

Productive and reproductive performance of Friesian cows at Kitulo livestock multiplication unit, Tanzania

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SUMMARY

Retrospective data were collected to assess reproductive and productive performance of Friesian dairy cows reared at Kitulo Livestock Multiplication Unit, Tanzania. Records of 314 cows within consecutive five productive periods; 2009 - 2014 were analyzed using Statistical Package for Social Science (SPSS). The overall mean age at first calving (AFC), calving interval (CI), days open (DO), number of services per conception (NSPC), lactation length (LL) and total lactation milk yield (TLMY) were 1151.72±9.63 days, 404.57±1.54 days, 121.82±1.24 days, 1.83±0.24, 306.54±5.53 days and 5,042.12±23.73 kg, respectively. CI differed significantly ($P < 0.05$) as it decreased with increasing parity but did not affect the TLMY. Number of services per conception positively correlated with DO and CI but negatively correlated with parity. Total lactation milk yield was significantly ($P < 0.05$) influenced by parity and lactation length, but TLMY had no significant ($P > 0.05$) effect on the average number of services per conception. It is concluded that reproductive and productive performance of Friesian dairy cows in the present study were low to moderate so it is required to improve management practices at the farm for better reproductive and productive performance.

Key words: calving interval, number of services per conception, lactation length, Friesian

INTRODUCTION

Dairy cattle industry is an important source of human food, regular household income and employment in Tanzania (MLDF, 2014). The dairy sub-sector in Tanzania is not homogeneous and can broadly be subdivided into large scale, medium scale and smallholder (MLDF, 2011). Tanzania smallholder dairy farms are relatively small in size having 1 – 5 cows per household under Zero grazing and are normally found in diverse climatic conditions. Medium Scale dairy farming system comprises of 10 – 50 cows mainly managed in paddock rather than grazing with the milk production is the main economic activity of

the farm. Large Scale State dairy farms are farms with 50 or more dairy cows managed by either government or privately owned. The efficiency of dairy farming is influenced greatly by the reproductive performance of the dairy cattle (Peters and Ball, 2004). Reproduction in livestock is crucial for production of the necessary replacement stock, for reducing unproductive periods, for initiation of lactation, for increasing lifetime milk production and income (Das *et al.*, 1986). When the reproductive efficiency of a farm is poor, losses that can occur include fewer calves being born due to longer calving intervals, increased veterinary costs due to more problematic cows, increased number

of matings to achieve conception as a result of poor heat detection, and increased number of replacement heifers needed for non-voluntary reproductive culls.

In Tanzania, data showing overall reproductive performance of dairy cows in the country is limited. The little information available in smallholder herds show the average calving interval ranging from 420 to 680 days (Donald, 1985; Kanuya *et al.*, 2000; Msanga *et al.*, 2001; Lovince, 2004; Lyimo *et al.*, 2004; Mgeni, 2010). These intervals are considerably longer than the 365 days expected on a commercial dairy farm under tropical conditions (Syrstad, 1995). Underlying causes of the long calving intervals are rather difficult to establish and evaluate; however, they do confirm the existence of poor reproductive performance. Such a long calving interval suggests existence of poor reproductive performance but does not pinpoint the underlying causes of the problem.

The productivity of dairy cattle in Tanzania is low, producing on average about seven kilograms of milk per day in the wet season and decline to nearly three kilograms per day in the dry season (Msangi and Kavana, 2002). The peak milk yield of the cow depends on body condition status at calving, her inherited potential, health status and feeding regime after calving (Mgeni, 2010). The amount of milk produced is determined by breed of the cow, environment and interaction between the two (Kifaro, 1995). Exotic breeds have high potential for milk production followed by crossbreds and finally indigenous breeds. However, variation in lactation milk yield for exotic breeds in tropics has been reported by various authors (Haile, *et al.*, 2009; Njubi, *et al.*, 2009; Effa, *et al.*, 2011; Lubago *et al.*, 2006; Sattar *et al.*, 2005; Ajili *et al.*, 2007). The variation in lactation milk yield

might be due to genetic differences existing within the same breed, management and environmental status (Gimbi, 2006; Guo-li *et al.*, 2006).

