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Demonstration of Boer x-Woyto-Guji crossbred goats in Bena-Tsemay Woreda, South Omo Zone, Ethiopia

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The study was conducted in the agro-pastoral agro-ecology of the Bena-Tsemay woreda to demonstrate, promote, and evaluate the productive performance of Boer x-Woyto-Guji crossbred bucks (75% and 50% Boer) and their progenies under agro-pastoral management systems. Data were analyzed using statistical software by SPSS version 23.0. The kids' body weight was recorded for one year in three age groups, 0-3, 3-6 and 6-12 months. A total of 139 (70 with 25% and 69 with 37.5% Boer blood) crossbred kids were evaluated to assess the effect of blood level on body weight (kg). The overall average BWT, WWT, SMWT, and YWT of the crossbred kids were 2.82kg, 9.3kg, 14.14kg, and 17.68kg, respectively. The average BWT, WWT, SMWT, and YWT of the 25% and 37.5% blood level crossbred kids were (2.79, 2.93kg), (8.60, 9.99kg), (13.47, 15.14kg) and (16.84, 19.02kg), respectively. In both blood levels and at different age categories, male and single kids had heavier BWT, WWT, SMWT, and YWT than twin and female kids. The overall ADG of crossbred from 0-3, 3-6, and 6-12 months were 69.01, 57.11, and 39.43gm/day. The crossbred kids had higher gain from birth to 180 days of age. There was a significant difference ($p<0.05$) in ADG of blood level, type of birth and sex from birth to six months of age. The pre-weaning mortality rates of single and twins were 11.5% and 15.38%, respectively. About 73.4% of households perceived and preferred the crossbred goat although criticized it as weak in disease resistance and special care requirements. It is concluded that, crossbreeding using 50% and 75% Boer crossbred bucks is an ideal

and suitable scheme for improving the indigenous goat body weight under agro-pastoral management conditions. Furthermore, the terminal crossbred bucks, kids not used to produce replacement, could be a remarkable option for marketing.

Keywords: *crossbred, crossbreeding, indigenous breed, demonstration, woyto-guji goat, boer goat, south omo, bena-tsemay*

INTRODUCTION

Small ruminants (Sheep and Goat) have socio-economic and cultural values other than their physical products, meat, milk, skin and manure. Small ruminants are considered as averters for a family through sales for quick and seasonal needs (Girma et al., 2022). In developing countries, goat is one of the major agricultural sectors and nearly 35% of the world goat numbers are found in Africa (Skapetas & Bampidis, 2016). All goats' type kept by societies in developing countries is considered as meat goat because they are not purposely selected in a specific direction and too diverge in size and other physical features; they recognized as the major providers of meat, milk, skins and fivers to their owners (Gall, 1981). The number of goats reported in the country is estimated as 46 million heads (CSA, 2022), it will be expected that their number will increase because it tends to follow the growth of human the population and the increase of meat demand too. Indigenous goats are observed as better resistant to harsh environmental and climate change compared to other ruminant species (Pragna et al., 2018). Goats are widely distributed and are adaptable to rural people of Africa in general and Sub-Saharan Africa in particular (FARM Africa, 2005). The goat is mainly kept by pastoralists, agro-pastoralists and farmers (in mixed farming system). Demonstrating goat-based interventions to benefit poor communities systematically investigated for moving goat keepers out of poverty and improving food security. Such small stocks could play an alternative source of income during the failure of crop and goats could be sold for food and medication purchase (FARM Africa, 2005). They are delivered about 3.4 and 1.6 times higher gross margin than sheep and cattle, respectively in the country (Woldu et al., 2016). In pastoral communities, they are used as payment of dowry for providing traditional or cultural ceremonies. Their merit over other large livestock species is associated with their small size, low initial cost, fast turnover, and efficient conversion of feed resources (Braker et al., 2002). Woyto-Guji (WG) goats dwell in a wide area covering from South Omo to Sidama and Wolaita and they are one of the main goat breed committed to meat, milk, skins and manure production in the areas (Girma et al., 2016).

