

Research Article

## Effect of non-genetic factors on prolificacy and pre-weaning kid mortality of Khari goats in Nawalpur, Nepal

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### ABSTRACT

Present study was carried out mainly aiming at studying the effect of non-genetic factors on prolificacy and pre-weaning kid mortality of *Khari* goats in Nawalpur, Nepal. The traits were recorded for 1005 does were measured and analyzed using fixed effect Least Square Mixed Model and Maximum Likelihood Computer Program (LSMMML PC-2). Results revealed that overall mean prolificacy and pre-weaning kid mortality in this study were 145 and 6.2%, respectively. According to the results, non-genetic factors such as altitude, coat color and dam's parity were the important sources of variation with respect to pre-weaning kid mortality and prolificacy of *Khari* goats in this study. Thus, the results of present study suggested the scope of improvement in prolificacy and pre-weaning kid mortality through selective breeding.

**Keywords:** *Khari* goats, mortality, prolificacy, twinning.

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### INTRODUCTION

Goats are the important livestock species in Nepalese farming system. Most of the rural population depends on goats for meat, manure, fibre, and pack purposes. Goat contributes in the food and economic security (Bhattarai *et al.*, 2019) and are usually known as cash generating animal during emergency and goat enterprise suitable for landless marginal and small farmers as well (Uperti, 2008). Goat meat production in Nepal ranks second (20.7%) after buffalo and shares about 4% to total GDP (MoALD, 2019). Goats can efficiently survive on available shrubs and trees in adverse harsh environment in low fertility lands where no other crop can be grown (Hagan *et al.*, 2012). There are four prominent indigenous genetic resources of goats in Nepal viz. Chyangra, Sinhal, *Khari* and Terai (Neopane, 1997). *Khari* goats are normal with conservation view point and widely preferred goats covering more than 50 percent of small ruminant population in Nepal (Neopane & Pokharel, 2004; Bhattarai *et al.*, 2019; Poudel, 2020).

There is a very wider genetic variability among Khari breeds of goats in Nepal in relation to variation in growth, reproductive and morphological traits. They have small body size ranging from 25 to 30 kg males and 20-25 kg females with low to medium body length, wither height and heart girth that enables it to survive under stressful environmental conditions, high disease incidence, and low input requiring (Neopane, 1997; Kolachhapati, 2006). Khari goats have little been explained with respect to prolificacy and pre-weaning kid mortality that are considered to be the important selection criteria of within breed selection for genetic improvement of does (Hagan *et al.*, 2012; Salako & Ngere, 2002). Prolificacy in general is associated with the reproductive functions of an adult does whereas, pre-weaning kid mortality is directly correlated to mothering ability of the lactating does. Based on this facets and figures, present study therefore sought to study the effect of non-genetic factors on prolificacy and pre-weaning kid mortality of Nepalese indigenous *Khari* goats in the mid-hills of Nawalpur district, Gandaki Province, Nepal. Thus, present study was mainly focused on determining the baseline values of prolificacy and kid mortality of *Khari* goats and to study the effect of some non-genetic factors associated to bring variation among these traits.

## **MATERIALS AND METHODS**

This study was carried out in the indigenous goat flocks of Hupsekot Rural Municipality (former Deurali VDC), Nawalpur, Nepal representing two agro-ecological domains i.e. Inner terai (lower altitude) and hill (upper altitude). Altogether, 1005 adult does were evaluated under farmers managed condition to study the prolificacy and pre-weaning kid mortality. There were altogether three non-genetic factors considered in this study. These non-genetic factors are being described hereunder.

### **Non-genetic factors considered**

#### **Altitude**

Altitude was an important non-genetic factor affecting the major economic traits of goats. There were two sub-classes of altitude. They were:

- a. Lower altitude: Altitude from 300 to 700 masl.
- b. Upper altitude: Altitude from 700 to 1100 masl.

#### **Coat color**

Coat color of the goats under this study was grouped into five sub-classes. Each sub-class is defined as follows:

- a. Black: The animals with solid black coat color.
- b. Black and white: Animals having black and white patches on the body.
- c. Brown: Animals with solid brown coat color.
- d. Mixed: Animals having the patches/spots of three or more than three colors on the body.
- e. White: Animals having solid white coat color.

#### **Parity of dams**

Parity of dams under this study was grouped under three sub-classes:

- a. Early parity: This sub-class consisted of the does having first and second kidding in their lifespan.

