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# Effect of Non-Genetic Factors on Milk Production Traits of Indigenous Buffaloes (*Bubalusbubalis*l.) In The Western Hills of Nepal

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**ABSTRACT**

*Understanding the influence of non-genetic factors on the phenotypic expression of milk production traits of buffaloes is important to develop selection/evaluation criteria with better accuracy.A research was carried out in the western villages, Ramjhathati of Parbat district and Faliyagaun of Myagdi districts of Nepal during October to November 2016 with the objective of evaluating the effect of parity on the different milk production traits of the Indigenous Lime and Parkote buffaloes, where breed and parity were considered as non-genetic factors. Altogether 98 buffaloes including 57 Lime and 41 Parkote were considered as the sample population. The milk production traits considered for the evaluation were Day 1 Milk Yield (DMY), Peak Milk Yield (PMY) and Average Daily Milk Yield (AMY). Data were analyzed by Henderson's Least Square Mixed Model and Maximum Likelihood (LSMMML PC-2) computer program using Harvey-1990 software. Results indicated that the pooled means for the DMY, PMY and AMY were observed 1.60 liter, 3.31 liter and 2.11 liter, respectively. Results revealed that breed and parity of indigenous buffaloes were not the important sources of variation with respect to the traits under study. However, higher value for the DMY, PMY and AMY were observed in the mid parity (4$^{th}$ – 6$^{th}$) as compared to that of early (1$^{st}$ -3$^{rd}$) and late (above 7$^{th}$) parity for both breeds. The peak milk yield in the Mid Parity was recorded higher in the Lime buffaloes (3.85±0.40 ltr) as compared to that of the Parkote buffaloes (3.32±0.52 ltr). Besides, the correlation coefficient between DMY and PMY, DMY and AMY, and AMY and PMY was determined 0.622, 0.498, and 0.623 respectively. Regression analysis of DMY, PMY and AMY indicated that PMY of Lime and Parkote buffaloes in this study is fluctuated by +1.0168 liter and +0.829 liter per liter fluctuation of DMY and AMY, respectively. Thusthere is great scope of improving indigenous Lime and Parkote buffaloes through selection within the population. The breed andnumber of parities could be the important non-genetic factors with respect to milk production traits, though they did not found significant in present study.High positive correlation and the results of regression analysis reflected that selection for increased DMY could increase PMY and AMY and vice versa.*

**Key words:** Indigenous breeds,Milk Production Traits, Parity, Lime,Parkote

## INTRODUCTION

Nepal is characterized by crop-livestock mixed farming system to sustain the rural livelihood in the country. Buffalo is one of the most important multi-purpose species contributing around 65% and 54% to the total milk and meat production and ranks

in the first position in both of the cases, despite the fact that this species constitutes only 41% of the total dairy population including cattle and buffaloes (MOAD, 2016). Lime, Parkote and Gaddi are the precious indigenous breeds of Nepal distributing in the west and far-west region of Nepal, respectively having great scope of genetic improvement. Importantly, Murrah and its crossbred population comprises of about 35% of the total buffalo population in Nepal.

Phenotypic expression of quantitative traits such as day 1 milk yield (DMY), peak milk yield (PMY) and average daily milk yield (AMY) is mostly governed by polygenes and is associated to several non-genetic factors (Lasley, 1963). Thus, it is important to know the strength and dimension of influence of such non-genetic factors on the expression of economic traits of buffaloes that helps in developing selection/evaluation criteria with better accuracy.

In these connections, present study was undertaken to investigate the influence of the non-genetic factors including genetic group (breed) and parity of the animal on milk production traits such as DMY, PMY and AMY that have been scarcely studied to date.

## MATERIALS AND METHODS

Present study was carried out in the Western hilly villages including*Ramjhathati,* Parbatand *Faliyagaun,* Myagdiover a period ofOctober to November, 2016.Study mainly aimed at evaluating the effect of parity on the different milk production traits of the Indigenous *Lime* and *Parkote* buffaloes under farmers managed production system.Altogether 98 lactating buffaloes with their production records were identifiedand considered as the study population. For analysis of each traits considered,the number of buffaloes involved in the collection of production data is presented in Table 1. The non-genetic factors such as breed and parity were considered in the study.

