Research Article

Early Growth of Adilo Kids under Smallholder Management Systems, Southern Ethiopia: Influences of Non–Genetic Factors

Deribe Gemiyo Talore[1*], Girma Abebe[2], Azage Tegegne[3]

[1]Southern Agricultural Research Institute, Areka, P.O. Box 79, Ethiopia; [2]Department of Animal and Range Sciences, P. O.Box 5, University of Hawassa, Ethiopia; [3]International Livestock Research Institute (ILRI), P.O. Box 5689, Addis Ababa, Ethiopia.

Abstract | Sluggish early growth and mortality are the major constraints for goat production in Ethiopia. We evaluated the effects of non–genetic factors on early growth performance of kids in Adilo district of southern Ethiopia with 587 kids owned by 60 households. Body weight (kilograms) of kids at birth, 30, 60, 90, 120 and 150 days were 2.34±0.03, 4.39±0.10, 6.61±0.14, 9.85±0.29, 11.8±0.24 and 13.7±0.24, respectively, while the average daily gain (ADG; gram) from birth to 30, 60, 90, 120, and 150 days were 68.3±3.02, 70.4±2.16, 82.3±3.18, 78.3±1.93 and 75.0±1.54, respectively. Season had profound effect on body weights of kids at all ages (except at 120 days) and ADG. There was significant sex effect ($P<0.05$) on body weights at 30 to 120 days. Except at weaning age (90 days), parity effect was important on body weights of kids. Type of birth influenced pre–weaning body weights ($P<0.05$) and ADG from birth to 30, 60 days ($P<0.01$), and birth to 90 days ($P<0.05$). There were significant ($P<0.05$) effects of parity by sex and parity by type of birth on body weights and ADG at weaning. The non–genetic factors evaluated in this study are important sources of variation and need to be taken into account in the improvement plan of Adilo goats under semi–arid tropical conditions. Efforts geared towards improved prolificacy (through dam age management), improved nutrition and healthcare would help farmers to exploit these huge indigenous goat genetic resources efficiently.

Editor | Kuldeep Dhama, Indian Veterinary Research Institute, Uttar Pradesh, India.
Received | May 09, 2014; **Revised** | September 04, 2014; **Accepted** | September 06, 2014; **Published** | September 30, 2014
***Correspondence** | Deribe Gemiyo Talore, Southern Agricultural Research Institute, Ethiopia; **Email**: deribeg2000@yahoo.com
Citation | Talore DG, Abebe G, Tegegne A (2014). Early growth of Adilo kids under smallholder management systems, Southern Ethiopia: Influences of non–genetic factors. Adv. Anim. Vet. Sci. 2 (8): 468-476
DOI | http://dx.doi.org/10.14737/journal.aavs/2014/2.8.468.476
ISSN (Online) | 2307-8316; **ISSN (Print)** | 2309-3331

INTRODUCTION

Ethiopia is endowed with a large number (22.6 million heads) of goats, classified into 14 breeds/types using phenotypic characterization, while a genetic characterization showed only eight distinctively different breeds/types (Tesfaye, 2004; CSA, 2012). Out of this, approximately 73 percent are found in arid and semi–arid areas (Bedhane et al., 2013). Adilo goats are categorized under Arsi–Bale breeds. Arsi–Bale goats are one of the breeds of Ethiopia distributed across wide agro–ecological zones, the majority in semi-arid areas (Kebede et al., 2012). The production system of the Adilo district is virtually traditional and contributes substantially to both subsistence and cash generation for smallholder farmers and national economy as an export commodity (Legesse et al., 2008; Kocho et al., 2011). Goats in these areas provide their owners with important products like immediate cash income, meat, milk and functions like risk spreading and social values (Kosgey and Okeyo, 2007; Bedhane et al., 2013). Increasing human population, urbanization and incomes, coupled with changing consumer preferences are creating more demand for these animals and their products (Kosgey and Okeyo, 2007).

