Study of Productive, Reproductive and Morphological Traits of Bucks in Different Eco-zones of Lumbini Province, Nepal

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ABSTRACT

Goat is a domesticated small ruminant, primarily reared by small farmers for meat production, across the country. The productivity of goat is often low, which could be related to several genetic and non-genetic factors. A field study was carried out to characterize, evaluate and estimate the effect of non-genetic factors on the productive and reproductive performance of hill goats in different eco-zones at Rolpa district of Lumbini province. Altogether 43 bucks of different age groups were identified for this study. Morphological attributes, productive, and reproductive performance were collected based on field monitoring and measurements within different altitudes of Rolpa district. Least square analysis was performed using Harvey (1990) computer software package, and means were compared using DMRT. The measurements of morphological traits were higher in male as compared to females. Results revealed the age at first service of bucks (336 days), the average body weight of buck was (38.76 kg), the overall body length of buck from one to four year was 78.01±0.35 cm, overall heart girth of one to four years' age buck was 77.57±1.65 cm, average wither height from one to four-year-old buck was 71.88±2.13 cm, overall average Scrotal circumference of bucks (1-4 years) were 24.38±0.71 cm respectively. The results of this study suggest that the performance of low-altitude goat flocks was better than mid and high-altitude goat flocks in the Rolpa district in terms of production and reproduction traits. The selection of the best performance of buck could be done on the basis of their traits for breeding. This result could be attributed to superior genotype along with better management practices followed by the farmers in Rolpa district.

Keywords: *Buck, Weight, breed, genetic*

INTRODUCTION

Nepal is an agricultural country where about 66 percent of its population is involved in agricultural occupation. Agriculture contributes to around 27.1 percent of the gross domestic product (GDP) of Nepal, of which, the livestock sector contributes about 11.5

percent of the total GDP and 25.7 percent of the agricultural GDP (AGDP) as reported by MOAD (2018). Goat farming is being the most popular means of self-employment among the youths in the country. Current statistics regarding to goat population indicated that there are more than 11.64 million of goats in the country (MOAD, 2018). Among the agricultural commodities, livestock plays an important role in agricultural development and economic upliftment of the country. Goat farming has been practiced by a large section of population in rural areas of Nepal. The recent population of goat is about 11.64 million and total meat contribution was 6.9 thousand metric ton per year (MOALD, 2018). The rate of increment in goat population during last 15 years (2008 to 2018) was reported 3.74 percent per year contributing about 20.1% to the total meat production in the country (MOALD, 2018). Goats breed in Nepal are quite different with locational difference. There are gradients of topography, environment and climatic conditions vary from South to North, and each breed evolved is acclimatized corresponding to each topographical zone (Pradhan and Gurung1985). In Nepal, there are four commonly documented breed of goats as Chyangra, Sinhal, Khari and Terai goats. Chyangra goats are found in 2400 meters in high Himalayans, while Sinhal found in high hill ranging 1500-3000 meters from sea level. Khari are available across the hills of Nepal while Terai goats are available in Terai region of Nepal. Chyangra (1%), Sinhal (16%), Khari/hill goat (56%) and remaining 27% are of Terai and other breeds (Pokharel and Neopane, 2008).

MATERIALS AND METHODS

This section deals with the site of study, data collection and recording procedures, data analysis techniques, description of data sets and models used for analyzing the recorded traits.

Location of the study

This study was carried out in Rolpa district of Lumbini province. Rolpa covers an area of 1,879 km² with population (2016) of 221,177. Rolpa is drained southward by the Madi River from a complex of 3,000 to 4,000 meter ridges about 50 kilometers south of the Dhaulagiri Himalaya (Statoids, 2014). The Rolpa district lies at the height of 701m to 3639 meters above the sea level. The total area is 189385 hectares out of which 59854.5 hectares land is used for crop farming, forest consists 84474 hectares, pasture consists 32698.8 hectare, wild plants and forages 9620.8 hectare and rivers and rocks 1251.9 hectares. The average temperature in Rolpa district is maximum (31.2 Celsius), minimum (3.6 Celsius) and annual rainfall is 441mm (CBS, 2016)

Sampling procedure and sample size

The datas were collected on the basis of Pocket areas of goats distributed within different altitude at Rolpa district. The selected high altitude VDCS were (Jaimakshala and

