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Reproductive and Productive Performance of Crossbred and Terai Cattle in Bardiya District of Nepal

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ABSTRACT

To compare the reproductive and productive performance of exotic crossbreds and indigenous Terai cattle under farmers' management condition, a household survey was carried out in 218 households of Bardiya, Nepal. Total of 262 cows [Jersey cross (n=107), Holstein cross (n=24) and indigenous Terai cattle (n=131)] were considered to determine the production and reproduction parameters. The age at first calving in months was the lowest in Jersey crossbred (27.8±1.8) followed by Holstein cross (29.5±4.0) and Terai cattle (45.7±3) (P<0.05). However, the number of services per conception, calving to conception interval (in months) and inter-calving interval (in months) were shorter in Terai cattle (1.3±0.7, 3.4±1.4 and 12.6±1.9) compared to Jersey cross (1.7±1.3, 4.4±2.2 and 13.5±3.1) and Holstein cross (1.8±0.9, 5.7±2.8 and 14.9±4.7), respectively (P<0.05). Total 6.5% of cattle had a history of reproductive problems; Incidence of repeat breeding tended (P<0.1)) to be higher in Jersey cross (8.4%) and Holstein cross (8.3%) than in Terai cattle (3.0%). Daily peak milk yield (L/day) was significantly lower in Terai cattle (1.7±1.1) than Jersey cross (13.5±3.1) and Holstein cross (14.9±4.7). The lactation length (months) was significantly shorter in Terai cattle than exotic crossbreds. Consequently, the length of dry period (in months) was significantly longer in Terai cattle (5.2±2.1) than in Jersey cross (2.5±0.9) and Holstein cross (2.2±0.7). The reproductive performance parameters in exotic crossbred cows under the farmers' management condition were satisfactory; however, their productivity was low. Thus, the good reproductive traits and variations in productivity of Terai cattle can be utilized in cross breeding programs.

Keywords: age at first calving, calving interval, infertility, milk yield, repeat breeding.

सारांश

कृषकको व्यवस्थापनमा पालिएका वर्णशंकर र रैथाने तराई गाईहरुको प्रजनन् तथा उत्पादनशील क्षमता जान्नको लागि बर्दिया जिल्लाको दक्षिणी भेगका २१८ घरधुरीबाट जम्मा २६२ गाईहरु (जर्सी क्रस-१०७, होल्स्टेन क्रस-२४ र रैथाने तराई गाई-१३१) प्रयोग गरिएको थियो। तथ्याङ्क सङ्कलन गर्न घरपरिवार सर्वेक्षण गरिएको थियो । पहिलो पटक ब्याएको उमेर (महिनामा) (औसत+SD) सबैभन्दा कम जर्सी क्रसमा (२७.८+१.८), त्यसपछि होल्स्टेन क्रसमा (२९.५+४.०) र तराई गाईमा (४५.७+३.८) थियो (पि <०.०५)। यद्यपि, गर्भ रहन आवश्यक बाली संख्या, ब्याएदेखि पुनः गर्भ रहने अवधि (महिनामा) र ब्याउने बेत अन्तराल (महिनामा) जर्सी क्रस (१.७+१.३, ४.४+२.२ र १३.५+३.१) र , होल्स्टेन क्रस (१.८+०.९, ५.७+२.८ र १४.९+४.७) गाईहरूको तुलनामा तराई गाईमा (१.३+०.७, ३.४+१.४ र १२.६+१.९) कम/छोटो थियो (पि<०.०५)। कुल ६.५% गाईवस्तुमा प्रजनन् समस्या भएको इतिहास थियो। बाली उल्टिरहने समस्या तराई गाईको (३%) तुलनामा जर्सी क्रस (८.४%) र होल्स्टेन क्रस (८.३%) मा बढी थियो (पि<०.१)। त्यसैगरी, दैनिक अधिकतम दूध उत्पादन (लि./दिन) र दुध दिने जम्मा अवधि (महिनामा) जर्सी क्रस (१३.५+३.१ र ९.८+०.५) र होल्स्टेन क्रस (१४.९+४.७ र १०+०.७९) को तुलनामा तराई गाई (१.७+१.१ र ५.०+१.७) को निकै कम/छोटो थियो। फलतः सुक्खा अवधि (महिनामा) जर्सी क्रस (२.५+०.९) र होल्स्टेन क्रस (२.२+०.७) को तुलनामा तराई गाईमा (५.२+२.१) निकै लामो थियो। निष्कर्षमा भन्नुपर्दा, किसानको व्यवस्थापनमा विदेशी वर्णशंकर गाईहरूमा प्रजनन क्षयमताका मापदण्डहरू सन्तोषजनक पाइयो तथापि, तिनीहरूमा उत्पादकत्व कम थियो। तसर्थ, तराई गाईको राम्रो प्रजनन गुण र उत्पादकत्वमा हुने भिन्नतालाई क्रस प्रजनन कार्यक्रममा उपयोग गर्न सकिन्छ ।