Despite the well-adapted large size and multifunctional role of Ethiopia's goat population, their overall productivity and production potential is too low in terms of growth, daily gain and maturity with high mortality among kids. The kids of WG are born with low birth weight and their growth is too slow. The production per unit of animals and their role to the national economy remain also too low due to low genetic potential, poor veterinary services and poor nutrition besides inappropriate management (Abebe et al., 2020). The indigenous goats have long kidding intervals, long age at first kidding, matured in small size, long age at slaughter and low milk production. Many attempts were conducted to improve indigenes goat productivity in Ethiopia, among which the crossbreeding approach mentioned. This approach involved the introduction of an exotic Boer goat breed, principally from South Africa, to improve meat production and growth performance traits by crossing the indigenous goat breed with the Boer goat. Crossbreeding is one of the ways to help realize quicker genetic improvement that can match genotypes with the local climate and support advantage from the complementarity of the breeds (Ahuya et al., 2004). The advantage of crossbreeding is exploiting a combination of superior traits which possessed by both parental breeds (Falconer & Mackay, 1996). Crossbreeding was promoted by using indigenous breeds as dams and exotic breeds as sires.

The crossbreds are more capable of growing larger body weight than the indigenous goats and are relatively adaptive to the local environment. The Blended goat was found to have better production potential with a high growth rate and higher reproductive performance compared to the indigenous breed tested at Jinka Agricultural Research Center. Boer bucks were imported with hard currency for crossing with indigenous goats with low productivity in resource-poor areas of the region where natural and manmade hazards limit the productivity of the animals. Since 2013, Boer x-Woyto-Guji goat crossing, evaluation and dissemination have been implemented at the Keyafer research substation, Jinka Agricultural Research Center. The final goal is to improve the performance of productivity of indigenous goats in pocket areas of south Omo zone. The crosses (75%, 50%) were evaluated at the substation and became successful in major traits compared to indigenous goats. Despite all these efforts to improve and increase goat production, most of the pastoral areas are still now keeping local breeds. However, the performances of crossbreeding indigenous goats with exotic Boer goats have not yet been thoroughly evaluated on-farm level. Hence, promoter of the Boer-WG crosses (75% and 50%) at on-farm conditions is essential. Therefore, this study aimed to demonstrate and promote Boer x-Woyto-Guji goat crosses (75% Boer x-Woyto-Guji and 50% Boer x-Woyto-Guji), evaluate pastoral perception on the introduced of crossbred goats and improve the capacity of agro-pastoralists towards proven technological options in Bena-Tsemay woreda.

MATERIALS AND METHODS

Description of the study area

The current study was conducted in the Bena-Tsemay woreda under the pastoral and agro-pastoral production system. The Woreda is located between 5°01' and 5°73' feet North latitude & 36°38' and 37°07' feet East longitude in the South Omo zone of southwestern Ethiopia. The climate of the woreda varied from warm to hot semi-arid ranging between 500 and 1800 meters above sea level. The rainfall is bimodal and long rainy season began in March and lasted until June, whereas, the short rainy season lasted from September to October (Adane & Hidosa, 2022). The mean annual rainfall in the upper part of the woreda was 1400 mm and the mean daily temperature ranges between 15.6°C to 26.5°C. Over 48% of the total land area of the woreda is used for grazing and browsing by cattle, sheep and goats (Admasu et al., 2010).

Site and beneficiaries selection

Baseline surveys and group discussions were made with selected villages of agro-pastoralists in the study Woreda. The target villages and participants were selected and established during problem identification before the actual study started. Accordingly, two potential sites were purposely selected through the assistance of woreda Agricultural and livestock experts. The site selection was based on better infrastructure, large numbers of goats, awareness of the goat keepers and their willingness to participate in the goat improvement program. One pastoral agro-pastoral research and extension group (PAPREG) comprising twenty-five (25) members was selected with the help of Woreda experts to participate in the promotion and evaluation of Boer x-WG crosses. Among the selected PAPREG members, 80% of females and 20% of males have participated based on operational research project criteria and willing to use the technology.

Design of the experimental goat

For this study, two groups of PRGs were formed from established PRGs (25 members) by the project partners. Each group held 12 members, and each member was required to contribute 10 doe/female goats with good physical conformation, healthy (tested free for brucellosis)

with no history of abortion, experienced doe in giving birth at least once and additional criterion to be set during the bylaw development of the beneficiary research groups. From the two groups of PRG, one group was arranged to participate in the production of 37.5% blood level Boer-WG crosses from 75% Boer x-WG while the other group was assigned to produce 25% blood level Boer-WG crosses from 50% Boer x-WG.

