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Environmental factors affecting performance of cholistani cattle in Pakistan

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Abstract

Pakistan has 47.8 million heads of cattle, which supply 36% of the total milk production in the country. Most of the cattle population in the country is non-descript and has low inherent milk producing capacity but there are few exceptions like Sahiwal, Red Sindhi and Cholistani cattle which are considered to be the best dairy animals in the tropics and sub-tropics and are well adapted to hot and humid climatic conditions of the country. They command a great resistance to several diseases prevalent in the area. These animals produce good quantity of milk, however, late age at first calving and long calving intervals of these animals result in reduced reproductive efficiency, calf crop and milk yield on lifetime basis that provides a great scope for the improvement of Pakistani cattle. Data on 1473 lactation records of 306 Cholistani cows kept at Government Livestock Farm, Jugait Peer, District Bahawalpur were utilized to evaluate the performance of Cholistani cows and the extent of different environmental sources of variation influencing important performance traits of Cholistani cows. The least squares mean for different traits were computed and the influence of different environmental factors were assessed.

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Introduction

The Cholistani cattle is zebu (*Bos indicus)* medium sized cattle that are generally kept for milk production and this breed's habitat is Cholistan desert which spreads over almost three districts of Punjab province viz; Bahawalnagar, Bahawalpur and Rahim Yar Khan. Bhutto *et al.*, 1993 reported that it can withstand extreme hot conditions of the desert and its longevity of production is very good despite the harsh conditions of its habitat. Mason, 1996 reported Cholistani cattle as a multipurpose breed, being used for meat, milk and draught purposes. The Average lactation milk yield of 305 days is 1800 liters (Bhutto *et al.*, 1993).

Reproductive performance of dairy cattle is an important trait for efficient milk production in a herd. A cow should calve annually for most profitable dairy production but it seldom happened under the desert conditions where animal has to walk miles together to fill their bellies. The low productivity is often attributed to the late maturity and long calving intervals. Several environmental factors could be attributed to these productive and reproductive in-efficiencies. The environmental factors include yearly and seasonal fluctuations, management deviations and other biological factors. The milk production of cows varies greatly due to age at first calving and calving intervals. Identification of genetically superior individuals is the main objective in all animal breeding programs. These environmental factors may mask the animal's true genetic ability and thus can make the true picture biased. The evaluation of their influence is vital in livestock.

Materials and methods

Pedigree and performance records of 306 Cholistani cows consisting of 1473 lactation records collected from Government Livestock Farm, Jugait Peer, District Bahawalpur over a period of 14 years were utilized which consisted of cow, service sire and calf identities, date of birth, date of service, date of calving, date of drying, date of disposal and lactation milk yield. The performance traits examined in the present study were: productive traits [first lactation milk yield (FLY), lactation milk yield (LY), lactation length (LL) and dry period (DP)], reproductive traits [age at first calving (AFC), service period (SP), calving interval (CI) and breeding efficiency (BE)] and lifetime traits [lifetime milk yield (LMY), productive life (PL), longevity (L) and herd life (HL)].

In addition to the basic edits of consistency checks for dates and animal identities, records of cows which had aborted, missed a year due to sickness or other reasons were eliminated. All the performance traits outside plus minus three phenotypic standard deviations from the unadjusted mean were also excluded. Age at calving was computed from birth and calving dates, and all cows with obviously unacceptable ages were eliminated. Errors in data recording compelled heavy editing. For data entry and manipulation MS Excel computer programme was used.

Statistical analyses

Evaluation of environmental effects

Effect of the environmental factors viz. year and season of birth /service /calving, age at first calving, lactation length and lactation number, as appropriate, on various performance traits was evaluated. The year was divided in to the following five seasons for the purpose:

Winter	December	to	February
Spring	March	to	April
Dry hot	May	to	June
Humid hot	July	to	September
Autumn	October	to	November

The mathematical model assumed was:

$$Y_{ij} = \mu + F_i + e_{ij} \quad \text{(Model 1)}$$

Where,

Y_{ij} = measurement of a particular trait

μ = population mean

F_i = the effect of all fixed effects with the restriction that Fi = 0

e_{ij} = the random error associated with each observation.

