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Productive and reproductive performance of local and cross-breed dairy cattle in Kanchan rural municipality, Rupandehi, Nepal

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ABSTRACT

A household survey was conducted to compare the productive and reproductive performance of local and crossbreed dairy cattle under farmer's management conditions in Kanchan Rural Municipality, Rupandehi, Nepal. A total of 115 households were surveyed, and the data of 141 cattle, local (n=38), Jersey cross (n=64), and Holstein Friesian (HF) cross (n=39), were collected and analyzed to determine their productive and reproductive performance. Peak milk yield per day and average milk yield per day were significantly lower in local than Jersey cross and HF cross, respectively. Lactation length was shorter and dry period was longer in local than Jersey cross and HF cross. Age at first mating, age at first calving, and postpartum heat period were significantly longer in local than Jersey cross and HF cross. However, calving to conception interval, calving interval, and service per conception were shorter in Local than JC and HF Cross. In the study, 31% had a history of repeat breeding, 5.7% had a history of abortion, and 24% of cattle had a history of anestrus. The incidence of repeat breeding was significantly higher in HF cross (59%), followed by Jersey cross (25%), and lower in local (13.2%). So, in conclusion, despite the overall productive and reproductive performance being higher, exotic cattle lack some traits that are more efficiently preserved in local cattle. The study also suggests using local cattle in a crossbreeding program to increase disease resistance and more efficient production.

Keywords*:* Calving age, Peak milk yield, Postpartum, Repeat breeding

People in Nepal are highly engaged in the agriculture sector, contributing the highest parts of GDP, which is 24.12% of national GDP. Livestock plays a significant role in the national economy, and within the livestock sector, raw milk contributes about 3.95% of agricultural GDP (MoALD 2023). The largest livestock population in Nepal is of cattle (24.79%), with a population of 7,413,197 (MoALD 2023). In fiscal year 2021-22, although the cattle population was decreased by 0.72%, total milk production is 25.66 lakh metric tons, which is increased by 3.5% compared to the previous year. Milk production of only cow is 1101812 MT which is increased by 3.9% compared to the previous year. This may be due to the increasing trend of purchasing improved breeds and adopting artificial insemination (AI) technology (MoALD 2023).

Cattle farming in Nepal primarily focuses on milk production, making it a major performance indicator that is closely interconnected with reproduction. Therefore, regular reproduction and timely calving are essential for consistent milk production. The key productivity indicators for cattle include milk production, lactation length, dry period, age of puberty, age of first mating, service per conception, age at first calving, post-partum heat period, service per conception after calving, and calving interval. These indicators are crucial for assessing the overall productivity and reproductive performance of cattle (Alam *et al*. 1970, Das 2022, Gautam and Khadka 2022, Meena *et al*. 2015, Miazi *et al.* 1970, Paul *et al.* 2013, Uddin *et al.* 1970). The reproductive and productive parameters are the major factors for determining the profit of cow farming (Torshizi 2016). The record of performance of cattle can be used to make breeding and management strategies to develop the dairy sector (Abrha *et al.* 2023).

In Nepal, only 6.73% of exotic breeds are notified (Central Bureau of Statistics 2022). The most common crossbred cattle reported are Jersey and Holstein Friesian (HF) cross with local breeds of cattle (DLS 2020). They are reported to have larger body sizes and higher productivity.

Productivity of exotic breeds is generally high, but their adaptation in this climatic condition is difficult. Similarly, their disease resistance is lower than that of the native breeds (Gautam and Khadka 2022). This issue emphasizes the need to identify which traits of native cattle are superior and which are inferior to those of exotic breeds. This knowledge can guide further studies aimed at managing native cattle populations and preventing the

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decline in their population. Furthermore, there is a lack of knowledge regarding the productive and reproductive performance of indigenous cattle in Nepal. Therefore, this study emphasizes the evaluation of the productive and reproductive potential of indigenous breeds and compares it with those of crossbred cattle.

