

# Factors Affecting Productive and Reproductive Traits of Indigenous Goats in Nepal

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## Research Article

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## Abstract

This is a review article to document the available literature on the effects of non-genetic factors on productive and reproductive traits of indigenous goats in Nepal. The review included journal articles, published reports, technical bulletins, post-graduate and doctoral dissertation. Scientific information regarding the factors affecting the productive and reproductive performance of goats is important in relation to developing the production and productivity improvement plans. This is a review article to document available literature one present study aims at reviewing the effects of non-genetic factors on productive and reproductive traits of indigenous goats in Nepal. The review included study was based on the review of available scientific literature including research journal articles, published reports, technical bulletins, post-graduate and doctoral dissertation. The study revealed that showed that altitude, season of conception, season of kidding, number of kids at birth, parity, size of doe are the major factors affecting productive and reproductive traits of indigenous goats of Nepal. These factors should be carefully, and such factors must be considered carefully to promote the indigenous goat production in commercial scale farming level.

## Introduction

Livestock is an integral part of Crop-livestock mixed farming systems the agricultural production system in Nepal, where, goat (*Capra hircus*) has been occupies a special position for mixed and subsistence farming. Recently, the goat has been recognized as the most important livestock species commodity for poverty reduction, livelihood enhancement, and food and nutritional security for smallholder farmers in Nepal of Nepal. Popularity of goat farming is increasing as it contributes Wide utility of goat for meat, milk, manure, leather and draft power as pack animals in the mountainous region has made it popular in the rural areas of Nepal. Demand for goat meat especially during religious festival (Along with it, religious importance of goat during major festivals like Dashain) significantly increases and high value of goat meat has made a large number of peoples to fetch higher prices involved in the production, slaughtering, processing, and trading of the goat and goat products. Also, goat occupies the highest population among the total livestock population of Nepal. In the year 2015/16, the population of the goat was estimated at 1.5 times of cattle, 2.12 times of buffalo, 13.72 times of sheep and 8.5 times of pigs). The average annual increment in goat population in year 2015/16 is about 7% [1].

High market price of goat meat, low initial investment and prolificacy of goats, goat farming Owing to the high market value and fast reproductive characteristics, goat farming is gaining popularity in Nepal. Besides this, low investment and multi-utility of products like meat and milk have made it a profitable business. It has been reported that about 86% of meat demand is fulfilled by domestic production [2]. Though it seems to be a growing business, there has not been major uptake of lack of commercial farming in practices has been seen as a hindrance, in the rural area of Nepal. Nepali et al.

[3] revealed that the most important technologies in goat farming and available goat technology include; y are breeds, reproduction, nutrition and feeding strategies, technology, health care and farm technology, management. technology and feed and nutrition technology, among which the health technology is the one causing greater hazard in goat populations in the hills. Due to weak extension/outreach services, and awareness of these technologies, goat farmers do not have Lack of awareness, knowledge, and access to access to these technologies are the hindrance to are the major constraint to efficient goat farming system. Similarly, the absence of a proper breeding plans, proper feeding strategies, under-nutrition, inbreeding and poor hygiene are common and is still widespread in the rural goat village production systems [4]. It has been reported that as well as the environmental condition and management of goat rearing habit of goat have significant impact on control the reproductive and the productive successes. traits of the goat. Kolachhapati et al. [5] reported that the important economic trait of goat which includes productive traits like birth weight, weaning, and post-weaning weight and reproductive traits: age of the first conception, first kidding, gestation length, kidding interval; and litter traits such as litter size and weight at birth and weaning vary greatly due to according to the non-genetic/environmental factors. Such factors include the season of year of kidding, parity, the season of kidding, dam's parity, sex of kids, birth type, and altitude location. This review paper describes aims to point the factors out all such factors affecting the productive and reproductive traits of the indigenous goat of Nepal.

## Materials and Methods

This review includes; Several journals, proceedings, research reports, technical bulletins, master and Ph. theses related to the productive and reproductive traits of goat specifically focused on Nepalese indigenous goats were reviewed. The findings were analyzed and correlated to determine the factors affecting the productive and reproductive traits of indigenous goats of Nepal.

