

## Research Article

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

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### Abstract

It is important to understand the scientific basis of raising goats to improve production and productivity of goats. This is a review article to document 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, conference proceedings, post-graduate and doctoral dissertations. The study revealed that altitude, season of conception, season of kidding, number of kid 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 considered to promote the indigenous goat production in commercial scale farming.

**Keywords:** Breed; Parity; Conception; Kidding; Altitude; Seasonality

### 1. Introduction

Livestock is an integral part of crop-livestock mixed farming systems in rural area where, goat (*Capra hircus*) occupies an important consideration. Goat is recognized as a important livestock species for poverty reduction, livelihood and food & nutritional security for smallholder farmers in Nepal. Goat farming is also being popular because it can be used as multi-purpose livestock. It is used for meat, milk, manure, leather and draft power in the mountainous region of Nepal. Demand for goat increases during religious festival of Nepalese like Dashain. And it fetches higher price during the period.

In Nepal, goat constitute highest population among the total livestock population. In the year 2015/16, the population of goat was estimated to be 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 reported to be about 7 percent (MoAD, 2015/16).

Due to the requirement of low initial investment, high prolificacy and high value of meat, goat farming is gaining popularity in Nepal. It has been reported that about 86% of meat demand of goat is fulfilled by domestic production [1]. Though it seems to be a growing business, there has not been major uptake of commercial goat farming in Nepal. According to Nepali et al. [2] breed of goat, reproduction, nutrition and feeding strategy, health care and farm management are the most important aspects of goat farming include. NARDF [3] reported that absence of proper breeding plans, feeding strategies, inbreeding and poor hygiene are the widespread problem in goat farming in Nepal. Similarly, weak extension service, and lack of awareness about the optimum farming techniques, becomes the hindrance to goat farmers for commercial goat farming. Kolachhapati et al. [4], reported that the productive traits: birth weight, weaning, and post-weaning weight and reproductive traits: age of the first conception, first kidding, gestation length and kidding interval vary greatly due to the non-genetic or environmental factors. Such factors include the season of kidding, dam's parity, sex of kid, birth type, and altitude. This review paper describes such non-genetic (environmental) factors which affect the productive and reproductive traits of the indigenous goat of Nepal.

## 2. Methodology

Necessary information were gleaned through journal articles, published reports, technical bulletins, conference proceedings, post-graduate and doctoral dissertations and reliable information on the factors affecting the productive and reproductive traits of goat were collected. Relevant information were arranged systematically. Findings are summarized in tables, briefed in texts with conclusive outline of the non genetic factors affecting the productive and reproductive traits of indigenous goats of Nepal.

## 3. Major Findings

### 3.1 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.

**3.1.1 Effect of breed:** The research finding of several authors revealed that reproductive characteristics of goat vary with its breed type. Accordingly, Shrestha et al. [5] reported that the average age of first kidding of Khari and Terai goats are 480 and 450 days respectively, while that of Sinhal and Chyangra is 720 days. However, Neopane et al. [6] reported the age of first kidding of Khari, Terai, Sinhal and Chyangra to be 453, 491, 576 and 555 days respectively. Similarly, Shrestha et al. [5] 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 et al. [6] reported that the kidding interval for Khari, Terai, Sinhal and Chyangra to be 302, 336, 287 and 354 days respectively. According to Shrestha et al. [5], Sinhal and Chyangra take the longest time to reach the age of first kidding and also has longest kidding interval. However, Neopane et al. [6] revealed that Sinhal takes the longest time to reach the age of first kidding and Chyangra has the longest kidding interval.

**3.1.2 Effect of location:** The location has been considered as the important factor affecting the first conception, kidding, postpartum estrus and gestation length. Kolachhapati et al. [7] 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 comparable 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) and plains (Nawalparasi) 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 ( $1.77 \pm 0.06$ ), 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. Similarly, 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]. However, Sharma et al. [8] reported that that location has a non-significant effect on gestation length.

**3.1.3 Effect of season of conception:** The season during which conception takes place also affects the reproductive trait of the indigenous goat of Nepal. Parajuli et al. [9] 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. However, 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 conceived during summer season gets relatively abundant nutritious fodder and forage which leads to the faster and proper growth of the fetus.

**3.1.4 Effect of season of kidding:** The season of kidding is of high importance for the reproductive trait. Parajuli et al. [9] 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. However, shorter gestation length ( $150.49 \pm 0.85$ ), earlier age at first kidding ( $401.54 \pm 5.02$  days) and longer post partum 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.

**3.1.5 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 [9].

**3.1.6 Effect of parity:** Insignificant variation of parity on gestation length and kidding interval is reported by Parajuli et al. [1]. 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 non significant 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) [9].

**3.1.7 Effect of age of kidding:** Shrestha et al. [5] reported that lower the age at first kidding and kidding interval, the better is the life time production of the goats. Similar findings were reported by Mioč et al. [10]. The authors reported that goats kidding early in the year had better milking performances i.e. longer lactation period, higher milk yield and higher content of milk fat, than goats kidding in the spring.