The repeated measures of performance traits viz. milk yield, lactation length, dry period, service period and calving interval were analyzed using a simple repeatability model. For these traits the mathematical model assumed was:

$$Y_{ij} = \mu + Cow_i + Fj + e_{ij} \quad \text{(Model 2)}$$

where, Cow_i = effect of ith cow having repeated records while other terms are the same as defined for model 1

For all these analyses Mixed Model Least Squares Maximum Likelihood (LSMLMW) computer programme (Harvey, 1990) was used.

Results and discussion

Phenotypic Performance

The unadjusted means along with standard deviations, least squares means (LSM) with standard errors for various performance traits are presented in Table (1). The least squares mean for first lactation milk yield was 1219.236±44.842kg. The least squares means for lactation milk yield, lactation length and dry period were 991.773±38.420kg, 223.326±9.835 days and 276.389±14.105 days, respectively. For reproductive traits i.e. age at first calving, service period, calving interval, and breeding efficiency, the estimates for least squares means were 1536.274±29.301 days, 42.951±9.804 days, 550.876±14.984 days, and 86.786±2.136 percent respectively. The corresponding values for lifetime traits i.e. lifetime milk yield, productive life, longevity and herd life were 4148.378±378.785kg, 592.325±68.098 days, 1931.073±61.596 days, and 992.258±165.618 days respectively.

Table 1. Unadjusted, LSM and coefficient of variations for various performance traits of Cholistani Cattle.

Traits	No.	Unadjusted mean± SD	LSM±SE	CV
Productive traits				
First lactation milk yield	96	1249.250±464.548	1219.236±44.842	37.186
Lactation milk yield	949	1233.011±399.472	991.774±38.420	32.398
Lactation length	1178	200.036±66.361	223.326±9.835	33.174
Dry period	1020	221.765±92.229	276.389±14.105	41.589
Reproductive traits				
Age at first calving	176	1593.795±325.663	1536.274±29.301	20.433
Service period	453	140.700±86.559	42.951±9.804	61.520
Calving interval	1124	425.116±104.567	550.876±14.984	24.597
Breeding efficiency	126	86.889±13.471	86.786±2.136	15.504
Lifetime traits				
Lifetime milk yield	112	4949.107±2930.851	4148.378±378.785	59.220
Productive life	135	791.437±527.907	592.325±68.098	66.702
Longevity	21	2030.286±376.678	1931.073±61.596	18.553
Herd life	75	1272.773±996.901	992.258±165.618	78.325

Environmental Factors affecting various Performance Traits

The influence of various environmental factors on FLY, LY, LL, DP, AFC, SP, CI, BE, LMY, PL, L and HL were studied as these traits showed a great variation in different sets of conditions (Table 2). The fixed effects viz. age at service (AAS), age at first calving, lactation length, calving interval, parity (P), and year & season of birth/calving/service on different performance traits were also studied by the analyses of variance using LSMLMW computer program (Harvey, 1990).

Table 2. Effect of different environmental factors on productive, reproductive and lifetime traits.

	YOB	SOB	YOC /YOS	SOC /SOS	LL	P	AFC/ AAS
a. Productive Traits							
First lactation milk yield	-	-	**	NS	**	-	NS
Lactation milk yield	-	-	**	NS	**	**	-
Lactation length	-	-	NS	NS	-	NS	-
Dry period	-	-	**	NS	-	*	-
b. Reproductive Traits							
Age at first calving	**	NS	-	-	-	-	-
Service period	-	-	**	**	-	-	**
Calving interval	-	-	**	**	-	**	-
Breeding efficiency	NS	NS	-	-	-	-	NS
c. Lifetime Traits							
Lifetime milk yield	**	NS	-	-	-	-	**
Productive life	**	*	-	-	-	-	*
Longevity	NS	NS	-	-	-	-	**
Herd life	*	NS	-	-	-	-	**

