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RESEARCH ARTICLE

Reproductive Performance of Nili-Ravi Buffaloes Kept Under Farm Conditions in Pakistan

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ABSTRACT

Record of 9300 buffalo heads was used to study the consequence of environmental factors on reproductive traits of Nili-Ravi buffaloes. The data was analyzed using different fixed effect models to identify the different environmental factors altering the reproductive performance. The averages for age at first calving was1685±9 days varied from 1604±14 days to 1792±20 days at Livestock Production Research Institute Bahadurnagar and Livestock Experiment Station Chak Katora, respectively. The calving interval was observed 501±2days with the range of 519±3 days and 491±4 days. The service period ranged from 264±3 days to 224±5 days with the average 240±2 days; whereas, the average services per conception and gestation period were 1.56±0.01 numbers and 308 days, respectively. The herd-year of calving, season of calving (birth) and parity significantly affected all the reproductive traits ($P<0.05$). Overall phenotypic trend for Age at first calving, calving interval and dry period increased by 1.6, 0.9 and 0.5 days per year, respectively. No change in service period and services per conception was observed during this period. Proper feeding, management and early heat detection of heifers reduced the age at first calving, number of services per conception and calving interval.

INTRODUCTION

The variation in age at first calving and effect of different factors on this trait indicates the fact that most of the reproductive parameters are greatly influenced by environment rather than genetics. Distinct variation in feeding, breeding management and other environment related factors like year, season ambient temperature and relative humidity directly influence the body weight and reproductive activities of the animals (Dangar and Vataliya, 2014).

The long calving interval is partly due to greater lactation stress in high yielding buffaloes and partly due to seasonality of breeding. Suckling of calf in buffaloes may be also results in failure of resumption of ovarian cyclicity following freshening, which adds to the lengthening of postpartum estrus interval and thus increasing calving interval. Services per conception is the result of a complex interplay among several elements; the decision policy of the breeder, physiology, nutrition, management and other environmental factors coupled with genetics. The number of services per conception required for a successful conception determine the fertility status of a breeding herd and thus the overall reproductive performance (Kumar, 2015).

The late age at first calving and long calving intervals in Nili-Ravi buffaloes result in reduced reproductive efficiency on lifetime basis. The lifetime profitability of buffaloes depends on age at first calving and calving interval (Bashir et al., 2007). The performance traits of buffaloes are influenced by several environmental factors. These environmental factors are year and season of calving, age of animal, lactation number and lactation length (Ali et al., 2011). The true genetic merit of the animals may be concealed by these factors. The study of environmental factors affecting reproductive performance traits of Nili-Ravi buffaloes is therefore very important for genetic evaluations of animals, developing breeding and general management strategies /programs.

Little information is available about the environmental factors affecting the reproductive performance of Nili-Ravi buffaloes in Pakistan. Year and season of calving and parity affected by calving interval and services per conception of Nili-Ravi breed at two institutional herds from 1951-1978 was reported by Cady et al. (1983). Later on a study to evaluate the effect of various non genetic factors i.e. herd, year and calving season was carried out on buffalo herd maintained at Military Farms Okara (Din, 1989). The effect of parity and season of calving in Nili-Ravi buffaloes resulted in reduced length of service period with increase in parity (Naqvi, 2000). He further reported significantly lower service period in spring and winter calver as compared with summer and fall. Therefore, due to lack of information on the reproductive performance of Nili-Ravi buffaloes. The present study was aimed to identify environmental sources of variation in reproductive traits and their phenotypic trends in Nili-Ravi buffaloes kept at four livestock experiment stations in Punjab province of Pakistan.

MATERIALS AND METHODS

Data on 9003 lactation records of Nili-Ravi buffaloes from four Livestock Experiment Stations (LES) namely LES, Haroonabad, District Bahawalnagar (LESHA) farm is situated in District Bahawalnagar. The area surrounding the farm is sandy, average rainfall in summer ranges from 30-70mm and in winter dry to 20mm. The temperature ranges from 1.5 to 45 ^{0}C. The climate is arid to semi-arid subtropical continental. Hot during the day in the summer and cold in night during winter. Rain fed area used for grazing of livestock and dry farming of gram, peanut and wheat. The composition of food varied according to the fodder crops available during the year.

The Livestock Experiment Stations Chak Katora (LESCK) is in the district Bhawalpur. The temperature and rainfall range is similar to LESHA. The soil is sandy (alluvial sedimentation of sand mass), the surface is undulating with sand ridges. The climate is arid to semiarid subtropical continental. Hot during the day in the summer and cold in night during winter. The composition of food varied according to the fodder crops available during the year.

