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Productive and Reproductive Performance of Sahiwal Cattle in Dry Zone of Sri Lanka in Relation to the Environmental Parameters

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Abstract

A study was conducted to assess the productive and reproductive performance and related to the effects of environmental factors and animal factors of Sahiwal cattle in the dry zone of Sri Lanka. Data was collected on calving, lactation, age at first calving and birth weight of calves were tabulated and analyzed in relation to ambient temperature (AT), relative humidity (RH) and rainfall (RF) during the period of 2000-2006. The mean AT fluctuated between 26.6°C and 34.9°C while RH varied between 64.7% and 87.6%. The annual RF (817.2±157.1 mm) was follow-up bimodal, reaching the highest level from October to December and a very small elevation from March to May. The majority of the calves (47%) were born from February to May. Birth weight of male (19.39± 3.18 kg) and female calves (18.84±3.20kg) were not significantly different. Gestation length (285.73±56.24 days) was not different between the sexes. Lactation length (279.5±52.18 days) and lactation yield (1401.92±540.5 liters) decline with the parity, Total milk yield increases till third lactation and reach a peak yield of 1497.6±521 lit in 281.5±51 days and decline there after. Mean ambient

temperature of the month (r=-0.342) is significantly ($p<0.05$) correlated to birth weight. The results suggest that the prepartum period as the most vulnerable stage to environmental stress. Mean temperature and relative humidity, as the most important environmental factors affecting the performance. Alleviating heat stress during prepartum is suggested as a means for improving reproduction performance of cows and birth weight of calves.

Key words: Lactation length, Birth weight, Gestation length, lactation yield, prepartum

Introduction

The livestock sector is an important component of the agricultural economy of Sri Lanka. It had 11.6 million cattle and 1.3 million buffalo in 2004. The estimated annual milk production in 2004 was 160 million liters from cow and 0.31 million liters from Buffalo [5]. It contributes to improve food and nutritional security by providing nutrient milk food products, generate income and employment etc. The Agriculture sector has contributed 17.9% of the National GDP [3] which is a decline of 0.7% compared to year 2003. In Sri Lanka Tropical Temperate and indigenous breeds are available. Indigenous and tropical cattles are most common dairy animals compare to other dairy animals. They are small, average lactation period and milk production 305 days and around 450kg respectively [6]. This level of production, while it may satisfy the needs of subsistence farming, is too low for commercial dairying, it therefore necessary to improve the production potential of the cattle in order to make them profitable[12]. Average monthly productions of cow and buffalo milk are 13,308,000 and 2,550,000 in liter respectively [5]. Venue Availability of milk per person annum in Sri Lanka is 32.8 liters [2]. The country milk supply is adequate to meet only about 30-35% of the requirements. The balance is fulfilling mostly by the imported powdered milk form [4]. The following objectives were set to my studies, Study the performance of production and reproduction in dry zone cattle, Study the relationship of these parameters related to the environmental variables, Identify the management practices adopted in Dry Zone of Sri Lanka and Suggest the ways to improve the existing production system in Dry Zone of Sri Lanka.

Materials and Methods

Location and Animals

The data used in this study were collected from the National Livestock Development Board (NLDB) farm, located at the Polonnaruwa, 20 km away from the town. It is located in the Polonnaruwa district of the North Central Province of Sri Lanka, at latitude, longitude and elevation of 8° 10' N, 80° 55' E and 50 ft, respectively. (table.1)

Management Practices:

Pasture and fodder land consist of *Bracharia brizantha, Bracharia mutica, Penisetum pupureum* (NB21) and tree legumes *Gliricidia muculata* and *Erythirina indica*. General feeding management practice adopted was a combination of zero grazing and semi-intensive management. During the first three months postpartum, the cows were managed under zero grazing, given a mixture of fodder and pasture grasses with 1-2 kg of concentrate mixture at milking time. Beyond three months postpartum, cows were sent for grazing in the field during 7.00 to 10.30 hrs.The composition of the concentrate is coconut poonac 32%, rice bran 49%, broken rice 9% molasses 9% and mineral mixture 1%. The feeding schedule for Stud bull, milking cow, dry cow and heifer are 5kg, 4.5kg, 4kg and 1-3kg per day respectively.