The genetic improvement program is less successful in developing countries in the tropics. One of the reasons is lack of focus on the actual production objectives of the farmers to whom new technologies were promoted and poor adaptability of exotic breeds in tropical environment (Kosgey and Okeyo, 2007). Indigenous goats are resistant to diseases and parasites, tolerant to adverse climatic conditions, have endurance to sustain droughts and low and fluctuating nutrient availability. However, extreme climatic stresses and poor quality feeds limit the potential expression of genetic merits in goat flock (Mabrouk et al., 2010; Baneh et al., 2012). Knowledge of non–genetic factors on production traits allows a more accurate assessment of breeding values (Dadi et al., 2008). Conservation, improvement and use of indigenous goat resources by enhancement of their growth capacities are essential (Kosgey and Okeyo, 2007). To this end, on–farm monitoring and identification of the underlying factors affecting growth rate of kids is important to improve productivity (Legesse et al., 2008). Hence, this study was conducted to evaluate the effects of non–genetic factors on early growth performance of Adilo kids under smallholder management systems.

MATERIALS AND METHODS

Descriptions of the Study Area

Adilo district is situated in South Nation, Nationalities and Peoples Region (SNNPR), 310 Km South of Addis Ababa. The district is located in 7° 17' N latitude and 38° 06' E longitude. The altitude of most of the villages around Adilo is between 1600 and 2000 m asl. The annual rainfall varies between 1055 and 1194 mm and in a bimodal pattern with light rains between March and June and main rains from July to October. There are three distinct seasons: dry (November, December, January and February), light rain (March, April, May and June) and heavy rain seasons (July, August, September, and October). The annual mean temperature varies from 17° C to 20° C with a mean of 18° C. Adilo is the district with mixed farming practices and the major crops grown include maize, sorghum, teff (*Eragrostis tef*), finger millet (*Eleusine coracana*), wheat, hot pepper, chat (*Catha edulis*) and haricot bean.

Breed Description and Flock Management

Adilo goats are categorized under the Arsi–Bale breed (Tesfaye, 2004). The breed is part of the rift valley family, occupying all the agro–pastoral lowlands within the rift valley, from Lake Abaya in the south to South Shoa in the north. The Arsi–Bale goat is a relatively tall goat with a predominantly straight facial profile (98%). Males have curved (47%) and straight (41%) horns mainly pointing backwards (58%) with some pointed straight upward (28%). The coat colour varies between any of seven colours (white, black, brown, fawn, grey, roan and red), with the first three being most dominant.

Natural pasture and browses are major feed resources for goats in the area. Tethered feeding is a common practice during cropping season, with uncontrolled year–round breeding system. Bucks run with flock to mate with any doe in heat during the day. Goat flocks are confined in small pens within residence houses at night and during harsh climatic periods. Feeding on crop leftovers, aftermaths and free wandering across villages is commonly observed management practice during crop harvesting period. Does at late pregnancy and young kids are kept around home while owners trek over other flocks to the long distances, searching for browses and water.

Source and Management of Data

A multistage stratified sampling technique was employed to select the participants, based on the size of land holding and goat density. In each site, adjacent villages were selected from goat keeping villages that have dry road accessibility. In addition having at least three does (female goats) per household was the criteria for household selection. A total of 60 households were selected; from which 30, 15, and 15 households were selected from sheep dominant site (SDS), mixed flock site (MFS) and goat dominant site (GDS), respectively. Site grouping criteria has been described by Kocho et al. (2011) and Deribe et al. (2014). All animals in the study flock were ear tagged at the start of the study and all additions were also immediately tagged. Within 24h of parturition, date of birth, birth weight, type of birth, sex of kid, and dam parity were recorded. Kids remained with their dams until weaning, which occurred at about 90 days. All kids were weighed at birth and then at 15–day intervals up to 3 months and monthly interval up to 12 months of age. All the weight measurements were recorded to the nearest 0.1 kg. Body weights at 30, 60, 90, 120, and 150 days of age were analysed separately. Live body weight at birth, 30, 60, 90, 120, and 150 days of age and average daily gain (ADG) from birth until 30, 60, 90, 120 and 150 days (ADG; g/day) were utilized in the computation of growth rate. We monitored a total of 587 kids, of which 141 were from the SDS, 324 from the GDS, and 122 from the MFS. Due to high flock dynamics in the area through sale and other forms of exits, weights beyond 150 days have not been included in our final analysis.