## Major Findings

### Reproductive traits

The reproductive trait is fitness trait concerned with reproduction and viability. It includes litter size, conception rate, calving interval, gestation length, survival ability, etc. The reproductive trait varies with several factors. Some of the important factors affecting the reproductive traits are the breed of goat, the location of rearing, the season of conception, the season of kidding, dam's birth type, the age of kidding and health care and nutrition.

### Effect of breed

Results revealed that reproductive characteristics of goat vary with its breed type as reported by several authors. Accordingly, Shrestha and Pokharel [6] reported that the average ages at first kidding of Khari and Terai goats are 480 and 450 days respectively, while that of Sinhal and Chyangra is 720 days. However, Neopane and Pokharel [7] reported the age of first kidding of Khari, Terai, Sinhal and Chyangra to be  $453 \pm 6.2$ ,  $491 \pm 5.1$ ,  $576 \pm 9.8$  and  $555 \pm 9.6$  days respectively. Similarly, Shrestha and Pokharel [6] reported that the kidding intervals for Khari and Terai goats are 270 and 225 days and that for Sinhal and Chyangra is 365 days. However, Neopane and Pokharel [7] reported that the kidding interval for Khari, Terai, Sinhal and Chyangra to be  $302 \pm 3.7$ ,  $336 \pm 4.2$ ,  $287 \pm 5.4$  and  $354 \pm 8.7$  days respectively. According to Shrestha and Pokharel [6] take the longest time to reach the age of first kidding and also has longest kidding interval. However, Neopane and Pokharel [7] revealed that Sinhal takes the longest time to reach the age of first kidding and Chyangra has the longest kidding interval.

### Effect of location

The location has been considered as the important factor affecting the first conception, kidding, postpartum estrus, gestation length, and productive traits as well. Kolachhapati and Devkota [5] reported that goats reared in valleys and inner Terai region of Nepal (including Chitwan, Nawalparasi, Surkhet, Kavre and Tanahun districts) have an outstanding level of growth performance as exotic breed Jamunapari and were as efficient in reproductive performance as indigenous breed Khari. Similarly, a study carried out in mid hills (Syangja and Dhading districts of Nepal) and plains (Nawalparasi district of Nepal) showed that goats reared in Syangja has early conception ( $229.37 \pm 10.34$  days), kidding ( $380.57 \pm 10.66$  days), higher kidding rate Syangja ( $1.77 \pm 0.06$ ), short kidding interval ( $253.93 \pm 10.21$  days) and short postpartum estrus 89 days than the hill goats reared in Nawalparasi and Dhading [8]. Though both Dhading (1339 m) and Syangja (1261 m) lies in mid hill region, the significant difference in reproductive traits may be because of altitude difference in the particular study area. Also, better nutrition and light condition may be the cause of greater reproductive efficiency in Syangja. However, a study carried out in Nawalparasi in Khari goat showed shorter gestation length of goat reared in lower altitude ( $150.76 \pm 0.84$ ) than those reared in upper altitude ( $152.32 \pm 0.85$  days) [9-12]. However, Sharma et al. [8,9] reported that location has a non-significant effect on gestation length.

### **Effect of season of conception**

The season during which the goat is conceived is of great importance in determining the reproductive trait of the indigenous goat of Nepal. Parajuli et al. [10] revealed that does born from dams conceived during summer attain earlier sexual maturity ( $258.24 \pm 2.07$  days) and first kidding ( $409.03 \pm 2.09$  days) than those conceived in winter ( $261 \pm 2.05$ ) and ( $413.03 \pm 2.09$ ) days respectively. Authors reported that gestation length, kidding, and postpartum estrus insignificantly varies with the season of conception. Shorter gestation length ( $150.79 \pm 0.35$ ), lower kidding interval ( $201.00 \pm 1.02$  days), and shorter postpartum interval ( $50.25 \pm 0.35$  days) was found for does conceive during the summer season. It might be because the does conceive during summer season gets relatively abundant nutritious fodder and forage which leads to the faster and proper growth of the fetus.

### **Effect of season of kidding**

As the season of conception, the season of kidding is also of high importance for the reproductive trait. Parajuli et al. [10] reported that summer season born kids attain earlier sexual maturity ( $253.05 \pm 4.97$  days) than winter born kids ( $257.31 \pm 4.74$  days). Authors revealed that gestation length, age of kidding and postpartum estrus insignificantly vary with season of kidding. Shorter gestation length ( $150.49 \pm 0.85$ ), earlier the age at first kidding ( $401.54 \pm 5.02$  days) and longer postpartum estrus interval ( $50.54 \pm 0.85$ ) was seen in summer born kids. Availability of sufficient green fodder during summer causes early sexual maturity of does, which causes active secretion of reproductive hormones and shorter gestation lengths during summer.