Milk production in Tanzania mainland comes predominantly from traditional cattle which account for 70% of the 1500 million metric tons of milk produced annually (Tanzania livestock sector development strategy, 2010). Endeavours to increase milk production and thus cope with population growth, Tanzanian government have planned and implementing a number of programs including selection and crossbreeding of indigenous breeds to *exotic* dairy breeds, countrywide use of artificial insemination, and establishment of dairy heifer breeding units or Livestock Multiplication Units (LMU) (Njombe and Msanga, 2008). Kitulo dairy farm is among the five LMUs with a major goal of producing dairy heifers. However, little is known about the productive and reproductive performance of Friesian dairy cows kept at Kitulo LMU. Therefore, the objective of this study was to determine the reproductive and productive performance of the Friesian cows kept at semi-temperate condition under grazing production system in a tropical environment.

MATERIALS AND METHODS

Description of the study area

This study was conducted at Kitulo Livestock Multiplication Unit (Kitulo LMU). Kitulo LMU is situated at an altitude of 2630 – 2820 meters above sea level in Makete district, Njombe region, about 50 km South-east of Mbeya city and 980 km from Dar es Salaam. The farm is in a semi-temperate climate with minimum and maximum temperatures ranging from 4°C to 8°C and from 14.5°C to 18.5°C, respectively. The area receives unimodal

rainfall with a range of from 1200 to 1600 mm per annum. The rain season starts in October and ends in May and it is followed by a cool dry period up to August.

Study Animals

In the study, a total of 314 Friesian lactating cows were included. Cattle were herded based on sex and age. Mature cows were separated based on reproductive and production status; milking herd and dry herd. During the day time animals graze on planted template pastures, comprising mainly *Lolium perenne*, *Lolium multiflorum* and *Infolium repens*. Milking cows were supplemented with homemade concentrate composed of maize bran and rice polish, (60-70%), sunflower seed cake or cotton seed cake (25%), mineral supplement 2% and 1% salt during milking. The amount of concentrate offered depended on the quantity (kg) of milk produced from each cow. New born calves were taken away from their dams shortly after birth (only allowed to suckle for three to five days to get colostrum) and were bucket-fed with 2kg/day to 4 kg/day for a maximum of four months. Weaning is practically done when calves attain an age of from 3 - 4 months depending on the health status of the calves. Weaned calves were separated according to sex and grazed on pasture with concentrate supplements until they reach puberty (about 18 months) before being introduced to bulls for breeding. All animals have *ad libitum* water supply. As for herd health management, animals were routinely vaccinated against Rinderpest, Contagious Bovine Pleuropneumonia (CBPP), Anthrax, Blackleg and Foot and Mouth Diseases. Deworming was practiced every three months in calves and after every 4 months in adult animals. To control external parasites, dipping was only

practiced twice per month when ticks are active, usually during November through May.

Breeding practices

Natural mating was done by using pure-bred bulls grazing in separate paddocks. Detection of signs of oestrous was done by close observation on the cows and heifer early in the morning and late evening by trained staff and herdsmen. Animals showing heat signs were introduced to breeding bulls on the same day and stayed with bulls for one to two days. Cows and heifer showing estrous signs 18 to 24 days post first service were mated again, and this was repeated until the particular animal conceives. Dates of mating were recorded daily and pregnancy diagnoses by rectal palpations were done three to four months after service. Male yearling were separated from female animals and commonly sold or castrated at the age of one year if not required for breeding. Replacement heifers were selected based on physical characteristics, growth performance and health status, and were allowed for mating for the first time when they were two years of age.

Data collection

Reproductive data of 314 Friesian cows for five consecutive years (2009 to 2014) were used in this study. Data were extracted and compiled from records kept on each individual animal record and field books. Records had identification number, date of birth, calving date, dry-off date, service date, lactation yield, lactation length, Data were entered in Excel spread sheet and used to calculate age at first calving, days open, number of services per conception, calving interval, lactation length and total lactation milk yield (Table 1).