Statistical Analysis

Data were analysed using the general linear model (GLM) procedure of the SAS (SAS, 2009). In the analysis, all factors were considered as fixed effects except the error term considered as random effect. Tukey's tests were used to separate significance of least squares means (LSMs). The following linear model was employed:

$$Y_{inhmjo} = \mu + L_i + X_n + P_h + B_m + S_j + (PX)\,hn + (PB)\,hm + e_{ijhmno}$$

Where

Y_{inlmjo} is the observation on production traits (birth weight, weight at different ages and ADG)

μ= is the overall mean

$L_{i=}$ is the fixed effect of the i[th] location (i= SDS, GDS, MFS)

X_n = is the fixed effect of n[th] kid sex (n=male, female)

$P_{h=}$ is the fixed effect of h[th] ewe parity (h= 1, 2, 3, 4, ≥5)

B_m = is the fixed effect of m[th] type of birth of kid (m=1=single, ≥2=multiple)

$S_{j=}$ is the fixed effect of j[th] season (j=dry, heavy rain, light rain)

$(PX)_{hn}$= is the interaction effect of parity and sex on birth, 30, 60, 90, 120 and 150 days and ADGs from birth to 30, 60, 90, 120 and 150 days

$(PB)_{hm}$= is the interaction effect of parity and type of birth on birth, 30, 60, 90, 120 and 150 days and ADG from birth to 30, 60, 90, 120 and 150 days weight

e_{inhmjo}= effect of random error.

RESULTS

Body Weights

Body weight (kg) at birth, 30, 60, 90, 120, and 150 days were 2.34 ± 0.03, 4.39 ± 0.10, 6.61± 0.14, 9.85 ± 0.29, 11.8 ± 0.24, and 13.7 ± 0.24 kg, respectively(Table 1). Location influenced (*P*<0.05) body weights of kids at birth, 60, 90 and 150 days. Kids born in the SDS showed significantly (*P*<0.01) lower birth weight compared to other locations. Kids born at the MFS had significantly (*P*<0.05) higher weights at 60 and 90 days compared to the GDS while non–significant (*P*>0.05) compared to the SDS. At 90 and 150

Table 1: Least square mean (LSM±SE) for body weights (kilograms) from birth to 150 days of age of Adilo kids by location (sheep dominant site, SDS; goat dominant site, GDS; and mixed flock site, MFS) and sex

Fixed effects	Body weight (kilograms)					
	Birth weight	30 day weight	60 day weight	90 day weight	120 day weight	150 day weight
Overall	2.34±0.03	4.39±0.10	6.61±0.14	9.85± 0.29	11.8±0.24	13.7±0.24
Location (farming system)	**	NS	*	*	NS	*
SDS	2.18±0.05[b]	4.43±0.14	6.81± 0.21[ab]	11.2 ±0.50[a]	12.0±0.56	13.6±0.57[a]
GDS	2.36 ±0.03[a]	4.29±0.19	6.27± 0.16[b]	8.68±0.60[b]	11.4±0.31	13.2±0.29[b]
MFS	2.41±0.09a	4.50±0.30	7.11±0.44a	10.8±0.30 a	12.5±0.48	14.6±0.47a
Sex	NS	*	*	*	*	NS
Male	2.35±0.04	4.59±0.15a	6.95±0.23a	10.3±0.33a	12.3±0.34a	13.9±0.35
Female	2.32±0.04	4.17±0.13[b]	6.27±0.14[b]	9.22±0.38[b]	11.2±0.31[b]	13.4±0.32

means with different letters (a, b) within a trait in a column are different at indicated P value: NS non–significant (P >0.05);*P <0.05; **P <0.01