MATERIALS AND METHODS

Location: The study was conducted in the Kanchan Rural municipality of Rupandehi, Nepal, which is located in tropical plains geographically known as the Terai region. The latitude of the study area is 27.65^{0}N and the longitude is 83.29^{0}E.

Animal: Local cattle in the study area are also known as Terai cattle. They are humped (*Bos indicus*) cattle with light-coloured and straight ears. They are mostly white-coated with black skin and occasionally found in black and other mixed colors. Its temperament varies from docile to semi-wild (Gorkhali *et al*. 2021). The crossbred here in the research means the cross between exotic breeds (Holstein Friesian and Jersey) and the local terai breed.

Sampling and survey: Farmers rearing the cattle were selected by using a simple random sampling technique, ensuring a diverse sample that considers variations in the number of cattle holdings, rearing practices, and socio-economic backgrounds of the farmers. Both primary and secondary data were collected during the study. A questionnaire was developed to gather the quantitative data regarding milk production, lactation length, dry period, age at first mating, age at first calving, post-partum heat period, calving to conception interval, calving interval, and service per conception of dairy cattle. A focused group discussion was conducted to explore the overall perception of the community regarding different breeds of cattle. Quantitative data was collected by face-to-face interviews with farmers.

Data collection and analysis: Data of a total of 141 parous cows [local= 38, Holstein cross= 39, and Jersey cross= 64] was collected from 115 households. Data was collected by using the Kobo toolbox and exported in an MS Excel sheet. The data was cleaned and imported in IBM SPSS version 25. The collected data was analyzed by using descriptive statistics and mean comparison. A one-way ANOVA was applied to compare continuous variables (different reproductive and productive performance parameters) between the groups of cows. The incidence of reproductive problems was compared by using the chi-square test at the level of significance of P<0.05.

RESULTS AND DISCUSSION

Out of 141 cows in 115 households, 62.4% reared only one cattle, 34% reared 2–5 cattle, and 3.5% reared >5 cattle. Farmers commonly used to milk the cattle twice a day. Among the surveyed cattle, 27.7% were Holstein Friesian (HF) cross, 45.4% were Jersey cross, and 27% were local cattle. Regarding the housing system, 93.6% used a 24-hour tie stall and 6.4% used daytime grazing. It was

Table 1. Productive and reproductive performance of different breeds (Mean±SD)

Breed	Average milk yield per day (in liters)	Peak milk yield per day (in liters)	Length of lactation period (months)	Length of dry period (months)	Age at first mating (months)	Age at first calving (months)	Postpartum heat period (months)	Service per conception	Calving interval (in months)	Calving to conception interval (in months)
Local Cattle	2.3±0.80^a	3.62±0.89^a	10.61±1.82^a	3.47±1.31^a	30.37±7.34^a	40.24±7.75^a	2.84±1.31^a	1.16±0.55^a	13.5±1.5^a	3.37±0.82^a
Jersey Cross	8.19±2.8^b	9.78±2.86^b	11.65±1.81^b	2.6±0.73^b	22.2±3.95^b	32.75±4.12^b	2.67±1.34^{ab}	1.56±0.71^b	14.16±1.99^{ab}	4.47±2.55^b
Holsten Friesian (HF) Cross	12.21±3.85^c	13.97±4.02^c	12.05±1.49^b	1.92±0.36^c	17.62±4.22^c	28.34±4.28^c	2.11±1.73^b	2.05±0.97^c	14.39±2.01^b	4.34±2.08^b

The values with different superscripts differ significantly (p< 0.05).

found that 89.4% used commercial feed, 56% cultivated pasture, and 70.9% of farmers provided supplementary feed. Among the surveyed households, most of the farmers reared crossbreed cattle. Feeding and watering of the cattle was done twice a day. Majority (60.3%) of the population used AI for breeding, 9.9% used natural, and 29.8% used both (AI and natural) breeding. Similarly, 64.5% of farmers had followed a half-yearly deworming routine, and 90.8% had done regular vaccination against HSBQ and FMD.

