) LSM±SE	N	**WW**(kg) LSM±SE	N	**SMW**(kg) LSM±SE	N	**YW**(kg) LSM±SE
Overall	865	1.71±0.02	864	2.05±0.01	330	6.51±0.08	237	10.38±0.12	131	17.03±0.21
Breed										
Felata	142	1.58^{b}±0.05	141	2.22^{a}±0.03	38	7.38^{a}±0.25	21	11.51±0.40	17	18.01±0.57
Gumuz	352	1.71^{ab}±0.03	352	2.01^{b}±0.02	150	6.52^{a}±0.12	111	10.13±0.17	56	17.01±0.32
Agew	371	1.75^{a}±0.03	371	2.03^{b}±0.02	142	6.27^{b}±0.13	105	10.43±0.18	58	16.77±0.31
p-value		<0.005		<.0003		0.0027		0.0555		0.1036
Birth year										
2017	60	1.73^{a}±0.07	60	2.12^{ab}±0.05	5	6.98^{ab}±0.68	4	10.50^{ab}±0.91	3	18.67^{a}±1.37
2018	188	1.7^{a}±0.04	188	2.23^{a}±0.03	76	7.63^{a}±0.17	70	11.55^{a}±0.22	53	17.94^{ab}±0.33
2019	232	1.78^{a}±0.04	232	2.05^{bc}±0.03	88	6.32^{ab}±0.16	45	9.98^{ab}±0.27	3	17.33^{bc}±1.37
2020	218	1.67^{b}±0.04	218	1.98^{c}±0.03	121	5.98^{b}±0.14	94	9.88^{ab}±0.19	72	16.29^{c}±0.28
2021	167	1.62^{b}±0.04	166	1.94^{c}±0.03	40	6.36^{ab}±0.24	24	9.69^{b}±0.37	-	-
p-value		0.0424		<.0001		<.0001		<.0001		0.0025
Season										
Dry	290	1.77^{a}±0.03	289	2.12^{a}±0.02	113	6.6±0.14	83	9.93±0.20	36	16.57±0.39
Short rain	288	1.72^{ab}±0.03	288	1.91^{b}±0.02	132	6.58±0.13	89	10.82±0.19	58	16.93±0.31
Main rain	287	1.63^{b}±0.03	287	2.14^{a}±0.02	85	6.83±0.16	65	10.38±0.23	37	17.65±0.39
p-value		0.0065		<.0001		0.9507		0.4481		0.1633
Birth type	-	-								
Single	-	-	309	2.18^{a}±0.02	122	6.8^{a}±0.14	92	11.14^{a}±0.19	53	17.32±0.33
Twine	-	-	501	2.01^{b}±0.02	185	6.39^{ab}±0.11	127	10.05^{b}±0.16	70	16.83±0.28
Triple	-	-	54	1.78^{c}±0.05	23	5.93^{b}±0.00	18	8.87^{c}±0.43	8	16.94±0.84
p-value				<.0001		0.0154		<.0001		0.3293
Sex	-	-								
Male	-	-	470	2.11^{a}±0.02	171	6.58±0.12	120	10.71^{a}±0.17	61	17.59^{a}±0.30
Female			394	1.99^{b}±0.02	159	6.44±0.12	117	10.05^{b}±0.17	70	16.55^{b}±0.28
p-value	-	-		<.0001		0.3337		0.0087		0.0039

***: p<001, **: p<0.01, *: p p<0.05, ns: Not significant, LS: Liter size, BW: Birth weight, WW: Weaning weight, SMW: six month weight, YW: yearling weight, LSM: Least square mean and SE: Standard error

Reproductive performance

Litter size

The overall least squares mean litter size (LS) of three goat breeds obtained in the current study is presented in (Table 3). The average litter sizes for Felata, Gumuz, and Agew were 1.58±0.05, 1.71±0.03, and 1.75±0.03 per doe per parturition, respectively. LS was significantly different ($p<0.05$) between breed, birth year, and season of birth. The higher litter size was recorded in Agew and followed by Gumuz goat breeds. The litter size of the Agew and Gumuz goats was not significantly ($P>0.05$) different. On the other hand, there was a significant ($P<0.05$) difference between Felata and Agew goat breeds. The current result was higher than the report for Arsi Bale goats (Tatek et al., 2004), and for Central Highland goats (Tesfaye et al., 2006; Mengistie et al., 2013). In line with our findings, Belete (2009) reported similar results who found that the average litter size of goats was 1.74 in the Goma District of Jimma Zone, Western Ethiopia. Dadi et al., (2008) also reported closer litter size of 1.6 kids per doe per parturition and the current result was in the range of 1-2(ESGIP, 2010). By contrast, Endeshaw (2007) and Bainesagne et al., (2021) reported a higher litter size for Woito-Guji goat (2.07) and Gumuz goat (2.34) breeds from a survey work in Metekel Zone, Benishangul Region. However, Temesgen et al., (2019) reported small number of kids (1.03, 1.40 and 1.09) per doe per parturition for Abergelle, Central Highland and Woyto-Guji goat breeds, respectively.

