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PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF FARMERS MANAGED DAIRY CATTLE IN WESTERN CHITWAN, NEPAL

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ABSTRACT

The productive and reproductive performances of dairy cattle along with the management aspects of the farm have a direct effect on farm profitability. The present study was carried out from a sample of 120 dairy herds using pretested and well-organized semi- structured questionnaire in Bharatpur Metropolitan City, Chitwan. Productive and reproductive performances of two common breeds, Jersey Cross and Holstein Cross were analyzed. The average daily milk yield, lactation length, lactation milk yield, peak yield and dry period for Jersey Cross and Holstein Cross with the Nepalese hill cattle were observed to be 7.39±0.87 and 9.30±0.76 L./day; 303.31±8.12 and 314.18±12.75 days; 2253.39±265.28 and 2936.36±237.55 L.; 12.77±0.92 and 15.11±0.85 L. and 65.26±7.71 and 70.83±10.27 days respectively. The age at first calving (29.08±1.99 and 30.42±1.81 months), Service period (82.37±10.99 and 100.64±13.44 days), service per Conception (1.71±0.54 and 1.82±0.58 times/cow) and Calving interval (365.37±10.92 and 385.56±13.46 days) respectively for Jersey crosses and Holesteinc crosses. The significant relationship ($p<0.05$) was found between farms having single breeds and double breeds on the productive performances. Likewise, the significant relationship ($p<0.05$) was also found between farms having single and double breeds on reproductive performances. The significant relationship ($p<0.05$) was observed between the herd size and age at first calving on jersey cross and none of the parameters showed significant relationship ($p>0.05$) between the herd size and productive parameters. Further research on needs to be carried out see the particular relationships among production, reproduction and management aspects.

Keywords: Average daily milk yield, Lactation length, Lactation milk yield, Dry period, Calving interval, Peak milk yield.

INTRODUCTION

Livestock farming is an important agricultural sub-sector in Nepal. Livestock sector contributes about 11.5 % of the total GDP (MOALD, 2019) and 25.7 % of the agricultural GDP (MOAD, 2014). Similarly, dairy sub- sector is one of the most viable and flourishing sectors in Nepal with 9 % share to the country's gross domestic product (GDP) and 25.68% of AGDP (MOAD, 2014) and it is one of the five high ADS priority sector/commodities in country producing a vital source of cash income, family nutrition, manure for agriculture and as a source of draft power for different agricultural works. Dairy processors in the country annually pay revenue of Rs. 1 billion to the government and supplies milk worth Rs.30 million daily to urban centers from rural production points (Times, 2018). Besides, the investment and policy implications in the national scale, however the small-scale dairy production is still not in profit due to management constraints. The breed management is one of those constraints in the small holder dairy farming system of Nepal. It has long been recognized that breed selection for the efficiency of dairy production is causing severe financial losses to producers. In mixed breed conditions, reproductive health management is an important issue for productive performance (Coleman *et al*., 1985) which has been neglected in many small

holder farms in Nepal. The reproductive performance varies in cows in the same herd and it is obvious somewhat in the mixed herds (Coleman *et al*., 1985). It is further obvious that the productive performance is related to the herd reproductive status (Whitemore *et al.*, 1974).

The purpose of this study is to determine the productive and reproductive performances of Holstein cross and Jersey cross cows using type of breed and herd size as the basis for comparison in Chitwan district of Nepal focusing on the western side of the district.

MATERIALS AND METHODS

Site selection

Chitwan district was purposively selected as a study site due to the potentiality of milk production, accessibility of researcher and budget and time constraints to study the impact of various parameters in the performance of dairy farms. The research was conducted in several wards of Bharatpur Metropolitan City of Chitwan district.

Farmers interview and survey

Especially the dairy farmers of the Western Chitwan area were selected as the sample population of the study. Dairy farmers were selected by simple random sampling method. The questionnaire survey was conducted at Bharatpur Metropolitan- 5 (Torikhet), Ward no. 6 (Kesharbagh and Parasnagar), and ward no. 23 (Prithvinagar and Champanagar). Pre-survey field visits were performed to gather preliminary information regarding the demographic, socio-cultural, and topographical settings of the site. This information was used in preparing questionnaires and designing a sampling framework.