Pakhapani) followed by mid altitude VDCS (Gairigaun and Libang) and low altitude VDCS (Masina and Jhenam). The elevations of high, mid and low altitude from the sea level in Rolpa district are at the range of 3639, 1375 and 701 m respectively. The elevation of selected areas for this research low, mid and high altitudes were 800-1000, 1200-1400 and 1500-1800 m respectively from the sea level. The two wards were selected from each VDCS. From each ward buck reproductive and productive parameters were recorded. The productive parameters include bucks were body weight, wither height, body length, heart girth, Scrotal circumference length etc. The reproductive parameters of buck age at first mating (puberty) etc. Within the population, in each selected site, sampling goats were identified randomly. A data recording format was developed to collect data and information related to growth performance, reproductive performance, litter traits, morphological traits and production system of hill goats reared in the study area.

Statistical analysis

Collected data were entered in the computer using MS- Excel and converted into text documents i.e. Text (MS-DOS). To study the main causes of variation and effects of non-genetic factors on productive and reproductive traits, as well as to overcome the difficulty of disproportionate subclass numbers, data were analyzed by least squares procedure using Harvey, (1990) which is based on least squares technique of variance analysis. The pair wise comparison of the least square mean comparison was made using DMRT (Duncan's Multiple Range Test) (Duncan, 1955) as modified by Kramer (1957).

Models used to analyze the collected data

A fixed effect model given by Handerson (1953) was used to analyze the body weights of male goat at different stages of growth.

Model I (fixed effect model) for buck weight, body measurements and reproductive traits

$$Y_{ijklmn} = \mu + a_i + b_j + c_k + d_l + e_{ijklmn}$$

Where, μ is the overall mean

a_i is the effect of i^{th} altitude (i=1,2 and 3)

b_j is the effect of j^{th} type of breed (j = 1 ,2and 3)

c_k is the effect of k^{th} type of colour (l= 1,2,3and 4)

d_l is the effect of age (k= 1,2,3 and 4)

e_{ijkl} is the random element assumed (error mean) to be normally and independently distributed among the sampled population.

RESULTS AND DISCUSSION

This chapter describes the study results focusing to the growth performance, morphological traits, reproductive traits as well as production systems of goats.

Body weight of bucks

The overall average body weight of buck was 38.76±0.35 kg as mentioned in detail Table (1). The data were collected and analyzed from one to four-year-old bucks. The bucks were also in crossed form like as does. Joshi *et al*. (2003) also reported Khari, Khapari and Khabari breed bucks were 28-40, 52±4.80, and 43.5±4.9 kg respectively. Various factors such as altitude color and age were considered in this study for the body weight of the bucks.

Table 1. Least square means for body weight (kg) of buck

Factors	LS±SE	NO	Significant Level
Overall	38.76 ±0.35	43	
Altitude			NS
LA	39.74±0.48	17	
MA	37.39±0.39	14	
HA	39.15±0.41	12	
Breed			**
Khari	35.68 ±0.55^{b}	29	
Khari dominent	37.29 ±1.04^{b}	8	
Jamunapari dominent	45.32 ±0.63^{a}	6	
Colour			NS
Black	40.78±0.66	27	
Brown	36.57±0.73	8	
Mixed	38.94±0.81	8	
Age			***
1Year	34.86 ±0.48^{c}	13	
2 Year	36.08 ±0.30^{c}	12	
3 Year	41.64 ±0.53^{b}	15	
4 Year	46.46 ±0.96^{a}	3	

Note: **significant at 1% (P<0.01) ***significant at 0.1% (P<0.001), NS-non significant, LS mean- Least square mean, SE- Standard error of mean. NO is the number of observations.

Body Length of buck

The overall body length of buck from one to four year was 78.01±0.35 cm. The various non- genetic factors affected the body length of buck in Rolpa district. The various factors affecting the body length of bucks are presented in the Table (2). The acute shortage of genetically superior buck throughout the country is one of the major constraints of goat production in Nepal. Existing haphazard breeding system may lead to the extinction of the genetic potential of goats which requires selection of superior buck. During selection

of buck attention should be given on the age, growth rate, body weight and soundness of the sexual organs and morphometric traits. In such case, body length and heart girth may be used as good reliable predictors to assess live weight (Islam *et al*., 1991).