INTRODUCTION

Livestock plays a significant role in the Nepalese economy contributing approximately 11.5% to the national Gross Domestic Product (GDP) and 25.7% to the agricultural GDP (MoALD 2019). Livestock farming is as an indispensable part of the socio-economic life of the vast majority of Nepalese farmers showing its high potential for growth of livestock sector in the country for financial and social security of its people. In terms of animal mass units, cow is the largest livestock in Nepal with its population to be 7,458,885 in the year 2019/2020 (MoALD 2021). Of the total cattle population, about 88% were indigenous and the remaining 12% were of exotic and their crosses (CBS 2016). Dairy cows contribute 40% to the total milk production in the country (MoALD 2021) excluding their contribution on draft power and fertilizer.

Terai cattle are the indigenous cattle breed of Nepal reared in southern plains of the country under low input system. They are hardy and suitable for hot climatic conditions (Neopane and Pokhrel 2005). Since these animals are less productive in terms of milk production, exotic crossbred cows are preferred for commercial purpose. Major exotic crossbreds reared are Holstein cross and Jersey cross. Crossbreds however reported to be more susceptible to various reproductive problems such as repeat breeding, abortion, prolonged calving to conception interval, inter-calving interval in comparison to indigenous breeds because exotic breeds are not well-adapted to local production conditions and their performance is generally not optimal (Nyamushamba et al 2017).

The productive and reproductive performance of cows are the major indicators of efficiency of dairy farming. Productive performance parameters of lactating cows mainly includes daily milk yield, peak milk yield, length of lactation period and dry period, and total milk yield of the 305-day lactation period, whereas the major reproductive performance parameters include the age at first service and calving, calving to conception interval, number of services per conception and inter-calving interval (Alam et al 2008, Noakes et al 2009, Paul et al 2013). There is very limited studies has been performed comparing the performance of indigenous Terai cattle with the exotic breeds in the farmers' management condition. Furthermore, very limited information is found regarding production and reproduction parameters of Terai cattle of Nepal (Neopane and Pokhrel 2005). Therefore, the objective of the present study was to determine the various reproductive and productive performance parameters and reproductive problems of crossbred and Terai local cows under farmers' management condition in southern part of Bardiya district of Nepal.

MATERIALS AND METHODS

Location of the study

The study was carried out at ward numbers 7, 8 and 9 of Madhuban Municipality which lies in the southern part of Bardiya district, Nepal. Bardiya lies in Lumbini Province in midwestern Nepal; it comprises a portion of the terai or lowland and valleys and is at 175 meters above sea level having subtropical climatic conditions with hot summer and mild winter. Most of Bardiya is in the fertile Terai plains, covered with agricultural land and forest where majority of the population in the area are depend on agriculture for livelihood. Cows, buffalo, goat, sheep and pig are among the common animals reared. The Southern part in Bardiya is considered as the pocket area for cattle production with 7,608 cows only in Madhuban municipality consisting of nine wards (MoLD 2017) and the number of cows in the study area (in three wards i.e. ward numbers 7, 8 and 9) was estimated to be one-third of 7,608 which is around 2,536.

Data collection

A semi-structured questionnaire was developed to collect data regarding husbandry practices, health status, productive and reproductive performance parameters of individual cow. Face to face interview was taken with the cow owners to collect data regarding management practices (feeding, deworming, adoption of artificial insemination practices etc.), age at first calving, number of services per conception, calving to conception interval, inter-calving interval, reproductive problems (repeat breeding, abortion, dystocia etc.), milk production and lactation length.

Sampling frame

Data of total 262 parous cows [Holstein cross (n=24), Jersey cross (n=107) and indigenous Terai cattle (n=131)] from 218 households were collected. Breed of a cow was determined based on the phenotypic traits. Purposive sampling method was used; each household on the way was visited and data were collected if the household had any parous cow until the sample size reached at least 10% of the estimated cattle population in the study area (i.e. 254).