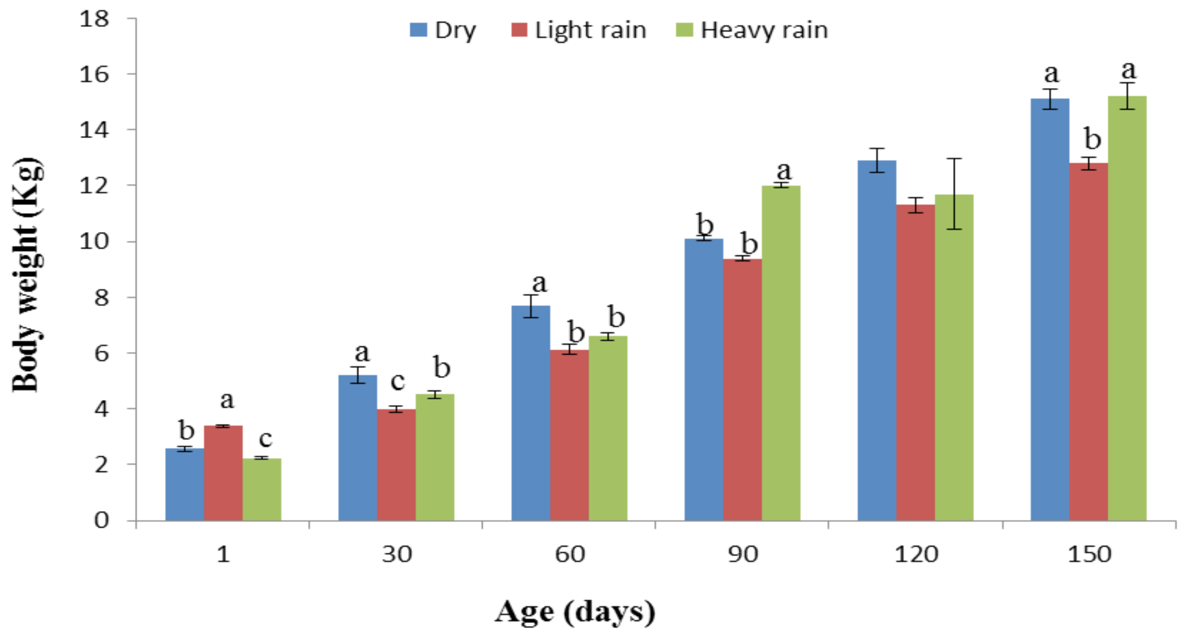

Figure 1: Body weights of kids from birth to 150 days of age as affected by the season of birth in Adilo district, south Ethiopia. Bars with different letters differ significantly at P value: non–significant, P>0.05 (at 120 days); P<0.001 (at birth); P<0.05(at 90 days); P<0.0001(at 30, 60 and 150 days)

days, kids born at the SDS and MFS demonstrated higher body weights in comparison to the GDS.

Season is one of the important sources of variation on body weight of kids (Figure 1). The effect of season was significant on body weights at all ages except at 120 day. Kids born during the light rain season had significantly (P<0.001) higher birth weight than those born during the dry and heavy rain seasons. Likewise, kids born during the dry season had significantly higher birth weight compared to those born during the heavy rain season. The body weight of kids at 30 days during dry season was higher (P<0.0001) than heavy rain season. At 60 day, kids born during dry season were higher (P<0.0001) than the light and heavy rain seasons whilst at weaning (90 day), kids born during heavy rain season had higher (P<0.05) body weight compared to dry and light rain seasons. Kids born in the dry and heavy rain seasons showed significantly heavier (P<0.001) weights at 150 days compared to the light rain season. The effect of sex is significant at 30, 60, 90 and 120 days (Table 1); male kids had higher (P<0.05) body weights compared to the female counterparts.

Does in parity three and four had significantly (P<0.001) higher birth weight compared to parity one, two and five (Table 2). Likewise, parity five showed significantly higher (P<0.01) birth weight compared to parity one. Parity effect was significant (P<0.05) at 30 and 60 days, non–significant at 90 days weight, while the significance resumed at 120 and 150 days. Parity four showed significantly higher body weight at 30 day compared to parity two. Parity one had higher weight at 60 day compared to parity five and two. At 120 days of age, parity five demonstrated higher (P<0.05) body weights compared to parity two. Similarly at 150 days of age, parity five showed significantly heavier weight compared to parity three and the lower parities. Parity by sex was significant at 90 and 120 days (data not presented). Female kids born from the fifth parity were lower (P<0.05) than females in lower parities and male in all combinations.

Type of birth is also an important source of variation on weight at birth as well as at weaning (Table 2). Single born kids grew faster (P<0.05) and reached weaning age earlier than multiple births. Type of birth influenced body weights of kids significantly from 30 to 90 days of age, and thereafter its effect disappeared. Single born kids were heavier (P<0.05) birth weight compared to multiple counterparts and they maintained their superiority at 30, 60 and 90 days of age.