Table 1. Reproductive and productive traits considered and their definitions

Reproductive/ productive parameter	Definition
Age at first calving (AFC)	Number of days from birth to the animal's first calving
Calving interval (CI)	The period between two consecutive calvings
Number of service per conception (NSC)	The number of services required for conception
Days open (DO)	The interval in days between calving and conception
Lactation length (LL)	The time of period from when a cow starts to secrete milk after parturition to the time of drying off.
Total lactation milk yield (TLMY)	The total amount of milk produced by a cow during one lactation period/length

Data analysis

Reproductive and productive indices studied were estimated using SPSS-11.5 (statistical packages for social science) computer package program and results expressed as mean and standard errors (\pm SE). To find out the level of significance for the effect of parity, least significant difference (LSD) procedure using SPSS was performed. A value of $P < 0.05$ was considered statistically significant.

The mathematical model used was as follows:

$$Y_{ij} = \mu + P_i + e_{ij}$$

Where, Y_{ij} = Dependable variables (AFC, NSPC, CI, DO, LL, TLMY);

μ = Population mean; P_i = the effect of i th lactation number (where $I = 1, 2, 3, \dots$);

and e_{ij} = random error with Y_{ij} observation.

RESULTS

The overall mean age at first calving was 1151.72 ± 9.63 days (range 1057 to 1230 days), with a coefficient of variation of 16.2% (Table 2). The overall mean for calving interval was 404.57 ± 1.54 days (range 345 – 504 days) (Table 2). The calving interval differed significantly ($P < 0.05$) with number of parturitions (Table 3). In all cases, the calving interval

decreased as the parity level increased. The calving interval observed in this study positively correlated (correlation coefficient, $r = 0.7947$; $P < 0.0001$; 95% CI = 0.7502 – 0.8320) with the number of service per conception as well as with days open ($r = 0.7123$; $P < 0.0001$; 95% CI = 0.6534 – 0.7626). But the calving interval did not affect significantly ($P > 0.05$) the average total lactation milk yields of cows.

The overall mean for days open (DO) was 121.82 ± 1.24 (range 93 – 176 days) with coefficient of variation of 21% (Table 2). With exception of parity four which differed significantly ($P > 0.05$) with other parities (1, 2 and 3), other parities were not significantly different between each other on the number of days open (Table 3). Also days open significantly correlated ($r = 0.9983$; $p < 0.0001$) with the number of services per conception. The mean number of service per conception was 1.83 ± 0.24 (range 1 – 3) with a coefficient of variation of 42.3% (Table 2). Numbers of services per conception were highest among primiparous (2.04) and were decreasing with parity. Both number of open days and parity correlated significantly ($P < 0.0001$) with the number of services per conception. However, the numbers of service per conception were not

significantly differing between parities (Table 3).

The mean total lactation milk yield in Friesian cows in the different parities are presented in Table 3. Parity significantly ($P < 0.05$) affected mean total lactation milk yield in the farm whereas the highest yields were observed in multiparous cows and with the yield tending to decrease with parity. Mean milk yield had no significant

effect ($P > 0.05$) on the average number of service per conception. The overall mean of lactation lengths was 306.54 ± 5.53 (Table 2). The lactation lengths decreased with increase in parity (Table 3). The results also revealed that the number of calving significantly ($P < 0.05$) influenced the lactation length. Primiparous cows had significantly ($P < 0.05$) longer lactation length than multiparous cows.

Table 2. Productive and reproductive performance of Friesian dairy cows kept at Kitulo LMU

Indices	Mean \pm SE	Median	Range
Age at first calving (days) (n=228)	1151.7 \pm 9.6	1175.55	1057 - 1230
Calving interval (days) (n=314)	404.57 \pm 1.5	403.00	345 - 504
Days open (days) (n=314)	121.8 \pm 1.2	120.00	93 - 176
Number of service per conception (n=314)	1.8 \pm 0.2	2.10	1 - 3
Lactation length (days) (n=314)	306.5 \pm 5.5	340.50	263 - 430
Total lactation milk yields (kg) (n=314)	5,042.1 \pm 23.7	5206.50	3150 - 6850

Table 3. Arithmetic means for reproductive and productive traits of Friesian dairy cows at Kitulo LMU.