**3.1.8 Effect of health care and nutrition:** Healthcare and nutrition can significantly affect the reproductive traits [11]. Balanced ration can improve the reproductive efficiency of female kids in terms of early conception, litter size and life time productivity Kolachhapati [12, 13], 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 [14]. Shrestha et al. [5] reported that feeding of maize and mineral mixture accordingly in line with treatment groups and deworming the goats 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 [15].

### 3.2 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, season of conception, season of kidding, feed intake, sex, birth type, age, parity and size of doe.

**3.2.1 Effect of breed:** Shrestha et al. [5] revealed that productive is largely influenced by the genetic makeup of animal. Among the four indigenous goat breed, Sinhal was reported to be the heaviest breed, followed by Khari and Terai respectively. Neopane et al. [6] reported that Terai goat has highest weight gain from birth to weaning (9.2 kg) and six to nine month (4.3 kg). Chyangra has highest weight gain from weaning to six month (2.3 kg) and Sinhal has highest weight gain from nine to twelve month (7.3 kg). But Shrestha et al. [5] reported that Sinhal goat has highest weight gain from birth to four month (9.35 kg) and nine to twelve month (4.71 kg) and Khari has highest weight gain from four to six month, six to nine month (3.45 kg and 4.21 kg). Weight gain of different indigenous goat breed of Nepal during different age are given in Table 1.

Age	Weight gain (kg) Shrestha et al. [5]				Weight gain (kg) Neopane et al. [6]			
	Khari	Sinhal	Terai	Chyangra	Khari	Sinhal	Terai	Chyangra
Birth to four month	5.82	9.35	5.98	-	5.85	8.3	9.2	7.9
Four to six month	3.45	6.00	2.06	-	1.3	1	1.2	2.3
Six to nine month	4.21	2.81	1.85	-	3.6	3.8	4.3	2.0
Nine to twelve month	4.01	4.71	1.65	-	3.9	7.3	3.9	<b>1.2</b>

**Table 1:** Weight gain of goat breed during different age. Source : (Shrestha and Pokharel [5] and Neopane and Pokharel [6]).

**3.2.2 Effect of location:** 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 [16]. Similarly, study on Khari goats in Nawalparasi showed that there is non-significant effect of altitude on birth weight but the weaning weight in lower altitude was significantly greater than that of higher altitude [17]. However, Parajuli et al. [18] revealed that goats reared in upper altitude has higher pre weaning weight ( $6.97 \pm 0.46$ ) than those reared in lower altitude ( $5.70 \pm 0.47$ ) and non significant effect of location on weaning weight. Similarly, Bhattarai et al. [16] 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. [18] for weight gain from six to nine month and nine to fifteen month. Authors also revealed that, birth weight and pre weaning weight of kids in upper altitude was 8 and 22 percent higher than goats reared in lower altitude. Weather condition and availability of nutritious fodder in lower altitude affect the average daily weight gain [16]. 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 that from central ( $31.8 \pm 0.4$ kg) and eastern region ( $27.7 \pm 0.5$ kg) [5].

**3.2.3 Effect of season of conception:** Kids born from does conceived during rainy season are heavier than those conceived during autumn, winter and spring season. Season of conception significantly affect pre weaning weight of goat [16]. 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 [17]. Parajuli et al. [18] report non significant effect of season of conception on birth weight, but significant 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 abundant availability of better nutrition to the doe during autumn, winter or spring season.

**3.2.4 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 ( $54.73 \pm 3.63$ ) [16]. 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 [17]. But Parajuli et al. [18] 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.

**3.2.5 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, et al. [5] 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 (81.7gm) 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.

**3.2.6 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 [21]. Sapkota et al. [22] report that the most productive parity for goat is from third parity to fifth parity. The goat kids born of middle parity (3rd to 5th) has highest body weight due to fully developed reproductive system. But, Parajuli et al. [18] report non significant effect of parity on birth weight, pre weaning weight, weaning weight, weight at six month and weight at nine month. Bhattarai et al. [17] reported non-significant effect of parity on the birth weight of Khari goat, whereas significant effect was reported for weaning weight. Goats of 3rd to 6th parity were reported to gain highest weaning weight. Similarly, Bhattarai et al. [16], reported that the kids born on early (1st and 2nd) and middle (3rd to 6th) 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.

**3.2.7 Effect of sex:** Males are generally heavier than females [5]. Bhattarai et al. [21] reported significant effect of sex on post weaning weight at six month and eight month in Terai goat. Parajuli et al. [18] reported significant effect of sex on birth weight, pre weaning weight, weaning weight, weight at six month and weight at nine month in hill goat. Similarly, significant effect of sex on weight gain from birth to weaning, weaning to nine month and nine to fifteen month was reported by Bhattarai et al. [16]. 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 [22].

**3.2.8 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 [22]. Bhattarai et al. [21] 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. [18] report significant effect of birth type on birth weight, pre weaning weight, weaning weight, weight at six month and weight at nine month. Bhattarai et al. [17] 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 month was reported by Bhattarai et al. [16]. 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.

**3.2.9 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 pre weaning period and weaning to nine month period compared to kids born from medium and small does. Bhattarai et al. [17], 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 [16].

#### 4. 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 post partum 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 need 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.

#### Conflict of Interest

Author's declare no conflict of interest.

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