YOB = Year of birth, SOB = Season of birth, YOC/YOS = Year of calving/Year of service,
SOC/SOS = Season of calving/Season of service, LL = Lactation length, P = Parity, AFC/AAS = Age at first calving/ Age at service).
** = Significant ($P<0.01$), * = Significant ($P<0.05$), NS = Non-Significant

Influence of AFC, AAS and LL on Performance Traits

The regression coefficients of FLY on AFC & LL; LY on LL; SP on AAS; BE on AFC; LMY on AFC; PL on AFC; L on AFC and HL on AFC were calculated. Analysis revealed that no significant change in FLY was observed with increase or decrease in AFC and both traits were found independent of each other. There was no significant effect of AFC on FLY according to the results, however, lesser age at first calving is the goal of every animal breeder along with better feeding and management practices. Thereby reducing environmental effects, better AFC should be achievable and thereby improving the lifetime performance of the animals.

The regression of service period on age at service was −0.21 i.e. there was decrease of 0.21 days in service period per day increase in age at service.

The regression of BE on AFC was found to be −0.01 percent per day which was non-significant (Table 2).

The AFC had a significant (P<0.01) effect on LMY (Table 2). The present study also found a reduction of 2.30±0.82kg in LMY with each day increase in AFC suggesting an increase in LMY with decrease in AFC.

The regressions of PL and L on AFC were −0.35±0.14 and 0.51±0.15 days which means that there was a decrease of 0.35± 0.14 days in PL and an increase of 0.51±0.15 days in longevity with each day increase in AFC. These findings suggest that an improvement in PL is expected with reducing the AFC.

The regression of herd life on age at first calving was −1.02±0.32 days. It means that a decrease of 1.02±0.32 days in hard life was expected with each day increase in age at first calving.

The regression of LY on LL was also significant (P<0.01) (Table 2). Although, LY increased with increase in the LL yet it did not appear to be advantageous to have lactations exceeding one year. The daily milk yield in later stages of the lactation becomes low, thereby reducing the lifetime production of an animal. Longer LL also increases CI thereby reducing both the productive as well as reproductive efficiency.

Year and Season of Calving

The Least squares mean of FLY, LY, LL, DP, SP and CI in Cholistani cows calving in different years showed a wide variation.

The variation in milk yield observed in different years reflected the level of management as well as environmental effects. The level of management is bound to vary according to the ability of the farm manager, his efficiency in the supervision of staff, his system of crop husbandry, method and intensity of culling (Ashfaq and Mason, 1954; Basu and Ghai, 1978). The results of analysis of variance for FLY revealed that year of calving had a significant (P<0.01) effect on the trait. The analysis revealed that year and season of calving had a non-significant effect on lactation length (Table 2).

The least squares mean for the FLY, LY, LL, DP, SP and CI among the cows calving during different seasons of year showed variation.

The FLY of cows calving in different years showed a wide variation. Year of calving had a significant (P <0.01) effect. The FLY was highest in cows calving during winter season and it was lowest in the cows calving during autumn season. The maximum number of calvings was recorded in winter season followed by spring, humid hot, dry hot and the lowest number of calvings were observed in the season of autumn. Season of calving had a non-significant (P>0.05) effect. The least squares mean for LL among cows calving during dry hot season was maximum and the minimum for cows calving during autumn season.

The LSM for LL showed a non-significant (P>0.05) variation over the years of calving. The LY showed a significant (P<0.01) variation over the years. The LY was highest in the cows calving during autumn and lowest among the cows calving during spring season. The analysis of variance of data revealed that LY of cows differed non-significantly due to season of calving (Table 2). The maximum number of calvings was recorded in the winter season followed by humid hot, spring, dry hot and autumn.

Much variation in length of DP in cows calving during different years was observed. The DP showed more or less a decreasing pattern over the years and revealed a significant (P<0.01) effect of year of calving on dry period (Table 2).