Average Daily Gain

The overall mean and standard errors of ADG from

Table 2: Least square mean (LSM±SE) for body weights (kilograms) from birth to 150 days of age of Adilo kids by parity and type of birth

Fixed effects	Body weight (kg)					
	Birth weight	30 day weight	60 day weight	90 day weight	120 day weight	150 day weight
Parity	***	*	*	NS	*	*
1	2.13 ± 0.03[c]	4.37 ± 0.27[ab]	7.16 ± 0.35[a]	10.33 ± 0.54	11.8 ± 0.48[ab]	12.9 ± 0.55[b]
2	2.26 ± 0.03[b]	4.01 ± 0.19[b]	5.86 ± 0.21[c]	9.13 ± 0.70	10.6 ± 0.47[b]	12.6 ± 0.53[b]
3	2.44 ± 0.07[a]	4.56 ± 0.16[ab]	6.64 ± 0.27[ab]	10.2 ± 0.55	11.9 ± 0.45[ab]	13.4 ± 0.41[b]
4	2.47 ± 0.07[a]	4.66 ± 0.22[a]	6.92 ± 0.27[ab]	9.72 ± 0.52	12.2 ± 0.38[ab]	14.3 ± 0.35[ab]
≥5	2.29 ± 0.09[b]	4.14 ± 0.22[ab]	6.27 ± 0.38[bc]	10.5 ± 0.67	12.8 ± 1.27[a]	15.2 ± 0.98[a]
Type of birth	*	*	*	*	NS	NS
Single	2.41 ± 0.05[a]	4.75 ± 0.17[a]	7.05 ± 0.23[a]	10.4 ± 0.37[a]	11.9±0.38	13.6 ± 0.39
Multiple	2.25 ± 0.03b	4.06 ± 0.09b	6.12 ± 0.19b	9.15 ± 0.31b	11.7±0.29	13.8 ± 0.26
Parity x Sex	–	–	–	*	*	–

Means with different letters (a, b) within a trait in a column are different at indicated P value: NS non–significant (P >0.05); *P <0.05; ***P<0.001

Table 3: Least square mean (LSM±SE) for average daily weight gain (grams) from birth until 30, 60, 90, 120 and 150 days of age of Adilo kids by location (sheep dominant site, SDS; goat dominant site, GDS; and mixed flock site, MFS) and season

Fixed effects	Average daily gain (gram)				
	Birth to 30	Birth to 60	Birth to 90	Birth to 120	Birth to 150
Overall	68.3±3.02	70.4±2.16	82.3±3.18	78.3±1.93	75.0±1.54
Location	NS	**	*	NS	*
SDS	70.7±4.50	77.0±3.53[a]	98.7±5.46[a]	80.5±4.51	75.2±3.72[b]
GDS	62.1±3.55	64.0±2.42[b]	69.5±3.57[b]	74.6±2.44	71.7±1.88[b]
MFS	68.3±3.02	76.1±6.21a	91.8±3.85ab	83.5±3.63	80.8±2.88a
Season	***	****	*	*	***
Dry season	88.0±7.15[a]	84.8±5.72[a]	82.8±4.40[b]	85.5±3.12[a]	83.0±2.31[a]
Light rains	54.6±4.02[b]	62.3±2.95[c]	77.8±3.93[b]	74.6±2.31[b]	85.8±3.52[a]
Heavy rains	77.4±4.09[c]	72.7±1.69[b]	107.2±13.5[a]	80.6±10.73[a]	68.8± 1.51[b]

Means with different letters (a, b) within a trait in a column are different at indicated P value: NS non–significant (P >0.05) *P <0.05; **P <0.01; ***P <0.001, ****P <0.0001

birth to 30, 60, 90, 120, and 150 days were 68.3±3.02, 70.4±2.16, 82.3±3.18, 78.3±1.93 and 75.0±1.54 kg, respectively (Table 3). The SDS and MFS showed higher ADG from birth to 60 days (P<0.01) while the SDS had higher (P<0.05) ADG from birth to 90 days compared to the GDS. Kids born in the MFS had significantly higher (P<0.05) ADG from birth 150 day compared to other locations.

Dry season showed higher ADG (at 30 day; P<0.001

and 60 day; P<0.0001) compared to the light and heavy rain seasons (Table 3). At the same time, kids born during the dry season had higher ADG (P<0.05) at 120 days compared to the light rain season and at 150 days (P<0.001) compared to the heavy rain season. The heavy rain season demonstrated significantly (birth to 60 days; P<0.0011, birth to 90 days; P<0.05) higher ADG compared to the light rainy season. Kids born during the heavy rain season had higher (P<0.05) ADG from birth to 90 days compared to the dry and light rain seasons.