Table 2. Least squares means for body length (cm) measurements of the bucks

Factors	LS±SE	NO	Significant Level
Overall	78.01 ±0.35	43	
Altitude			NS
LA	78.77±0.35	17	
MA	73.46±0.33	14	
HA	74.58±0.35	12	
Breed			NS
Khari	70.28±0.40	29	
Khari dominent	79.43±0.38	8	
Jamunapari dominent	71.28±0.45	6	
Colour			NS
Black	74.8±0.48	27	
Brown	79.07±0.53	8	
Mixed	75.05±0.58	8	
Age			***
1Year	63.60 ±0.33^{c}	13	
2 Year	70.89 ±0.38^{b}	12	
3 Year	79.54 ±0.32^{a}	15	
4 Year	81.39 ±1.80^{a}	3	

Note: ***significant at 0.1% (P<0.001), NS-non significant, LSD-Least significant difference, LS mean- Least square mean, SE- Standard error of mean. NO are the numbers of observations.

Heart girth of buck

The overall heart girth of one to four years' age buck was 77.57±1.65 cm. The various factors affecting the heart girth of buck are presented in Table (3). The acute shortage of genetically superior buck throughout the country is one of the major constraint of goat production in Nepal. Existing haphazard breeding system may lead to the extinction of the genetic potential of goats which requires selection of superior buck. During selection of buck attention should be given on the age, growth rate, body weight and soundness of the sexual organs and morphometric traits. In such case, body length and heart girth may be used as good reliable predictors to assess live weight (Islam *et al*., 1991). The present investigation was designed to obtain some basic morphometric information and to relate body weight with different body measurements of goats.

Table 3. Least square means for heart girth (cm) of buck

Factors	LS±SE	NO	Significant Level
Overall	77.57 ±1.65	43	
Altitude			NS
LA	78.30.±2.28	17	
MA	77.19±2.20	14	
HA	77.24±2.29	12	
Breed			*
Khari	77.86 ±0.25^{b}	29	
Khari dominent	80.46 ±0.48^{a}	8	
Jamunapari dominent	81.35 ±0.27^{a}	6	
Colour			NS
Black	77.97±0.30	27	
Brown	76.07±0.33	8	
Mixed	78.66±0.35	8	
Age			**
1Year	68.65 ±2.23^{c}	13	
2 Year	76.12 ±2.48^{b}	12	
3 Year	82.55 ±2.51^{a}	15	
4 Year	82.95 ±1.67^{a}	3	

Note: * significant at 5% (P<0.05), **significant at 1% (P<0.01), NS-non significant, LSD-Least significant difference, LS mean- Least square mean, SE- Standard error of mean. NO is the number of observations.

Buck wither height

The average wither height from one to four-year-old buck was 71.88±2.13 cm in this study. The various factors affecting the wither height from one to four-year-old bucks are presented in the Table (4). During selection of buck attention should be given on the age, growth rate, body weight and soundness of the sexual organs and morphometric traits. In such case, body length, wither height and heart girth may be used as good reliable predictors to assess live weight (Islam *et al*., 1991). The present investigation was designed to obtain some basic morphometric information and to relate body weight with different body measurements of goats.

Table 4. Least squares means for wither height (cm) of bucks

Factors	LS±SE	NO	Significant Level
Overall	71.88 ±2.13	43	
Altitude			NS
LA	71.67±0.53	17	

MA	71.47±0.68	14	
HA	72.99±0.96	12	
Breed			**
Khari	71.51 ±0.83[b]	29	
Khari dominent	78.44 ±1.52[a]	8	
Jamunapari dominent	74.19 ±0.88[ab]	6	
Colour			NS
Black	74.32±2.43	27	
Brown	72.72±1.09	8	
Mixed	69.11±1.21	8	
Age			NS
1Year	63.65±0.68	13	
2 Year	72.79±0.76	12	
3 Year	73.20±0.73	15	
4 Year	78.58±1.37	3	

Note: **significant at 1% (P<0.01), NS-non significant, LSD-Least significant difference, LS mean- Least square mean, SE- Standard error of mean. NO is the number of observations.