Animal management and Measurement

The goats were raised under agro-pastoral management practices with some homemade concentrate feed supplementation depending upon the status of the goat and the season of the year. Before breeding, the dams and bucks were fleshed through feeding locally available feed sources which are better in major nutrients of energy and protein. In addition, at the outset, both the dams and bucks were dewormed using Albendazole and sprayed with Diazinone against the external parasites. They were also vaccinated against common diseases in the area. After starting mating, dams and bucks were allowed to browse natural pastures during the day and kept indoors during the night together throughout the experimental period. The selected goats were kept separately and no other goat mix was allowed until the mating plan was completely finished. This was performed to ensure the expected offspring was produced. The newborn kids were measured their weight and ear tagged for identification; and they kept separately until weaning age. After weaning, they kept together with the natural pasture around the surrounding area of the homestead. Thereafter, following birth, kids were recorded and weighed at birth, weaning, six month and yearly body weight. All weight measurements were taken in the morning before feeding and watering using the salter scale spring balance with a capacity of 50 kg. Data was taken from 2021 to 2022 for analysis of 25% (N=70) and 37.5% (N=69) blood levels on 90 male and 49 female crossbred kids.

Materials used and procedures followed

Source and management of improved bucks

The mating group arrangement is indicated in Table 1. The source of goats for this demonstration had undertaken a crossbreeding between Woyto-Guji does with Boer bucks on the Keyafer Boer goat breed evaluation and multiplication research substation. The aim of this demonstration was the crossing of indigenous dam lines (Woyto-Guji goats) with an exotic Boer buck of 50% and 75% genotype crossbred with beneficiaries of agro-pastorals to produce a 25% and 37.5% Woyto-Guji genotype crossbred goat with better body weight and growth performance. The selected bucks weighed above 25 kg with two normal testicles and were free from any reproductive abnormality.

Table 1. Mating group arrangement based on blood level categories.

Mating Group	Expected progeny Blood level
75% Boer cross X- Woyto-Guji goat	37.5% Boer and 62.5% Woyto-Guji goat
50% Boer cross X -Woyto-Guji goat	25% Boer and 75% Woyto-Guji goat

Hormonal treatment

After the breeding doe selection was performed, all doe`s were tested for brucellosis, and those goats were negative for brucellosis prostaglandin F2α was injected for bringing them to heat at a similar time and to collect the subsequent data accordingly. Prostaglandin F2α was acquired and used at a 2ml dose level, which was effective for on-station evaluation. Thus, hormonal treatments were used to control the kidding season for the production of multiple merits of offspring in a similar time and to adjust feeding availability time in the area. At the beginning of

the breeding season (March to May), bucks were introduced to the breeding flock and served the dose based on the mating arrangement procedures. Following the method a group of 25-30 does get mated by a buck (s). The buck remains for 7-15 days until all get mated and serviced.

Training and participatory evaluation

The awareness creation and training were given to the 25 selected beneficiaries and three community workers or development agents on all management aspects and data collected. The training covered both theoretical and practical sessions. The theoretical training was qualified on goat breeding, health care, feeding, housing, record keeping, and more details of crossbred management. Leaflets on goat production were provided to each trainee for future reference. Data collection formats were also prepared to record all required data. At the different stages of evaluation, a pastoralist's field day was organized between pastoralists' research groups, non-pastoralist research groups, development agents, experts, and other important stakeholders to create an opportunity for experience sharing among PAPREGs and key stakeholders.

Data collection

Animal performance data such as birth, weaning, six months and yearling weight was collected by both development agents and causal laborers and crosschecked by researchers. PAPREGs perception and preference towards the technological option were captured using pre-tested checklists.

Data analysis

The BWT, WWT, SMWT, and YWT, and the kids' weight gain at different ages were recorded as dependent variables. Sex, blood level, and birth type were recorded as independent variables. The collected data were analyzed by descriptive statistics using Statistical Package for Social Sciences (SPSS 23.0, IBM, USA). The differences were considered significant at $p< 0.05$. The average daily gain (gm/day) was computed as:

$$\text{Daily BW gain up to weaning age (gm/day)} = \frac{\text{WWT} - \text{BWT}}{90} * 1000$$

$$\text{Daily BW gain from weaning up to 6 months age (gm/day)} = \frac{\text{SMWT} - \text{WWT}}{90} * 1000$$

$$\text{Daily BW gain from 6 months up to yearling age (gm/day)} = \frac{\text{YWT} - \text{SMWT}}{180} * 1000$$

