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REPRODUCTIVE PROFILE OF HOLSTEINS KEPT IN BALOCHISTAN PROVINCE OF PAKISTAN-II

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This study was planned to explore the reproductive profile of the imported and farm-born Holsteins covering the parameters like age at first service (AFS), age at first calving (AFC), service period (SP), gestation period (GP), calving interval (CI) and dry period (DP) kept under the local conditions of Balochistan province of Pakistan. Effect of locations of dairy farms on various reproductive parameters was also explored. Overall average values for AFS were 315 to 986 d with an average of 660.42±12.42, AFC 604 to 1299 d with an average of 944.08±12.71, GP 275 to 299 d with an average of 280.62±0.25, SP ranged from 29 to 886 d with an average of 240±9.61, CI ranged from 301 to 922 d with an average of 451.10±5.55 and DP averaged as 59.15±20.61 d. The effect of year of calving, season of calving, age of the dam, sex of the calf, type of birth, calving number and location of the farm were studied and the results revealed that the year affected the AFS, AFC and SP ($P<0.01$); GP ($P<0.05$) but not the CI. No effect of season on AFS, AFC, SP and CI ($P>0.05$) was observed except GP ($P<0.05$). The age of the dam affected the AFC, GP and SP ($P<0.05$) but not the CI. No effect of sex of the calves, type of birth and calving number on GP ($P>0.05$) was observed. Location of the farm did exert effect on AFS, AFC ($P<0.01$), CI ($P<0.05$) but not on GP and SP ($P>0.05$).

Keywords: Reproductive profile, Holsteins, Balochistan, Pakistan

INTRODUCTION

Livestock is the backbone of Pakistan's national and is an important sub-sector of agriculture in Pakistan as it accounts about 50% of agriculture value added and about 10.4% of the GDP. Its net foreign exchange earning were to the tune of Rs.53 billion in 2000-2001, which is almost 12.3 percent of the overall export earning of the country. The role of livestock in rural economy may be realized from the fact that 30-35 million rural population is engaged in livestock raising. The average household size is 2-3 cattle/buffalo and 5-6 sheep/goat per family deriving 30-40% of their income from it. The main livestock species include cattle, buffaloes, sheep, goat, camels and horses etc (Economic Survey, 2006-2007).

Most of the cattle population in Pakistan is non-descriptive type, which do not belong to any specific breed and termed as indigenous cattle. There is large variation in their body size. Their productive and reproductive performance is lower than that of indigenous and cross bred milch cattle. According to recent estimates the population of non-descript cattle comprises of 11752 thousands heads in Pakistan (Khan et al. 2008)

Several physiological and environmental factors affect the reproductive profile of Holsteins in tropical and sub-tropical environment but they still perform significantly well. These pure exotic Holsteins were imported from Denmark and maintained in the Balochistan province of Pakistan to increase milk production. The productive parameters of these Holsteins have been discussed in first part of the study (Bilal et al., 2002) while this paper deals with the reproductive profile of these animals imported and farm-born kept at different Government dairy farms at various locations in Balochistan province.

MATERIALS AND METHODS

Data for the present study were collected from seven different Government dairy farms of Balochistan province located at Kalat (1), Khuzdar (2), Loralai (3), Mustung (4), Pishin (5), Quetta (6) and Zhob (7). The number of animals comprised more than 210 with 750 lactation records covering 18 years from 1977 to 1994. The data were analyzed to determine the reproductive profile of imported Holsteins and their farm born daughters kept under different managemental and climatic conditions. The reproductive parameters included were: the age at first service (AFS), age at first calving (AFC), service period (SP), gestation period (GP), calving interval (CI) and dry period (DP).

The effect of year of calving, season of calving, age of the dam, sex of the calf, type of birth, calving number and location of the farms were studied. To determine the effect of season, the year was divided into four seasons viz.: winter (Dec-Feb), spring (Mar-May), summer (Jun-Aug) and autumn (Sep-Nov).

The mathematical model for determining the environmental factors on age at first service (AFS) was as follow:

$Y_{ijkl} = \mu + Y_i + S_j + L_k + \mu_{ijkl}$

where:

i = 1, 2,..........p (number of years = 18)

j = 1, 2,.......q (number of seasons = 4)

k = I, 2,........r (number of age groups of dams = 7)

l = 1, 2,.......s (number of locations = 7)

m = 1, 2,.......t (type of birth i.e; single or twin)

Y_{ijklm} = age of the *kth* heifer at *lth* location born in *jth* season of the *ith* year.

