

EVALUATION OF REPRODUCTIVE PERFORMANCE OF INDIGENOUS AND CROSSBRED CATTLE IN KERALA: A FIELD LEVEL STUDY

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ABSTRACT

A survey was conducted among the small holder dairy farmers in 80 Panchayaths of 14 districts in Kerala in order to evaluate the reproductive performance of crossbred cattle population in Kerala at field level. Analysis of the data showed that the herd size of cattle in Kerala was around 3 per house during the period of 2012 and 2013. Three fertility traits, age at first calving (AFC), calving interval (CI) and number of services per conception (NSC) were studied in detail and the averages of these traits were 1093 ± 10.52 days, 551 ± 48 days and 2.02 ± 0.01 services per conception, respectively. Fixed model analysis was carried out to see the effect of some of the major factors leading to variation in AFC, CI and NSC and found that there was significant difference in reproductive performances among different genetic groups. AFC and NSC of crossbred Holstein Friesian cows and CI of Sunandini cows were lower compared to other genetic groups. Other factors significantly influencing AFC were period of birth and season of birth. Apart from genetic groups, number of services per conception was influenced by type of semen used and also the level of peak milk production.

Key words: Kerala, crossbred cattle, age at first calving, calving interval, number of services per conception

INTRODUCTION

The present study was undertaken to evaluate the reproductive performance of crossbred cattle at farmers herd in Kerala. There are reports on decreasing reproductive performance as a

result of vigorous selection oriented towards improving milk production which could be due to change in management practices and negative correlation between production and fertility traits. The reproductive traits are important economically since a poor reproductive performance may lead to

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increased inseminations, increased veterinary cost and higher culling rate therefore more emphasis needs to be given in management aspects. There are different factors influencing the reproductive performance of animals like feeding management including supplementation of minerals, genetic group of the cows, proper detection of estrous, timely insemination, the semen used for insemination, age of the cow, seasonal variations and others. Most of the studies in this regard were done at farm levels but there is a need for understanding the status of reproductive traits at field level as majority of animals are being reared by low to marginal farmers with two to three animals per herd.

MATERIALS AND METHODS

Data collection

A questionnaire was designed and survey was conducted during the period of 2013 and 2014. The survey covered 10765 households in 80 panchayaths of 14 districts in Kerala state. Along with the primary data on genetic group of the animal, basic information on management practices followed by the farmer, the information on date of birth, date of first calving, date of present as well as date of last calving were recorded. The number of inseminations required for conception, the semen used for insemination and other details regarding estrus were also collected. Out of 10765 households covered in the survey, 6536 records on date of birth of cows, 2405 records on date of first calving, 8083 records on date of present calving, 1408 records on date of last calving, 8700 records on number of services per conception were available. From the date of birth and date of first calving, from the date of present and last calving, age at first calving and calving interval were generated respectively. The data was normalized by removing the extreme values i.e., data falling in the group, mean \pm 2SD. The count trait, namely number of services per conception was transformed to arcsin values.

Classification of data

The data on AFC were classified into different subclasses based on genetic group of the cow, season of birth and period of birth. The data on calving interval was grouped based on genetic group of the cow, season of last calving and age of the cow at last calving. The data on number of services per conception was classified based on genetic group of the cow, semen used for insemination, time of AI as well as peak milk production of the cow. The year was classified into three seasons (1. Winter: January & February, Summer: March to May and Monsoon comprising South West Monsoon and Post Monsoon: June to December). The climatic classification was done as suggested by Sooraj (2013) with minor modification as combining of South West Monsoon and Post Monsoon as single season. There were six major genetic groups *viz.*, non-descript (ND) +Indigenous, crossbred Jersey (CBJ), crossbred Holstein Friesian (CBHF), Sunandini, more than 50 per cent inheritance of Holstein Friesian and more than 50 per cent inheritance of Jersey obtained as a result of using premium bull semen. The year of birth was classified into five groups *viz.*, 2006 and earlier, 2007, 2008, 2009 and 2010 and later. Age of the cow at last calving was grouped into four *viz.*, less than 3yrs, 3 to 4 yrs, 4 to 5 yrs and more than 5 yrs. Four types of semen were used *viz.*, semen doses provided by Animal Husbandry Department (AHD), progeny testing semen, premium semen and private semen. Natural service was also followed using bulls. The time of AI was divided into two as within 24hrs after seeing the estrous signs and after 24 hrs of estrous signs. Based on the peak yield of milk, the cows were grouped into three as less than 7 L, 7-15L and more than 15L.