RESULTS AND DISCUSSION

The Boer-Woyto-Guji goat crossbred kid`s growth performance of both blood level categories (25% and 37.5%), sex, birth type and age groups for all kids are given in Table 2. The recorded data in this study indicated that the differences ($p< 0.05$) between the two blood level categories of 25% (Figure 1) and 37.5% (Figure 2) in the average body weight at different ages, blood levels, sex, and birth types. The overall birth weight, weaning weight, six-month weight, and yearling weight of crossbred goats were 2.82±0.04, 9.3±0.25, and 14.14±0.26 and 17.68±0.32kg, respectively. A comparable result was also disclosed by Girma et al. (2016) on the overall BWT (2.89kg) and WWT (10.39kg) on Boer X Woyto-Guji; Deribe et al. (2015) on Boer X-central highland goat with BWT (2.78kg), WWT (10.5kg) and SMWT (14.06kg); Belay et al. (2014) on Boer X Abergelle crossbred goat with BWT of 2.9kg and Debele et al. (2015) on Boer X- Arsi-Bale goats with BWT of 2.84kg.

The current results are clear; the average body weight of Boer crossbreds was higher than compared to the average body weight of indigenous goats as reported by Deribe et al. (2015). Interestingly, a similar finding was observed in the study of Ahmed et al. (2015), these authors highlighted that crossbred kids from Boer with Damascus Goats performed better in Egypt. The nearest result was also reported by Abd-Allah et al. (2016) for Boer x- Baladi crossbred kids in Egypt at birth and weaning age groups. According to Deribe et al. (2015), birth weight and weaning weight of Boer crossbreds were significantly higher than the weight of indigenous breeds and the difference diminished as the age of the kids advanced. The aforementioned may be due to the management conditions and may not allow animals to express their genetic potential. The shortage of forage, lack of concentrate feed, diseases and low veterinary care are associated with a high mortality rate of kids and also contributed to their share (Kosgey et al., 2006; Manirakiza et al., 2020).

Figure 1. The 25% Boer x-Woyto-Guji crossbred goats

Figure 2. The 37.5% Boer x-Woyto-Guji crossbred goats

The current findings on average BWT (2.79), WWT (8.6), SMWT (13.47), and YWT (16.84) of 25% Boer crossbred goats were lower than the report of Tesema et al., 2022 who stated BWT (3.10kg), WWT (9.77kg) and YWT (19.57kg) of 25% Boer-Borana crossbred goats. But similar results in SMWT (13.47kg) were reported by those authors (13.43kg). The kids' birth weight may also be influenced by the breed of kid, sex, and litter size, season of birth, experiment, and genotype × sex interaction (Pérez-Baena et al., 2021). Tesema et al. (2017) revealed that, weight at birth, type of birth, pre-weaning, post-weaning, parity of doe and kids birth season are the vital traits that can affect goat profitability. These vital traits are affected by many factors (Girma et al., 2022). The current finding in BWT, SMWT and YWT were higher than the result of Mustefa et al. (2019) for Boer x-central highland goats crossbred kids, but, similar in WWT. The milk yield of respective does can influence the growth rate of kids (Tesema et al., 2017).

Table 2. Least square mean and standard errors of BWT, WWT, SMWT, and YWT of 25% and 37.5% Boer x-Woyto-Guji crossbred (kg)

Source of variation	BWT		WWT		SMWT		YWT	
	N	LSM±SE	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall mean	139	2.82±0.04	131	9.3±0.25	122	14.14±0.26	117	17.68±0.32
Blood level								
25%	70	2.79±0.04^{a}	66	8.60±0.21^{a}	61	13.47±0.26^{a}	59	16.84±0.29^{a}
37.5%	69	2.93±0.05^{b}	65	9.99±0.26^{b}	61	15.14±0.23^{b}	58	19.02±0.32^{b}
Sex								
Male	90	2.96±0.04^{a}	84	9.81±0.21^{a}	78	14.74±0.23^{a}	75	18.53±0.29^{a}
Female	49	2.67±0.04^{b}	47	8.37±0.28^{b}	44	13.53±0.29^{b}	42	16.83±0.35^{b}
Birth type								
Single	113	2.94±0.03^{a}	113	9.72±0.20^{a}	98	14.63±0.21^{a}	94	18.36±0.26^{a}
Twine	26	2.52±0.03^{b}	26	7.58±0.24^{b}	24	12.97±0.31^{b}	23	16.13±0.43^{b}

Values in the same row and sub-table not sharing the same subscript are significantly different at $p< 0.05$. BW (Birth weight), WW (weaning weight), SMW (six-month weight), and YWT (yearling weight).