Data collection and analysis

Primary data collection was done through the direct interview schedule with the help of a semi-structured questionnaire for 120 farms. Focus Group Discussion, Key Informants interviews, and direct interviews were done for the primary data collection. The relevant data for this study were collected from different sources like journals, books, thesis, and official reports of line ministries, NGOs, dairy cooperatives, libraries, and different related websites. The local political leaders, working agencies, and local government were also the source of secondary information. The statistical package for social science (SPSS) version 25, in which the one-way analysis of variance was used to quantify the differences between the productive and reproductive parameters.

RESULTS AND DISCUSSION

Productive Performances

A significant relationship ($p<0.05$) was observed between breed and productive performances in this study, might be due to the differences in the breed performances and diversity in management the farmers were practicing in the research area which is in agreement with Nielsen *et al.* (2003). Similar relationship was reported between breed and milk yield on a study done in Chitwan and Nawalparasi districts (Paneru *et al.*, 2016). Likewise, Jago and Berry (2011) and El-Tahawy (2017) reported the significant relationship between herd size and productive performances but in this study, we could not find such relationship between herd size and productive performances which could be due to the

reasons like a smaller number of samples, poor record keeping, small herd sizes and lack of professionalism in farming.

Average daily milk yield

The average daily milk yield of Jersey cross cows was found out to be 7.39 litres while that of Holstein cross was 9.34 liters. The relationship between farms with single breeds and double breeds was found to be significant ($p<0.05$) with average daily milk yield. While the relationship between herd size and average daily milk yield was found to be insignificant ($p>0.05$).

This result is obvious as HF crosses have high production potential than that of Jersey cross and in line with past reports. Timsina (2010) reported comparable figure of average daily milk yield (7.93 litres) in Phulbari, Chitwan to this finding. Similarly, Upadhyaya *et al.* (2018) also documented the average daily milk yield of cow to be 9.24±0.21 liters in Chitwan. This finding is also comparable to the report of 6.85 litres per day average daily milk yield of Jersey cow in Ethiopia as they have comparable economic and dairy farming context to Nepal (Hunde *et al*., 2015; Meena *et al*., 2015). In contrary, Ayalew, *et al.* (2015) observed the average daily milk of 11.21 litres per day in Holstein cross which is slightly more than present finding.

Table 1. Relationship between dairy cattle breeds and their productive performances within farms in Western Chitwan, 2020

Productive Parameters	Single crossbreds		SD	F-value	P-value	Both crossbreds		SD	F-value	P-value
	J	H				J	H			
Average DMY (L.)	7.31	9.51	0.98	11.35	<0.05	7.49	9.32	1.21	143.37	<0.05
LL (days)	303.23	315	9.12	3.35	>0.05	303.40	314.15	11.69	28.27	<0.05
LMY (L.)	2229.23	2900	297.65	11.41	<0.05	2283.02	2937.74	409.16	189.95	<0.05
PMY (L.)	12.80	14.50	0.94	6.89	<0.05	12.74	15.13	1.50	187.55	<0.05
DP (days)	65.31	67.50	7.24	0.18	>0.05	65.38	71.04	9.74	9.69	<0.05

Note: J= Jersey Cross, H= Holstein Cross, SD= Standard Deviation, DMY= Daily Milk Yield, LL= Lactation Length, LMY= Lactation Milk Yield, PMY= Peak Milk Yield, DP= Dry Period

Lactation length

A total of 118 of the farms had Jersey cross cows which had an average lactation length of 303.31 days whereas 55 of the farms possessed Holstein cross with an average lactation length of 314.18 days. The relationship between farms with multiple breeds was found to be significant ($p<0.05$) with lactation length while the relationship between farms having single breeds and herd size with lactation length was found to be statistically similar ($p>0.05$).

