Buffalo Bulletin (January-March 2025) Vol.44 No.1
https://doi.org/10.56825/bufbu.2025.4414582

NON-GENETIC FACTORS AFFECTING THE FIRST LACTATION PRODUCTION EFFICIENCY TRAITS IN BUFFALOES-A REVIEW

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Received: 16 September 2021
Accepted: 24 March 2025

ABSTRACT

Buffalo has been an integral part of livestock agriculture in Asia over 5,000 years producing milk, meat, draft power and hides. Buffalo is important for draft power and provides up to 30% for agricultural operations. The world population of buffaloes has undergone demographic changes over a period of time in different tropical countries. Due to geographical location and domestic need, riverine buffaloes acquired preponderance over swamp buffaloes across various agro-climatic regions of the country. Buffalo, by and large, remained neglected as compared to cattle by national and international agencies despite its economic status. Approximately, 80% of Indian buffaloes are non-descriptive while the remaining belongs to eight classified breeds. The dairy industry is dependent to a greater extent on level of production and reproduction performance of the animals in India. There are many non-genetic factors like period of calving, season of calving, age of dam etc., which influence the phenotypic expression of production and reproduction traits. Production and reproduction traits are antagonistic to each others. There are many production efficiency traits like Milk yield per day of lactation length (MY/FLL), Persistency (P), milk yield per day of calving interval (MCI) and milk yield per day of age at second calving (MSC) might be thought of as combinations of production and reproduction traits and can be used as selection tool. The productive efficiency performances of buffaloes are determined by milk yield and different reproduction traits. Therefore, production efficiency traits which are based on both production and reproduction traits are the best criteria for the selection and overall improvement.

Keywords: *Bubalus bubalis*, buffaloes, production efficiency traits, persistency, non-genetic factors, first lactation yield

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INTRODUCTION

The domesticated buffaloes are originally the descendants of *Bos arni*. There are two types of buffaloes found in India are riverine and swamp buffaloes although both the types are called *Bubalus bublis*. World's 97.42% buffalo population is with Asia sub-continent. India has the largest buffalo population in the world. India's contribution is 96.39% of world's buffalo population and 57.89% of Asia's total buffalo population (FAOSTAT, 2018). Buffalo is an important livestock species in world and well known for its milk and beef production as well as for draft work since long ago in India and nearby countries. India is having some of the best buffalo breeds.

Selection of buffaloes is mainly done on the basis of milk production. The aim of the selection programme is to improve milk production and to reduce the cost of milk production. The first lactation milk yield is the most used production trait as a selection criterion for the selection of dairy animals (Chakraborty, 2008). But a better approach would be if selection were on the production and reproduction traits rather than milk yield alone (Pathodiya and Jain, 2004). The success of the dairy industry is very dependent on the level of production and reproduction performance of the animals. The efficiency of production performance of dairy animals is determined by milk yields and duration of lactation (Chakraborty and Dhaka, 2020). There are many genetic and non-genetic factors, which influence the phenotypic expression of production and reproduction traits. Therefore, it is important to know how the different factors are affecting production efficiency traits in buffaloes. The production efficiency traits considered in the present studies are persistence (P), milk yield per day of first lactation (MY/FLL), milk yield per day of first calving interval (MCI) and milk yield per day of age at second calving (MSC).

Average yield per day of first lactation (MY/FLL)

Average yield per day of the lactation trait is important to know the milk producing capacity of an animal. It can be calculated as a total first lactation milk yield divided by total first lactation length. Studies pertaining to MY/FLL reported by various workers are presented in Table 1. The perusal of table indicated that average milk yield per day of lactation ranged from 2.45±0.12 kg/day in Bhadawari buffaloes (Singh and Nivasarkar, 2000) to 6.85±0.09 kg/day in Murrah buffaloes (Dev *et al.*, 2015).