- b. Middle parity: The does having third, fourth, fifth and sixth parity.
- c. Late parity: The does having seventh and above parity.

### **Data analysis**

Data were analyzed based on C.R. Henderson model using “Least Square Mixed Model and Maximum Likelihood Computer Program (LSMMML PC-2)” (Harvey, 1990).

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

Where,  $Y_{ijkl}$  = adjusted mean for body morphological traits.

$\mu$  = Pooled/overall mean

$a_i$  is the effect of  $i^{\text{th}}$  altitude ( $i = 1, 2$ ): lower and upper.

$b_j$  is the effect of  $j^{\text{th}}$  coat color of kids ( $j = 1, 2, 3, 4, 5$ ); black, black and white, brown, mixed and white.

$c_k$  is the effect of  $k^{\text{th}}$  number of parity of dams ( $k = 1, 2, 3$ ); early, middle and late.

$e_{ijkl}$  is the random element (residual effect) assumed to be normally and independently distributed.

## **RESULTS AND DISCUSSION**

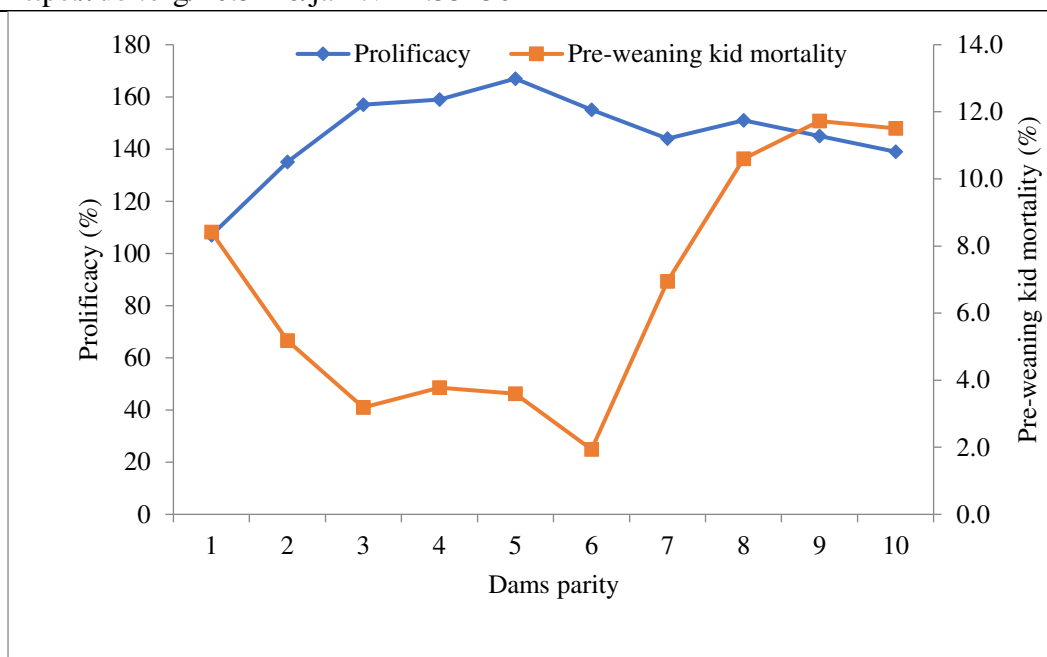
### **Prolificacy (%) and pre-weaning kid mortality (%)**

Results of this study revealed that total prolificacy of the *Khari* does was 145%. At the meantime, findings of present study also indicated that pre-weaning kid mortality within the flock of *Khari* does was 6.2%.

### **Effect of parity**

Present findings revealed that prolificacy and pre-weaning kid mortality was varied with respect to the parity of dams (Figure 1). Accordingly, prolificacy percent was observed to be increased with advances parity of dams up to 5<sup>th</sup> parity and was declined beyond this parity. More or less, a plateaued prolificacy was also observed from 3<sup>rd</sup> to parity of *Khari* does. This indicated that, more attention should be paid during these stages of growth for improving reproductive efficiency of the does and highly profitable goat enterprise.