**Table 1. Distribution of sample buffaloes under different non-genetic factors in the analysis of milk production traits**

| Breed | Number | Parity | Number | Parity Vs. Breed | Lime | Parkote |
|---|---|---|---|---|---|---|
| *Lime* | 57 | Early ($1^{st}$ – $3^{rd}$) | 72 | Early ($1^{st}$ – $3^{rd}$) | 43 | 29 |
| *Parkote* | 41 | Mid ($4^{th}$ – $6^{th}$) | 19 | Mid ($4^{th}$ – $6^{th}$) | 12 | 07 |
| | | Late (Above $7^{th}$) | 07 | Late (Above $7^{th}$) | 02 | 05 |

The milk production traits under study were day 1 milk yield (DMY), peak milk yield (PMY) and average daily milk yield (AMY). To study the effect of non-genetic factors on production traits and to overcome the difficulties of disproportionate sub-class numbers, data were analyzed by Henderson's

Least Square Mixed Model and Maximum Likelihood (LSMMML PC-2) computer program using Harvey-1990 software.The following model was used to understand the influence of breed and parity on the milk production traits with theassumptions that different components being fitted into the model were independent and additive.

$$Y_{ijk} = \mu + B_i + Pj + (BP)_{ij} + e_{ijk}$$

Where, $Y_{ijk}$ is the observation on the k$^{th}$parity of i$^{th}$ breed; $\mu$ is the pooled (overall) mean; $B_i$isthe fixed effect of $i^{th}$breed of buffalo; $P_j$is the fixed effect of$j^{th}$parity;$(BP)_{ij}$ is the effect of interaction between $i^{th}$ breed and $j^{th}$ parity; and $e_{ijk}$is the random error that is assumed to be normally and independently distributed [~NID(0, ó$^2$e)].

## RESULTS

### Day one milk production (DMY)

Results of this study reflected that the overall mean DMY was 1.60±0.08liters with the range of 0.28 to 4.54 liters (Table 2). Accordingly, breed had no significant effect on day one milk yield (DMY). However, DMY of Parkote was slightly higher (1.65 liters) as compared to that of Lime buffaloes (1.54 liters). Similarly, parity also had non-significant effect on DMY of *Lime* and *Parkote* buffaloes in this study (Table 2). However, it was observed that the phenotypic value of the trait was slightly higher (1.79 liters) for the buffaloes of mid parities (4$^{th}$-6$^{th}$) as compared to early (1$^{st}$-3$^{rd}$) and late parities (above 7$^{th}$).In addition, DMY was not significantly influenced by the effect of interactions between breed and parity (B×P) of the lactating buffaloes (Table 2). However, comparatively higher value of DMY was observed in case of the *Parkote* buffaloes with mid parities (4$^{th}$-6$^{th}$) as compared to other breed x parity combinations.

### Peak milk yield (PMY)

The overall mean PMY was 3.31±0.14with the range of 0.85 to 6.81liters (Table 2). Peak milk yield was not significantly influenced by parity of the animals. However, higher value (3.63 liters) of PMY was observed for the lactating animals of mid parities (4$^{th}$ to 6$^{th}$ parities) as compared to that of early (3.22 liters) and late parities (3.17 liters) (Table 2). In contrast, Thiruvenkadan*et al.* (2014) observed the significant effect (P<0.01) of parity with respect to peak milk yield of Murrah buffaloes in Tamil Nadu, India, who reported the lower value of PMY at 1$^{st}$ parity and increased from 2$^{nd}$ to 4$^{th}$ parity and gradually decreased above 4$^{th}$ parity.
Similarly, breed of buffaloes in present study also had no significant effect on peak milk yield (Table 2) indicating the similar values of PMY (3.30 liters) for both breeds under consideration.In contrary,Dahama and Malik (1991), Birader (1990) and Chaudhary*et al.* (2000) reported the significant influence of breed on PMY of buffaloes.

Moreover, the effect of interactions between breed and parity in present study was also found

non-significant with respect to PMY of Lime and Parkote Buffaloes (Table 2). However, Lime breed of mid parity ($4^{th}$ – $6^{th}$) was reported superior as compared to that for other breed-parity combinations.