To estimate the effect of these factors on AFC, CI and NSC, the following fixed models of least-squares analysis were used (SPSS 15.0).

$$\text{Model 1: } Y_{ijkl} = \mu + B_i + S_j + P_k + e_{ijkl}$$

Y_{ijkl} was the age at first calving of individual cows

$$\text{Model 2: } Y_{ijkl} = \mu + B_i + C_j + A_k + e_{ijkl}$$

Y_{ijkl} was the calving interval of individual cows

$$\text{Model 3: } Y_{ijklm} = \mu + B_i + D_j + T_k + M_l + e_{ijklm}$$

Y_{ijklm} was the number of services per conception

μ is overall mean

B_i is fixed effect of i^{th} genetic group ($i = 1$ to 6)

S_j is fixed effect of j^{th} season of birth ($j = 1$ to 3)

P_k is fixed effect of k^{th} year of birth ($k = 1$ to 5)

C_j is the fixed effect of season of calving ($j = 1$ to 3)

A_k is fixed effect of k^{th} age group ($k = 1$ to 4)

D_j is fixed effect of type of semen ($j = 1$ to 4)

T_k is fixed effect of time of AI ($k = 1$ to 2)

M_l is fixed effect of l^{th} peak milk yield group ($l = 1$ to 3)

e_{ijkl} and e_{ijklm} are the random errors which is assumed to be normally and independently (NID) distributed, with mean zero and constant variance.

Duncan's Multiple Range Test was performed to see the significant difference among the least-squares means.

RESULTS AND DISCUSSION

Among the total 10765 household covered, the average herd size was 3, which included lactating cows, non-lactating cows, heifers and calves. Majority of the animals were Jersey crossbreds followed by HF crossbreds and Sunandini. Some of the farmers were rearing animals with high level of HF and Jersey (more than 50per cent). The number of non-descript/indigenous animals was lowest indicating the

success of crossbreeding programme in Kerala. The breeding details indicated that only very few cows (22) were bred using bulls whereas 9435 cows were bred by artificial insemination. Sixteen per cent of the lactating cows were inseminated using progeny testing semen, 6per cent using premium semen, 4.8 per cent using private semen and remaining animals were inseminated with semen being distributed through AHD. The duration of heat, common symptoms exhibited by the animal and time of insemination were also enquired and these were classified into different groups. Based on the duration of heat or estrus signs exhibited, the cows were grouped into five as the cows exhibiting the estrus signs up to 6 hrs, up to 12 hrs, up to 18 hrs, up to 24 hrs and the cows exhibiting more than 24 hrs. The per cent of cows falling in each group has been described in Figure1. Bellowing, mucus discharge, reduction in feed intake, reduction in milk production etc were the main symptoms of estrous exhibited by the cows. About 50per cent of the farmers were inseminating their cows after 12hrs of beginning of estrous.

Three fertility traits, age at first calving (AFC), calving interval (CI) and number of services per conception (NSC) were studied in detail and the different factors influencing these traits were evaluated using fixed model analysis.

Age at first calving

Age at first calving (AFC) was recorded as the age of the cow at its first parturition. This economic trait is very important in starting the productive life of the heifer. In the present study, the average AFC was 1093 ± 10.52 days (Table 1). The present findings are in agreement with Kurian *et al.* (2011), who reported an AFC of 1095 days in crossbreds. Stephen (2010) and Thomas and Anilkumar (2009) also studied the age at first calving in crossbreds and reported 1139 and 1077 days, respectively. Multiple comparison test / posthoc test revealed that AFC was lowest for