μ = overall population mean

Y_i = effect of ith year of birth

S_j = effect of jth season of birth

A_k = effect of kth dam age group

L_l = effect of lth location

μ_{ijkl} = random error associated with the age at first service of *kth* heifer at *lth* location born in *jth* season of *ith* year. It was further assumed that μ_{ijklm} was normally and independently distributed with mean zero and variance σ^2 Mathematical models for the age at first calving (AFC) was similar to that of age at first service. In the model of service period and calving interval, age of the animal was included in addition to all other environmental factors as considered in AFS. While in gestation period, the model assumed was:

$Y_{ijklmnop} = \mu + Y_i + S_j + A_k + X_l + T_m + L_n + C_o + \mu_{ijklmnop}$

where:

i = 1,2,..........p (number of years = 18)

j = 1,2,.......q (number of seasons = 4)

k = l,2,........r (number of age groups = 8)

l = 1,2,........s (sex of calf)

m = 1,2,....... t (type of birth i.e; single or twin)

n = 1,2,....... u (number of locations = 7)

o = 1,2,........v (calving number = 7)

$Y_{ijklmnop}$ = gestation period of *pth* cow of *oth* calving number kept at *nth* location which gives *mth* type of birth with *lth* sex, having *kth* age group calved in *jth* season of the *ith* year.

A_k = effect of kth age group of the animal

X_l = effect of lth sex

T_m = effect of mth type of birth

L_n = effect of nth location

C_o = effect of oth calving number.

(, Yi and Sj were similar to that of model described in the AFS model.

(ijklmnop = random error associated with the gestation period of pth cow of oth claving number kept at nth location which gives mth type of birth with lth sex, having kth age group calved in jth season of the ith year. It was further assumed that (ijklmnop was normally and independently distributed with mean zero and variance (2 ..

It will be worth mentioning that the animals were imported from Denmark in the fiscal year of 1977-78 and the data before the year of importation was got transferred on history sheets alongwith the pregnant animals. However, the figures before the year 1977 were not included in the statistical analyses.

As the data of different parameters represented unequal dis-appropriate sub-class frequencies and were thus analyzed by using Mixed Model Least Squares and Maximum Likelihood (Harvey, 1990) computer program.

RESULTS AND DISCUSSION

Overall General Performance

Overall reproductive values for Holsteins kept at different locations in Balochistan are presented in Table 1. Overall average values for the AFS were 315 to 986 d with an average of 660.42±12.42, the AFC were 604 to 1299 d with an average of 944.08±12.71, SP ranged from 29 to 886 d with an average of 240±9.61, GP ranged from 275 to 299 d with an average of 280.62±0.25, CI ranged from 301 to 922 d with an average of 451.10±5.55 and DP averaged as 59.15±20.16 d.

The effect of environmental factors like year and season of calving, age of the dam, sex of the calf, type of birth, calving number and location of the farms were also analyzed. The discussion on these factors is presented in the ensuing paragraphs.

Age at First Service (AFS)

The effect of year and season of calving alongwith the effect of different locations of the farms on AFS in Holsteins is presented in Table 2.

The year of birth had shown highly significant effect (P<0.01) on the AFS. The year 1977 and 1983 are those years which have shown worst effect on the AFS (Figure 1). The lengthy AFS in these two years have affected (prolonged) the AFC. In 1977 the animals were imported and they were under stress, soon as the process of adaptability completed, the animals resumed the normal age of service and calving. The transmitting ability of this trait has been reported as low, in other words the environment plays an important role as compared to the genetics. The year effect may be ascribed due to the managerial abilities. As predicted in the figure, the year 1990 and 1991 have shown least (very early) AFS which is highly appreciable and acceptable by the livestock owners which in return gives more production in the lifetime. The effect of season of calving and location of farms on the age at first service (AFS) is presented in Table 3. The effect of season on AFS was explored and it was observed that AFS was 730.80±38.14, 778.57±48.53, 768.64±49.99 and 752.84±45.57 d in winter, spring, summer and autumn, respectively. The