Effect of blood level on body weight changes

The growth patterns of Boer x-Woyto-Guji crossbred at 25% and 37.5% blood level categories are illustrated in Figure 3. The average birth, three, six months and yearling weight of the blood level 25% and 37.5% of crossbred kids were (2.79kg, 2.93kg), (8.60kg, 9.99kg), (13.47kg, 15.14kg) and (16.84kg, 19.02kg), respectively (Table 2). The current study of mean weights at weaning (8.6kg) and six months (13.47kg) for 25% of crossbred kids were lower than Boer-Abergelle crossbred with 13.2kg and 16.6kg, respectively (Fitsum et al., 2023). The average BWT and WWT of the crossbred (25% Boer) males and females were comparable with the study of Birhanie et al. (2016) who obtained (2.85kg, 2.68kg) and (9.11kg, 8.85kg), respectively. However, the average WWT and SMWT of males and females in the current study were lower than Birhanie et al. (2016) who published 16.4kg and 15.39kg, respectively. The study revealed that in both blood levels (25% and 37.5%) and at different age categories, male and single kids had heaver birth, weaning, six-month and yearly weight than twin and female kids and that in line with Deribe et al. (2015) and Tesema et al., 2022). This may be the single fetus could engage more amounts of nutrients from its mother compared to twin fetus during embryo growth (Atkins & Gilmour, 1981).

Effect of sex and birth type on weight changes

The effect of sex and birth type on weight change is shown in Figure 4. The average birth, three, six-month and yearly weight of male and female crossbred kids were (2.96, 2.67kg), (9.81, 8.37kg), (14.74, 13.53kg) and (18.53, 16.83kg), respectively. The current findings indicated that male kids were heavier than females. The same result was also disclosed by Girma et al. (2022). The current result revealed that the average birth weight based on the type of sex was greater in males than females ($p<0.05$) and that covenant with Girma et al. (2016). Also, Tesema et al., 2022 noticed that Boer with Borana goats produced a higher birth weight of males (3.17kg) than females (2.96kg). Another result published by Mustefa et al. (2019) found significance difference among males and females in birth weight. The current finding was higher than those authors in BWT, SMWT, and YWT in both sex groups. The superiority of male kids in growth with higher birth weight may be the occurrence of androgens which play the main role in growth (Kiango, 1989) and it could be the reasons females to have smaller body and lighter weights compared to males (Baneh & Hafezian, 2009). The elaborated study by Hermiz et al. (1997) also revealed that the sex difference between males and females increase with their growth rate and which indicating male are more responsive to improving in the environment.

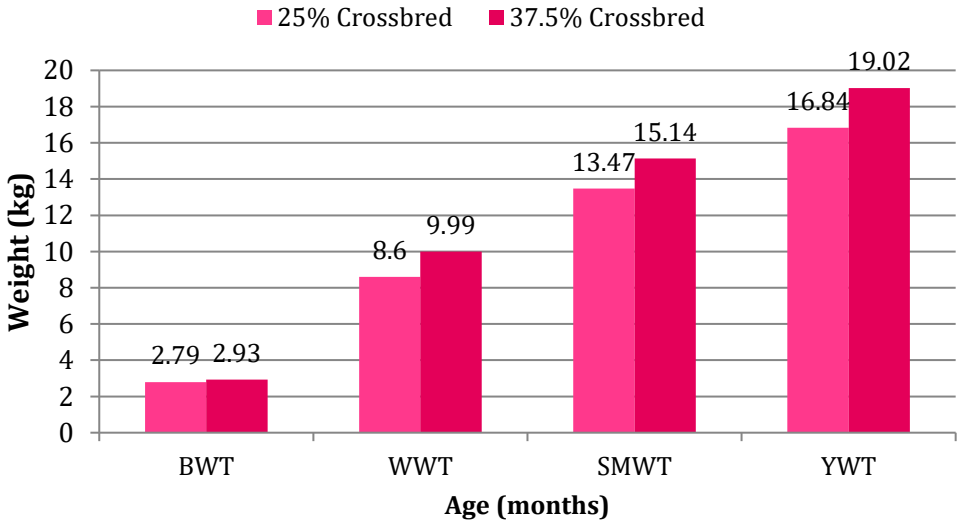

Figure 3. The growth patterns of Boer x-Woyto-Guji cross at 25% and 37.5% blood levels; BWT (birth weight), WWT (weaning weight), SMWT (six month weight) and YWT (yearling weight).