The Livestock Experiment Stations Khushab (LESKH) farm is in Distrcit Khushab. District Sargodha adjoins the district Khushab on the East across the river Jhelum. On the West is Mianwali district. The Northern boundary of the district adjoins Chakwal and Jhelum districts while Jhang and Bhakkar districts from the Southern and South-Western boundary. District Khushab is spread over an area of 6511 Square Kilometres. District Khushab has extreme hot and cold climate. Its land comprises mainly hills, plateaus, plains and deserts with river Jhelum flowing on its East. Some of the areas of Tehsil Khushab are low lying and get flooded in rainy season. The soil is sandy (alluvial sedimentation of sand mass), the surface is undulating with sand ridges.

The Livestock Production Research Institute Bahadurnagar (LPRIBN) farm is located at the Livestock Production Research Institute, Bahadurnagar, Okara. The area is canal irrigated with loamy soil. The climate is relatively dry and rain usually occurs during the months of July – September. During summer months, day temperature may go as high as 50^{o}C and during winter night temperature may fall to 0^{o}C.

These four Livestock Experiment Stations in Punjab Province of Pakistan were utilized for the present study. Data were collected on date of calving, sire's date of birth, date of drying, dam's date of birth, date of disposal, date of service, number of services per conception (Natural and AI) and lactation milk yield. The derived variables were age at first calving, calving interval, service period and gestation period.

Incomplete lactation records of buffaloes due to culling, abortion or diseases were also excluded. Along with the basic edits of consistency checks for dates and animal's identities, records of buffaloes that had aborted, missed a year due to sickness or other reasons were eliminated. The records of animals with calving interval <300 or >730 days, gestation period <285 or >335 days, age at first calving <900 or >2400 days were also excluded (Cady et al., 1983).

Data were analyzed to evaluate the influence of different environmental factors i.e. herd, year and season of birth/calving and age at first calving/age code etc on different reproductive traits. The calving months were grouped into four seasons: winter; spring; summer and autumn, (Dahlin, 1998). Season was fitted as a separate fixed effect along with the herd-year (Dahlin, 1998). Preliminary analysis showed no appreciable difference (R^2 varied by 0.02 to 0.06 % for various traits) between model with herd-year-season and herd-year and season as separate fixed effects. Thus, herd-year was chosen instead of herd-year-season which otherwise may have been more appropriate.

The following statistical model was used for yield traits

$$Y_{ijkl} = \mu + HY_i + SOC_j + Age_k + b_1(DIM)_{ijkl} + e_{ijkl}$$

Where,

Y_{ijkl} = Individual observation for any trait

μ = Population mean

HY_i = Fixed effect of herd-year (1-104)

SOC_j = Season of calving (1-4) winter, spring, summer and autumn, respectively

Agek = Age code (1-30),

$b1(DIM)_{ijkl}$ = Days in milk as a covariate

e_{ijkl} = Random error concomitant with each observation

For the analysis of reproductive traits, age was replaced with parity. For the age at first calving, however, only

herd-year and season of birth were included in the model. Analyses were performed using SAS® (1996). To get solutions across herds, for year of calving, season of calving or parities, the above model was modified accordingly.

RESULTS AND DISCUSSION

Age at first calving

Age at first calving observed in this study was 1685±9 days. The age at first calving varied from maximum at LPRIBN to minimum at LESCK (Table 1). The overall age at first calving increased by 4 days during 1971-2000. However, calving age decreased by 51 days at LESKH and increased 20 days at LESHA (Figure 1) during the study period.

Analysis of variance revealed that herd-year of birth had significant (P<0.01) effect on age at first calving among the buffaloes born during different years. Season of birth was found to be important (P<0.01) source of variation. The maximum age at first calving was observed in spring births (1756±24 days) followed by summer (1722±13 days) and winter (1709±18 days) births. The decrease in age at first calving in autumn born calves might be attributed to the abundant availability of good quality fodder alone that may have helped maintain their growth rate in early and later period of age (Figure 2). (Kumar et al., 2009; Arpana et al., 2005; Mohamed et al., 1993).

Herd differences represent the differences in management practices planned or unplanned. Lower age at first calving in buffaloes at LPRIBN than at LESCK indicates better heifer management at LPRIBN than on LESCK during the specified period. The level of management is bound to vary according to the ability of the farm manager. The large variation in this trait suggest reduction in calving age is possible through better management of heifers. The importance of feeding and body condition for reproduction has been emphasized by Mukasa (1989). That is earlier the heifer attains the puberty weight the less would be the age at first calving.