**Average daily milk yield (AMY)**

The overall mean average daily milk yield (AMY) in this study was recorded 2.11±0.12liters with the range of 0.28 - 5.11 liters (Table 2). In contrast, Shah (2011) reported higher value (3.22 liters) of AMY in Lime buffaloes at Lumle. Moreover, Pokharel and Tiwary (2007) observed higher value of AMY in another indigenous breed of Nepal i.e. Gaddi. It was found that the average daily milk yield of Gaddi buffaloes in Western Nepal for the first three months after calving was 4.69 liters from two teats and in the next three months AMY was 4.62 liters from three teats. Shrestha*et al.* (1994) studied the milk production traits of local and Murrah crossbred buffaloes in eastern Nepal where he observed the AMY of local buffalo as 2.55 kg for local buffalo and 3.26 kg for Murrah crossbred buffaloes. Hence, it is established that Murrah crossed local breeds in Nepal are found to have increased their milk productivity.

The mean AMY of Lime and Parkote buffaloes slightly resembled to the Anatolian water buffaloes of Turkey where the overall means AMY was reported as 2.76±0.051 kg (Kul et al., 2015). Similar result was also reported by Şekerden et al. (1999) for Turkish Anatolian water buffaloes. On the other hand, Park (2002) reportedsignificantly higher value of AMY (7-10 liters) of the buffaloes in India.

Findings revealed that there was non-significant effect of breed was on the AMY of buffaloes under present study (Table 2). However, Parkote buffaloes were reported slightly superior as compared to Lime for the expression of this trait.

Likewise, parity of buffaloes also had no significant influence on AMY of indigenous buffaloes in this study (Table 2). However, the higher value (2.52 liters) of AMY was recorded for the buffaloes of mid parities ($4^{th}$-$6^{th}$) as compared to those of early ($1^{st}$-$3^{rd}$) and late parities (above $7^{th}$) parities. In contrary, Khosroshahi (2011) reported significant effect ($P<0.01$) of parity with respect to average daily milk yield (AMY) of Azarbaijan native buffaloes. Similarly, Jamuna et al. (2015) also reported the highly significant influence ($p<0.01$) of parity on AMY of Murrah buffaloes reared at NDRI Livestock Farm, India.

Additionally, findings of present study indicated that the effect of interactions between breed and parity did not significantly influence the performance of the lactating buffaloes with respect to AMY (Table 2). However, Lime buffaloes having mid parity ($4^{th}$ – $6^{th}$) were found superior as compared to that for other combinations of breed x parity interaction.

**Table 2.Least Square mean and standard error of milk production traits of Lime and Parkote buffaloes at different parity in Western Hills of Nepal, 2016.**

| Non-genetic factors | Day 1 Milk Yield (Ltr.) | Peak Milk Yield (Ltr.) | Average Daily Milk Yield (Ltr.) |
|---|---|---|---|
| Range | 0.28 - 4.54 | 0.85 - 6.81 | 0.28 - 5.11 |
| Pooled Mean | 1.60±0.08 | 3.31±0.14 | 2.11±0.12 |
| Breed | | | |
| *Lime* | 1.54±0.17 | 3.30±0.29 | 2.12±0.24 |
| *Parkote* | 1.65±0.17 | 3.30±0.25 | 2.15±0.24 |
| Significance | NS | NS | NS |
| Parity | | | |
| $1^{st}$ – $3^{rd}$ Parity | 1.52±0.10 | 3.22±0.16 | 2.04±0.14 |
| $4^{th}$ – $6^{th}$ Parity | 1.79±0.19 | 3.63±0.32 | 2.52±0.26 |
| Above $7^{th}$ | 1.68±0.38 | 3.17±0.63 | 1.94±0.56 |
| Significance | NS | NS | NS |
| Interactions | | | |
| *Lime* x $1^{st}$ – $3^{rd}$ Parity | 1.48±0.12 | 3.17±0.21 | 1.96±0.17 |
| *Lime* x $4^{th}$ – $6^{th}$ Parity | 1.79±0.24 | 3.85±0.40 | 2.76±0.33 |
| *Lime* x Above $7^{th}$ | 1.42±0.60 | 3.12±0.98 | 1.84±0.81 |
| *Parkote* x $1^{st}$ – $3^{rd}$ Parity | 1.57±0.15 | 3.30±0.25 | 2.16±0.21 |
| *Parkote* x $4^{th}$ – $6^{th}$ Parity | 1.78±0.32 | 3.32±0.52 | 2.15±0.43 |
| *Parkote* x Above $7^{th}$ | 2.04±0.38 | 3.23±0.62 | 2.08±0.66 |
| Significance | NS | NS | NS |

**Correlation coefficients among DMY, PMY and AMY**

Results of this study reflected that there was moderate to high positive correlation between the milk production traits under consideration. Accordingly, the correlation coefficient between DMY and PMY, DMY and AMY, and AMY and PMY was determined 0.622, 0.498, and 0.623, respectively.