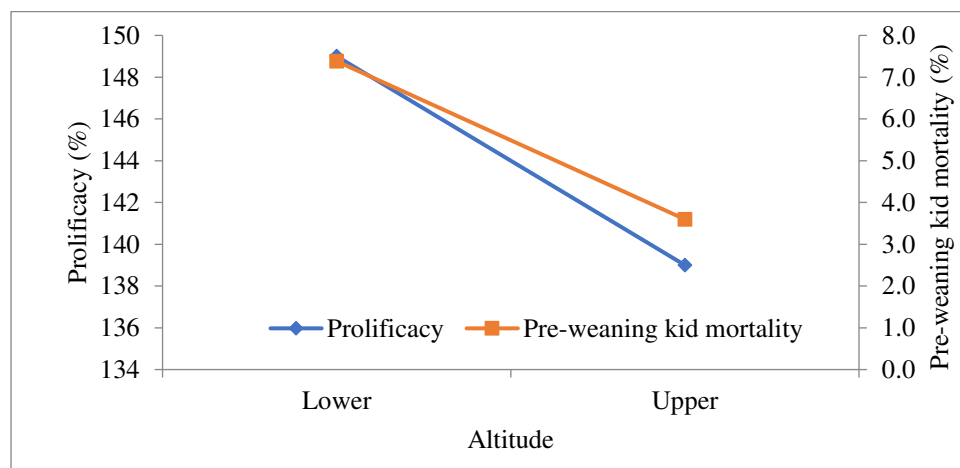
On the other hand, in contrast to the prolificacy, pre-weaning kid mortality was decreased with advancement in the parity of dams up to 6<sup>th</sup> parity and afterwards, it was increased at increasing rate (Figure 1). Values of both prolificacy and pre-weaning kid mortality in the adjoining Figure 1 indicated that the does of advanced parity will lose their genetic potentials with respect to these traits and is suggested to cull the does reaching to more than 7<sup>th</sup> parity.



**Figure 1. Prolificacy and pre-weaning kid mortality (in %) with respect to the parity of dams of Khari goats in Nawalpur, Nepal.**

*Effect of altitude*

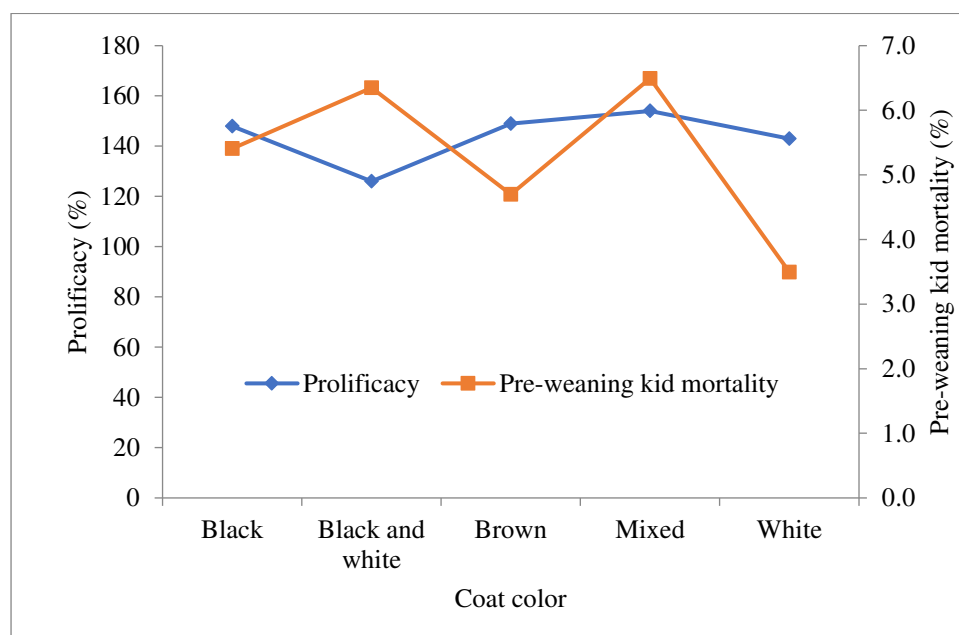
Prolificacy and pre-weaning kid mortality was also influenced with the variation in altitude (Figure 2). Accordingly, higher rate of prolificacy and pre-weaning kid mortality was observed for the does of lower altitude and both traits were observed to be declined while moving to the upper altitude. Higher pre-weaning kid mortality (%) in lower altitude than in upper might be associated with the occurrence/prevalence of higher parasitic loads in lower altitude.



**Figure 2. Prolificacy and pre-weaning kid mortality (in %) of Khari goats with respect to altitude**

**Effect of coat color**

Results also revealed that pre-weaning kid mortality was influenced with the variation in their coat color (Figure 2). Accordingly, higher rate of pre-weaning kid mortality was observed for the does of black & white and mixed colored does. On the other hand, prolificacy was not so affected by the coat color of does (Figure 2). However, black and white colored does had quite lower rate of prolificacy as compared to those of other coat colors.