For calves they are mixing milk powder addition.

Breeding Program:

Both natural service and artificial insemination (AI) were practiced. During the study period there were 2 vasectomies bulls used as teaser to detect the heat and 4 stud bulls for natural service. The cows, which were not come to heat even after 90 days, their ovaries were checked by veterinarian. If the ovaries were found functioning, they were subjected to AI again.

Data Collection and Analysis

Animal Parameters:

A total number of 155 records history sheets of Sahiwal, almost they are same in age with at least one calving cover a period of years from

2000 to 2006 was selected. From that, cow identity, service date, type of service, calving date, lactation number, date of dry off, birth weight of calf, sex of calf, lactation length, total milk yield were collected. Data concern with abortions, still birth and lactation less than 100 days were excluded from the analysis, because, such incidences were considered to be abnormal. After excluding all the above mentioned "abnormalities", only the data from 155 cows and 462 calves were included in the analysis.

Environmental parameters: Meteriological data on daily ambient temperature (AT mean), maximum ambient temperature (AT max), minimum ambient temperature (AT min), relative humidity (RH mean), maximum relative humidity (RH max), minimum relative humidity (RH min) rainfall (RF mean) maximum rainfall (RF max) and minimum rainfall (RF min) were obtained from the Polonnaruwa Meteriological Station and the farm.

Colleted data on animal parameters and environmental parameters were tabulated and statistical analysis were carried for mean value and standard deviation and the regression by using the SPSS version 13.0.

Results and Discussion

Environmental Parameters

Overall mean and standard deviation of monthly ambient temperature (AT), rainfall (RF) and relative humidity (RH) that prevailed in the area during the study period is given in Table 2.

Ambient temperature fluctuated diurnally between 26.6°C and 34.9°C. Mean monthly ambient temperature was highest in June and lowest in December. AT was not significantly varied among the months. The mean and standard deviation of annual rainfall of the area 817.2±157.1 mm was varied significantly depending on the month of the year. Minimum value in July and maximum in November. Annual rainfall was not show a distinct bimodal pattern, yielding a maximum rainfall during October to December and slightly increase in March to May. Relative humidity varied between 87.6% and 64.7% during the day time. Humidity high in November to December and low from June to August.

Association between Environmental Parameters

Temperature and the rainfall was negatively correlated each other among the month of year ($r=-0.5829$; $p<0.05$) (Fig.1). Rainfall and humidity was positively correlated ($r=0.54$; $p>0.05$) each other. (Fig.2) Temperature and the humidity was negatively correlated each other among the month of years association ($r=-0.8157$; $p<0.01$).

Animal Parameter

Calving Pattern

Monthly distribution of calving percentage is given in table 3. It shows that calving occurred through out the year. Highest percentage (47%) of births took place between February to May and another small peak period of calving was evident. During October to December calving percentage little bit higher (22-24%) compare to February to May. Rest of the month, approximately 18-25% calf birth took place.

Birth Weight (BW)

The overall mean birth weight of the calves born during 2000- 2006 was 19.14±3.2kg.

The birth weight of bull calves (19.39±3.18kg) and heifer calves (18.84±3.20kg) were not significantly varied among the sex. Birth weight also was not significantly varied among the months. However higher mean birth weight was (20.12±3.10kg) in January and lower (17.58±2.83kg) in July.

Age at First Calving

Age at first calving varied from 2 years and 8 months to 5 years and 4 months and the mean age at first calving was approximately 44.1±10 months. Less than 7% of heifers delivered the first calf before 36 months of age, while majority of the heifers (91%) calved for the first time between 36 to 60 months of age. A very few number (2%) delivered calf beyond 60 months of their age.