Table 1. Overall average values of AFS, AFC, SP, GP, CI and DP in Holsteins

Trait	No. of Obs.	Range	Means + S>E.
Age at first service (AFS)	155	315-986 d	660.42 ± 12.42
Age at first calving (AFC)	156	604-1299 d	944.08 ± 12.71
Service period (SP)	323	29-886 d	240.00 ± 9.61
Gestation period (GP)	371	275-299 d	280.62 ± 0.25
Calving interval (CI)	516	301-922 d	451.10 ± 5.55
Dry period (DP)			59.15 ± 20.16

Table 2. The levels of significance of the means squares and the residual mean squares for AFS, AFC, SP, GP and CI in Holsteins

SOV	AFS		AFC		SP		GP		CI	
	df	Sig	Df	Sig	Df	Sig	Df	Sig	Df	Sig
Year of calving	12	**	12	**	15	**	17	*	17	NS
Season of calving	3	NS	3	NS	3	NS	3	*	3	NS
Age of the dam					5	*	7	*	6	NS
Sex of the calf							1	NS		
Type of birth							1	NS		
Calving number							6	NS		
Location of Farm	6	**	6	**	6	NS	6	NS	6	*
Residual	142	40102.01	142	31479.25	270	20670.64	487	47.89	430	13089.67

** Significant = (P<0.01), *Significant = (P<0.05), NS = Non-significant

season of calving had shown no difference (P>0.05) on the AFS. However, our findings are in contrast to Hawk et al. (1954) who reported the significant effect of different seasons on AFS. The balanced feeding and improved management are more important in the occurrence of first oestrus and establishing age at first service. The effect of season of birth may be pronounced till weaning age and then these effects melt with the passage of time.

Location wise AFS was observed as 805.15±118.55, 720.03±74.83, 1084.89±64.98, 670.70±56.76, 529.51±155.75, 397.64±119.53 and 1096.09±73.82 in Kalat, Khuzdar, Loralai, Mastung, Pishin, Quetta and Zhob, respectively.

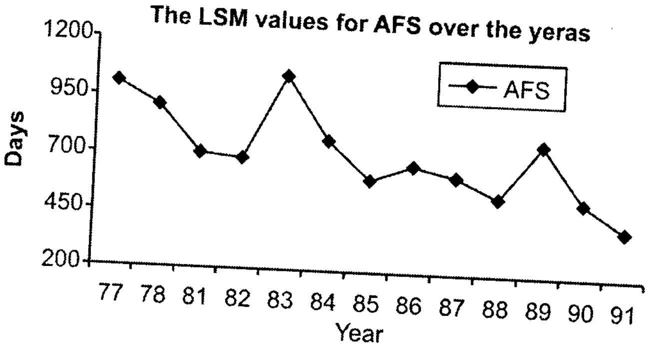

Fig. 1

The differences in AFS due to various seasons and locations (P<0.01) showed an undesirable lengthy AFS in the animals of location 3 and 7 (Loralai and Zhob) while the cows of location 6 (Quetta) showed a shorter and desirable AFS (one year) which is highly acceptable age.

Age at First Calving (AFC)

The AFC of imported and farm-born Holsteins from 1977 to 1994 maintained at various locations have been presented in Figure 2. The year of birth had

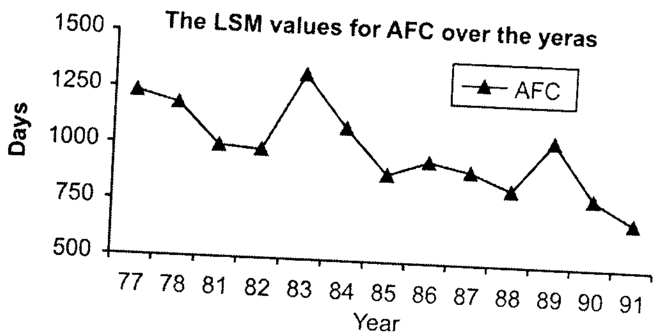

Fig. 2

shown highly significant effect on the AFC (P<0.05). The years 1977 and 1983 were the worst years with maximum AFC then other years, while the year 1990 and 1991 had shown very good AFC which is minimum days than others. This trend was similar to that of AFS. The figure shows a decreasing trend of AFC over the years that may be due to the addition of farm born, local raised and adopted replacements. These variations among age at first calving may be due to the

