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Reproductive Performance of Central Highland Goats under Traditional Management in Sekota District, Ethiopia

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ABSTRACT

A study was conducted in the sub humid parts of Sekota District, Amhara Regional State, Ethiopia, to evaluate the reproductive performance of Central Highland goat types raised under the traditional management system of farm households. Twenty-two randomly selected flocks were monitored for two years during which reproductive data were collected on 524 does. The mean least squares Age at first kidding, litter size, kidding interval and kidding rate was found to be 407.9 days, 1.16 ± 0.04 kids, 1.46 ± 0.03 , and 307.9 days, respectively. Age at first kidding was affected ($p < 0.01$) by season of birth that does born during the hot season had short age at first kidding. Kidding interval was shorter ($p < 0.01$) for does that kidded during cool season and single litter. Litter size was also affected ($p < 0.01$) by parity and season of kidding. Does kidded in the hot season and those with higher parities had larger litter. The effect of type of birth and season of kidding on annual reproductive rate was significant that multiple bearing does and those kidded in the hot season had larger reproductive rate. The effect of season on most of the traits indicates the need for supplementation of does during the dry season when the grazing condition is very poor for better reproductive efficiency.

Key words: Central highland goats, kidding rate, kidding interval, Sekota district, reproductive performance

INTRODUCTION

The goat population of Ethiopia is estimated to be 21.7 million (CSA, 2012) found distributed in different agro-ecological zones. A large proportion (58%) is found in the lowlands of the country raised in large flocks by pastoralists while the rest, 42% of the total are found in the highlands (ESGPIP, 2008).

Goats in Ethiopia make an important contribution to the poor household in particular and national economy in general. They provide 30% of all domestic meat consumption and generate cash income from exports of meat, mainly as live animals and skins (Zelalem and Fletcher, 1993). Goats in the traditional production system are maintained with a very little resource input and therefore are low productive.

According to breed characterization reports (FARM-Africa, 1996), central highland goats are among the goat breeds found distributed Central highlands, west of the Rift Valley, Wollo, Gondar and Shoa (ESGPIP, 2008; FARM-Africa, 1996). These goats are grouped in the small east African family goats. These goats are characterised as Medium-sized, broad-faced, thick horns and

reddish-brown in colour (FARM-Africa, 1996). The average number of kids born per breeding female is 2.9 of which single births account for 83% of all births while twins account for 17% (FARM-Africa, 1996).

Reproductive performances and survival rate are important traits in goat production since productivity is determined by reproductive efficiency and kid mortality (Matika *et al.*, 2003). The objective of this research was to evaluate the reproductive performances of Central Highland goats under traditional management systems in Sekota district.

MATERIALS AND METHODS

Study area: The study was conducted in Sekota District, Waghimra Administrative Zone in the Amhara Regional state. It is located about 720 km North from Addis Ababa (Capital city of Ethiopia). The Altitude of the area varies from 1340 to 2200 m a.s.l (ZAD, unpublished). Annual rainfall ranges between 350-700 mm, falling mainly from July to September. The pattern and distribution of the rainfall is erratic and uneven. Average temperature ranges from 16-27°C (ZAD, unpublished). The vegetation can be characterized as being semi-arid shrubs dominated by various acacia species with a sparse ground cover of annual grasses. The district is characterized by long dry season lasting from October to June.

On-farm flock monitoring: For the study, two rural kebeles were purposively chosen in the sub humid part of the district based on goat population. From the two kebeles, twenty-two households who owned Highland Goats were randomly selected and the flocks were monitored. All animals in the flock were identified with plastic ear tags applied at the beginning of the research, at purchase and at birth. The age and parity of does in the flock were determined by dentition and information from owners at the beginning of the monitoring.

Animals were maintained under traditional management system. They were grazing in a communal grazing land during the whole day and housed in the night times. Breeding was year round and uncontrolled. During the course of data collection, animals have been de-wormed and sprayed for internal and external parasite control three times a year. Vaccinations for prevalent diseases of the area like Pasteurellosis, PPR and anthrax has been given once in a year.

Data collection and management: Data on reproductive parameters such as doe id, kidding date, kid id, kid sex, parity, kid weight, birth type (litter size) were recorded within 24 h of kidding by trained enumerator recruited on site. Researchers were supervising the monitoring activity on a monthly interval. Kidding interval was calculated as the difference (in days) between two successive kiddings for all does with more than one kidding record. Age at first kidding was calculated as the difference (in days) between birth and first kidding date of does. Litter size was computed as number of kids born/doe/kidding. Annual Kidding Rate (AKR) was calculated as: $AKR = \text{litter size} \times 365 \text{ per subsequent kidding interval}$. All data were recorded and managed in MS-excel computer program.