**Figure 3. Prolificacy and pre-weaning kid mortality (in %) with respect to coat color of Khari goats**

**DISCUSSION**

Kharel and Neopane (1998) opined that in comparison to Nepalese indigenous breeds viz. *Chyangra* (in mountains), *Sinhal* (in high hills), and *Terai* (in Terai), Nepalese Khari (in hills) is one of the most popular breeds for its productivity, prolificacy, twinning ability and adaptively.

**Kid mortality**

Bushara *et al.* (2013) reported the overall average mortality rate of 4.3% reaching to 9.6% in rainy season in case of Taggar goats in western Sudan. Al-Najjar *et al.* (2009) reported the mortality rates at birth and from birth to weaning ranging from 4% to 24% and 3% to 18%, respectively in Shami goats in Damascus, Syria.

Al-Najjar *et al.* (2009) also reported the significant effect of parity ( $P < 0.05$ ) on mortality rates at birth and from birth to weaning. This might be due to an age effect; as dams increased in maturity the survival rate of kids improved. Results of present study are in agreement with the findings of Mazumdar *et al.* (1980) using Pashmina goats and kids, and Barding *et al.* (2000)

working with Osmanabadi goats; but in disagreement with the results of Mandonnet *et al.* (2003) who worked with Creole goats.

According to Deribe *et al.* (2014) parity has significant effect ( $p < 0.01$ ) on preweaning mortality rates of kids. Accordingly, mean pre weaning mortality rate was 12.59%. Similarly, Berhan and Arendonk (2006), reported that under uncontrolled breeding conditions the mortality rate was 15% and Goonewardene *et al.* (1998) reported preweaning mortality was 9.4%.

Tesema *et al.* (2017) reported that the pre weaning mortality was about 24.2% in Central Highland x Boer crossbred goats in North Eastern Ethiopia. Similarly, Preweaning mortality rate of Borana and Arsi-Bale breed was 43% and 25% respectively and Hailu *et al.* (2006) reported that parity was an important source of variation with respect to preweaning kid survival. Gradual decrease in pre-weaning mortality rate to the fourth parity thereafter it elevates. Accordingly, preweaning mortality was highest (77%) with advanced parity (6<sup>th</sup> parity). Average pre-weaning mortality rate for South African Angora goats was reported to be 11.5 (range 8.6-16.5%) (Snyman, 2010). Early neonatal kid mortality was reported to be 7.5% by Sharif *et al.* (2005) due to different causes in Jordan. Donkin and Boyazoglu, (2004) reported that the mean annual goat kid mortality was 29%. Similarly, overall preweaning kid mortality for different breeds of Israel and Sinai was 17.81% (Rattner *et al.*, 1994).

### **Prolificacy**

Khari breed has its prominent characteristics of high prolificacy i.e. 1.83 (Pradhan & Gurung 1985). According to Crepaldi *et al.* (1999) Parity had significant effect ( $p < 0.001$ ) on prolificacy with mean of 1.2, 1.5 and 1.7 kids in first, second and fourth parity then with advanced parity no. kids/kidding decreases.

Haldar *et al.* (2014) reported that the average litter size of Black Bengal goats as 1.75 in a study was quite comparable with some world prolific goat breeds including Nubian, Pygmy, American Alpine, French Alpine, Saanen and Toggenburg with the average litter size of 2.0, 1.9, 1.9, 1.7, 1.7 and 1.6, respectively. These findings suggests that Nepalese indigenous Khari goats are prolific goat breed.

### **CONCLUSIONS**

In conclusion there is wider variation in prolificacy and pre-weaning kid mortality existed within the flock of *Khari* does. Parity of dams, altitude and coat color of the animals were the major sources of variation with respect to the prolificacy of the does and pre-weaning mortality of kids. Prolificacy percent increases with increase in parity up to 5<sup>th</sup> parity and the declines beyond this parity in contrast, pre-weaning kid mortality decreases with advancement in the parity of dams up to 6<sup>th</sup> parity and afterwards. Upper altitude is suitable for *Khari* as compared to lower altitude since there is substantially lower pre-weaning kid mortality in these regions.

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### Author's Contribution

NB conceived, designed and performed experiments, collected and analyzed data and drafted the manuscript, revised it and finalized the paper.

### Conflicts of Interest

The author declares that there is no conflict of interest.

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