care and attention paid by the manager and its staff indicating that it can be controlled by improved management. Our results are in line with that of Duc and Taneja (1984) who reported a significant effect of year but are in contradiction with those of Silva et al. (1986) who observed no trend of AFC over the years.
Aggregate analysis of the data revealed no difference (P>0.05) due to seasons of birth as for as the AFC is concerned (Table 2). The AFC values for winter, spring, summer and autumn respectively were 1001.66±33.79, 1053.85±43.02, 1039.38±44.29 and 1042.69±40.37 d. All the animals reached at a parturition stage from 2.5 to 3 yr period. Our results revealed that the feeding and management practice are more important in the occurrence of first estrous, establishing the AFS and AFC as compared to the seasons of birth. The effect of season of birth if whatsoever, may be significant at birth and may remain significant upto weaning or maximum upto 6-9 mo of age then this effect can be overcomed through management as the results show it disappears at the AFS or AFC. No significant effect of seasons have been reported by many workers (Arora and Sharma, 1983; Janicki, 1980 and Ribas et al., 1983a and Sattar et al., 2004) which are in line with the results of this study.
Table 2 also indicates that the AFC among various locations which differed significantly (P<0.01) and it was observed that longest AFC was at location 3 and 7 while the AFC in location 6 was very good and giving the calf at around 2 years of age while the figures at others locations were also in acceptable ranges (Table 3). The effect of different seasons and various locations is also presented in the Table 3. The AFC values ranged from minimum values of 722.77±105.90 at Quetta to a maximum values of 1389.77±65.40 d at Zhob.

Service Period (SP)

The SP of Holsteins maintained at various farms ranged from 72.09±41.52 in 1992 to 387.93±91.03 d in year 1987. The overall trend of the SP over the years is shown in Figure 3. The year of calving exerted a significant difference (P<0.01) on SP while the effect of age of the dam was also significant (P<0.05). The mean values for SP in winter was 232.67±31.99, in spring it was 262.08±33.08, in summer it was 253.36±29.96 and in autumn it was 231.69±31.97 d (Table 3). The average values for SP were only available for Mastung and Quetta which were 301.80±74.96 and 188.10±92.0 d, respectively. The mean values for other locations were not picked up by the statistical package due to the restriction imposed during the analysis due to wide range of the values. However, the mean values were not affected by the season of calving (P<0.05) and the location of the farms (P<0.05).

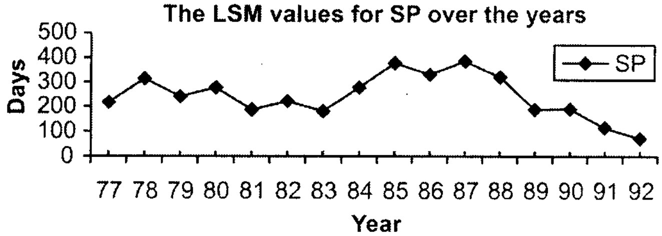

Fig. 3

The mean values for SP over different lactations were observed from 207.62±20.01 to 277.85±55.16 d in 1st and 5th lactation, respectively. These values are much higher than the ideal values and even showed an increasing trend as the lactation number increased which indicates the lower priority given to the reproductive management of the cows making them more pron to reproductive failure or disorders.
The averages SP obtained from the data are quite high which indicate poor breeding management and substandard records kept at the farms. Higher values for SP have also been reported by Mangurkar et al. (1985) as 187 d, MA and Chyr (1976) as 188 d and Cheema (1985), but the values in this study are much higher than these reports. While Egyptian workers (Shehata at al., 1995), concluded that season of calving (autumn and winter) was the major factor affecting service period, calving interval and total milk yield. Azam et al. (2001) and Sattar et al. (2004) also observed that service period was affected by season of calving. They reported a mean SP of 70 days and further added that SP and CI are primarily associated with husbandry decisions, with the length of both periods depending on the stockman's opportunities and the reproductive goals of the farm.
Khan (1988) while working at Harichand Farm reported a SP of 126±6 and 114±9 d for imported and farm born Holsteins, respectively. In contrast to our study he reported a significant effect of season on SP while it did not exert any influence in case of our investigations. This difference may be attributed due to locations of the Farms in Balochistan having a better environment or ambient conditions as compared to Harichand at Charsadda, NWFP. Quetta, Kalat, Mastung and Pishin are located at a higher elevation as opposed to Peshawar and Charsadda where the Harichand Farm is located. Our results are in close agreement with those of McDowell at al. (1976) who reported that age and season had a little influence on SP. Our results are in further disagreement with Bradly (1978) reporting 81 d; Schaeffer and Henderson (1972) reporting 99 to 101 d; Britt (1975) reporting 85 d and Dumitrescu et al. (1981) reported as 65 to 74 d.