Statistical analysis: Data on reproductive performances were analysed using the General Linear Model Procedures of Statistical Analysis System (SAS, 2003). The response variables considered in the analysis include Age at First Kidding (AFK), Kidding Interval (KI), Litter Size (LS) and Annual Kidding Rate (AKR). The fixed effects considered were parity of doe, type of birth and season of birth. Season was categorized as, (1) Wet season: Spans from July to September and green natural pasture is available, (2) Cool season: From October to January which is characterised as relatively

cool temperature with aftermath grazing. The quantity and quality of natural pasture is depleted in this time, (3) Hot season: From February to June and have a very hot temperature and both the natural pasture and aftermath grazing is scanty. Type of birth was classified as single when single and multiple when it is two and above.

The statistical model used was:

$$Y_{ijk} = \mu + P_i + T_j + M_k + a_{ijk}$$

Where:

Y_{ijk} = Observation on age at first kidding, kidding interval, litter size and annual kidding rate

μ = Overall mean

P_i = Fixed effect of parity (i = 1, 2,... >6)

T_j = Fixed effect of type of birth of doe (j = Single, Multiple)

M_k = Fixed effect of the season of birth of doe (k = Wet season, Cool season, Hot season)

a_{ijk} = Random error term

RESULTS

Age at first kidding: The least square mean age at first kidding of Central Highland goats found in the current study was 407.9 days (Table 1). This is within the range of values reported by Payne and Wilson (1999) for goats in the tropics that stated the mean ages at first kidding to be between 12 to 18 months. The obtained result is much lower than the report for Arsi Bale goats (Dadi *et al.*, 2008). Ayalew (2000) reported that 36% of the does had their first kidding by eruption of their first incisor teeth among the goat types of southern Ethiopia; it is lower age as compared to the current result.

Season of birth influenced (p<0.05) age at first kidding of Central Highland goats that wet season born does kidded their first kid at later age than their dry and cool season born counterparts. This effect is in agreement with the reports of Zeshmarani *et al.* (2007) and Hassan *et al.* (2007) for Black Bengal goats.

Table 1: Least squares Mean (\pm SE) of age at first kidding (days) of central highland goats in Sekota district

Variables	N	LSM \pm SE
Overall	31	407.9 \pm 40.48
Parity of dam		ns
1	3	360.9 \pm 58.57
2	6	404.4 \pm 40.93
3	6	393.4 \pm 42.93
4	6	426.2 \pm 40.85
5	5	454.6 \pm 40.26
>6	5	407.7 \pm 43.49
Type of birth		ns
Single	22	431.2 \pm 25.00
Multiple	9	384.5 \pm 38.93
Season of birth		*
Hot season	2	341.0 \pm 64.09 ^a
Cool season	15	390.6 \pm 25.29 ^a
Wet season	14	492.0 \pm 24.93 ^b

Means within the same column of the same factor are significantly different at the indicated p-value; *p<0.05; ns: Not significant (p>0.05), LSM: Least square mean, N: No. of observation, SE: Standard error

Table 2: Least squares Means (\pm SE) of kidding interval, litter size and annual kidding rate of central highland goats in Sekota district

Variables	Kidding interval (days)		Litter size (No.)		Annual kidding rate	
	N	LSM \pm SE	N	LSM \pm SE	N	LSM \pm SE
Overall	192	307.9 \pm 14.20	524	1.16 \pm 0.04	193	1.46 \pm 0.06
Parity of dam		ns		***		ns
1	34	335.7 \pm 16.50	110	1.03 \pm 0.04 ^e	35	1.71 \pm 0.07
2	33	315.5 \pm 15.00	87	1.05 \pm 0.04 ^{de}	33	1.82 \pm 0.07
3	35	330.6 \pm 14.30	90	1.15 \pm 0.04 ^{de}	35	1.74 \pm 0.07
4	41	308.5 \pm 13.40	90	1.31 \pm 0.04 ^{ab}	41	1.88 \pm 0.06
5	34	318.4 \pm 14.50	84	1.23 \pm 0.04 ^{bc}	34	1.87 \pm 0.06
>6	15	284.2 \pm 21.10	63	1.35 \pm 0.05 ^a	15	1.98 \pm 0.10
Season of birth		***		*		***
Wet season	60	315.2 \pm 11.30 ^b	114	1.16 \pm 0.03 ^b	61	1.82 \pm 0.05 ^b
Cool season	81	278.3 \pm 11.30 ^a	277	1.16 \pm 0.02 ^b	81	1.66 \pm 0.05 ^c
Hot season	51	352.8 \pm 10.70 ^c	133	1.24 \pm 0.03 ^a	51	2.02 \pm 0.06 ^a
Type of birth		**				***
Single	159	292.55 \pm 7.10 ^a			160	1.32 \pm 0.03 ^b
Multiple	33	338.36 \pm 13.7 ^b			33	2.34 \pm 0.07 ^a