The average lactation length observed for Jersey cross (303.31 days) and Holstein cross (314.18 days) in this study was a bit longer than the standard recommended for good dairy husbandry management, which might be due to the variation in farmers range from subsistence to the commercial-oriented one. Timsina (2010) reported the average lactation length of 9.37 months (281.1 days) in a case study conducted in Phulbari, Chitwan district which is, though less, in line with this finding. Similarly, this result is comparable with Ayalew, Aliy, & Negussie (2015) who reported the average lactation length of 319 days in

Ethiopia for Holstein cows. Sandhu *et al.* (2011) also documented the statistically similar finding of average lactation length (314 days) for Holstein in Balochsitan, Pakistan.

Lactation milk yield

The average lactation milk yield of Jersey cross cows was reported to be 2253.39 litres per lactation while that of Holstein cross cows was 2936.36 liters per lactation. The relationship between farms with single and double breeds was found to be significant ($p<0.05$) with lactation milk yield but the relationship between herd size and lactation milk yield was found to be non-significant ($p>0.05$).

The average lactation milk yield recorded for Jersey cross (2253.39 litres/Lactation) and Holstein cross (2936.36 litres/Lactation) was in disagreement with (Hunde *et al*., 2015) who reported the average lactation milk yield of Jersey and Holstein cow to be 2090.35 litres and 3578.33 litres (Ayalew *et al.* (2015) in Ethiopia. Similarly, Paneru *et al.* (2015) observed much better performances in terms of the average lactation milk yield for Jersey and Holstein cow to be 2652.95 litres and 3,077.81 litres respectively in Chitwan and Nawalparasi district.

Table 2. Relationship between herd size and productive performances of dairy cattle in Western Chitwan, 2020

Herd size		DMY (L.)		LL (days)		LMY (L.)		PMY (L.)		DP (days)	
		J	H	J	H	J	H	J	H	J	H
<3	Mean	7.17	9.25	302.93	317.08	2186.96	2900	12.7	15	64.57	68.75
	N	46	12	46	12	46	12	46	12	46	12
3-6	Mean	7.46	9.40	302.86	310.53	2276.19	2952.63	12.79	15.11	66.22	71.84
	N	42	19	42	19	42	19	42	19	41	19
>6	Mean	7.62	9.34	304.5	315.62	2323.33	2941.67	12.87	15.17	65	71.09
	N	30	24	30	24	30	24	30	24	30	23
Total	Mean	7.39	9.34	303.31	314.18	2253.39	2936.36	12.77	15.11	65.26	70.83
	N	118	55	118	55	118	55	118	55	118	55
	SD	0.87	0.76	8.12	12.75	265.28	237.55	0.92	0.85	7.71	10.27
F-Value		2.72	0.14	0.43	1.26	2.72	0.19	0.32	0.15	0.52	0.34
P- Value		>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05

Note: J= Jersey Cross, H= Holstein Cross, SD= Standard Deviation, DMY= Daily Milk Yield, LL= Lactation Length, LMY= Lactation Milk Yield, PMY= Peak Milk Yield, DP= Dry Period

Peak Milk Yield

The average peak yield of Jersey Cross cows was found out to be 12.77 litres while that of Holstein Cross cows was 15.11 litres. The relationship between farms with single breeds and double breeds was found to be significant ($p<0.05$) with peak milk yield while the relationship between herd size and peak milk yield was observed to be insignificant ($p>0.05$).The peak milk yield observed for Jersey Cross (12.77 litres) and Holstein Cross (15.11 litres) was comparable with Thakur and Singh (2000) who documented the peak yield of 11.03 litres from 3083 lactation records of 1203 purebred Jersey cows and 12.9 litres from 642 Holstein crosses in India, which is slightly lesser than this finding.

Dry Period

It was found that the average dry period for the Jersey cross was 65.26 days while that for the Holstein cross was 70.83 days. The relationship between farms with double breeds was found to be significant ($p<0.05$) with the dry period while the relationship between farms having single breeds and herd size with respect to the dry period was found to be non-significant ($p>0.05$).

The average dry period for the Jersey cross (65.26 days) and Holstein cross (70.83 days) is at par with the standard recommendation of good husbandry management for proper recovery of wear and tear in the udder and secretory cells. Similar observations were reported by Upadhyaya *et al.* (2018) from Phulbari, Chitwan in dairy cows with a dry period length of 61.55±1.76 days which is slightly less than the present results. But, Adebayo and Oseni (2016) showed a different picture of the Jersey cow's dry period (87.5±2.52 days) in Nigeria under the tropical condition. Similarly, Rahman and Alemam (2008) reported the average dry period of Holstein cattle in Sudan to be 90 days which is much higher than the findings of the present study.