Source of variation	Levels	numbers	Reproductive and productive indices*				
			CI (days)	NSC (No)	DO (days)	LL (days)	TLMY (kg)
Overall		314	404.57	1.89	121.8	306.5	5042.12
Parity	1	26	408.50 ^a	2.04 ^a	125.5 ^a	315.3 ^a	4729.51 ^a
	2	119	406.13 ^b	1.93 ^a	124.4 ^a	311.2 ^a	4979.24 ^b
	3	83	405.03 ^c	1.81 ^a	124.3 ^a	301.9 ^b	5162.49 ^c
	≥ 4	86	398.62 ^d	1.78 ^a	116.1 ^b	297.6 ^c	5297.28 ^d

* CI, Calving interval; NSC, number of service per conception; DO, days open;

LL, lactation length; TLMY, total lactation milk yield

Means with the same superscript within a column do not differ significantly ($P > 0.05$).

DISCUSSION

Age at first calving is an economically important trait that determines the age when an animal begins its economic return from milk production and reproduction. The mean value for AFC (1151.5 days, approximately 38.4 months) presented in this study is similar to 38.4 ± 0.5 months found in Ayrshire and Boran crossbred cattle kept in smallholder farms in Mufindi district, Tanzania (Chenyambuga and Mseleko, 2009) and the 34.8 ± 4 months

reported by Dinka, (2012) for crossbred dairy cows under smallholder condition in Ethiopia. However, the values in the present study were higher than the 29.3 months reported for Friesian-Holstein cows in Tunisia (Ajili *et al.*, 2007), 988 ± 9.81 days (32.7 months) in Pakistan (Sattar *et al.*, 2005), and 39.2 ± 7.5 months in Ethiopia (Tadesse *et al.*, 2010) and 32.4 months for dairy cattle crossbreeds under tropical environments (Syrstad, 1995). Variation in mean AFC reported in different studies could be attributed to factors such as poor

nutrition and management practices. With good nutrition it is expected that heifers would exhibit fast growth and attain higher weights at relatively younger ages hence early age at first calving.

The mean calving interval obtained in this study concurs with the results by Chenyambuga and Mseleko. (2009) who reported mean calving interval of 402.6 ± 3.0 days in Ayrshire and Boran crossbred cattle kept in smallholder farms in Mufindi district, Tanzania. The mean CI is lower than the mean calving intervals of imported Friesian cows (449 days) and local born Friesian cows (436 days) reported in Pakistan (Niazi and Aleem, 2003) and 477 (335 ± 860) days in dairy cattle kept in smallholder herds in a rural highland area of northern Tanzania (Kanuya *et al.*, 2000). However, the calving intervals in the present study are above the recommended interval of 365 days expected on a commercial dairy farm (Syrstad, 1995). These long calving intervals are mainly associated with the longer time to conceive which could be related to environment, management practices like poor nutrition, irregularity in estrous and bull to cow (bull: cow) ratio used in the herd. Likewise, nutritional problems especially low phosphorus levels in the natural pastures contribute to the long calving intervals in cows (Syrstad, 1995). The current results indicate that parity had a significant effect on the length of calving intervals. Calving intervals decreased as the number of parities increased. The decrease in calving interval between the first and subsequent parities conforms to earlier studies (Kifaro, 1984; Chenyambuga and Mseleko, 2009; Msuya, 2002).

The overall mean number of services per conception was 1.83 ± 0.24 (Table 3), is close to the findings by Asimwe and Kifaro. (2007) of 1.66 in dairy cattle under

smallholder production system in Bukoba district, Tanzania but lower than the results found by Kanuya *et al.* (2000) of 2 in dairy cattle kept in smallholder herds under natural services in a rural highland area of northern Tanzania. Also the present finding is lower than the results reported by Ngodigha *et al.* (2009) of 2.0 in Holstein Friesian dairy cattle under artificial insemination (AI) in Nigeria, Niazi and Aleem. (2003) of 2.1 in Holstein Friesian dairy cattle in Pakistan, and Ben Salem *et al.* (2006) of 2.2 in Holstein Friesian dairy cattle under AI in Tunisia. Such differences could be ascribed to differences in management practices and mating systems used (natural services versus AI). Mean number of service per conception decreased as the parity level increased. The effect of parity on number of services per conception observed in this study is in agreement with a number of studies (Negussie *et al.*, 1998; Demeke *et al.*, 2004; Haile *et al.*, 2009; Mwatawala and Kifaro (2009). From these studies it has been observed that older cows are more efficient with respect to reproduction than heifers or first calvers.