Scrotal circumferences of buck

The overall average scrotal circumference of bucks (1-4 years) were 24.38±0.71 cm as mentioned in Table (5). Testicular sizes of animals are important for identification of those with adequate sperm production. Abba et al. (2015) observed scrotal circumference (17.00 –21.80) cm in Nigerian goats. Bezerra *et al*. (2009) also reported scrotal circumference of Boers goats on average 7.9 ± 0.8 to 25.7 ± 2 cm in Brazil. This is the maximum dimension around the pendulous scrotum after pushing the testes firmly into the scrotum (Akpa *et al*., 2010). Raji *et al*. (2008) reported 23.17cm for Red Sokoto bucks at 2 years of age. These are higher than that of the present study at similar age group. Higher results had also been reported by Keith *et al.* (2009) and Mekasha *et al*. (2008). However, similar to what is obtained in the present study was the results of Ugwu (2009) who reported 17.25 ± 0.76 cm in west African dwarf. The variability may be due to breed difference, contemporary group level, age, weight and height of bucks (Bourdon and Brinks, 1986). Kabiraj *et al*. (2011) also reported that Scrotal Circumference for 0.5 to 1.0,1.5 to 2.0 and 2.5 to 3.0 years were 17.50±0.65, 21.38±0.43 and 22.88±0.66 respectively. These values were higher than those obtained in this current study. This is probably as a result of breed difference, differences in the age and number of bucks, dam's age at first breeding and rate of rebreeding as well as the general body size of the bucks. The SC was measured according to the method of Coulter and Foote (1979). The testes were first retracted into the lower part of the scrotum for measurement of the SC. In order to prevent the two testes from separation, the thumb and finger were placed on the sides rather than the front or

back of the scrotum. Then a flexible measuring tape was looped and placed around the greatest diameter of the scrotum and pulled so that the tape was firmly in contact with the entire circumference. The scrotal circumference is important traits considering in context of breeding of bucks.

Table 5. Least square means of Scrotal circumference (cm) of buck

Factors	LS±SE	NO	Significant Level
Overall	24.38 ±0.71	43	
Altitude			NS
LA	24.91±2.43	17	
MA	23.41±2.36	14	
HA	24.81±2.43	12	
Breed			NS
Khari	24.13±1.11	29	
Khari dominent	23.19±2.05	8	
Jamunapari dominent	25.73±1.24	6	
Colour			NS
Black	24.66±1.32	27	
Brown	25.09±1.44	8	
Mixed	23.39±1.60	8	
Age			NS
1Year	22.63±0.93	13	
2 Year	24.33±1.90	12	
3 Year	25.14±1.04	15	
4 Year	25.45±1.06	3	

Note: NS-non significant, LS mean- Least square mean, LSD-Least significant difference, SE- Standard error of mean. N0 are the number of observations.

Age of First service of buck

The overall age of buck during first service at Rolpa district is 336.93±1.04 days. Male goats up to 12 months of age are sometimes referred to as "buckling." Adult male goats can weigh anywhere between 100 to 350 pounds, depending on their breed, health and nutritional status. Although they can come into puberty and breed does as early at 4 months of age, waiting until a buck is a year of age to start using him for breeding is best. The number of does a buck can breed during the breeding season is often referred to as "Buck Power" (Noble, 2004). The sexual behavior of goats is an important factor for flock breeding efficiency and productivity in goat farming. Male fertility is a vital issue because numerous does are generally mated to a single buck. On the other hand, if sexual behaviors are expressed and semen is collected at earlier ages, these could be used in breeding programs to shorten the generation interval. Therefore, evaluation of male fertility using a serving capacity test prior to mating is good practice to reach breeding success. In goat bucks, courting (latency and amount of courting anogenital

sniffing, vocalization, nudging, and flehmen) and copulatory (mounting and ejaculation) behaviors are evaluated using a sexual performance test that is part of a serving capacity test (Darwish and Mahboub 2011). The various factors affecting age of first service of buck are presented in Table(6).