Data analyses

The data were entered into excel sheet (MS-Excel, version 2010) and analyzed using SPSS version 20 (SPSS Inc, Chicago, IL, USA). Continuous variables (various productive and reproductive performance parameters) among the groups of cows were compared using one way ANOVA and the Duncan's Multiple Range test (DMRT) was used as a post hoc test to measure specific differences between pairs of means. Similarly, the proportions among/between the groups for percentage of adoption of AI practices and incidence of repeat breeding cases were compared by using Chi-square test; if the expected frequency was <5 in more than 20% of the cells, the Fisher's exact probability test was used. Probability value $p<0.05$ was considered as significant whereas $0.05<P< 0.1$was considered to have tendency effect.

RESULTS

Number of cows per household (mean±SD) was 2.5±2.0 and the range was 1-14. Average number of parous cows per household (mean±SD) was 1.2±0.7 and the range was 1-9. All lactating cows were milked twice daily. Similarly, the cattle owners used to provide the commercial feed and mineral supplementation only to the crossbred cows and not to the indigenous cattle. Total 90% households used to graze their cows during day time. Total 58.8% households had cultivated grasses. Only 63% households used to deworm their cows. However, 37% households rarely dewormed their cows and those households reared only Terai cattle. Data on some parameters were not available for some cows, the number of total cows are, therefore, varied.

Reproductive performance

Age at first calving in three different breeds has been shown in **Table** 1. The age at calving was the lowest in Jersey cross followed by Holstein cross and Terai cattle ($P<0.05$).

Table 1. Age at first calving in different breeds of cattle

Breed	Age at first calving (months)	
	Mean±SD	Range
Holstein cross (n=24)	29.5±4.0[a]	23-40
Jersey cross (n=107)	27.8±1.8[b]	22-32
Terai cattle (n=131)	45.7±3.8[c]	40-58
Overall (n=262)	36.9±9.4	22-58

[a,b,c]within column, the values with different superscript differ significantly ($P<0.05$).

Table 2 shows the number of services per conception in parous cows. Holstein and Jersey cows required more number of services per conception as compared to Terai cattle ($P<0.01$).

Table 2. No. of services per conception in different breeds of cattle

Breed	No. of services per conception	
	Mean±SD	Range
Holstein cross(n=24)	1.8±0.9[a]	1-4
Jersey cross (n=107)	1.7±1.1[a]	1-6
Terai cattle (n=131)	1.3±0.7[b]	1-5
Overall (n=262)	1.5±0.9	1-6

[a,b]within column, the values with different superscripts differ significantly ($P<0.05$).

Table 3 shows the calving to conception interval in three breeds of cattle. Calving to conception interval was longer in Holstein and Jersey cows than in Terai cattle (P<0.05).

Table 3. Calving to conception interval in different breeds of cattle

Breed	Calving to conception interval (months)	
	Mean±SD	Range
Holstein cross (n=20)	5.7±2.8[a]	3-18
Jersey cross (n=90)	4.4±2.2[a]	3-15
Terai cattle (n=109)	3.4±1.4[b]	3-14
Overall (n=219)	4.0±2.6	3-18

[a,b]within column, the values with different superscripts differ significantly (P<0.05).

Table 4 shows the inter-calving interval in three breeds of cows. Inter-calving interval was the shortest in Terai cattle followed by Jersey cross and Holstein cross.

Table 4. Inter-calving interval in different breeds of cattle

Breed	Inter-calving interval (months)	
	Mean±SD	Range
Holstein cross (n=20)	14.9±4.7[a]	12-24
Jersey cross (n=90)	13.5±3.1[ab]	12-24
Terai cattle (n=109)	12.6±1.9[b]	12-22
Overall (n=219)	13.2± 2.9	12-24

[a,b]within column, the values with different superscripts differ significantly (P<0.05).

Table 5 shows the percentage of artificial insemination (AI) practice in different breeds of cows. AI was practiced almost exclusively in crossbred cows, whereas it was practiced only in 10.6% of Terai cattle.

Table 5. Percentage of AI practice in different breeds of cow

Breed		AI performed	Percentage (%)
Holstein cross	n=24	24	100[a]
Jersey cross	n=107	97	90.6[a]
Terai cattle	n=131	14	10.6[b]
Total	n=262	135	51.5

[a,b]within column, the values with different superscripts differ significantly (P<0.001).

Total 6.5% of cattle had a history of reproductive problems where 0.76% had abortion and 5.7% had repeat breeding. The incidence of repeat breeding in different breeds of cows has been shown in **Table** 6. There was a tendency that the incidence of repeat breeding was higher in Jersey cross and Holstein cross than in Terai cattle.