### **Effect of dam's birth type**

Single and multiple born dam have significantly different reproductive traits. The dam's born in single birth type conceive earlier ( $247.79 \pm 4.74$  days), has earlier first kidding ( $403.81 \pm 4.79$  days), shorter gestation length ( $150.01 \pm 0.81$  days), lower kidding interval ( $185.16 \pm 2.33$  days), and shorter post-partum interval ( $43.81 \pm 0.81$  days) than multiple born. However, the traits like the age of conception, kidding and gestation length insignificantly vary with the effect of dam's birth type. Multiple born kids struggle for food and survive under stress condition since the mother has to share the food among many kids, while the single born kids get proper nourishment which helps for earlier maturation of reproductive organs [10-12].

### **Effect of parity**

Insignificant variation of parity on gestation length and kidding interval is reported by Parajuli et al. [10-12]. Authors dictate that third and fourth parity of hill goat have longer gestation length ( $152.48 \pm 0.81$  days) and lower kidding interval ( $196.10 \pm 2.35$  days) as compared to those of other parity. Similarly, a nonsignificant effect of parity on kidding interval, gestation length was reported by Sharma et al. [8]. However, a significant effect of parity was reported for postpartum estrus and kidding rate. Shorter gestation length at increase in parity are because of full maturity and efficient function of the uterus. The days of postpartum estrus interval is reported to increase from first parity (48.99 days) up to seventh parity ( $52.78 \pm 0.86$  days) [10-12].

### **Effect of age of kidding**

Shrestha [13] reported that lower the age at first kidding and kidding interval, the better is the lifetime production of the goats. Similar findings were reported by Mioč et al. [14]. These authors reported that goats kidding early in the year had better milking performances i. longer lactation period, higher milk yield and higher content of milk fat, than goats kidding in the spring.

### **Effect of health care and nutrition**

Healthcare and nutrition can significantly affect the reproductive traits. Balanced ration can improve the reproductive efficiency of female kids in terms of early conception, litter size and life time productivity [15]. Kolachhapati [16], found that first conception and kidding could be reduced by about 5-6 months and the number of kids per kidding could be increased up to 2.05 with a minimum provision of health care and nutrition. Study on stall feeding of goat conducted in Pakhribas, showed better result for early sexual maturity and efficiency of goat in terms of early conception [17]. Shrestha and Pokharel [6] reported that feeding of maize and mineral mixture accordingly in line with treatment groups and deworming the goat results in healthier goats with glossy hair coat, reduced kidding interval (two kidding within 14 months), reduced kid mortality and makes healthy kids with sufficient milk from the doe were produced. Similarly, selenium administration in does before and after parturition shows improved fertility and minimizes the reproductive failure [6].

## Production traits

Production traits include meat and milk yield, growth rate, feed efficiency and weaning weight. The growth rate of goat varies with breed type, location, the season of conception, the season of kidding, feed intake, sex, birth type, age, parity and size of doe.

## Effect of breed

Shrestha and Pokharel [6] revealed that weight gain trait is largely influenced by the genetic makeup of animal. Among the four indigenous goat breeds, Sinhal was reported to be the heaviest breed, followed by Khari and Terai respectively. Neopane and Pokharel [7] reported that weight gain from birth to weaning, from weaning to six month, six to nine month and nine to twelve is highest for Terai goat (9.2 kg), Chyangra (2.3 kg), Terai (4.3 kg) and Sinhal (7.3 kg) respectively. But Shrestha and Pokharel [6] reported that weight gain from birth to four month, four to six month, six to nine month and nine to twelve months is highest for Sinhal goat (9.35 kg), Khari (3.45 kg and 4.21 kg) and Sinhal (4.71 kg) respectively. The variation in the body weight of different breed of goat is attributed by the genetic makeup of the goat (**Table 1**).