Table 6. Least square means for Age (days) of first service of Buck

Factors	LS±SE	NO	Significant Level
Overall	336.93 ±1.04	43	
Altitude			NS
LA	321.90±1.44	17	
MA	334.80±1.39	14	
HA	344.54±1.49	12	
Breed			NS
Khari	306.49±1.67	29	
Khari dominent	361.89±0.30	8	
Jamunapari dominent	340.85±1.85	6	
Colour			NS
Black	346.98±1.98	27	
Brown	307.71±2.13	8	
Mixed	355.19±2.38	8	
Age			NS
1Year	316.84±1.39	13	
2 Year	324.15±1.57	12	
3 Year	356.71±1.67	15	
4 Year	350.02±0.27	3	

Note: NS-non significant, LS mean- Least square mean, LSD-Least significant difference, SE- Standard error of mean. NO are the numbers of observations.

DISCUSSION

This study was designed to characterize and evaluate the productive and reproductive performance of hill goat reared under farmers' condition in Rolpa district of Nepal during December, 2015 to July 2016. The other objectives were to study the effect of non-genetic factors like altitude, colour, age, sex, parity etc in relation to the existing goat production system. Periodic observations on morphological traits, productive and reproductive performance were measured and recorded. The high altitudes VDCS were (Jhamksala and Pakhapani) followed by mid altitude VDCS (Gairigaun and Libang) and finally to low altitude VDCS (Masina and Jhenam). The elevation of selected high, mid and low altitude from the sea level in this research is at the range of 3639, 1375, 701 m respectively. The elevation of selected goat pocket areas for this research at low, mid,

high altitudes were 800-1000, 1200-1400, 1500-1800 m respectively from the sea level. The two wards were selected from each VDCS. There were three recognized breeds Khari, Khapari (Khari*Jamunapari) and Khabari (Khari*Barbari). However, Chyangra, Boers and Terai crosses were also observed in a few numbers. The data of 43 bucks were collected from different altitudes of Rolpa districts. The numbers of kids above five months' age were found in less number during data collection. So, they were not analyzed in this research. Farmers and technicians claimed the selected goats of being pure Khari, (Khari and Jamunapari) 50% cross breed and (Khari and Barbari) 50% cross breed. The bucks were also found in cross type genetically. However, characterization of such breeds at molecular level was not carried at Rolpa district. So, it could not be understood so far their DNA level.

Morphological attributes, productive, and reproductive performance were collected based on field monitoring and measurements. Least square analysis was performed using Harvey (1990) computer software package. Information on goat production systems were collected by employing a semi-structured questionnaire and analyzed using SPSS.

The data of bucks were collected from (1-4) years age. The overall mean body weights of bucks were 38.76±0.35 kg. Body weight of buck differ significantly ($P<0.001$) within ages and also differ significantly ($P<0.01$) within breed. Khabari buck body weight (45.32±0.63 kg) was significantly higher ($P<0.01$) than that of Khari buck (35.68±0.55 kg) and Khapari (37.29±1.04 kg) bucks.

The mean age of first service of buck was 336.93±1.04 days The overall mean for wither height of bucks were 71.88±2.13 cm. Wither height of buck differed significantly ($P<0.01$) within breed. The overall mean for body length of bucks were 78.01±0.35 cm. Body length of bucks differed significantly ($P<0.001$) with respect to ages. The overall mean for heart girth of buck were 77.57±1.65 cm. Heart girth of buck differed significantly ($P<0.01$) with respect to ages, and also significant ($P<0.05$) within breed. The overall mean for scrotal circumference of bucks were 24.38±0.71 cm. Goat farming was practiced as a subsistence occupation with three distinct systems of feeding i.e. extensive grazing, stall feeding, and grazing plus stall feeding supplementing little maize grains and flour as per availability. Majority of the farmers depended on the community forest as well as on their own farmland for collecting fodder and forages. Major problems of goat farming in Rolpa district were occurrence of epidemic disease, lack of veterinary and technical advice, and attack of wild animal. Thus the results of this study suggest that the performance of low altitude goat flocks was better than mid and high altitude goat flocks in Rolpa district in terms of production and reproduction traits. The selection of the best performance of bucks could be done to obtain higher weight and production of offspring at later stages. This result could be attributed to superior genotype along with better management practices followed by the farmers in Rolpa district.

CONCLUSION

The selection of the best performance of male kids could be done on the basis of both birth and weaning weights to obtain higher weight at later stages. The best kid could be selected as buck for breeding. This result could be attributed to superior genotype along with better management practices followed by the farmers in Rolpa district.

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