The DP was shortest in the cows calving during autumn while it was longest in the cows calving during spring season followed by dry hot, winter and humid hot. The maximum number of calvings was recorded in winter season followed by humid hot, spring, dry hot and autumn seasons.

There was much fluctuation in the LSM for SP among cows bred during different years of service.

The least squares analysis of variance revealed that year and season of service had a significant (P<0.01) effect on SP as depicted in Table (2).

The longest SP was observed in cows, which were bred during humid hot season while the shortest service period was observed in winter season. The season of service had a significant (P<0.01) influence on SP. The CI in farm animals is by and large determined by the SP. The SP is positively and significantly correlated with LY, LL and CI (Basu, 1985). It means that increase in SP will cause longer LL and thereby more milk but breeding efficiency would be deteriorated.

There was variation in CI during different years of calving. A reduction in CI is desirable as it increases the productive life and the more number of calves are produced during the life span of the animal hence improving the overall productivity of dairy animals. The year of calving had a significant (P<0.01) effect on CI. The least squares means for the cows calving during different seasons showed variation. The longest CI was observed in spring season while the shortest CI was observed in cows calving during autumn season.

Effect of Parity

The least squares mean for LY, LL, DP and CI among the cows during different parities showed variation.

There was a significant (P<0.01) effect of lactation number (parity) on LY. Maximum LY was observed in the first lactation and minimum was found in 12th lactation. The LY showed a decreasing trend over the parities. The LL was not significantly influenced by lactation number. There was an increasing trend in LL with increase in lactation number. Lactation number is an indicator of the age of the cow. So it can be said that with increase in age the LL also increases. Longer LL increases the generation interval by widening the CI, thereby resulting in decreased lifetime production.

A significant (P<0.05) effect of lactation number was observed on DP (Table 2). The longest DP was observed in 11th lactation while the shortest DP was observed in the 2nd lactation. The longest CI was observed in cows in the 12th parity while the shortest was found in the cows, which were in their first parity. A general increasing trend from 1st parity onward was observed. A significant effect of parity (P<0.01) on CI (Table 2). Parity is an indicator of the age of the cow. So the results suggest that with difference of age in cows difference in calving interval is expected.

Year and Season of Birth

The least squares mean for AFC, BE, LMY, PL, L and HL for cows born during different years and seasons showed variation.

The least squares analysis of variance for AFC revealed that year of birth had a significant (P<0.01) effect on AFC while season of birth had a non-significant effect on AFC (Table 2).

The AFC is a very important factor in efficiency of dairy production. The longer AFC may be a reflection of poor feeding and management, poor heat detection, improper time of insemination etc. Therefore, better feeding, management and disease control are the key factors in decreasing the age at first calving. A non-significant effect of year and season of birth was observed on BE (Table 2).

The least squares means for LMY in cows born during different years showed variation. The year of birth had a significant (P<0.01) effect on LMY (Table 2). The data on LMY for different seasons of birth showed variation. These estimates were lowest in autumn and highest in dry hot season of birth.

The least squares mean for PL for cows born during different years and seasons showed variation. There was a great variation in productive life among the cows born during different years. The year of birth had a significant (P<0.01) effect on PL (Table 2). The AFC had a significant (P<0.05) effect on PL.

The least squares means for the cows born during different seasons showed some variation. A non-significant effect of year and season of birth on

Longevity was seen but a significant ($P<0.01$) effect of AFC on longevity was observed (Table 2).

The least squares mean for HL among the cows born during different years showed a wide variation. The HL among the cows born during different seasons also showed variation. Year of birth had a significant ($P<0.05$) effect and AFC also had a significant ($P<0.01$) effect on HL (Table 2).

Conclusion

An insight about a very important cattle breed of Pakistan maintained at Cholistan desert to highlight and evaluate its productive and reproductive profile in a habitat being one of the great desert of the country which is usually drought stricken with harsh climatic conditions shows that the breed has got a great potential to a bridge the gap of milk and meat in the country if its potentials are fully exploited and breed is provided with good husbandry practices.

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