Sex effect was significant (P<0.05) on ADG from birth to weaning and non–significant (P>0.05) at other ages (Table 4). Males were heavier than those of females at weaning. Variation due to parity was significant (P<0.05) on ADG from birth to 60 and birth to 150 days while it was non–significant (P>0.05) at other ages. There was significant (P<0.05) parity by sex interaction on ADG from birth to 90 and 120 days. Female kids born from the fifth parity were significantly lighter than other combinations.

Type of birth influenced ADG of kids at all ages until weaning (Table 4). Single births were heavier (P<0.01) compared to multiple births from birth to 30 and 60 days. The influence of birth type on ADG of kids was disappeared after 120 days. There was significant (P<0.05) parity by type of birth interaction on ADG from birth to 90 days. Single births from parity five had significantly higher ADG compared to the other comparisons (data not presented).

DISCUSSION

Effects of Flock Density/Farming System

Flock density group/farming system is an important source of variation in Adilo district because land size varies across the location that further determines the availability of feed for grazing and /or browsing. The higher birth weight of kids in GDS and MFS is partly attributed to the availability of browses due to larger landholding. The GDS is a production system dominated by goats due to the fact that browses are

Table 4: Least square mean (LSM±SE) for average daily weight gain (grams) from birth until 30, 60, 90, and 120 and 150 days of age of Adilo kids by sex, parity, and type of birth

Fixed effects	Average daily gain (gram)				
	Birth to 30 days	Birth to 60 days	Birth to 90 days	Birth to 120 days	Birth to 150 days
Sex	NS	NS	*	NS	NS
Male	72.8 ± 4.21	74.5 ± 3.51	86.8 ± 3.67[a]	81.2 ± 2.65	75.7 ± 2.21
Female	63.3 ± 4.25	66.4 ± 2.41	76.4 ± 5.44[b]	74.5 ± 2.67	74.0 ± 2.11
Parity	NS	*	NS	NS	*
1	73.6 ± 9.05	83.2 ± 6.07[a]	91.1 ± 8.38	80.4 ± 4.25	71.9 ± 3.96[b]
2	58.1 ± 6.40	59.6 ± 3.54[b]	76.2 ± 8.47	69.3 ± 4.00	69.0 ± 3.67[b]
3	70.7 ± 5.58	68.7 ± 4.69[b]	85.9 ± 6.20	78.7 ± 3.98	73.0 ± 2.86[b]
4	74.1 ± 5.58	73.7 ± 3.85[b]	78.9 ± 5.54	80.2 ± 2.89	77.8 ± 2.17[a]
≥5	61.8 ± 6.94	67.6 ± 5.25[b]	89.8 ± 5.10	86.3 ± 9.48	85.3 ± 6.21[a]
Type of birth	**	**	*	NS	NS
Single	76.3 ± 4.90[a]	75.7 ± 3.51a	87.9 ± 4.59[a]	78.7 ± 2.97	73.9 ± 2.47
Multiple	60.6 ± 3.33[b]	64.6 ± 2.03b	75.5 ± 3.99[b]	77.8 ± 2.45	76.1 ± 1.76
Parity x Sex	–	–	*	*	–
Parity x Type of birth	–	–	*	–	–

Means with different letters (a, b) within a trait in a column are different at indicated P value: NS non–significant (P >0.05); *P <0.05; **P <0.01

abundantly available (Kocho et al., 2011). Dadi et al. (2008) has shown similar systems of village sheep production in western Ethiopia. The lower birth weight in the SDS found in this study is likely due to high human population pressure, land shortage and associated tethering pressure (Deribe et al., 2013), since most of the lands put under cultivation (Legesse et al., 2008). The lower pre–weaning weight gain of kids in the GDS, mainly during dry season, is partly attributed to the trekking over of goat flock to long distances searching for water, and associated stress and weight loss.