Table 6. The incidence of repeat breeding in different breeds of cows

Breed		No. of repeat breeder	Percentage (%)
Holstein cross	n=24	2	8.3[a]
Jersey cross	n=107	9	8.4[a]
Terai cattle	n=131	4	3.0[b]
Total	n=262	15	5.7

[a,b]within column, the values with different superscripts had tendency to differ (P<0.1).

Productive performance

Milk yield was recorded in the form of highest milk yield per day. Peak milk yield among three breeds has been shown in **Table** 7. Peak milk yield was the highest in Holstein cross followed by Jersey cross and Terai local (P<0.05).

Table 7. Peak milk yield (lit/day) of different breeds of cattle

Breed	Peak milk yield (liter per day)	
	Mean±SD	Range
Holstein cross (n=19)	11.5±2.6[a]	10-14
Jersey cross (n=77)	8.9±0.9[b]	8-10
Terai cattle (n=94)	1.7±1.1[c]	1-5
Overall (n=190)	5.5±3.9	1-14

[a,b,c]within column, the values with different superscripts differ significantly (P<0.05).

Lactation length in three breeds of cows has been shown in **Table** 8. Lactation length in Terai local cows was only around 5 months, which was significantly lower than in Holstein and Jersey breeds.

Table 8. Lactation length in different breeds of cattle

Breed	Lactation length in months	
	Mean±SD	Range
Holstein cross (n=20)	10±0.79[a]	9-11
Jersey cross (n=90)	9.8±0.5[a]	9-11
Terai cattle (n=109)	5.0±1.7[b]	3-8
Overall (n=219)	7.6±2.6	3-11

[a,b]within column, the values with different superscripts differ significantly (P<0.05).

Length of dry period in three breeds of cows has been shown in **Table** 9. Dry period was significantly longer in Terai cattle as compared to Holstein cross and Jersey cross.

Table 9. Length of dry period in different breeds of cattle

Breed	Length of dry period (months)	
	Mean±SD	Range
Holstein cross (n=20)	2.2±0.7[a]	1-3
Jersey cross (n=90)	2.5±0.9[a]	1-5
Terai cattle (n=109)	5.2±2.1[b]	2-10
Overall (n=219)	3.8±1.8	1-10

[a,b]within column, the values with different superscripts differ significantly (P<0.05).

DISCUSSION

This study determined the reproductive and productive performance and reproductive problems of crossbreds as well as indigenous Terai cattle in southern part of Bardiya district. Production and reproduction parameters are important economic traits for determining the profit of cow milk production (Torshizi 2016). Age at first calving in the present study was found to be earliest in Jersey cross followed by Holstein cross and Terai local cows. The mean age at first calving in Holstein cross (29.5 months) and Jersey (27.8 months) in this study was almost similar as reported by the various researchers from the UK (Eastham et al 2018; Boothby et al 2020). These finding revealed that the performance of Holstein cross and Jersey cross were similar as in their home tract proving that at least 50% exotic crosses are well adapted to the existing production system of Nepal. Mean age at first calving in Terai cows in this study (45.7 months) was found to be longer than exotic crosses whereas about four months lesser than that reported in Terai cattle about two decades ago (49.9 months) (Neopane and Pokhrel 2005). Improvement of Age at First Calving in Terai as compared to previous study might be due to awareness amongst the farmers regarding better nutrition, health, breeding and husbandry management.

The number of services per conception in Holstein cross (1.8) and Jersey cross (1.7) in this study were lower than that reported in a recent study in which it was 2.2 among 55,685 Polish Holstein-Friesian cows (Siatka et al 2017). This might be due to the presence of less milk producing cows (range: 8-14 lit per day) in the present study. Various studies have reported that the number of services conceptions was influenced by the daily milk yield of the cows (Nebel and McGilliard 1993, Siatka et al 2017).

Number of services per conception in Terai cattle (1.3) was significantly lower than that in Holstein cross and Jersey cross cows. It might be due to the fact that almost 90% of Terai cattle were bred naturally with bull whereas more than 90% crossbred cows were artificially inseminated, and it can be assumed that conception rate would be better with natural mating than with AI as there might be chances of errors on various steps during AI (Farin et al 2006). Number of service per conception in Terai cattle in this study was almost similar to that (1.3) in Desi local cattle in Bangladesh (Alam et al 2008).