Means within the same column of the same factor are significantly different at the indicated p-value; *p<0.05, **p<0.01, ***p<0.001, ns: Not significant, LSM: Least square mean, NL: No. of observation, SE: Standard error

Litter size: During the study period, a total of 520 does kidded 608 kids of which 88 (16.9%) does gave twins and the rest 432 (83.1%) gave single births. FARM-Africa (1996) reported similar result for the same breed that single births account for 83% of all births while twins account for 17%.

The overall least squares mean litter size of Central Highland goats obtained in the current study (1.16 \pm 0.04, Table 2) was slightly lower than that of Arsi Bale (Tatek *et al.*, 2004) and Central Highland goats (Tesfaye *et al.*, 2006). Dadi *et al.* (2008) reported 1.6 kids per doe kidding. However, the obtained figure is in comparison with the report of FARM-Africa (1996) for the same breed.

Parity of doe had showed significant difference (p<0.001) in litter size that higher parity does gave higher litter than lower parity ones. This agrees with the research findings of Dadi *et al.* (2008) that the largest litter sizes achieved at about sixth parity. Hossain *et al.* (2004) has also reported an increase litter size from first to third parity doe. Moaen-Ud-Din *et al.* (2008) reported that litter size was highest at fourth kidding (2.7 \pm 1.0) and lowest during first kidding (1.5 \pm 0.7) in Matou goat of Central China. Advancement in age of does results in improved ovulation rate, uterine capacity and other maternal traits affecting the reproductive efficiency (Fahmy, 1990) which in turn increases fecundity.

Higher (p<0.01) litter size was obtained during hot dry season as compared to other seasons considered. This might be because of the better feed availability during conception which was the wet season. Better nutrition during mating season improves body condition and body weight which in turn increases the number of ova shed and fertilized. This result complies with several authors (Bushara *et al.*, 2013; Dadi *et al.*, 2008; Mellado *et al.*, 2006).

Kidding interval: The overall least squares mean kidding interval of Central Highland goats were 307.9 \pm 14.20 (Table 2) which is in comparison with Arsi-Bale goats (Dadi *et al.*, 2008). The obtained result is somewhat larger than the values reported for goats in the tropics from 180 to 300 days by Payne and Wilson (1999).

Type of birth affected ($p < 0.01$) kidding interval in Central Highland goats. Those does kidded single kids had shorter interval than their multiple born counterparts (292.55 ± 7.1 vs. 338.36 ± 13.7). Similar effect of litter size on kidding interval is reported in the literature (Bushara *et al.*, 2013). This might be due to the fact that multiple born does need to produce much more milk to nurse their kid therefore will have poor body condition especially when feed is scarce.

Season also had an effect ($p < 0.001$) on kidding interval that does kidded in the cool season had a shorter kidding interval followed by does that gave birth in the wet season. Does require better nutrition before and after kidding in order to gain body condition and come to heat. Nutrition have direct influence on ovulation rate and fertility, since the nutritional stress appears to be a prime probable cause of cyclicity and long kidding interval in the goats (Bushara *et al.*, 2013). As stated by Dadi *et al.* (2008), kidding interval could be affected by change in the quality and quantity of forages, which occur during the various seasons of the year.

Annual kidding rate: Annual kidding rate which is the number of young produced per year is an important parameter in overall reproductive performances and total productivity (Payne and Wilson, 1999). Since it is produced from two other important traits, litter size and kidding interval, it can be used as an index to select productive does in the flock.

The overall least squares mean annual kidding rate of Central Highland goats obtained in the present study was 1.46 ± 0.06 litters (Table 2). This value is within the range of values reported for tropical goats (Payne and Wilson, 1999).

The analysis of variance showed that annual kidding rate was affected ($p < 0.001$) by birth type and season of birth. Does that gave twin births had larger annual kidding rate. Similarly, does kidded in the hot season had better kidding rate followed by those delivered in the wet season. It is stated in the literature (Payne and Wilson, 1999), that the time of mating has an important effect in the annual reproductive rate especially where intra-year climatic variations are great and there are likely to be periods of plenty alternating with periods of deficit.

CONCLUSION

The current study depicts that central highland goats perform lower than most Ethiopian and tropical goats. Different fixed effects affected the reproductive traits considered. The effect of season on most of the traits indicates the need for supplementation of does during the dry season when the grazing condition is very poor.