Effects of Season of Birth

The higher birth weight of kids born during dry season is attributed to the better body condition of the dams due to good body reserves during late heavy rain and early dry season. Body weights gains and losses were reported previously in similar traditional management situations where feed availability fluctuates within and across seasons (Hailu et al., 2004; Bedhane et al., 2013). Similar to our findings, Zahraddeen et al. (2008) reported that winter kids had heavier birth weight than spring or summer births. Hailu et al. (2004), Dadi et al. (2008) and Mabrouk et al. (2010) also shown that kids born during dry season had higher pre–weaning growth performance than wet season. The superiority of birth weight in dry season is attributed to free feed selection and feeding upon quality feeds and less tethering pressure. Tethering pressure affects weight of dams and kids during light and heavy rain seasons, as majority of lands put under cultivation (Legesse et al., 2008). The incidence of pests and diseases are also relatively low in dry season. The body weight of kid's depends on the condition of the dam, during late gestation and prior to weaning (Dadi et al., 2008), reflecting that growth rate of kids is dependent on dam's size, condition and plane of nutrition (Legesse et al., 2008). The higher weaning weight for kids born during the heavy rain season is due to the fact that relatively high feed availability both in quality and quantity immediate after kids stop suckling. This compensatory growth from 60 to 90 days (at about weaning age) slowed down after 120 days. This may also be explained when kids stop suckling, weaning shock might contribute for further slow growth. Similar finding has been reported by Mabrouk et al. (2010) who found stagnant growth of kids in heavy rain season at age of 120 or 150 days. In contrast, Annor et al. (2012) reported higher body weights and faster gain of kids born during heavy and light rain seasons.

Sex Effects

Sex effect is not important at birth weight while as kids grew up, from 30 to 120 days, it becomes an important source of variation. These results agree with the previous reports (Annor et al., 2012; Baneh et al., 2012; Bedhane et al., 2013) while others reported the significant effect of sex on birth weight (Mabrouk et al., 2010) and subsequent body weights (Dadi et al., 2008). The superiority of males over females may be explained by the precocity, the sexual dimorphism in favour of body growth in males than females (Mabrouk et al., 2010). The superiority of male over female on body weights at 30, 60, 90 and 120 days of age and ADG from birth until 90 days, is consistent with other reports from similar eco–zones; for Arsi–Bale goats (Dadi et al., 2008) and local Nigerian goats (Zahraddeen et al., 2008) under similar management systems. Male kids had consistently heavier body weights to the age of 150 days than those for females (Mabrouk et al., 2010). On the other hand, Annor et al., (2012) showed less general effect of sex on body weights and ADG at 90 and 120 days.

Effects of Parity

Kids from higher parties were generally heavier than lower parties. Poor kid and dam management and influences of harsh (water stressed) environmental conditions at Halaba might have contributed for the observed decrement of kid weight after fourth to fifth parity. Except at 90 day weight, kids of higher parties showed higher body weights, due to the fact that dams reach physiological maturity (Dadi et al., 2008). Zahraddeen et al. (2008) observed that there were consistently higher kid weights from higher parties. Dadi et al. (2008) showed that parity influenced body weight of kids up to 180 days of age and that the effect disappeared thereafter. On the other hand, previous studies also showed that parity did not have significant effect ($P>0.05$) on 90 day weight (Dadi et al., 2008; Annor et al., 2012) and pre–weaning growth rate (Annor et al., 2012). The aging effect of dams (after fifth parity) due to drought–induced heat stress and poor nutrition may attribute to decline in body weights of kids in fifth and above parities. This perhaps implies the maximum productive ages of does or the optimum age of culling them under such harsh environments. The faster weight gain of kids at 150 days is likely due to the adaptation of kids to roughage feeds and compensatory growth after weaning shock.

Effects of Type of Birth

The superiority of single kids over their multiple counterparts found in this study agrees with reports of other studies (Dadi et al., 2008; Zahraddeen et al., 2008; Baneh et al., 2012). This is due to the competition of young's for suckling the limited amount of milk of their dams among multiple births than single. The superior body weights and ADG of single births over the multiple births confirms previous reports of local and other African countries (Dadi et al., 2008; Zahraddeen et al., 2008; Mabrouk et al., 2010). Zahraddeen et al. (2008) reported higher ADG of single kids from birth to 60 days (in favour of kids born single). After 90 days of age, the significance effect of type of birth disappeared. Mabrouk et al. (2010) reported the non–significant differences between single and multiple kids in adult ages, similar to our findings. This could be explained by the compensatory growth in the older periods of growing (Mabrouk et al., 2010). Our results; however, contradict with results of Adama and Arowolo (2002) who reported the non–significant effect of type of birth on ADG of kids. In our study, single births gained 15.7 g/day (25.9%) and 11.1(17.2%) more ADG at 30 and 60 days compared to multiple births. The consistent ADG advantage (kids born single) may be related to pre–and–early post–natal nutrient competition. Does with less inter–uterine space and in cases when they carry two or more foetuses, there is high competition among multiple births for nutrients.