**Relationship between DMY, PMY and AMY**

Positive linear relationship between DMY and PMY, DMY and AMY, and AMY and PMY was observed and is presented in Figures 1, 2 and 3 below. The regression equation of relationship

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between day 1 milk yield (DMY) and peak milk yield (PMY) was determined as ***PMY=1.0168*DMY+1.6799***; with the adjusted $R^2$ value of 38.7% (Figure 1). Where, 1.0168 is the regression coefficient of DMY to PMY and 1.6799 is the constant.

Similarly, the regression equation for daily milk yield (DMY) and Average daily milk yield (AMY) was determined as ***AMY=0.6802*DMY+1.0304***; with the calculated $R^2$ value of 24.22% (Figure 2). Where, 0.6802 is the regression coefficient of DMY to AMY and 1.0304 is the constant. Moreover, the regression equation for average daily milk yield (AMY) and peak milk yield (PMY) was determined as ***PMY=0.829*AMY+1.5736***; with the calculated $R^2$ value of 48.33% (Figure 3). Where, *0.829* is the regression coefficient of AMY to PMY and 1.5736 is the constant.

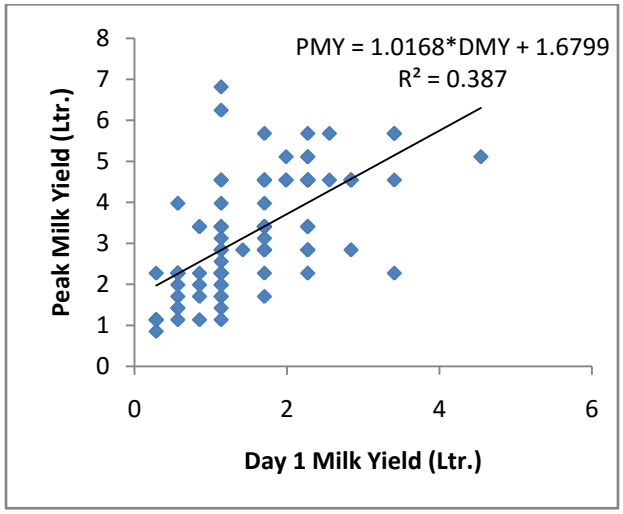


Figure 1. Relationship of day-1 milk yield and peak milk yield of Lime and Parkote buffaloes

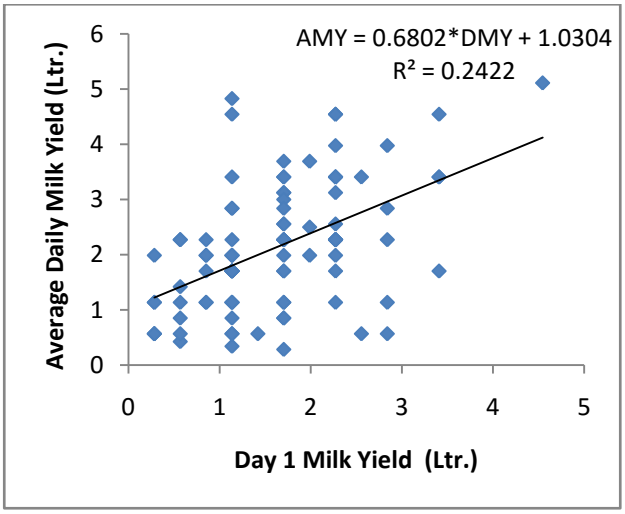


Figure 2. Relationship between day 1 milk yield and average daily milk yield of Lime and Parkote buffaloes