Milk production: Milk production varied significantly among the different cattle breeds, with local breeds producing 2.3±0.80 L/day, Jersey Cross yielding 8.19±2.8 L/day, and HF Cross reaching 12.21±3.85 L/day (Table 1). For local cattle, the peak milk yield was 3.62±0.8 L/day, while the average yield was 2.3±0.8 L/day, consistent with findings by Neopane and Pokhrel (2005) (2.1 L/day) and higher than the 1.7 L/day reported by Gautam and Khadka (2022). Jersey Cross showed a peak yield of 9.78±2.86 L/day and an average of 8.19±2.8 L/day, whereas HF Cross recorded the highest values, with a peak of 13.97±4.02 L/day and an average of 12.21±3.85 L/day. Milk production of pure Holstein and Jersey was found 17 litres per day and 13.86 litres per day, respectively, in Ireland (Coffey *et al.* 2016). It is difficult to interpret whether the production of Holstein and Jersey is satisfactory or not because of their unknown blood level. Milk production was found to be higher in Holstein crossbred, followed by Jersey and local breeds in our research area.

Lactation length and dry period: The lactation lengths for Local, Jersey Cross, and HF Cross cattle are found to be 10.6 months, 11.6 months, and 12 months, respectively (Table 1). The lactation length of local cattle ranges from a minimum of 7 months to a maximum of 15 months due to various anestrus problems, possibly due to improved husbandry practices compared to previous findings (Gautam and Khadka 2022, Neopane and Pokhrel 2005). The length of the dry period is significantly higher in local cows, followed by Jersey crossbreds and HF crossbreds. These results closely align with the study of Gautam and Khadka (2022). This variation is primarily due to differences in the genetic makeup of the breeds and their production traits. Additionally, differences in husbandry practices, such as types of feed, feeding frequency, deworming, vaccination, and other supplementary nutrients, contribute to the production differences. Generally, crossbreed farmers implement better husbandry practices, resulting in greater differences in milk production (Azad *et al.* 2023).

Age at first mating and age at first calving: The age at first mating for Local, Jersey Cross, and HF Cross was 30.4±7.34 months, 22.2±3.95 months, and 17.62±2.2 months, respectively (Table 1). The age at first mating for local cattle commonly found in the Terai region was previously reported as 39.4±0.5 months (Gorkhali *et al.* 2021), which is more than the current study. Similarly, age at first calving was found to be earlier in HF cross, followed by Jersey cross, and later in local breeds. This result is similar to the study by Coffey *et al.* (2016). The age at first calving in the case of local cattle of Nepal was less than the previous studies by Gautam and Khadka (2022) and Gorkhali *et al.* (2021), which may be due to increased awareness among farmers about proper husbandry practices and nutrition management. The previous studies also have found that the first mating age and calving age are comparatively higher in local cattle bread than in the exotic and crossbred; this may be due to their breed difference or due to genetic makeup (Paneru *et al.* 2016, Ibrahim and Seid 2017, Perry 1991).

Post-partum heat period and service per conception: The post-partum heat period was shorter in HF crossbreds, followed by Jersey crossbreds and local cattle. The post-partum heat period was 2.84±1.31 months for local cattle, 2.67±1.34 months for Jersey crossbreds, and 2.11±1.73 months for HF crossbreds (Table 1). The result is similar to previous research by Norman *et al.* 2009, which reported a post-partum heat period of 2.83 months for Holstein and 2.76 months for Jersey cattle. The breed of the cattle plays a significant role in the heat of a cattle after parturition (Larsson *et al.* 1984).

The number of services per conception in local cattle was found to be 1.16±0.55, which is significantly lower than in Jersey crossbreds and HF crossbreds. The lower number of services per conception in local cattle may be due to the fact that most of them are bred naturally (Gautam and Khadka 2022). The number of services per conception in HF crossbreds (2.05±0.97) is almost similar to the previously reported value of 2.2 by Siatka *et al.* (2017). The number of services per conception depends on the breeding system that is being used and is usually higher


Local Cattle


HF crossbred


Jersey Crossbred

Table 2: Incidence of various reproductive diseases in different breeds of cattle

Breed	Repeat breeding		Abortion		Anestrus	
	Number	Percentage	Number	Percentage	Number	Percentage
Local Cattle (38)	5	13.2%[a]	2	5.3%	8	21%
Jersey Cross (64)	16	25%[a]	3	4.7%	19	29.7%
Holsten Friesian Cross (39)	23	59%[b]	3	7.7%	8	20.5%
Total (141)	44	31%	8	5.7%	35	24.8%

The values with different superscripts differ significantly, $p < 0.05$.

in natural breeding than in artificial insemination (Ibrahim and Seid 2017).