Calving interval

The longest and shortest calving interval was noticed in the Nili-Ravi buffaloes maintained at LPRIBN and LESCK, respectively (Table 1). The average calving interval in the present study increased (0.86 days/year) over the years (Figure 3). The longest calving interval in the Nili-Ravi buffaloes calved during the winter season. The average calving interval for summer calvers was the shortest. Whereas the calving interval in spring and autumn calvers was 479±6 days and 481±4 days, respectively (Figure 4). The least squares mean for calving interval in the first three parities showed a gradual decrease from first to later parities with a minimum in the 8th parity. There was 15% decrease in calving interval from first to 8th parity (Figure 5).

The increased calving interval may be due to the high dry period (258±2 days). The lactation length was significantly affected by parity but not much fluctuated during the parity. The dry period decreased along with the parity is supported by the studies carried out by Cady et al., 1983; Syed et al., 1996; Thevamanoharn, 2002; Kandasamy et al., 1993; Patel and Tripathi, 1998). That ultimately reduced the calving interval in later ages.

Another plausible reason might be better feeding, management and seasonality of calving in buffaloes (Khan, 1997) as winter calvers wait longer to rebreed as compared to summer calvers. Ahmad et al. (1981) studied the calving interval in Nili-Ravi buffaloes and found that winter (569 days) and spring (570 days) calving intervals were comparatively longer than those of summer (506 days) and autumn (516 days). Management of buffaloes would require special attention to reduce calving interval in these herds.

Service period

The longest and shortest service period was observed in buffaloes maintained at LPRIBN and LESHA, respectively. There was no significant change in service period over the year (-3 to 2 days) Figure 6. The longest service period was observed in the buffaloes calving during winter seasons while the shortest service period

Table 1: Herd* means for different reproductive traits of Nili-Ravi buffaloes

Traits	Overall	LESHA	LESCK	LESKH	LPRIBN
Age at first calving (day)	1685±9.3 (2050)	1771±31.3 (184)	1792±20.5 (500)	1744±22.9 (410)	1604±13.8 (956)
Calving Interval (day)	501±1.6 (5526)	494±4.5 (812)	491±3.5 (1518)	492±3.8 (1353)	519±2.9 (1843)
Service period (day)	240±1.8 (6396)	224±4.9 (913)	229±3.9 (1656)	227±4.2 (1483)	264±3.0 (2344)
Services per conception (No.)	1.6±0.01 8823	1.3±0.03 (1197)	1.3±0.03 (2309)	1.2±0.03 (2108)	2.3±0.02 (3209)
Gestation period (day)	308±0.1 (9003)	308±0.3 (1200)	309±0.2 (2309)	307±0.2 (2112)	308±0.2 (3382)

* LESHA = Livestock Experiment Station, Haroonabad, LESCK = Livestock Experiment Station, Chak Katora, LESKH = Livestock Experiment Station, Khushab, LPRIBN = Livestock Production Research Institute, Bhadurnagar, Figures in parenthesis are number of observations