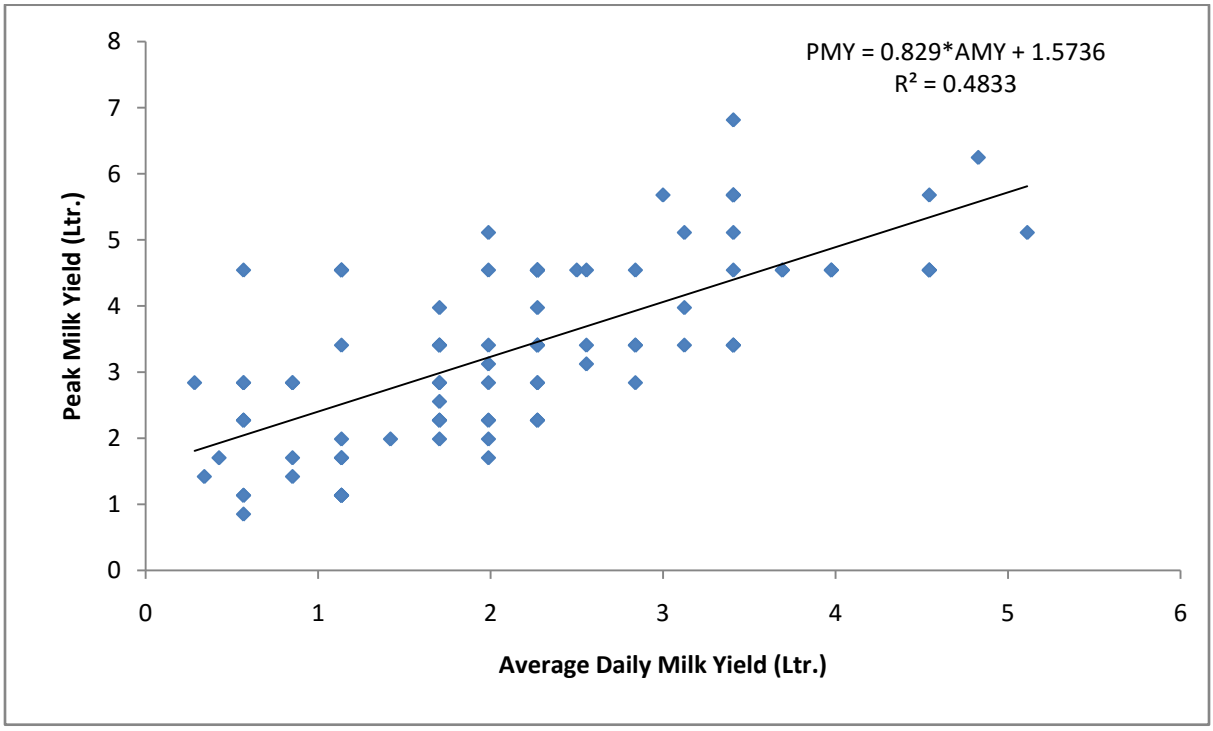


Figure 3. Relationship between average daily milk yield and peak milk yield of Lime and Parkote buffaloes

## DISCUSSION

Results of present study reflected that the buffaloes expressed large variation (range) in the major economic traits under study i.e. day one milk yield (DMY), peak milk yield (PMY) and average daily milk yield (AMY) suggesting the greater scope of improvement in these traits through selecting the best and mating among the best individuals. These results could be supported by the findings of Pokharel and Tiwary (2007), Shrestha*et al.* (1994), Şekerden et al. (1999), Khosroshahi (2011), and Jamuna et al. (2015. The differences in AMY of different breeds of buffaloes in present study might be due to influence of different sires used for breeding and their own genetic potential as reported by Jamuna et al. (2015).

Moderate to high positive correlation coefficients calculated for DMY and PMY, DMY and AMY, and AMY and PMY indicated that selection in favor of DMY will give positive response towards PMY and AMY while developing improvement plan for these traits in the buffalo population considered in present study.

The regression equations (Figure 1, 2 and 3) reflected that there was a linear relationship between DMY and PMY (Adjusted $R^2$ = 0.387), DMY and AMY (Adjusted $R^2$ = 0.242), and AMY and PMY (Adjusted $R^2$ = 0.483), respectively. Similarly, results obtained through the analysis of the

relationship between different milk production tratis indicated that PMY of *Lime* and *Parkote* buffaloes is fluctuated by +1.0168 liter and +0.829 liter per liter fluctuation of DMY and AMY, respectively. Similarly, AMY is fluctuated by +0.6802 liter per liter fluctuation in DMY of the indigenous *Lime* and *Parkote* buffalo population in the western hills of Nepal.

## CONCLUSIONS

Based on the findings of present study, it can be concluded that *Lime* and *Parkote* buffaloes had high potentiality with respect to milk production traits with a greater scope of improvement through selection within the population. The breed and number of parity could be the important non-genetic factors affecting milk production traits such as DMY, PMY and AMY, though they did not influenced these traits significantly in present study. So, further study covering wider area and considering larger population is recommended for greater precision.

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