**Table 1.** Weight gain of goat breed during different age.

	Kha ri	Sinhal	Terai	Chyangra	Khari	Sinhal	Terai	Chyangra
Birth to four months	5.8 2	9.35	5.98	-	5.85	8.3	9.2	7.9
Four to six months	3.4 5	6	2.06	-	1.3	1	1.2	2.3
Six to nine months	4.2 1	2.81	1.85	-	3.6	3.8	4.3	2
Nine to twelve months	4.0 1	4.71	1.65	-	3.9	7.3	3.9	6.2

## Effect of location

Different study shown that location has great influence on the productive traits of goat. Accordingly, a study on kids of hill goat carried out in Nawalparasi district, showed that goat reared in lower altitude has higher weight from birth to weaning than those reared in lower altitude [18]. Similarly, study on Khari goats in Nawalparasi showed that there is nonsignificant effect of altitude on birth weight but the weaning weight in lower altitude was significantly greater than that of higher altitude [18]. However, Parajuli et al. [10] revealed that goats reared in upper altitude has higher preweaning weight ( $6.97 \pm 0.46$ ) than those compared lower altitude ( $5.70 \pm 0.47$ ) and nonsignificant effect of location on weaning weight. Similarly, Bhattacharai et al. [18] reported higher weight gain from nine to fifteen month in upper altitude than those born in lower altitude. Similar results were revealed by Parajuli et al. [10] for weight gain from six to nine month and nine to fifteen months. Authors also reveal that, birth weight and preweaning weight of kids was 8% and 22% higher than goats reared in lower altitude. Weather condition and availability of nutritious fodder in lower altitude affect the average daily weight gain [18]. Similarly, different results on body weight of goat was reported from different regions of Nepal. Higher adult body weight of Khari goats from mid-western region ( $38.6 \pm 0.8$  kg) have been reported compared to the Khari goats from central ( $31.8 \pm 0.8$  g) and eastern region ( $27.7 \pm 0.8$  g) [6].

## Effect of season of conception

Based on season of conception, indigenous Nepali goats show different productive traits. Kids born from does conceived during rainy season are heavier than those of autumn, winter and spring season. Season of conception significantly affect preweaning weight of goat [18]. Similarly, study on Khari goats in Nawalparasi showed that does conceived during rainy season has higher birth and weaning weight than does conceived in autumn, spring and winter [11]. Parajuli et al. [10] report nonsignificant effect of season of conception on birth weight, but significantly effect on pre and post weaning weight and weaning weight. Authors report kids born from the dams conceived during summer season were heavier compared to those kids born from dams conceived during winter season. Higher weight of summer season conceived kids is because of more availability of better nutrition to the doe during summer season.

## Effect of season of kidding

Pre-weaning average daily weight gain is significantly influenced by the season of kidding, whereas gain at the period weaning to nine months and nine months to fifteen months is not varied significantly with season of kidding. Highest pre-

weaning average daily gain was observed for the kids born during winter season ( $60.83 \pm 1.94$ ) followed by those born during spring ( $58.93 \pm 1.99$ ), autumn ( $55.64 \pm 2.02$ ) and rainy ( $54.73 \pm 3.63$ ) [18]. Also, study on Khari goat in Nawalparasi showed highest birth weight of kids born in rainy season. However, high weaning weight of kids was found for those born in winter season [11]. But Parajuli et al. [10] reported a non-significant effect of season of kidding on birth weight, weaning weight, six-month weight and nine-month weight. Also, the authors reported higher weaning weight for summer born kid ( $6.68 \pm 0.47$ ) than winter born kid ( $5.99 \pm 0.46$ ). This is because of the availability of green grasses and pastures during the summer seasons and the dam is able to provide greater amount and quality milk to the kids.

### **Effect of feed Intake**

Proper feed intake is essential to maintain a sound growth performance. Several authors have worked to find out the effect of feed intake on the productive trait of indigenous goat of Nepal. Shrestha and Pokharel [6] reveal the importance of proper nutrition to fully express the genetic potential. Therefore, proper and balanced feeding is essential to obtain an efficient weight gain. Growth performance study carried out on male goat kids showed a linkage between the quality aspect of feed and the higher growth rate and weight gain of goat. Supplementation of 14 to 16% CP content during the early growth of kids in grazing-based system is found to have positive effect on growth performance and weight gain [19]. Authors also report that feed conversion ratio per kg body weight gain was observed higher for forest mixed fodder (adlib) +commercial concentrate mixture @ 1.5% (22.49:1) similarly, Khanal [20] report that there is highest average daily weight gain/goat (81.7 gm) with feeding forages and concentrate 1% of body weight of goat followed by feeding forages with maize flour 1% of body weight of goat (76.2 gm) and the least (69.6 gm) in feeding only forages.