Effect of period of calving

Significant effect of period of calving on MY/FLL was reported in Bhawdawari buffaloes by Singh and Nivasarkar (2000). Significant ($P<0.01$) effect of period on MY / FLL was also reported by Pathodiya and Jain (2004) in Surti buffaloes. Chakraborty *et al.* (2010) were also reported significant effect of season of calving in MY/FLL in Murrah buffaloes.

Effect of season of calving

Kumar (2008) reported significant effect of the season of calving in Surti buffaloes. Shrivastava *et al.* (1999) reported non-significant effect of season of calving on average milk yield per day of lactation. Non-significant effect of season of calving on AYL was reported by Pathodiya and Jain (2004) in Surti buffaloes and Chakraborty *et al.* (2010) in Murrah buffaloes.

Effect of age at first calving

Singh *et al.* (1992) reported significant

effect of age at first calving on average milk yield per day of first lactation in Murrah buffaloes. Chakraborty *et al.* (2010) in Murrah buffaloes also reported significant effect of age at first calving (linear) on MY/FLL. Chakraborty *et al.* (2010) reported statistically non-significant significant effect of AFC (quadratic) on FLMY/FLL in Murrah buffaloes.

Persistency (P)

Persistency can be defined as the extent to which peak yield is maintained (Wood, 1967). Persistency of milk production determines the ability of an animal to maintain milk production at a high level after peak production or usually refers to the rate of decline in daily milk yield after peak of lactation (Togashi and Lin, 2004). High persistence is necessary to maintain a high level of production. More persistent animals have more productive lives and more milk yield. Economical milk production depends mainly on peak yield and persistency of milk production (Chakraborty *et al.*, 2010). Lactation persistence may be defined as the ability of an animal to maintain milk production at higher level after the peak of lactation. A persistent lactation curve is of more economic interest because of the physiological strain put on the animal due to higher daily milk yield (which often causes reproductive and metabolic disorders) is diminished. Persistency can be estimated by various methods. Chakraborty *et al.* (2010) reported in ratio method in Murrah buffaloes. The mean values of persistence by different methods have been presented in Table 1.

Effect of period of calving

Bhat and Kumar (1979); Kumar *et al.* (1979); Chakraborty *et al.* (2010) reported significant effect of period of calving on persistency in Murrah buffaloes. Non-significant effect of period of calving on persistency was reported by Savaliya and Ahlawat (2016) in Jaffrabadi buffaloes.

Effect of season of calving

Significant effect of season of calving on persistency of milk yield was reported by Savaliya and Ahlawat (2016) in Jaffrabadi buffaloes, whereas non-significant effect of season of calving on persistency of milk yield was reported by Chakraborty *et al.* (2010) in Murrah buffaloes.

Effect of age at first calving

Rao *et al.* (1970) reported non-significant effect of age at first calving in Murrah buffaloes. Chakraborty *et al.* (2010) also reported statistically significant effect of AFC (linear) on Persistency but, non-significant AFC (quadratic) effect on Persistency in Murrah buffaloes.

Milk yield per day of first calving interval (MCI)

It is an important trait measuring the efficiency of milk production and reproduction. The animals which gave more milk per day of calving interval are not only efficient producers but also have superior reproductive efficiency. Review of available literature pertaining to MCI revealed (Table 1) that this efficiency trait ranged from 2.09±0.03 kg/day in Surti buffaloes (Tailor, 1995) to 4.40±0.07 kg /day in Murrah buffaloes (Patil *et al.*, 2018).

Effect of period of calving

Significant effect of period calving on milk yield per day of calving interval was reported by Singh and Nivasarkar (2000); Pathodiya and Jain (2004) in Bhadwabari buffaloes and Surti buffaloes, respectively. On the other hand, Chakraborty *et al.*

(2010) reported the non-significant effect of period of calving in Murrah buffaloes.

Effect of season of calving

Tailor (1995); Shrivastava *et al.* (1999) reported the non-significant effect of season of calving on milk yield per day of calving interval. Effect of season of calving on milk yield per day of first calving interval (MY/FCI) in Surti buffaloes was found non-significant by Pathodiya and Jain (2004). Chakraborty *et al.* (2010) in Murrah buffaloes reported non-significant effect of season of calving on first lactation milk yield per day of calving interval.

