



Productive and reproductive performance of cattle in the tropical part of India

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The livestock sector in India has a significant influence on the country's economy and the socio-economic condition of millions of people living in rural households. The majority of the milk producers in the country belonging to the category of small, marginal, and landless farmers reside in rural India (DAHD 2020–21). As per the 20th Livestock Census, India's total cattle and buffalo population stood at 193.46 million and 109.85 million. The population of exotic/crossbred cattle and indigenous/non-descript cattle in the country was reported to be 51.36 million and 142.11 million, respectively (20th Livestock Census). Several studies have been carried out on the productive and reproductive performance of cattle and buffaloes in different regions of the country. However, scant research attention has been given to comparative studies among various breeds of cattle and buffaloes. Also, the number of studies conducted on productive and reproductive traits in non-descript cattle was meagre. Therefore, to identify the current production potential of dairy animals in tropical wet and dry India, the present study of the productive and reproductive performance of animals was conducted. The study will help to identify the areas where scientific interventions can be applied under field conditions or at the farmers' level in order to exploit the maximum production potential.

Data and sampling: The purposive- multistage random sampling method was employed to collect primary data. The region was selected purposively, followed by the selection of two districts based on the Bovine Population Density Index (BPDI), one with a high BPDI and the other with a low BPDI. Then, within each district, two taluks

were selected randomly, followed by the random selection of five villages per taluk, and 10 dairy farmers rearing at least 2 breedable bovines from each village. Thus, a total of 200 households were covered from 20 villages in 4 talukas. Primary data was collected through personal interviews using a structured interview schedule. The study encompassed a total of 1156 animals, including 134 non-descript cattle, 725 crossbred cattle, and 297 buffaloes.

Statistical analysis: One-way ANOVA was employed using Statistical Package for the Social Sciences (SPSS for Windows, Version 21.0; SPSS Inc., USA) to compare the productive and reproductive parameters of different breeds (non-descript, crossbred and buffaloes) among different categories (parous and heifer) of breedable bovines and the results were expressed as mean $\pm$ standard error (SE). To conduct pairwise comparisons of means, Tukey's Honest Significant Difference (HSD) test was employed. The minimum level of significance considered was $P < 0.01$ in the analysis. Accordingly, the parameters, viz. average milk yield (litres/day), peak yield (litres/day), average lactation length (days), milk yield per lactation (litres), dry period (days) for productive traits and age at puberty (months), age at sexual maturity (months), age at first calving (days), service period (days), number of services per conception and calving interval (days) for reproductive traits were evaluated.

The productive and reproductive traits of milch animals (parous and heifers) were compared for non-descript cattle, cross-bred cattle and buffaloes to assess their health status and production potential. The parameters included for the productive (Table 1) and reproductive traits of parous animals (Table 2), and the parameters of reproductive traits in heifers (Table 3) have been discussed in detail here.

Productive traits: Average milk yield (AMY in litres/day) directly reflects the productivity and profitability of milch animals and helps in estimating the returns to dairy farmers. AMY in cross-bred cows was found to be significantly higher than the buffaloes and non-descript cattle (Table 1). The estimated AMY of crossbred cows was in accordance with the findings of Vijayakumar *et al.* (2019) in which the AMY of crossbred cows was 8.06 liters/

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Table 1. Productive traits in parous animals

Trait	Non-descript cows	Crossbred cows	Buffaloes	P-value
Average milk yield (litres/day)	3.97±0.0 ^a	8.01±0.04 ^c	5.52±0.04 ^b	<0.001
Peak yield (litres/day)	5.86±0.08 ^a	10.32±0.05 ^c	8.10±0.06 ^b	<0.001
Milk yield per lactation (litres)	1108.05±9.53 ^a	2608.44±11.94 ^c	1957.36±10.65 ^b	<0.001
Average lactation length (days)	282.57±3.42 ^a	326.24±0.76 ^b	365.47±0.45 ^c	<0.001
Dry period (days)	150.34±0.85 ^b	76.24±0.76 ^a	150.47±0.45 ^b	<0.001

^{a,b,c}Means with different superscripts in a row differs significantly ($P \leq 0.01$).

Table 2. Reproductive traits in parous animals

Trait	Non-descript cows	Crossbred cows	Buffaloes	P-value
Age at first calving (days)	1131.55±8.71 ^b	997.37±3.39 ^a	1582.28±4.09 ^c	<0.001
Calving Interval (days)	432.91±3.96 ^b	402.49±1.51 ^a	515.94±0.9 ^c	<0.001
Service period (days)	152.91±3.96 ^b	122.49±1.51 ^a	205.94±0.91 ^c	<0.001
No. of services/ conception	2.42±0.08 ^a	2.65±0.03 ^b	2.98±0.04 ^c	<0.001

^{a,b,c}Means with different superscripts in a row differs significantly ($P \leq 0.01$).

day. The AMY for buffaloes was lower as compared to the results of Kale *et al.* (2018) with an AMY of 7.98±1.73 litres in Haryana.

Peak milk yield (PMY in litres/day) denotes the maximum production potential the animal can reach during its lactation period. The higher PMY results in higher milk yield per lactation. The overall PMY in crossbred cows was significantly higher, followed by buffaloes and non-descript cows (Table 1). The results for buffaloes and cross-bred cattle were similar to the findings of the study conducted by Kale *et al.* (2018) in Odisha with the average peak milk yield of 8.25±0.87 and 9.37±1.87 litres/day in buffaloes, crossbred cows, respectively. The results for non-descript cows did not corroborate with the findings of Kale *et al.* (2018).