Calving to First Service Interval (CFS)

It is estimated as the interval from calving to first detected estrous or first service, ranged from 90 to 759 days, with the mean value of

111.39±106.13 days. Calving to first service interval was varied among the month. Mean length of calving to first service interval was lowest (87.09±54.97 days) in cows that calved during the March to June, while CFS was longest during November (154.67±114.67 days) and February (151.08±191.65 days). Calving to first service interval was longest in cows that calved in November and February. It could be lack of management practices and reproductive disorders

Calving Interval (CI)

The mean calving interval of the study herd was 11/2 -2 years. The parameter decline from the first to the fifth calving intervals of cows following the first, second third, fourth and fifth calving were 496±171, 445±140, 449±186, 428.5±130 and 428±129 days respectively. Longest mean calving interval was observed in the month of January while the shortest mean in March. [9] obtained mean calving interval of 486 days while, [8] recorded 488±61.4 days and, [11] obtained 445±94.9 days in Bangaladesh, but it worse than that obtained by [13] 342±37 days in Sri Lanka.

First Service to Conception Rate (FSC)

According to the available records on dates of service of cows, the first service conception rate was 68%. Lower and higher FSC were found during August and September respectively. It may be physiological status of cow, rainfall and temperature effect of month when the services were done. In the September there was moderate amount of rainfall and modest in ambient temperature leads to the high conception rate, it was achieved due to most of the heat stress reduced by the rainfall and also the pasture availability was high, leads to keep the animal more nutritious than in the other months. When ambient temperature was very high, this was adversely affect feed intake of forages already low in nutritive value as well as efficiency of feed utilization thus leading to further deterioration of fertility. Heat stress alone was not bringing the poor first service conception rate; it should be accompanied by other factors, such as timing and type of insemination.

Gestation Length (GL)

Gestation length as estimated from last service to subsequent calving was 285.73±56.24days. Gestation length attributed to the sex of the calf could be detected, Gestation length, for male calf was 289.31±4.24 days and for female calf was 281.29±9.89 days. Nevertheless there is no significant difference between the gestation length and the sex of birth.

Sex ratio

There were approximately 271 male to 208 female. That is 56.57 male births, a finding that is not significantly different from the theoretical 50:50 ratio. In April higher percentage of female calves were born. July and February very low in female calves born percentage.

Association within the Animal Parameters

Birth weight was affect the milk yield ($r=-0.2821$; $p>0.05$), lactation length ($r=-0.2409$; $p>0.05$) calving interval ($r=0.1781$; $p>0.05$) and calving to first service interval ($r=-0.0023$; $p>0.05$).

Age at first calving was affect the birth weight of calf ($r=0.0167$; $p>0.05$), calving interval ($r=0.2362$; $p>0.05$), gestation length ($r=0.0471$; $p>0.05$), milk yield ($r=0.0761$; $p>0.05$) and calving to first service interval ($r=0.154$; $p>0.05$).

Association between the Environmental Parameters and Animal Parameters

Correlation and regression of the birth weight with the AT, RF and RH indicated that the birth weight was negatively correlated to mean ambient temperature of the month

($r=-0.342$; $p<0.05$) (Fig.3) However humidity and rainfall were positively correlated to birth weight ($r=0.342$; $p>0.05$) and ($r=0.065$; $p>0.05$) respectively, which were not significantly associated.

Anyhow there was a variation for birth weight among the environmental parameters (AT, RF and RH). Higher calves births were found in the month of January. This could be large amount of good quality and nutritious forage were available. It is coincide with high

rainfall during November and December. Not only increase the feed, but also reduced the heat stress, this lead to increase the feed intake, as well as efficiency of feed utilization [10]. Negative relationship has been found birth weight and ambient temperature. It could suggest the detrimental effects of high environmental temperature condition of foetal nutrition during prepartum. During this study derived overall mean value for birth weight is higher than that calculated by [1].

Age at first calving negatively correlated with rainfall and relative humidity and positively correlated with AT. None of them were significantly correlated.

Calving to first service period was correlated with AT (r=-0.1423), RH (r=0.1082) and RF (r=0.2189) in the month of calving. AT, RF, RH were slightly correlated with CFS. But none of them were significantly correlated.