Pertaining to the average birth, three months, six months and yearling weight of single and twin crossbred kids were (2.94kg, 2.52kg), (9.72kg, 7.58kg), (14.63kg, 12.97kg) and (18.36kg, 16.13kg), respectively. The result showed that, single kids performed better than twins and the findings are corroborate with those of Mustefa et al. (2019) who reported that single kids weighted more than multiple births. Tesema et al. (2017) mentioned that, the survival rate of kids was negatively influenced when increasing the little size. On the other hand, heavy weight kids have better survival rate than lighter kids. The space of uterine and sharing of available nutrients by twins may be responsible for reducing birth weight through increasing litter size (Tesema et al., 2017). In order to maintaining reduction of body weight particularly for multiple birth, improve feeding and management during mating and pregnancy are crucial.

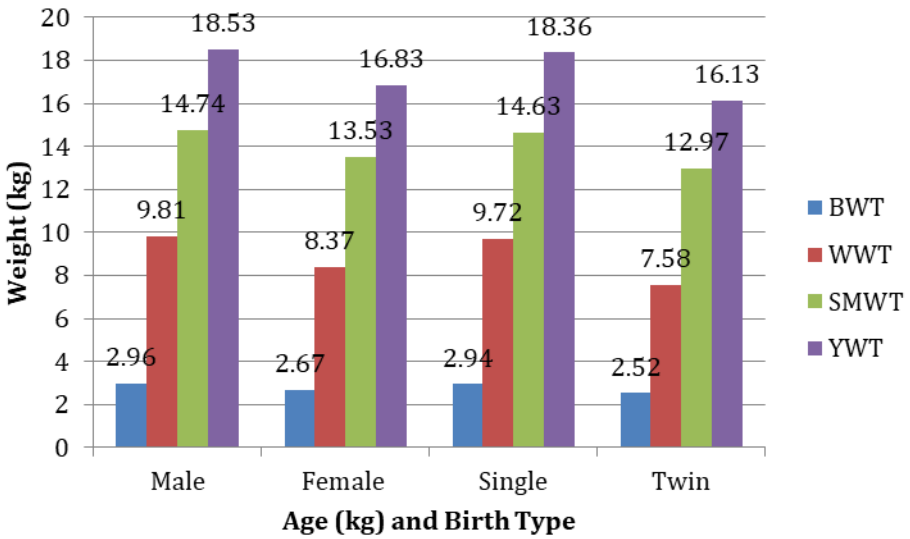

Figure 4. The effect of sex and birth type on weight changes; BWT (birth weight), WWT (weaning weight), SMWT (six month weight) and YWT (yearling weight).

Weight gain (ADG) performance of crossbred kids

The overall pre-weaning and post-weaning average daily gains for the crossbred kids are shown in Table 3. In the current study, the overall average daily gains of crossbreds from 0 to 3, 3 to 6, and 6 to 12 months were 69.01, 57.11, and 39.43gm/day. A comparable finding was corroborated by Mustefa et al. (2019) who obtained 69.73g/day gain at weaning age but comparatively less than 6 months to a yearling of age for Boer central highland crossbred goats. Average daily weight gain decreases as age advances, which might be due to weaning stress and poor management. The higher weight gain of crossbred from birth up to weaning age was closely related to enough amounts of milk production and intake during weaning and it gradually dropped with decreasing milk production. Availability of energy level offered to the doe during lactation is influencing the growth rate of kids (Sibanda et al., 1999). The same trend was also mentioned by Abd-Allah et al. (2016) for Egyptian Baladi goats. The ADG of crossbreed kids was higher than that of Boer X- central highland goats (50%) reported by Abebe et al. (2020) who obtained 56.92, 27.47 and 18.83gm/day for weaning, six and twelve months weight gain respectively.

The present study demonstrated that crossbred kids had higher gain from birth up to 180 days of age. The ADGs of the 25% and 37.5% Boer blood proportions from 0 to 3, 3 to 6 and 6 to 12 months were 64.58, 76.72g/d; 55.21, 58.31g/d and 37.34, 43.26g/d, respectively. There was a significant difference ($p<0.05$) in ADG (gm/day) among blood level, sex and types of birth from birth up to six months. Sex, birth season, parity, and birth type might be affected by pre weaning ADG of kids. Many authors were resemblance with this study (Osinowo et al., 1994; Tesema et al., 2017; Gatew et al., 2019; Girma et al., 2022). In all age categories and blood level proportions, there was no significance difference ($p>0.05$) on average weight gain from 6 months to yearling. In the current result, the growth of single kids was faster than that of twin kids; and the ADG of single kids was higher than that of twin kids. In the most growth traits male kids was higher ($p<0.05$) than females and which follows Rensch's rule (Rensch, 1950) who stated that, in the particular species males are usually heavier than females. The secretion of testosterone hormones by buck kids are contributed for variation between the male and

female because this hormones enhancing the muscle mass and skeletal development (Baneh & Hafezian, 2009).