CBHF, followed by CBJ, high-grade Jersey and Sunandini (Table 1), whereas cows with higher HF inheritance (more than 50 per cent) and nondescript cows showed significantly higher AFC. The lower AFC of HF and Jersey crossbreds compared to cows with a high degree of HF inheritance could be due to the better adaptation of these crossbreds in Kerala. Seasonal influence was also noticed on AFC. Higher AFC was found for the cows born during winter season and lowest AFC for those cows born during monsoon. This is indicative of the possible availability of more fodder during monsoon. In Kerala, there is no clear demarcation of seasons like winter and summer as seen in other states. The winter season is experienced hardly for two months and the temperature ranges from 18-28°C in majority of the places, except the highlands, where the temperature may fall even below 10°C. The summer season which follows winter last up to June, during which the day temperature may rise up to 36°C and a reduced fodder production due to water scarcity is experienced in some parts of the state. In agreement with the present study, significant effect of season of birth was reported in crossbreds in Andhra Pradesh, with highest AFC (1173.95 ± 5.89 days) during summer season (Varaprasad *et al.*, 2013). Various researchers had reported a non-significant effect of season of birth on AFC in Sahiwal (Mohanty, 2001; Banik, 2004; Singh *et al.*, 2005 and Manoj *et al.*, 2012). These reports further indicated the adaptation of Indian breeds to the tropical climate. Period of birth was also analyzed to see whether there was any significant difference in AFC over the years. Based on the date of birth, the animals were grouped into five. Even though there was a significant difference in AFC of cows born during 2007 period and cows born after 2010, there wasn't any trend of reduction of AFC over the years.

Calving interval

Calving interval (CI) or inter-calving period (ICI) is another important fertility trait. In

order to make the dairy farming more profitable, it is advisable to have one calf every year i.e. a calving interval of around one year. If the calving interval is more, the total number of calving and lifetime milk production will decrease. The average CI in the present study was 551 ± 48 days. Yadav *et al.* (2004) reported a similar finding in crossbred cattle. There was a wide variation in the data as indicated by the coefficient of variation (34%). The variation in CI could be due to variation in service period (the period from calving to conception/successful AI) because gestation period in majority of cows will be constant with 280 ± 10 days. In order to attain the target of one calf per year, a service period of 80-85 days is optimum. Assuming the gestation period as 280 days, the average service period was 272 days in the studied population and only 5 per cent had conceived within 80 days. It was also found that the average number of services per conception was 2, which indicated that the time between calving to the first service might be longer in these cows. One of the reasons could be poor management during the transition period of the cows. The transition period is generally counted as 21 days before and 21 days after calving. Another reason could be improper heat detection. Since most of these fertility traits are lowly heritable, good management practice is more important to improve these traits. The effect of factors like genetic group, season of last calving and age of the cow were evaluated and found that there was a significant difference in calving interval among the genetic groups (Table 2). Cows with a high level of HF blood level showed highest CI (613 days) and lowest CI was showed by Sunandini cows (473 days). Sooraj (2013) reported a calving interval of 506 days in crossbreds cows maintained at Cattle Breeding Farm, Thumburmuzhi. The reports of Kurian *et al.* (2011) in crossbred cows of Kerala (447.14 days) were also comparable with CI of Sunandini cows observed in the study. Reports from various studies showed that CI in Jersey cows was as low as 389 days and in purebred HF cows it was 400 days (Ojango and Pollot, 2001; Hare *et al.*,

2006; Saleem *et al.*, 2011). The poor reproductive performance of these crossbreds in field condition of Kerala could be due to nutritional deficiencies, management problems, heat intolerance or a combination of these factors. Other factors like season of last calving and age of the cow at last calving were statistically non-significant.

Number of services per conception

The third trait analyzed in the study was number of inseminations per conception. Different factors like genetic groups, time of AI, semen used for insemination and peak milk production of the cows were analyzed. The average number of services per conception was 2.02 ± 0.01 . Fixed model analysis revealed a significant influence of all these factors on number of inseminations per conception. The least-squares means of number of services per conception after back transformation of the arcsin values have been presented in Table 3. CBHF and CBJ cows were conceived with least number of AI where as Sunandini and the cows with high level of Jersey inheritance showed an increased number of AI. Various reports suggested that the number of services per conception in HF ranged from 1.67 (Wallet *et al.*, 2003) to 3.07 (Sattar *et al.*, 2005). In Jersey breed, Sattar *et al.* (2004) reported 2.81 numbers of services per conception which is higher than the findings of the present study. There are also reports on number of services per conception in crossbreds like Karan Fries and Karan Swiss with 1.75 and 2.10 respectively for the two breeds (Annual Report, 2010-11, NDRI). Time of AI after detection of estrus did not show any significant effect. The farmers who used progeny testing or premium quality semen for inseminating their cows had reported lower number of inseminations compared to others. Another factor which was found to have a significant effect was the milk yield of the cows. The DMRT revealed that cows producing more milk needed more number of inseminations per conception. That is in agreement with the statement that when the milk production is increasing there is