Reproductive Performances

The result showed that Holstein crossbreds had a longer duration at calving and the trend was similar for the number of services per conception though the service period and calving interval was similar between the two genotypes respectively (Table 3). A significant relationship was found between breed and reproductive performance in research conducted by Nielsenet *et al*. (2003) which is similar in our case too. A significant relationship was found between breed and reproductive performances in research conducted on dairy cattle under smallholder production system (Asimwe & Kifaro, 2007) which is similar in our case too as feed efficiency, genetic potential, adaptability to various climatic conditions differs which ultimately causes the differences in reproductive performances among various breeds of cattle.

Expanding herds and large herds were found to have a higher reproductive performance relative to non-expanding and small herds (Jago & Berry, 2011; El-Tahawy, 2017) but this study could not find such significant relationship between herd size and reproductive performances which might be due to various reasons like a smaller number of samples, poor record keeping, small herd sizes and lack of professionalism in farming.

Table 3. Relationship between breeds and reproductive performances of dairy cattle within farms in Western Chitwan, 2020.

Reproductive Parameters	Farms having single Breeds		Std. deviation	F-value	P-value	Farms having both Breeds		Std. deviation	F-value	P-value
	J	H				J	H			
AFC (months)	29.28	30.50	1.92	0.78	>0.05	28.85	30.42	2.09	17.08	<0.05
SP (days)	81.23	97.50	11.27	4.25	<0.05	83.77	100.75	14.95	50.25	<0.05
SC	1.74	1.50	0.57	0.34	>0.05	1.68	1.83	0.55	2.02	>0.05
CI (days)	364.23	380.50	11.27	4.25	<0.05	366.77	385.75	15.54	62.78	<0.05

Note: J= Jersey Cross, H= Holstein Cross, AFC= Age at First Calving, SP= Service Period, SC= Service per Conception, CI= Calving Interval.

There was a similar age at calving across the herd size category in Jersey crossbreds, while it was significantly ($p<0.05$) affected by herd size in Holstein. In the case of service period, service per conception and calving interval were affected by herd size in the survey farms respectively for both types of genotypic crossbreds (Table 9).

Table 4. Relationship between herd size of dairy cattle and reproductive performances in Western Chitwan, 2020

Herd size		AFC (months)		SP (days)		SC		CI (days)	
		J	H	J	H	J	H	J	H
<3	Mean	29.61	30.83	81.63	95	1.65	1.75	364.63	379.83
	N	46	12	46	12	46	12	46	12
3-6	Mean	28.45	30.37	82.14	102.63	1.74	1.84	365.14	387.53
	N	42	19	42	19	42	19	42	19
>6	Mean	29.17	30.25	83.83	101.88	1.77	1.83	366.83	386.88
	N	30	24	30	24	30	24	30	24
Total	Mean	29.08	30.42	82.37	100.64	1.71	1.82	365.37	385.56
	N	118	55	118	55	118	55	118	55
	SD	1.99	1.81	10.99	13.44	0.54	0.58	10.92	13.46
F- Value		3.91	0.42	0.38	1.38	0.48	0.10	0.51	1.41
P- Value		<0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05

Note: J= Jersey Cross, H= Holstein Cross, AFC= Age at First Calving, SP= Service Period, SC= Service per Conception, CI= Calving Interval, N= Number of Farms

a. Age at first calving

It was evident from the survey that the age at first calving of Jersey cross cows was 29.08 months while that for Holstein cross cows was 30.42 months. The relationship between farms with double breeds and herd size of Jersey cross cows was found to be significant ($p<0.05$) with age at first calving but the relationship between farms having single breed and herd size of Holstein cross cows was found to be insignificant with respect to age at first calving ($p>0.05$).