The overall milk yield per lactation (litres) was significantly higher in crossbred cows, followed by buffaloes and non-descript cows (Table 1). In comparison with crossbred cows, the lactation yield of non-descript cows was extremely low. The similar observations were made in the study conducted by Vijayakumar *et al.* 2019 which reported milk yield per lactation of 2580.11±84.51 litres in crossbred cows.

The average lactation length (days) for buffaloes was significantly higher compared to the crossbred and non-descript cows (Table 1). The estimated mean lactation length of crossbred cows was lower when compared with the findings of Vijayakumar *et al.* (2019) which reported a mean lactation length of 364.21 days. The computed average lactation length of buffalo was higher in comparison with the findings of Thiruvankadan *et al.*

(2010) in Tamil Nadu with a mean lactation length of 312.8±5.7 days.

The dry period (days) in buffaloes and non-descript cows was found to be significantly higher than in crossbred cows (Table 1). Generally, a dry period of approximately 60 days should be allowed for replenishment of nutrients and recovery from stress by the body of an animal, which was found satisfactory for cross-bred cattle in the study area. However, the dry period for non-descript cows and buffaloes was much higher compared to the normal dry period, which will lead to losses in production over the herd life of an animal. According to the findings of Vijayakumar *et al.* (2019) and Thiruvankadan *et al.* (2014), the dry period of 139.07±14.92 days in crossbred Jersey cows and 230.2 days in buffaloes, respectively, was not in corroboration with the present study. However, the dry period for buffaloes was similar to the findings of Kale *et al.* (2018) who estimated an average dry period of 156.35±30.04 in buffaloes in Haryana.

Reproductive traits in parous animals: Age at first calving, calving interval, and service period were found to be significantly higher in buffaloes ($P < 0.001$), followed by non-descript cows and cross-bred cows (Table 2). The results of the study related to the age at first calving were higher for cross-bred cows as compared to the findings of Vijayakumar *et al.* 2019, i.e. 883.08±32.95 days and the results were in corroboration with the findings of Thiruvankadan *et al.* (2010) in case of buffaloes, i.e. 1578.7 days. The results for the calving interval in non-descript cattle were lower compared to the findings of Vijayakumar *et al.* (2019), i.e. 460.56±11.08 days. According to the

Table 3. Reproductive traits in heifers

Trait	Non-descript heifer	Crossbred heifer	Buffalo heifer	P-value
Age at puberty (months)	27.35±0.50 ^b	21.49±0.27 ^a	37.02±0.18 ^c	<0.001
Age at sexual maturity (months)	29.74±0.46 ^b	23.51±0.27 ^a	39.02±0.18 ^c	<0.001
No. of services/ conception	2.32±0.13 ^a	2.57±0.05 ^a	2.88±0.08 ^b	<0.001

^{a,b,c}Means with different superscripts in a row differs significantly ($P \leq 0.01$).

study conducted by Thiruvankadan *et al.* (2014), the calving interval in buffaloes was reported to be 532.8 days.

The ideal service period is the post-partum interval required by an animal for the involution of the uterus and recovery from stress till its conception, i.e. in between 60 to 90 days. The service period for cattle and buffalo in the study area was quite longer than the ideal service period (Table 2), this can be attributed to the ideology of farmers in the study area that breeding their animals in the early phase of lactation will drastically decrease the milk yield. The results for cross-bred cows were comparatively less than the findings of the study conducted by Vijayakumar *et al.* (2019), i.e. service period of 213.15 ± 14.21 days. However, the findings of Thiruvankadan *et al.* (2014) related to the service period of buffaloes, i.e. 225 days were similar to the findings of the present study.

The number of services per conception was significantly higher in buffaloes, followed by crossbred cows and non-descript cows (Table 2). These results were in corroboration with the findings of Kale *et al.* (2018) which reported the average number of services of 2.24 ± 0.78 in buffaloes, 2.34 ± 0.77 in crossbred cattle and 2.05 ± 0.79 in indigenous cattle in Haryana.

Reproductive traits in heifers: The results for reproductive traits in heifers are presented in Table 3. Under ideal conditions, Taurus cattle and their crossbreds attain puberty at an early age than the zebu or indigenous cattle (Diro *et al.* 2020). The age at puberty (months) in the present study for buffaloes was significantly higher ($P < 0.001$), followed by non-descript heifers and crossbred heifers, similar to the findings of Diro *et al.* 2020. According to Falvey and Chantalakhana (1999), the optimum and acceptable age of puberty for cattle should be less than 18 and 24 months, and for buffaloes should be less than 30 and 36 months, respectively.

After attaining puberty and desirable body weight, when an animal is capable of conceiving and sustaining pregnancy till parturition, at this age, an animal is said to be sexually matured. The age of sexual maturity (months) displayed a similar pattern as that of age at puberty was significantly higher ($P < 0.001$) in buffaloes, followed by non-descript heifers and crossbred heifers. The number of services per conception was significantly higher in buffalo heifers ($P < 0.001$), followed by crossbred and non-descript heifers. The number of services per conception for heifers was lower as compared to the parous animals.

SUMMARY

The assessment of productive and reproductive traits helps in identifying animals with superior germplasm in comparison to their population mean which helps in selecting animals for breeding purposes. The early detection of low-performing animals based on the parameters considered for the evaluation of productive and reproductive traits in

the study can help in culling animals at an early age, thus saving the cost of maintenance or losses for dairy farmers.

Overall, it was observed that the productive and reproductive performance of cross-bred cows was better as compared to the buffaloes and non-descript cows. Therefore, the study advises taking the following steps; record keeping, regular testing for various diseases, balanced ration, maintenance of proper hygiene, availability of nearby veterinary services, and upgradation of non-descript animals to exploit maximum production potential at farmers' level.

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