Table 3. Least squares mean and standard errors of ADG weaning to 90, 90-180 and 180-365 days of Boer x-Woyto-Guji goat crossbreds (gm/day)

Source of variation	Gain to 90 days		Gain 90 to 180 days		Gain 180 to 365 days	
	N	LSM±SE	N	LSM±SE	N	LSM±SE
Overall mean	132	69.01±2.55	122	57.11±1.94	117	39.43±4.07
Blood level						
25%	66	64.58±1.96[a]	61	55.21±1.83[a]	59	37.34±1.77[a]
37.5%	66	76.72±2.97[b]	61	58.31±1.93[a]	58	43.26±2.53[a]
Sex						
Male	85	74.72±2.34[a]	78	55.85±1.69[a]	75	42.43±2.14[a]
Female	47	63.29±2.75[b]	44	58.36±2.18[a]	42	36.43±1.93[a]
Birth type						
Single	106	74.19±2.15[a]	98	55.94±1.51[a]	94	41.41±1.68[a]
Twin	26	56.20±1.21[b]	24	60.09±2.77[a]	23	35.65±3.85[a]

Least squares mean (LSM) within a column bearing different superscripts are significantly different. N: number of observations; SE: standard error; ADG: average daily gain.

The mortality rate of pre and post weaning growth

The mortality rate of pre-weaning and post-weaning growth of Boer crossbred goats is shown in Table 4. The survival rate of kids with high blood level were lowest than kids with lower blood level and this indicating that, as the kids blood level advanced they need special care and better management for survival. In the current result, the relative post weaning mortality was recorded and this might be due to the recurrent drought in the area associate with the movement of goats from place to place for searching feed and water and this is also associated with infection of disease and parasites (ticks) and attacks by predators. These results partially agreed with Nigussie (2010). The current finding of post-weaning kids' mortality was lower than the result of Dea et al. (2019) who mentioned higher (40.81%) pre weaning mortality rate of Boer X-Woyto-Guji crossbred in Arbaminch zuria. Study conducted by Dea et al. (2019) revealed that the high post-weaning mortality may have been the result of poor nutritional access after weaning and milk suckled by kids was replaced by poor quality grazing.

According to Tesema et al. (2017), in the lowland areas high disease and parasite infestation occurred when the communal grazing and movement of animals from place to place practiced. During long dry season and recurrent drought, in pastoral and agro-pastoral areas high goat mortality are reported as the main causes (Tolera & Abebe, 2007). Many authors (Molla, 2016; Tesema et al., 2017; Mustefa et al., 2019; Yitagesu & Alemnew (2022)) reported that gastrointestinal related diseases such as diarrhea and internal parasites, pneumonia, miss-mothering (miss-mothering starvation exposure complex), heartwater and weak kids were mentioned as the major causes of kid mortality at Ataye sub-site in Debre birhan agricultural research center. However, most authors revealed that most (44.50%) of kids death causes were not clear in anti-mortem and post-mortem lesions (causes are unknown). Pertaining to the birth type, kids born as singles and twins, the pre-weaning mortality rate is 11.5% and 15.38%, respectively. Tesema et al., 2022 reported 23.38, 13.08 and 35.08% mortality rates of pre-and post-weaning growth traits for Borana goats and their crosses with Boer. This may be due to competition for nourishment by suckling their mother`s milk.

Despite these particulars, other factors which may affect the loss of kids' pre-and post-weaning was predators such as monkeys and falcons, stabbing with other goat and accident that may contribute to kids' loss. The kids' mortality in the current finding was lower than with the result of Yitagesu & Alemnew (2022) who obtained high kids and adult goat mortality in the Ataye Boer goat evaluation research site. Regular vaccination, control of external parasites (ticks); intense follow-up and good husbandry practices (proper housing, feeding, watering and healthcare) are important preconditions to reduce the stress of goats and minimize kid mortality.