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REFERENCES

- Ayalew, W., 2000. Do Smallholder farmers benefit more from crossbred (Somali x Anglo-Nubian) than from indigenous goats? Ph.D. Thesis, Georg-August University of Göttingen.
- Bushara, I., O.M.A. Abdelhadi, M.B. Elemam, A.O. Idris and D.M. Mekki *et al.*, 2013. Effect of Season of Birth and Litter Size on Taggar Goat's Production in Western Sudan. Wudpecker J. Agric. Res., 2: 128-133.

- CSA, 2012. Agricultural sample survey. Report on Area, Production and Yield of Meher Season Crops for Private Peasant Holdings. Statistical Bulletin 505, CSA, Addis Ababa, Ethiopia.
- Dadi, H., G. Duguma, B. Shelima, T. Fayera, M. Tadesse, T. Woldu and T.A. Tucho, 2008. Non-genetic factors influencing post-weaning growth and reproductive performances of Arsi-Bale goats. *Livestock Res. Rural Dev.*, Vol. 20.
- ESGPIP, 2008. Ethiopia Sheep and Goat Productivity Improvement Program. In: Sheep and Goat Production Handbook for Ethiopia, Yami, A. and R.C. Merkel (Eds.). Brana Printing Press, Addis Ababa, Ethiopia, pp: 5-26.
- Fahmy, H.H., 1990. The accumulative effect of Finn sheep breeding in crossbreeding schemes: ewe productivity under an accelerated lambing system. *Can. J. Anim. Sci.*, 70: 967-971.
- FARM-Africa, 1996. Goat Types of Ethiopia and Eritrea: Physical Description and Management Systems. FARM-Africa, London, UK.
- Hassan, M.M., S.N. Mahmud, S.A. Islam and O.F. Miazi, 2007. A comparative study on reproductive performance and productivity of the Black Bengal and Crossbred goat at Atrai, Bangladesh. *Univ. J. Zool. Rajshahi Univ.*, 26: 55-57.
- Hossain, S.M.J., N. Sultana, M.R. Alam and M.R. Hasnath, 2004. Reproductive and productive performance of Black Bengal goat under semi-intensive management. *J. Biological Sci.*, 4: 537-541.
- Matika, O., J.B. van Wyk, G.J. Erasmus and R.L. Baker, 2003. A description of growth, carcass and reproductive traits of Sabi sheep in Zimbabwe. *Small Rumin. Res.*, 48: 119-126.
- Mellado, M., R. Valdez, J.E. Garcia, R. Lopez and A. Rodriguez, 2006. Factors affecting the reproductive performance of goats under intensive conditions in a hot arid environment. *Small Rumin. Res.*, 63: 110-118.
- Moaeen-Ud-Din, M., L.G. Yand, S.L. Chen, Z.R. Zhang, J.Z. Xiao, Q.Y. Wen and M. Dai, 2008. Reproductive performance of Matou goat under sub-tropical monsoonal climate of central China. *Trop. Health Prod.*, 40: 17-23.
- Payne, W.J.A. and R.T. Wilson, 1999. *An Introduction to Animal Husbandry in the Tropics*. 5th Edn., Oxford, Blackwell Science, USA., ISBN: 9780632041930 Pages: 815.
- SAS, 2003. *Statistical Analysis. SAS user's Guide, Statistic*. SAS Institute Inc., Cary, North Carolina, USA.
- Tatek, W., D. Hailu, G. Mieso, and G. Dadi, 2004. Productivity of Arsi Bale goat types under farmers management condition: A case of Arsi Negelle. *Proceedings of the 13th annual conference of the Ethiopian Society of Animal Production, August 25-27, 2004, Addis Ababa, Ethiopia*, pp: 67-71.
- Tesfaye, G., L. Sisay, T. Dereje, M. Abebe and G. Solomon, 2006. Growth and reproductive performance of central highland goats in North Shoa and South Wollo. *Proceeding of the 1st Annual Conference on Completed Livestock Research Activity, August 14-17, 2006, Amhara Region Agriculture Research Institute, Bhar Dar, Ethiopia*.
- Zelalem, A. and I.C. Fletcher, 1993. Small ruminant productivity in the central Ethiopia mixed farming systems. *Proceedings of the 4th National Livestock Improvement Conference, November 13-15, 1991, Addis Ababa, Ethiopia*, pp: 73-78.
- Zeshmarani, S., K.C. Dhara, A.K. Samanta, R. Samanta and S.C. Majumder, 2007. Reproductive performance of goats in Eastern and North-Eastern India. *Livestock Res. Rural Dev.*, Vol. 19.