Effect of age at first calving

Chakraborty *et al.* (2010) reported significant effect of age at first calving (linear) but statistically non-significant effect of AFC (quadratic) on MCI in Murrah buffaloes.

Milk yield per day of age at second calving (MSC)

It is the per day milk yield by an individual up to her age at second calving. It is the most important efficiency trait as this component takes care of milk production in combination with age at second calving, where age at second calving is the sum of age at first calving and first calving interval. Very few reports were available pertaining to lactation milk yield per day of age at second calving in buffaloes. The milk yield per day at age at second calving in buffaloes as mentioned in Table 1 ranged from 0.46±0.007 kg/day in Surti buffaloes (Tailor, 1995) to 1.18±0.03 kg/day in Murrah buffaloes (Singh *et al*., 1990).

Effect of period of calving

Umrikar and Deshpande (1985); Singh *et al.* (1990); Kandasamy *et al.* (1991); Chakraborty *et al.* (2010) reported significant ($P<0.01$) effect of period of calving on milk yield per day of age at second calving in Murrah buffaloes. On the other hand, Kumar (2008) reported a non-significant effect of period of calving in Surti buffaloes.

Effect of season of calving

Significant effect of season of calving was reported in Surti buffaloes (Kumar, 2008). Non-significant effect of season on milk yield per day of age at second calving was reported by Umrikar and Deshpande (1985); Singh *et al.* (1990); Chakraborty *et al.* (2010) in Murrah buffaloes.

Effect of age at first calving

Umrikar and Deshpande (1985) reported significant effect of age at first calving on lactation milk yield per day of age at second calving interval. Chakraborty *et al.* (2010) reported highly significant effect of age at first calving on lactation milk yield per day of age at second calving interval in Murrah buffaloes.

CONCLUSION

Production efficiency traits are important as they are based on both production and reproduction traits. It can be concluded from different literature cited in this article that different non-genetic factors like period of calving, season of calving, Age at first calving etc. are affecting significantly the production efficiency traits in buffaloes. The variations in production efficiency traits may be due to genetic factors like merit of sires and non-genetic factors like environmental variations, sampling of population and data edits. Significant effect of period/ year of calving

Table 1. Average Performance of Production efficiency traits in Buffaloes.

Traits	Mean ± SE	Breed	Reference
Persistency (P)	5.71±0.10	Murrah	Kumar *et al.* (2000)
	6.09±0.03	Murrah	Godara (2003)
	5.33±0.12	Murrah	Suresh *et al.* (2004)
	194.12±2.42	Murrah	Chakraborty *et al.* (2010)
	0.82±0.02	Jaffrabadi	Savaliya and Ahlawat (2016)
Milk yield per day of first lactation (MY/FLL) (kg/day)	5.65±0.05	Nili-Ravi	Singh *et al.* (1989)
	3.65±0.03	Surti	Tailor (1995)
	2.45±0.12	Bhadawari	Singh and Nivasarkar (2000)
	5.5±0.01	Murrah	Dutt *et al.* (2001)
	3.78±0.05	Murrah	Singh (2002)
	6.09±0.03	Murrah	Godara (2003)
	4.22±0.06	Surti	Bharat *et al.* (2004)
	5.33±0.12	Murrah	Suresh *et al.* (2004)
	3.95±0.07	Surti	Kumar (2008)
	6.09±0.07	Murrah	Chakraborty *et al.* (2010)
	6.8±0.2	Nili-Ravi	Singh *et al.* (2011)
	6.80±0.20	Murrah	Singh and Barwal (2012)
	6.16±0.04	Nili-Ravi	Thiruvenkadan *et al.* (2014)
	6.85±0.09	Murrah	Dev *et al.* (2015)
	6.59±0.09	Murrah	Patil *et al.* (2018)

Table 1. Average Performance of Production efficiency traits in Buffaloes. (Continue.)