Table 4. The mortality rate of pre-weaning and post-weaning growth Boer crossbred goats

Factors	Pre-weaning			post-weaning		
	N	Kids died	Mortality (%)	N	Kids died	Mortality (%)
Blood level			12.96			19.67
25%	70	8	11.42	61	11	18.03
37.5%	69	10	14.49	61	13	21.3
Sex			10.1			17.57
Male	90	9	10	78	15	19.23
Female	49	5	10.2	44	8	18.18
Birth type			13.5			17.05
Single	113	13	11.50	98	13	13.26
Twin	26	4	15.38	24	5	20.83

Perception and preference of pastoral Agro-Pastoral on crossbreds

The cross-bred was evaluated from the agro-pastorals point of view by comparing with their indigenous goat breed. There is seldom a difference in perceptions of pastorals and agro-pastorals about the Boer crossbred technology among the crossbred keepers. More than half of the Pastoral-Agro-Pastoral (73.4%) stated that they still prefer to keep the Boer crossbred than indigenous goats. Boer crossbreds are having better advantages in body size whereas indigenous animals are harsher environment and diseases resistant (Kisito et al., 2017). About 80% of farmers in the Raya Kobo Woreda and 57.1% of the households in Amhara Sayint woreda showed a strong interest in crossbreeding as reported by Tesema et al. (2022). In the current study, some few (21.7%) respondents claimed that the Boer crossbreds unable to survive better in their environment due to need of special management such as indoor feeding and watering, frequent health follow-up and treatment and adequate housing; this makes to be labour intensive and extensive for goat keeper. In contradiction to this Tesema et al. (2022) reported that 77.8% of the respondents do not prefer crossbreeding because of poor adaptability of the crossbred kids in the Habru Woreda.

On the other hand, the reasons of Boer crossbred preferences by respondents were due to its adaptive behavior confirmed by their capability to tolerate shortage of feeds, poor quality forages, drought and diseases. The current study also revealed that the pastorals and agro-pastorals who preferred to keep Boer crossbreds believed that the Boer crossbred grows faster, has a big mature body size, has an attractive phenotype and sold at an exorbitant price in the market compared to the indigenous breed and a similar finding was observed in the study of Tesema et al. (2022) for Boer × Central Highland crossbred goats. The study conducted by Farm-Africa (2022) confirmed that, Boer crossbred kids' fast grower, better efficient in feed conversion and better milk and meat producers compared to indigenous goats, being easier to rise than purebred Boer goats. Generally, the current findings revealed that Boer crossbred goats are imperative to the pastoral and agro-pastoral of communities and have better adaptive characters that allow them to live and produce under low levels of management practice.

Improving productivity only may lead to poor fitness and it is better to balance production and adaptation ability.

CONCLUSION

Boer woyto-guji crossbred goats are adaptable and can best perform in pastoral and agro-pastoral areas of south omo zone. Based on the data result, it could be said that the crossbred kids of 37.5% blood level had superior birth, three months, six months and yearly body weight; average daily gain compared to those of the 25% kids. Study findings revealed that the male kids had a higher weight in birth than female kids; single birth kids had better weight than twins' birth. Using 75% sires (75% Boer: 25% indigenous) on indigenous dams gave better growth of kids compared with kids of the indigenous breed. Crossbred goats required special care as a compare to the local goat breeds and goat keepers' preferred Boer crossbreds for their local adaptation, early maturity, docile behavior, attractive physical and body appearance, non-selective consumer, better browser and grazers and market preference. However, a few participants of goat keepers criticizing the Boer crossbred are weak resistance to disease, drought, and heat.

The result of terminal crossbreeding of crosses bucks (50% with woyto-guji dams) that are not used to produce replacement of kids could be a remarkable option for pastoral and agro-pastoral areas for marketing purposes as crossbred goats (25% Boer crossbred) have a higher weight gain. Hence, in scaling out of these crossbreds, the keepers should have skills in how to manage the flocks in general and the crossbreds in particular. Therefore, with the foregoing findings, the researchers concluded that intervention in efficient veterinary service and improved forage development is required to introduce crossbreds to the beneficiaries. Although Boer crossbreds performed better than indigenous breeds in growth and weight gain, the sustainability issue is doubtful.

ABBREVIATIONS

ADG: Average daily gain
BWT, WWT, SMWT, and YWT
BWT: Birth weight
CSA: Central Statistical Agency
PAPREG: Pastoral agro-pastoral research and extension group
SMWT: Six months weight
WG: Woyto-Guji
WWT: Weaning weight
YWT: Yearling weight

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AUTHOR CONTRIBUTIONS

Mr. Demerew Getaneh prepared the concepts, wrote the proposal, securing the funding, reviewed and edited the proposal and manuscript, analyzed and wrote the full manuscript. Mr. Aschenaki Abate collected data in the field.

COMPETING INTERESTS

The authors declare they have no conflict of interest. The manuscript has not been submitted for publication in other journal.

ETHICS APPROVAL

Not applicable

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