Calving to conception interval was significantly shorter in Terai cattle (3.4 months) than in Holstein cross (4.4 months) and Jersey cross (5.7 months). This was in agreement with a study in Bangladesh in which calving to first postpartum estrus interval was shorter in Desi local cattle than the crossbred cows (Alam et al 2008). As a consequence, the inter-calving interval was also shorter in Terai cattle (12.6 months) than the Holstein cross cows (14.9 months). It can be assumed that the indigenous cattle are more adapted to the existing environment, and thus had optimum reproductive performance under the existing environmental and management conditions. Jersey cross had relatively shorter inter-calving interval (13.5 months) than the Holstein cross cows which was in agreement with the previous study in which the pure Jersey cows had shorter calving interval than the pure Holstein cows (Garcia-Peniche et al 2005). Inter-calving intervals in Terai cattle and Jersey cross in the present study were almost near to ideal calving interval of 12-13 months, while in case of Holstein cross it was longer than an ideal calving interval.

Practice of AI by the cattle owner was 100% in Holstein cross, 90.6% in Jersey cross and only 10% in Terai cattle. Very low percentage of AI adoption in Terai cattle might be due to subsistence-based farming practice and lack of awareness about AI among Terai cattle farming households. Also, due to the semi-wild temperament of Terai cattle, farmers and AI technicians have not adopted AI practice in those cows. It can be assumed that the practice of natural breeding might have contributed to have lower number of services per conception, shorter calving to conception interval and shorter inter-calving interval in Terai cows as compared to crossbred cows.

Interestingly, there were very few reproductive problems in the cattle as reported by the owners. Only the repeat breeding (incidence 5.7%) and abortion (incidence 0.76%) were the reproductive problems of cattle. Incidence of repeat breeding and abortion in the present study was lower than that (31.8% and 11.2%, respectively) reported in dairy cattle kept in a semi-intensive system by small and marginal farmers in Meghalaya province of North-Eastern India (Khan et al 2016). Very few reproductive problems in the present study might be due to intensive care of the cows by the owners as the number of parous cows per household was only 1.2 (range:1-9) so that owners could manage their cows efficiently.

Since the cattle owners did not keep the record of milk yield of the whole lactation period but they had the data of the highest milk yield per day of the individual cow, thus, the peak milk yield per day was used to compare the milk productivity among three breeds. Peak milk yield per day differed significantly among three breeds. Although the exact blood level of Holstein and Jersey was not known, the crosses reared in Nepalese context can be assumed to have 50-75% of exotic breed blood. Because of uncertainty of blood level, it was difficult to interpret whether their level of production was satisfactory or not, however it was quite lower than that of pure breeds (Siatka et al 2017). Regarding Terai cattle, daily milk yield (1.7 L) was lower than that (2.1 L) reported earlier (Neopane and Pokhrel 2005). Similarly, lactation length of Holstein cross and Jersey was satisfactory. However, lactation length of Terai cattle was only 5 months (range: 3-8 months) which was lower than that (8 months) reported earlier (Neopane and Pokhrel 2005). As a result, dry period was significantly increased in Terai cattle as compared to crossbred cows. Not only the genetics but also the husbandry practices of indigenous cattle might have been affecting the production and productivity because the survey result showed that the owners used to provide the commercial feed and mineral supplementation only to the crossbred cows and not to the indigenous cattle. Similarly, deworming practice was also rare for indigenous cattle. Also, it was observed that even in the same household there was biasness in feeding and deworming practices between indigenous and crossbred cows.

Although the average daily milk yield and lactation length were quite low in Terai cattle, there were quite large variations in these parameters (range: 1 to 5 lit/day and 3-8 months, respectively). The finding reveals good potentiality within the indigenous Terai cattle for more milk production employing genetic selection.

CONCLUSION

Exotic crossbred cattle raised in hot and humid climatic condition of terai region of Nepal had exhibited equally good performance as purebred population in their home tract in most of the reproductive and productive parameters have proven that they adapted in the existing farming system. Although production and productivity of Terai cattle was found to be lower than either of the crossbreds, we need to keep in mind that the provision of nutrition for this breed is poorer as well. Despite the low input to these they are producing up to five litres, which proves that this breed has the genetic potential. Furthermore, most of the reproductive parameters in Terai cattle were better in comparison with exotic breeds which revealed that they are more adapted to the existing environment. These genetic characteristics need to be utilized to improve the cattle population for the Terai region with hot and humid climatic condition. Furthermore, the Terai cattle exhibited high variation within the population in terms of productive and reproductive performance, it is warranted to improve Terai cattle population applying genetic selection.

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