Traits	Mean ± SE	Breed	Reference
Milk yield per day of first calving interval (MCI) (kg/day)	4.17±0.11	Murrah	Singh *et al.* (1990)
	3.08±0.08	Murrah	Murli Dhar and Deshpande (1995)
	2.09±0.03	Surti	Tailor (1995)
	3.67±0.03	Murrah	Kuralkar and Raheja (1997)
	3.23±0.01	Buffaloes	Shrivastava *et al.* (1999)
	3.65±0.07	Murrah	Kumar *et al.* (2000)
	3.6±0.1	Murrah	Dutt *et al.* (2001)
	4.00±0.03	Murrah	Godara (2003)
	2.58±0.08	Surti	Bharat *et al.* (2004)
	3.20±0.13	Murrah	Suresh *et al.* (2004)
	2.16±0.05	Surti	Kumar (2008)
	3.98±0.06	Murrah	Chakraborty *et al.* (2010)
	4.70±0.10	Nili-Ravi	Singh *et al.* (2011)
	4.40±0.07	Murrah	Patil *et al.* (2018)
Milk yield per day of age at second calving (MSC) (kg/day)	1.07±0.03	Murrah	Bhalaru and Dhillon (1981)
	1.18±0.03	Murrah	Singh *et al.* (1990)
	0.738±0.016	Murrah	Kandasamy *et al.* (1991)
	0.62	Surti	Tailor *et al.* (1995)
	0.46±0.007	Surti	Tailor (1995)
	0.9±0.01	Murrah	Dutt *et al.* (2001)
	0.49±0.01	Surti	Kumar (2008)
	1.00±0.02	Murrah	Chakraborty *et al.* (2010)
	1.08±0.01	Murrah	Patil *et al.* (2018)

Table 2. Non-genetic factors affecting production efficiency traits in Buffaloes.

Traits	Period	Season	AFC	Breed	Reference
Persistency (P)			NS	Murrah	Rao *et al.* (1970)
	S			Murrah	Bhat and Kumar (1979)
	S			Murrah	Kumar *et al.* (1979)
	S	NS	NS	Murrah	Chakrborty *et al.* (2010)
	S	NS		Jaffrabadi	Savaliya and Ahlawat (2016)
Milk yield per day of first lactation (MY/FLL) (kg/day)	S			Murrah	Bhalaru (1977)
	S	S		Surti	Tailor (1995)
		NS		Buffaloes	Shrivastava *et al.* (1999)
	S	S		Bhadawari	Singh and Nivasarkar (2000)
	S	NS		Surti	Pathodiya and Jain (2004)
	S	NS	S	Murrah	Chakrborty *et al.* (2010)
	NS	S		Nili-Ravi	Singh *et al.* (2011)
	S	NS		Murrah	Patil *et al.* (2018)
Milk yield per day of first calving interval (MCI) (kg/day)	S	S		Murrah	Umrikar and Deshpande (1985)
		S		Nili-Ravi	Singh *et al.* (1989)
	S				Singh *et al.* (1990)
	S			Murrah	Shabade *et al.* (1993)
		NS		Surti	Pathodiya (1997)
	S			Bhadawari	Singh and Nivasarkar (2000)
	S	NS		Surti	Pathodiya and Jain (2004)
	NS	NS	S	Murrah	Chakrborty *et al.* (2010)
	NS	NS		Nili-Ravi	Singh *et al.* (2011)
	S	NS		Murrah	Patil *et al.* (2018)
Milk yield per day of age at second calving (MSC) (kg/day)	S	NS	S	Murrah	Umrikar and Deshpande (1985)
	S	S		Murrah	Kandasamy *et al.* (1991)
	S	S		Surti	Tailor (1995)
	S	NS	S	Murrah	Chakrborty *et al.* (2010)
	S	NS		Murrah	Patil *et al.* (2018)

on different production efficiency traits may be attributed due to use of sires of different merit over different periods, availability of green fodders, climatic variations over the periods etc. Therefore, the effect of non-genetic factors should be adjusted for accurate and unbiased estimates of genetic parameters and selection of good merit animals for future use.

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