Age at first service

The overall age at first service was 238.31±1.52 days (Table 4). There was significant difference between breeds in age at first service. The longest age at first service (258.4±3.8 days) was recorded for Felata goats while the shortest (231.1±2.1 days) was for Gumuz goat breed. The shorter age at first service observed in Gumuz goats, in particular is a desired trait for further breed improvement.

The current results of age at first service for Gumuz and Agew goats fall in the range of 5-8 months as reported by ESGIP (2010) for most tropical breeds, while Felata breed had longer age at first service exceeding this range. The present result for Felata goats is also similar to the reports of Tesfaye (2009) indicating age at first service was 8.2 ± 1.64 months for goats of Metema district.

Gestation Length

The average gestation lenght for Felata, Gumuz, and Agew goat breeds was 150.33±0.39, 147.89±0.26, and 148.65±0.24 days respectively (Table 4). Gestation legth was longer for Felata goats whereas it was slightly shorter for Gumuz and Agew goat breeds. The gestation length was significantly different ($p<0.05$) among breeds.

Age at first kidding

The overall age at first kidding was 391.86±4.61days (Table 4). The reproductive parameter of age at first kidding was significantly (P<005) different between breeds. Goat breed that came to first service at earlier age would naturally give birth at earlier age, too. Gumuz goats gave first kids at earlier age of 378.89±7.04 days and followed by Agew goats with age at first kidding of 394.47±7.44 days. Felata goats had longer age at first kidding (413.84±10.63 days) compared to the other two breeds.

The current result on age at first kidding is similar to that of most tropical breeds ranging between 12 and 15 months (ESGIP, 2010). It also concurs with the results of Bainesagne et al., (2021) reporting 12.39 months and Mengistie et al., (2013) reporting 13.59 months for the Central Highland goats. The average age at first kidding (13.06 months) obtained in this study is lower than the 16.8 months reported for indigenous goats in Bati, Meta, and Kebri-Beyah districts (Dereje et al., 2014) but similar to the average value of 13 months reported for indigenous goats in Oromya Region (Workneh and Rowlands, 2004).

Kidding Interval

The average kidding interval obtained in this study was 287.12±3.97 days and significant difference was observed between breeds. The longest kidding interval was recorded with Felata goats (316.2 months) and Agew goats (295.6 months). The shorter kidding interval (266.7 months) seen in Gumuz goats is one of the desirable selection traits for improving the breed.

The current result on kidding interval is higher than the reported value of 8 months for most tropical breeds (ESGIP, 2010). However, the value of kidding interval obtained from the present study is similar to the results of previous studies reported by Bainesagne et al. (2021) and Tilahun et al. (2019). On the other hand, the present value of kidding interval was lower as compared to the values of 11.31 and 10.3 months for Abergele and Central Highland goats, respectively (Belay, 2008). Temesgen et al. (2019) reported kidding interval values of 12.06, 8.93 and 10.3 months for Abergelle, Central Highland and Woyto-Guji goats, respectively.

Table 4: Least squares mean and standard error of reproductive data for the Felata, Gumuz and Agew goat breeds

Classes	N	AFS(days) LSM±SE	N	GL(days) LSM±SE	N	AFK(days) LSM±SE	N	KI(days) LSM±SE
Overall	157	238.31±1.52	476	148.64±0.16	133	391.86±4.61	133	287.12±3.97
Breed								
Felata	25	258.36^{a}±3.82	82	150.33^{a}±0.39	25	413.84^{a}±10.63	25	316.24^{a}±9.16
Gumuz	82	231.05^{b}±2.11	188	147.89^{b}±0.26	57	378.89^{b}±7.04	57	266.75^{b}±6.07
Agew	50	240.20^{b}±2.70	206	148.65^{b}±0.24	51	394.47^{ab}±7.44	51	295.61^{a}±6.41
p-value		<.0001		<.0001		0.0288		0.0001

***: p<001, **: p<0.01, *: p p<0.05, ns: Not significant, AFS: Age at first service, GL: Gestation length, AFK: Age at first kidding, KI: Kidding interval, LSM: Least square mean and SE: Standard error

Conclusions and Recommendations

In the current study, the productive and reproductive performances were evaluated for Felata, Gumuz and Agew goat breeds. They have shown promising performance on most of the traits considered for evaluation, but the effect of breed was significant for most of the traits. In this study, the growth and reproductive performance of Gumuz goat is observed to be higher than the other two breeds on the desired traits like age at first service, age at first birth, shorter kidding interval and higher litter size. Agew and Felata breeds are also the second and the third better performing goats in the study area. Since goat production is the most important farming practices in the study area, the Benishangul-Gumuz regional state authorities should give much emphasis to promote improved goat production practices in order to benefit the local community. Thus, it can be concluded that under the same management condition in most performances parameters of Gumuz goat breeds was higher than Agew and Felata Goats. Therefore, Gumuz goats should be improved as first priority by establishing a community-based breeding program.

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