The overall mean DO of 121.82 ± 1.24 days in this study concurs with those observed with Tadesse *et al.* (2010) in Holstein Friesian dairy cows in Ethiopia and Cilek (2009) in Holstein Friesian cows in Turkey. However, the observation is lower than the results reported by Asimwe and Kifaro. (2007) of 205.2 ± 2.6 and Kanuya *et al.* (2000) of 232 – 246 days. Such differences could have been caused by difference in environmental factors under which animals kept or management factors such as ability of farmers to detect heat signs after calving. For all parities studied, animals that calved in parity one had the highest mean DO of 125.5 days followed by those in second, third and the fourth parities (Table 3). The tendency of DO to decrease with advancement of age

observed in this study is in agreement with a number of studies (Asimwe and Kifaro, 2007; Tadesse *et al.*, 2010). In early lactations, first calving heifers experience physiological changes permitting the first calvers to put on weight prior to next calving (Mwatawala, 2006). This is because heifers at the beginning of lactation have high nutrition demands for growth, milk production and reproduction. As a result heifers delay to conceive after calving, have longer days open and hence longer calving intervals after first calving compared to subsequent parities.

The mean total lactation milk yields of 5,042.12 kg/cow obtained in this study is slightly similar to 5152 kg/cow in Holstein Friesian population in Canada (Jairath *et al.*, 1995), but lower than 6536kg/cows in the Iranian Holstein Friesian cows (Hosein-Zadeh and Ardalan, 2011) and 5905 kg/cow in Tunisian Holstein Friesian cow (Ajili.*et al.*, 2007). However, our observation is higher than the results reported by Lubago *et al.* (2006) of 2165.0 kg/cow for Holstein Friesian cows in Ethiopia and Tadesse *et al.* (2010) of 3710 kg/cow in Holstein Friesian dairy cows in Ethiopia. Variation in total lactation milk yield is mainly due to genetic and various non-genetic causes. Genetic group, herd size, environments, managements, season of calving and parity has significant effect on lactation milk yield (Kumar, *et al.*, 2014). Parity was among the non-genetic factors influencing lactation milk yield in this study. Other researchers (Mwatawala, 2006; Migose *et al.*, 2006; Tadesse *et al.*, 2010) have reported similar significant effect of parity on the milk yield. The increases in lactation milk yield with increase in parity is due to the fact that mature cows use most of the nutrients for milk production and have the ability of gaining body weight and condition quickly after calving whereas the first calvers face lactation stress and partition nutrients for

continuous body growth and milk production.

The mean values of the lactation length of the present study were in agreement with the findings of the several authors (Syrstad 1995; Kifaro, 1995; Sattar *et al.*, 2005; Sandhu *et al.*, 2011; Ayalew *et al.*, 2015). On the contrary, Usman *et al.* (2012) reported higher estimates of 366 days for the same breed in Pakistan. The probable reason for this variation might be environmental variation and management of the farm. The lactation number (parity) showed non-significant effect on lactation length. This result conforms to the findings by Rehman *et al.* (2006) and Kifaro (1995). Genetic group and parity has significant effect on lactation length (Kumar *et al.*, 2014).

The study reveals that the overall reproductive and productive performance of Friesian dairy cows kept at Kitulo LMU is low to moderate. To harvest the better results in reproductive and productive efficiency of *Bos taurus* cows in tropical environment, proper management of the animals through various phases of life from birth to maturity is necessary to ensure their early age of service and calving, better conceivability, lower calving interval and high milk yield. Therefore, management practices at the farm need to be improved for better reproductive and productive performance of the herd.

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