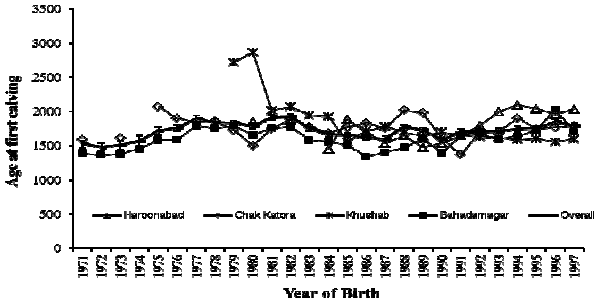

Fig. 1: Age at first calving in different herds during different years

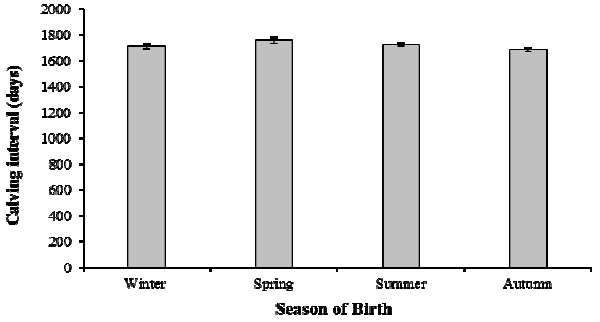

Fig. 2: Age at first calving in different seasons

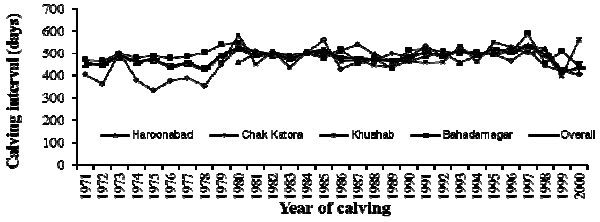

Fig. 3: Calving interval in different herds during different years

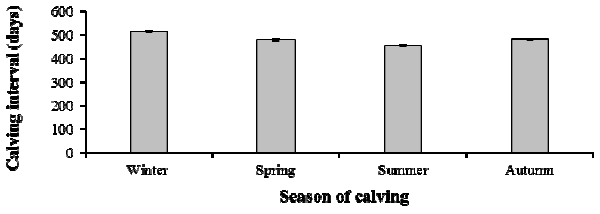

Fig. 4: Calving interval in different seasons

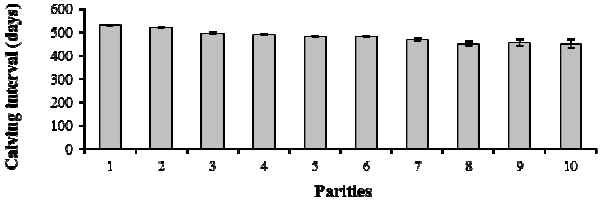

Fig. 5: Calving interval in different parities

was found in the buffaloes calving during summer seasons. During spring calvers the service period was 206±8 days, while during the autumn calvers the service period was 227±6 days (Figure 7). The maximum service period was observed in the 1st and minimum in 8th parity (Figure 8).

The results of the present study are supported by Cady et al. (1983) in Pakistani buffaloes, whereas quite variation in service period have been reported in Indian buffaloes (Komori et al., 1994). There may be difficulty for early conception in the first calvers, as first calvers suffer more from stress due to growing, producing and insufficient energy available to them. As a result buffaloes took longer service period in this study.

This variation in service period may be attributed to difference in extremes of climatic conditions during different years and seasons within the year, management practices, presence of teaser bull and skill to detect heat by labour. Higher service period for first parity buffaloes and buffaloes calving in winter would again need special managemental practices. Monitoring of body weight might also help to detect specific patterns. The service period and gestation period are the two components of the calving interval. Only service period can be altered to reduce the calving interval.

Services per conception

The average number of services per conception among the buffaloes in the four institutional herds was 1.6±0.01 with very high variability (Table 1). The highest and lowest number of services per conception were observed in the buffaloes maintained at LPRIBN and LESKH, respectively. The services per conception fluctuated over the year with no specific trend (Figure 9). Maximum services per conception were in spring calvers and minimum in autumn calvers followed by winter and summer calvers Figure 10. The number of services per conception were more in earlier parities as compare to the later parities (Figure 11).

The services per conception for Nili-Ravi and Egyptian buffaloes (Cady et al., 1983; Khan et al., 1997; Mostageer, 1989); whereas, the higher services per conception was similar to the average reported by Prasad and Prasad (1998). The services per conception in LPRIBN, was higher as compared to other three institutional herds in the present study (Figure 9).

The parity was also important ($P<0.01$) for the services per conception in buffaloes. In previous studies, Singh et al. (1994) reported that the average services required per pregnancy was 2.35 and it was significantly affected by parity number. The general trend was increase in services per conception as parity increases (Bagnato and Oltenacu, 1993) in cattle.

Average number of services per conception is in an acceptable range if less than two service per conception but this variable is generally difficult to record as many of the cycles are silent and some heats are missed