Calving interval and calving to conception interval: The calving interval was also found to be shorter in local cattle, followed by HF crossbred and Jersey crossbred. There was a difference between HF cross and local breeds in the calving interval only (Table 1). These results align with previous studies in Bangladesh and India (Alam *et al.* 1970, Meena *et al.* 2015, Miazi *et al.* 1970, Uddin *et al.* 1970). The conception rate depends on various factors like breed of cattle, bull used and its breed, health status of animal, environmental and nutritional condition, etc. (Slama *et al.* 1976). The calving to conception interval was also found to be shorter in local cattle, followed by Holstein crossbreeds and Jersey crossbreeds. There is a significant difference between the calving to conception interval of local cattle compared to Jersey crossbred and HF crossbred, but there is no significant difference between Jersey crossbred and Holstein crossbred.

Reproductive disease: Reproductive diseases are also major indicators of reproductive performance in cattle. Various reproductive diseases, such as repeat breeding, anestrus, and abortion, significantly reduce the profitability of cattle farming. The incidence of repeat breeding was 13.2% in local cattle, 25% in Jersey cross, and 59% in HF cross; similarly, abortion was 5.3% in local breed, 4.7% in Jersey cross, and 7.7% in HF cross; and anestrus was 21% in local breed, 29.7% in Jersey cross, and 20.5% in HF cross. This incidence rate is significantly higher than reported by Gautam and Khadka (2022), which noted only 5.7% for repeat breeding and 0.76% for abortion. This higher incidence may be attributed to less awareness among farmers regarding good reproductive health and husbandry practices

The incidence of reproductive diseases is higher in exotic crossbreeds and lower in local cattle in the present study. Additionally, the case of repeat breeding was significantly higher in HF cross at 59%, followed by 25% in Jersey cross and 13.2% in local cattle in the present study, which is similar to the findings reported by Gautam and Khadka (2022). In a previous study by Bhat *et al.* (2012) in Kashmir, India, the incidence of repeat breeding was reported to be higher in Jersey crossbreds and HF crossbreds than local cattle without any significant difference. There was also no significant difference between breeds for anestrus and abortion.

Repeat breeding has been associated with high milk production (Eshete *et al.* 2023, Hasan *et al.* 2018), so this may be a contributing factor to the higher incidence of repeat breeding in HF cross followed by Jersey cross and local cattle in the present study (Table 2). The higher incidence of reproductive diseases in exotic breeds might be due to their lesser adaptation to the local environment. Additionally, the higher incidence of repeat breeding in exotic breeds might be attributed to insemination failures due to human and technical errors, whereas local breeds are more likely to be bred naturally.

The productive performance of local cattle was found to be low in comparison with exotic crossbreeds. Exotic crossbreeds were observed to perform well in the local climatic conditions in terms of various productive parameters than the local cattle. This difference in performance can be attributed to the provision of better nutrition and other facilities for exotic breeds compared to local breeds.

Despite the lower facilities and nutritional management for local cattle, they were still found to perform well. Some reproductive traits were even more effective in local breeds compared to crossbreeds. Like, service per conception, calving to conception interval, and calving interval were shorter in local breeds. Additionally, the incidence of reproductive problems was lower in local breeds than in exotic breeds, indicating higher adaptability of local breeds to the existing environment.

These favourable traits in local breeds are essential for long-term productivity and conservation of native genetic potential. To enhance the quality of local breed production and conserve our native genetic resources, we should implement scientific selection procedures and improve husbandry practices. These measures will promote the productive and reproductive performance of local breeds in the future.

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