Correlation and regression analysis of the milking yield with the AT (r=0.2358; p>0.05), RF (r=-0.1596; p>0.05) and RH (r=-0.1581; p>0.05). Calving occurred during the February and March, which cows have given higher milk yield. However these correlations were not significantly correlated.

There was not a significant effect of temperature, rainfall and relative humidity on calving interval. But CI is negatively correlated (r=-0.1373; p>0.05) with temperature and rainfall (r=-0.0086; p>0.05) and positively correlated with humidity (r=0.0819; p>0.05).

Gestation length very slightly correlated between Rainfall (r=-0.0156; p>0.05) temperature (r=0.0577; p>0.05) and RH (r=0.0002; p>0.05)

Conclusion

This study revealed that many of the productive and reproductive traits are characterized by wide range of values and high standard deviation. Such large deviations are indicative of opportunities for improvement in these traits. The majority of the calves were born from February to May, male calves birth weight high compare to female. Perpartum period as the most vulnerable stage to environmental

stress. Mean temperature and relative humidity, as the most important environment factors affecting the performance. Alleviating heat stress during prepartum is suggested as a means for improving reproduction performance of cows and birth weight of calves. Since most of the traits have low heritability, so the progress can be achieved by paying attention to environmental factors, especially ameliorating the unfavorable effects of heat stress and improving the nutritional value of the forages. There is a need for a concerted effort to reduce the age at first calving. Greater attention to improve nutrition and alleviating the adverse effects of high temperature would be of help.

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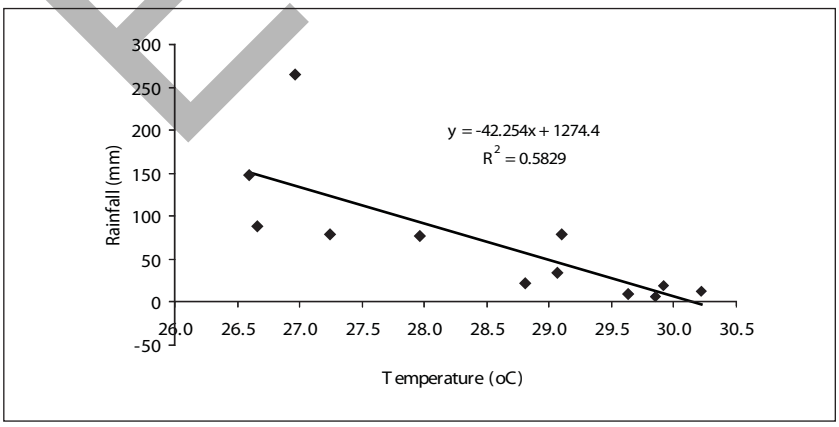