The non-genetic factors in this study were shown to influence daily gain and total body weight of lambs during early growth. Season of birth is generally more severe than other factors, and can be related to low rainfall of the area and associated fluctuation of feed resources in quantity and quality. The non-genetic factors estimated in this study are important and need to be taken into consideration in goat breeding plan under Halaba semi-arid, tropical conditions. Gearing efforts towards managing dam age through replacement ewes, improved nutrition and healthcare would help farmers to exploit these huge indigenous goat genetic resources efficiently.

ACKNOWLEDGEMENT

Smallholder sheep and goat owners are dully acknowledged for giving permission to use their animals. Improving Productivity and Market Success (IPMS) of Ethiopian farmers (International Livestock Research Institute, ILRI) and Southern Agricultural Research Institute (SARI) are dully acknowledged for supporting this on–farm study.

REFERENCES

- Annor SY, Ahunu BK, Aboagye GS, Boa–Amponsem K, Cassady JP (2012). Non–Genetic factors affecting Grasscutter production traits. 1. Growth Traits. World App Sci J, 18: 1412 – 1424.
- Adama TZ, Arowolo IO (2002). Body weight and body condition of Yankasa kids and Savanna Brown kids from birth to 100 days of life. *J. Agric. Sci. Technology* 12, 92-96.
- Baneh H, Mojtaba N, Ghodrat R (2012). Genetic parameter estimates for early growth traits in Naeini goat. Anim Prod Sci. 52: 1046 – 1051
- Bedhane M, Haile A, Dadi H, Alemu T (2013). Estimates of genetic and phenotypic parameters for growth traits in arsi–bale goat in Ethiopia. J Anim Sci Adv. 3: 439 – 448.
- Central Statistical Agency (CSA) 2012. Report on Livestock and Livestock Characteristics. Agricultural Sample survey. Federal Democratic Republic of Ethiopia Central Statistical Agency. Vol.2. march 2012, Addis Ababa.
- Dadi H, Duguma GB, Shelima T, Fayera M, Tadesse T, Woldu T, Tucho A (2008). Non–genetic factors influencing post–weaning growth and reproductive performances of Arsi–Bale goats. Livest Res Rural Dev. 20: 1 – 10.
- Deribe G, Abebe G, Azage T (2014). Influences of non-genetic factors on early growth of Adilo lambs under smallholder management systems. Trop Anim Health Prod, 46(2): 323–329
- Hailu D, Mieso G, Lama F, Dadi G, Tadle M, Negatu A (2004).The influence of environmental factors on pre–weaning growth performances in Arsi–Bale goats. AJOLE. 3: 23 – 27.
- Kebede T, Haile A, Dadi H (2012). Smallholder goat breeding and flock management practices in the central rift valley of Ethiopia. Trop Anim Health Prod. 44: 999 – 1006.
- Kocho T, Abebe G, Tegegne A, Gebremedhin B (2011). Marketing value–chain of smallholder sheep and goats in crop–livestock mixed farming system of Alaba, Southern Ethiopia. Small Ruminant Res. 96: 101 –

105.
- Kosgey IS, Okeyo AM (2007). Genetic improvement of small ruminants in low–input, smallholder production systems: Technical and infrastructural issues. Small Ruminant Res. 70: 76 – 88.
- Legesse G, Abebe G, Siegmund–schultze M, Vallezarate A (2008). Small ruminant production in two mixed–farming systems of southern Ethiopia: status and prospects for improvement. Exp Agric. 44: 399 – 412.
- Mabrouk O, Najari S, Roberto GC, Gaddor A, Ben A, Elgaaied A, Juan VD (2010). The effect of non–genetic factors on the early body weights of Tunisian local goats. R. Bras. Zootec. 39: 1112 – 1117.
- SAS (2009). SAS Version 9.3. SAS Institute Inc., Cary, NC. USA.
- Tesfaye AT (2004). Genetic characterization of indigenous goat populations of Ethiopia using microsatellite DNA markers. PhD thesis, National Dairy Research Institute, Karnal (Haryana), India.
- Zahraddeen D, Butswat ISR, Mbap ST (2008). Evaluation of some factors influencing growth performance of local goats in Nigeria. AJFAND. 8: 464 – 479.