This result is similar to Hunde *et al*. (2015) in Ethiopia for Jersey cattle where the average age at first calving was observed to be 29.9±0.17 months and Rahman and Alemam (2008) in Sudan for Holstein Friesian cattle where the average age at first calving was found to be 29.8 months. Similar finding was also reported by Paneru *et al*. (2016) in Chitwan and Nawalparasi, Nepal and documented the age at first calving to be 816 ±27.41 days (i.e., 27.2 months).

b. Service period

It was found that Jersey cross cows took 82.37 days on average as the service period while Holstein cross cows took 100.64 days as service period on an average. The relationship between farms with single and double breeds was found to be significant ($p<0.05$) with service period while the relationship between herd size and service period was found to be insignificant ($p>0.05$).

These findings are not in agreement with Sattar *et al.* (2004) who observed the average service period for Jersey cows to be 152.66 ± 4.85 days in Punjab, Pakistan. Rahman and

Alemam (2008) reported the average service period of 167.8 days for Holstein cattle in Sudan, which is very higher than our finding. Paneru *et al.* (2016) also reported the service period to be 149.93±27.04 days in Chitwan and Nawalparasi of Nepal, which is higher than the findings of the present study. The present findings with better performances in terms of the average service period might be due to the superior genetic make-up of study animals (managed through artificial insemination) and the better feeding management.

c. Service per conception

It was observed that the service per conception rate of 1.71 was observed in Jersey cross cows while the service per conception rate for Holstein cross was found to be 1.82 in the research area. The relationship between farms with single and double breeds along with herd size was found to be insignificant with respect to service per conception ($p>0.05$). This finding is better than that of Ayalew *et al.* (2015) in Ethiopia on Holstein cows with the average services per conception of 2.02±0.02 and Sattar et al. (2004) in Punjab, Pakistan on Jersey cows with the average number of services per conception of 2.81 ± 0.09. In contrast, a fairly fine observation in terms of the service per conception (1.38) was reported by Paneru *et al.* (2016) in Chitwan and Nawalparasi districts of Nepal than what observed in the present study.

d. Calving interval

It was found that the average calving interval for Jersey cross cows was 365.37 days and 385.56 days for the Holstein cross cows. The relationship between farms with single and double breeds was found to be significant ($p<0.05$) with calving interval but the relationship between herd size and calving interval was found to be insignificant ($p>0.05$). This finding is much better and not in agreement with Sattar *et al*. (2004) in Punjab, Pakistan for Jersey cows having the average calving interval of 430.15±4.87 days. Norman *et al.* (2009) reported in the US for Holstein cows having the average calving interval of 422 days which is a bit higher than this finding. Similarly, Paneru *et al.* (2016) also reported the higher average calving interval of 422.8±7.71 days in Chitwan and Nawalparasi districts of Nepal which is higher than the present findings.

The findings of this study clearly indicated that the genotypes used in crossbreeding and herd size are the important multitudes of factors affecting the production performance (Caraviello *et al*., 2006) at the setting of nutritional balance (Veerkamp *et al.,* 2000). However, prevalence of specific disease was not observed devastating to the milk and reproductive performance of cattle in the smallholder farmers. As such the information gathered is useful tool on all aspects of small-scale dairy operations from the general management view point. Several key challenges and ideas were identified mostly for raising Holstein as Holstein had a more concern on the Tropical environment of Chitwan, Nepal. In addition, the shorter days of dry periods also hint for the better adaptability of the Jersey genotypes as compared to the Holstein type.

CONCLUSIONS

The research results shows that the performance of Holstein crossbreds is comparatively better than the Jersey crossbreds in terms of production performance except for dry period which was found better for the Jersey cross cows under both single breed raisers and mixed breed raisers.

The research results further indicated that herd size within the study area had no influence on productive performances. Moreover, the Jersey cross is seen rather better in the reproductive performances than the Holstein cross without any influence by the herd size except in the case of age at first calving of Jersey cross which showed significant relationship. It is still unclear in the present study whether the pregnancy rate is falling and further work is needed to gather the information to quantify the reproductive performance in larger number of farm survey. Up to the breed level, it is clear to the productive and reproductive performances however, in herd level further work is needed to confirm the effect of herd size on productive and reproductive performances in the given management regime.

Authors Contributions:

S. Poudel did a field survey and writing, D.K. Chhetri and S.R. Barsila developed the research protocol and revised the manuscript.

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