Gestation Period (GP)

The data on GP of Holsteins in the years under study is presented in Figure 4. The year-wise distribution of GP data indicated a very close range of 271.17±3.68 in 1978 to 282.98±3.34 d in 1983. The effect of year and season of calving and age of the dam exerted a significant (P<0.05) effect on GP whereas the sex of calf, type of births, calving numbers and various locations of the farms showed a non-significant effect (Table 2). The values of GP for male and female calves were observed very close and were found to be 276.02±2.74 and 275.35±2.74 d, respectively. The least square mean values of GP for calves born over 18 yr as single and twin births were also not much different being as 277.11±1.07 and 274.26±5.15 for male and female calves, respectively. The calving number in GP over the years for the Holsteins did not show any significant effect.

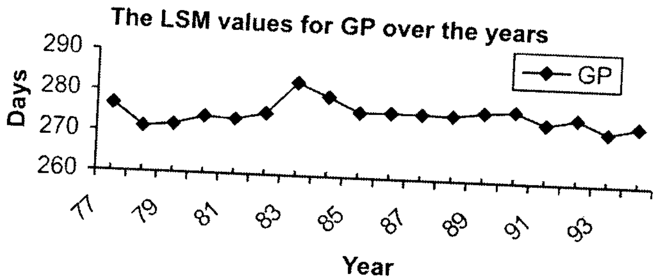

Fig. 4

The effect of season of calving on GP revealed 277.80±2.76, 275.68±2.84, 273.90±2.78 and 275.37±2.75 d in winter, spring, summer and autumn, respectively. Location wise GP was observed as 279.63±3.65, 274.50±3.07, 275.34±2.74, 275.74±4.16, 274.96±3.09, 275.46±3.29 and 278.76±3.17 d, respectively in Kalat, Khuzdar, Loralai, Mustung, Pishin, Quetta and Zhob farms (Table 3). These results were in line with Mondal et al et al (2005) and Azizunnesa et al (2008).

Type of birth, in case of twin births in the uterus reduces the length of GP due to heavy weight and more forces but in case of our study the number of observations were too low in twin births. So a concrete inference can't be concluded from such a less number of observations in twin births.

Year and season differences were mainly due to feeding and management. Well fed animals are expected to have somewhat little gestation period because of ready flow of nutrients, efficient blood circulation maintaining required hormonal niche to attain foetus a required weight at proper time (Lodge et al., 1980). Gestation period is the lowest for summer calvers may be due to heat stress or high metabolic rate (Figure 3). The differences of days due to age in GP were pronounced (P <.05) and the reduction in GP as the age advances was seen in the study which is in contrast to Shin et al. (1986) who reported that as the year of calving progressed GP values increased while no effect of the season has been reported by Bradly (1978). However, our results are in agreement with that of Silva (1977) who reported the significant effect of season on GP.

Location effects on GP were studied by some workers (Shin et al., 1986) who observed the significant effect while no difference of location were observed in this study. As authors assume that it is a natural and biological phenomenon and is generally not affected by location. Sex of calves and calving number revealed no differences but followed the same pattern as reported by these scientists (Shin et al., 1986) who say that male took a little more time in the body of dam as compare to female calves and a longer GP as the calving number increased. Though not statistical different, a little increasing trend of GP was seen in younger cows which took shorter GP than older cows.

Calving Interval (CI)

The trend of observations recorded for 7 locations for CI in Holsteins is presented in Figure 5. The average mean values for CI within the years ranged from 412.88±35.51 in 1993 to 525.28±49.57 d in the year 1980. No difference of the year and season of calving and age of the dams was observed on CI, however, location of the farm had a significant effect (P <0.05) on this trait (Table 2).