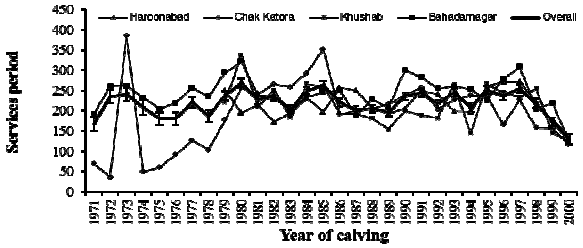

Fig. 6: Service period in different herds during different years

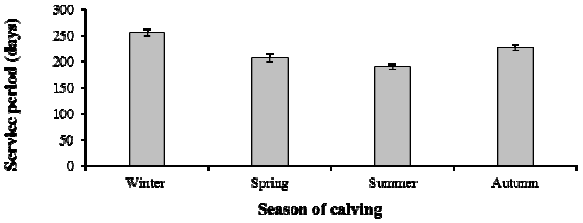

Fig. 7: Service period in different seasons

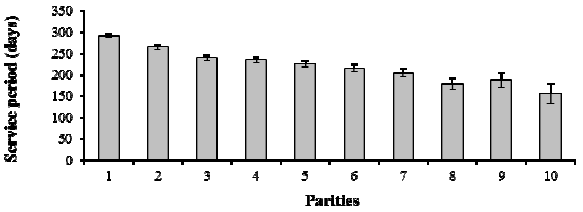

Fig. 8: Service period in different parities

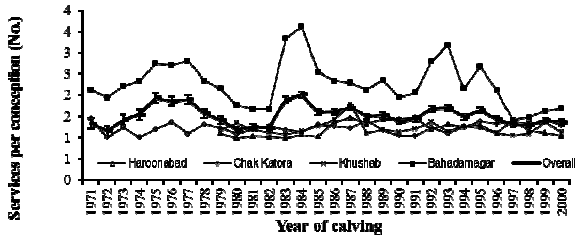

Fig. 9: Services per conception in different herds during different years

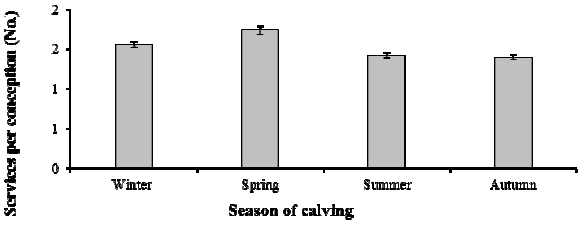

Fig. 10: Services per conception in different seasons

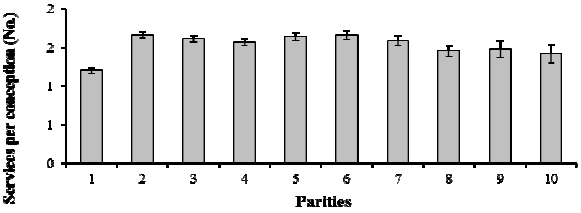

Fig. 11: Services per conception in different parities

because symptoms are not full or timings are not right. Differences in parity do not separate first parities from others as was the case in service period and calving interval. Seasonal differences may be due to nutritional status of the animal, cyclicity and managemental reasons. The other possible reasons of variation may be the semen quality, silent heat, venereal diseases, technician's expertise and general management of the herd.

Gestation period

The gestation period is less frequently studied trait in buffaloes. It averaged 308 days in the present study with least variability (CV= 2.7 %). It did not fluctuate over the years (Table 1). Parities did not affect it. However the statistical significance might be due to herd-year was due to low variation among herds or years. Gestation period in Indian buffaloes is in similar range (310.8±0.64 days) for Murrah buffaloes. It was reported that average gestation period (pooled over the 1st three calvings) was different among farms (Gupta et al., 1994). However, did not find dissimilarity in gestation period due to farms.

Differences of three months for age at 1st calving among herds under study indicated feeding and managemental difference, mainly in terms of adequate fodder supply. Within herd variation further indicated a lot of scope for improvement. Heat detection using teaser bulls would be another important managemental aspect that needs to be ensured to improve reproductive performance.

Seasonal fluctuation represent both feed supply and effect of temperature and humidity. Seasonality of breeding may also be an added factor for variable performance across different seasons. Summer is harsh in Pakistan, especially at the places where these farms were located. Buffaloes calve less frequently in summer, while more calvings are recorded in autumn season. Those calving in most frequent calving season (Autumn) produced better milk. Most important reason for better milk production in winter calvers seems to be availability of lush green fodder in abundance.

Variation in mean values and effect of different factors on reproductive traits indicated a significant effect of environmental factors. Variation in herd, year and season directly influenced the reproductive activities of the animals. This indicates that improvement in reproductive traits can be achieved by proper heat detection, timely service, balanced feeding and

adequate housing. Age at first calving and calving interval increased by 1.6 and 0.9 days per year, respectively. No change in service period and services per conception was observed during the study period. Improved management of heifers may reduce age at first calving and culling on the basis of reproductive performance may improve buffaloes in future. The green fodder should be preserved in the form of hay or silage for using during scarcity months.

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