### **Effect of parity**

Kids born from does in a specific parity are proved to be efficient in terms of productive trait than those born from other parity. A study on Terai goat carried out in Siraha district showed significant effect of parity on post weaning weight gain at eight months [11]. Sapkota et al. [9] report that the most productive parity for goat is from third parity to fifth parity. The goat kids born of middle parity (d to h) has highest body weight due to fully developed reproductive system. But, Parajuli et al. [10] report nonsignificant effect of parity on birth weight, preweaning weight, weaning weight, weight at six month and weight at nine months. Bhattacharai et al. [11] reported non-significant effect of parity on the birth weight of Khari goat, whereas significant effect was reported for weaning weight. Goats of d to h parity were reported to gain highest weaning weight. Similarly, Bhattacharai et al. [18] reported that the kids born on early (t and d) and middle (d to h) parity of does showed higher weight gain from birth to weaning. However, weight gain from nine to fifteen months was found higher in the kids born in late parity of does. Author describes higher weight gain in the middle parity as a result of higher rate of ovulation resulting from well-developed reproductive system.

### **Effect of sex**

Males are generally heavier than females. Bhattacharai and Sapkota [9] reported significant effect of sex on post weaning weight at six month and eight months in Terai goat. Parajuli et al. [10] reported significant effect of sex on birth weight, pre-weaning weight, weaning weight, weight at six month and weight at nine months in hill goat. Similarly, significant effect of sex on weight gain from birth to weaning, weaning to nine month and nine to fifteen months was reported by Bhattacharai et al. [18]. The higher weight of males is attributed by the male sex hormone secreted from gonads which has anabolic effect. Besides the effect of male sex hormone, the aggressiveness nature of male during suckling and feeding is a reason for higher weight of males [21].

### **Effect of birth type**

Weight up to weaning is the function of birth weight and maternal ability. The kids born singly are heavier than multiple born kids because they get larger amount of milk from their dam and proper space during the fetus development. However, post weaning weight is largely dependent on management practices and nutrition availability [21-25]. Bhattacharai and Sapkota [9] reported significant effect of birth type on birth weight, two months weight, four months weight and six months weight in Terai goat. Parajuli et al. [10] report significant effect of birth type on birth weight, pre-weaning weight, weaning weight, weight at six month and weight at nine months. Bhattacharai et al. [11] reported that litter weight at birth and litter weight at weaning were high for the does having triplets (5.51 kg and 25.11 kg, respectively) as compared to those having single and twin kids. Similarly, significant effect of birth type on weight gain from birth to weaning, weaning to nine month and nine to fifteen months was reported by Bhattacharai et al. [18]. Single born kids showed higher weight gain than those born as twins or triplet. Authors describes that competition among kids for space and nutrition and limitation of uterine environment for multiple born kids may be the reason for the higher weight gain in kids born as single.

### **Effect of size of dam**

Size of dams has significant effect on the average weight gain of kids from birth to weaning and from weaning to nine months. The kids born from large does has higher gain during preweaning period and weaning to nine-month period compared to kids born from medium and small does. Bhattacharai et al. [11], highest birth ( $4.21 \pm 0.07$ ) and weaning weight ( $19.51 \pm 0.38$ ) of kids born from large sized dam than those born from medium and small sized dam. It is due to the nutritional status of the does which in most cases is reflected by the size of does [18].

### **Conclusion**

The reproductive as well as productive traits are affected by several factors including breed, season of conception, season of kidding, age, sex and health and nutritional status of individual. Upper altitude, summer conception, single birth type and goat in third parity attain earlier sexual maturity, conception, kidding, kidding interval and postpartum estrus. Summer/rainy season conceived does, goats of third to fifth parity, goats born from large sized does and males have higher weight gain and better productive performance. However, altitude and season of kidding were found to have non-uniform effect on productive trait of goat. Similarly, the effect of location on the gestation length of indigenous goat was found non-uniform. Therefore, detailed study needs to be carried out for accessing the effect of altitude and season of kidding on productive traits and effect of location on gestation length of goat. For commercial goat farming the factors affecting productive and reproductive traits of goat are the major consideration.

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