The mean values for winter, spring, summer and autumn CI were 479.24±19.47, 477.26±22.22, 470.97±20.41 and 443.97±19.47 d, respectively. As for as the location of the farm is concerned, the data revealed that location had a significant effect on the CI (P <0.05). The CI was minimum at Quetta with a value of 408.12±33.32 d and a higher 475 d at Loralai and Pishin and with maximum at Kalat with a mean value of 526.84±52.55 d as shown in (Table 3). These findings were in line with the results of Sattar et al. (2004) and Al-Amin et al. (2007).

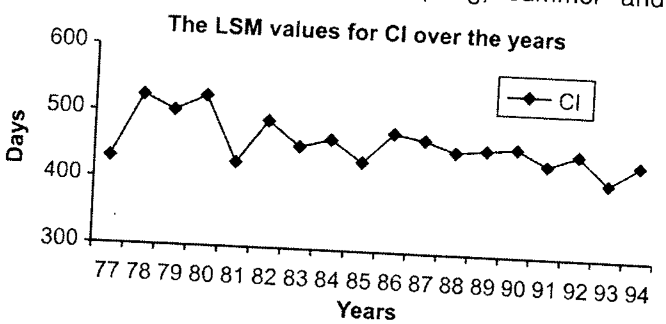

Fig. 5

The CI of 12 mo has long been accepted as the ideal for Holsteins. With an average GP of 280 d, approximately 85 d would remain after calving for conception to occur in order to maintain a 12 months CI (Lodge et al., 1980). As most of the animals did get bred at proper time or 90 d postpartum, the calving intervals prolongs instead of considerable reduction to make it an ideal period.

The findings recorded from our data having a longer CI (413 to 525 d) for Holsteins are very similar to those of Abubakar et al. (1986) and Uddin (2001) who reported an unadjusted mean for calving interval as 421 d and Arora and Sharma (1983) reporting an average CI of 422 d while Shehata at al. (1995) reported a CI of 435 days.

A lower CI was not observed in this study as those reported by Silva (1977) as 399 d and Stout (1978) as 392 and 387 d. Bradly (1978) also reported a 409 d CI from Morocco. Our values match only to lower levels of the CI as reported by Coleman and Dailey (1983) who reported an average CI of 418 d and with higher levels of Bhat et al. (1978).

Our findings are much better than those reported as longer as 500 d CI by MA and Chyr (1976) or much higher as 585 d by Salazar and Huertas (1976). Indian scientists (Kumar et al., 1980 and Mangurkar et al., 1985) reported even higher (946 d) in imported as well as farm born cows.

In conclusion, the effect of the year, season of calving and the age of animals were non-significant in our findings while some scientists (Duc and Taneja, 1984) have reported the significant effect of season on calving interval. In this study, the effect of location was pronounced on the lactating cows may possibly be due to the variability of SP, heat detection methods and services per conception, etc. This notion is supported by Gual et al. (1982) reporting no significant difference in CI among cows born in Mexico, USA or Canada, but the cows of Canadian origin had more days open (129±57) than those from Mexico (109±49) or the USA (112±49).

Dry Period (DP)

The LSM analysis for dry period (DP) was tried and the effect of year and season of drying, year and season of calving, age and location were explored. The overall LSM value, however, was observed as 59.15±20.61 d out of about 132 observations. The lower number of values was the result of restrictions imposed on the data due to incomplete records, and with a wide range if whatsoever the data was made available. Due to the paucity of the sufficient data observations at all locations and in all lactations, the complete inferences could not be drawn.

The mean DP value (59 d) observed in our study is in close agreement with the findings of Wood (1985) who reported a DP of 51 to 60 d and Coleman and Daily (1983) who reported as 62 d. Some workers have reported even shorter DP than our study like Ribos et al. (1984) who reported 31 to 60 d. In contrast to our observations, higher values of DP as 92 to 177 and 143 to 320 have been reported by Bhat et al. (1978) and Adeneye and Adebanjo (1978), respectively.

CONCLUSIONS

To harvest the better results in reproductive efficiency of Holstein cows in an exotic environment, proper care and management, efficient insemination techniques are necessary to let these animals enjoy an enhanced productive life to exhibit their genetic potentials. Proper management of the animals through various phases of life from birth to maturity will ensure their early age of service and maturity, better conceivability and a lower calving interval.

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