Fig.1 Relationship between temperature and rainfall

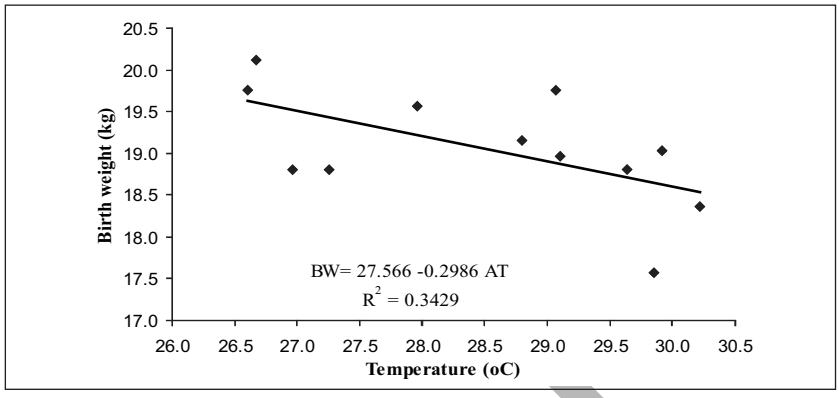

Fig. 2 Relationship between rainfall and humidity

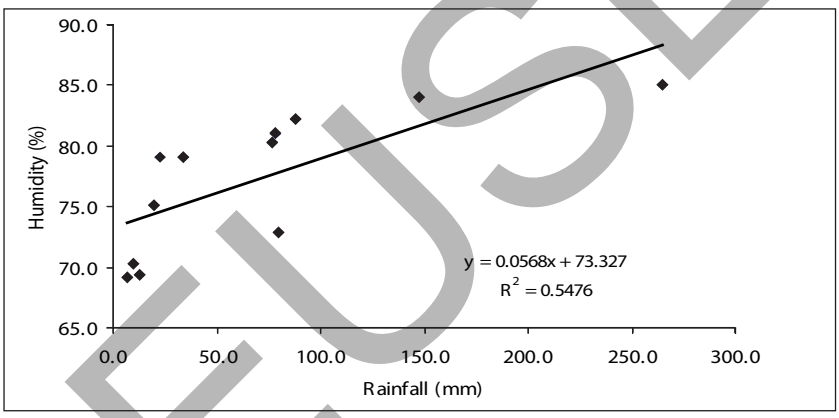

Fig.3 Relationship between birth weight and mean monthly ambient temperature.

Table.1 Herd composition in NLDB Polonnaruwa farm.

Herd Structure			Sahiwal
Cows	Milking cows		111
	Dry cows		151
Calves	Heifer	0-1 yr	75
		1-2 yr	79
		2-3 yr	61
		3-4 yr	54
		4< yr	15
	Bull	0-1 yr	54
		1< yr	7
Stud bull			4

Table 2: Mean and standard deviation monthly ambient temperature, relative humidity and rainfall among the months.

Month	Temperature(°C)			Humidity (%)			Rainfall (mm)		
	mean	max	min	mean	max	min	Mean	max	min
January	26.7±0.4	28.7	24.7	82.3±0.8	83.5	81.2	88.3±73.1	216.9	26.4
February	27.3±0.5	29.5	25.1	81.0±2.8	85.2	77.4	78.2±58.0	130.1	0.0
March	28.8±1.0	31.4	25.3	79.1±1.7	81.2	76.7	22.2±25.8	65.0	0.0
April	29.1±0.3	32.9	26.0	79.0±1.3	80.9	77.5	33.8±36.6	86.6	0.0
May	29.9±0.5	34.0	26.8	75.2±2.8	78.1	70.1	19.8±13.5	37.8	1.5
June	30.2±0.4	34.9	26.5	69.4±4.2	75.0	64.8	12.6±22.4	56.6	0.0
July	29.9±0.4	34.8	26.5	69.1±4.4	77.0	64.7	6.9±14.0	35.1	0.0
August	29.6±0.2	34.4	26.4	70.3±2.7	73.1	66.4	10.0±13.3	31.8	0.0
September	29.1±0.5	33.3	25.9	72.9±4.1	79.7	68.5	79.6±122.1	291.6	0.8
October	28.0±0.3	31.5	25.5	80.4±1.2	82.4	79.2	77.0±75.4	202.7	6.1
November	27.0±0.3	29.4	25.0	85.1±2.1	87.6	82.6	264.5±103.5	432.3	148.3
December	26.6±0.4	28.9	24.6	84.0±1.7	86.3	82.3	147.6±106.2	275.3	27.4

Table 3: Monthly distribution of calving percentages and birth weights of calves

Month	No of calves	Percentage of calving	Birth weight (kg)
January	26	5.3	20.12±3.10
February	56	11.4	18.81±3.57
March	52	10.5	19.15±3.18
April	65	13.2	19.75±3.37
May	51	10.3	19.02±3.19
June	38	7.7	18.37±3.38
July	33	6.7	17.58±2.83
August	25	5.1	18.80±2.38
September	29	5.9	18.97±3.83
October	43	8.7	19.56±3.55
November	35	7.1	18.80±1.97
December	40	8.1	19.75±2.74

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