chance of negative energy balance in the body of cow which may adversely affect the reproductive functions. This also suggests that cows with high production performance need more care and proper management. The survey also pointed towards the lack of record keeping among the farmers, even though data on present calving and production details were available with majority of the farmers, a proper record on previous calving was lacking. Out of 10765 houses covered in the survey, less than 10% maintained records on previous calving. Educating the farmers on this aspect is necessary for proper evaluation and further improvement of the cattle population.

CONCLUSION

A survey was conducted in 10765 households of 80 Panchayaths of 14 districts in Kerala to evaluate the reproductive performance of cattle at small holder dairy farming system in Kerala during 2013-14. Age at first calving, calving interval and number of services per conception were studied in detail and the averages were 1093 days, 551 days and 2 services, respectively. The average calving interval noticed in the study was higher than those reported earlier and it needs further investigation. Analysis of data also revealed a significant difference in these fertility traits among different genetic groups. HF and Jersey crossbreds were found to be superior in reproductive performance. Apart from genetic group, type of semen and peak yield of the cow were also influencing the reproductive performances.

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Table 1 Least-squares means of age at first calving

Effects	n	Mean±S.E.
Overall	1418	1093 ± 10.52
Genetic group	58	1119.07 ± 27.44 ^{bc}
ND+Indigenous		
CBJ	698	1074.06 ± 10.23 ^{ab}
CBHF	208	1030.30 ± 16.56 ^a
Sunandini	150	1105.45 ± 17.89 ^{bc}
More than 50 % HF	233	1140.27 ± 14.94 ^c
More than 50 % Jersey	71	1098.99 ± 25.01 ^{bc}
Year of birth		
2006 and earlier	68	1088.60 ± 25.36 ^{ab}
2007	97	1135.95 ± 21.89 ^b
2008	242	1088.85 ± 14.90 ^{ab}
2009	327	1104.67 ± 13.44 ^{ab}
2010 and later	684	1066.50 ± 10.57 ^a
Season of birth		
Winter	657	1144.63 ± 10.90 ^b
Summer	105	1037.32 ± 21.00 ^a
Monsoon	656	1032.76 ± 10.66 ^a

Least-squares means with different superscripts were significantly different from each other (p<0.05)

n = No: of observations

Table 2 Least-squares means of calving interval

Effects	n	Mean±S.E.
Overall	445	551 ± 48 days
Genetic group		
ND+Indigenous	21	496.04 ± 42.19 ^a
CBJ	230	556.62 ± 17.46 ^{ab}
CBHF	46	580.37 ± 30.30 ^{ab}
Sunandini	71	482.17 ± 25.06 ^a
More than 50 % HF	63	611.76 ± 27.23 ^b
More than 50 % Jersey	14	581.94 ± 73.53 ^{ab}

Least squares means with different superscripts were significantly different from each other (p<0.0)

n = No: of observations

Table 3 Least-squares means of number of services per conception

Effects	n	Mean
Overall	6630	2.02
Genetic group		
ND	259	1.95 ^{ab}
CBJ	3331	1.86 ^a
CBHF	1512	1.83 ^a
Sunandini	603	2.00 ^{bc}
More than 50 % HF	722	1.88 ^{ab}
More than 50 % Jersey	203	2.07 ^c
Type of semen used		
Semen distributed by AHD	4763	1.97 ^{bc}
Progeny testing	1098	1.54 ^a
Premium	426	1.71 ^{ab}
Private	322	1.99 ^{bc}
Bulls	21	2.38 ^c
Peak yield group		
≤ 7 L	740	1.78 ^a
7-15L	4673	1.86 ^b
≥15L	1217	1.99 ^c

Least squares means with different superscripts were significantly different from each other ($p < 0.05$)
n = No: of observations

Figure 1 Duration of estrus signs in cows