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The performance of Jersey cattle at Naming'omba Tea and Coffee Estate in Malawi

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Abstract

A retrospective study was carried out to document the performance of Jersey cattle at Naming'omba Tea and Coffee Estate, which is a potential source of breeding stock for smallholder farmers in Malawi. Data were collected from 55 cows with a total number of 373 records kept between 1996 and 2012. General linear and mixed models were used to estimate age at first calving (AAFC, days), calving interval (CI, days), lactation length (LL, days) and lactation milk yield (LY, kg), and repeatabilities of CI, LL and LY.

The least squares means of AAFC, CI, LL and LY were 1065 days (35.5 months), 491 days, 307 days and 2704 kg, respectively. The repeatabilities of CI, LL and LY were 0.133±0.364, 0.422±0.156 and 0.271±0.119. The age at first calving and calving intervals were high, while the lactation lengths and yields were comparable to those for Jersey and other cattle in similar production systems in the country and region. It is concluded that the use of Jersey cattle for dairy production may be promoted in Malawi.

Key words: *age at first calving, calving interval, lactation length, lactation yield, repeatability*

Introduction

The dairy industry in Malawi is small (Banda 2008), with about 14,710 pure exotic and 49,669 crossbred dairy animals (DAHLD 2014). Most of these dairy animals are of Holstein-Friesian origin, and some are of Jersey origin. Milk production from the pure exotic and crossbred dairy cattle is 17,743 and 34,332 tons of milk annually, respectively (DAHLD 2014). Most of the dairy cattle are owned by smallholder farmers, but there are also commercial farms that rear Holstein-Friesian cattle, while a few, such as Naming'omba Tea and Coffee Estate, have pure Jersey cattle. Although the Holstein-Friesian dairy cattle are recommended for smallholder farmers in the country, there is a general consensus that the farmers' management levels limit their ability to raise pure bred Holstein-Friesians, and the livestock policy of Malawi Government recommends that the smallholder farmers should use crosses of the same (DAHLD 2006). An appropriate cross breeding level for the smallholder dairy sector has not been determined yet.

For sustainability and in the context of climate change, a better option for smallholder dairy farmers in Malawi may be the use of dairy breeds with smaller body frames such as the Jersey (Missanjo et al 2013). Jersey cattle efficiently convert feed into milk compared to other breeds, leading to lower cost of production per unit land area per unit time (Ahmad et al 2007; Missanjo et al 2013). Jerseys have been reported to perform better than Holsteins and Brown Swiss when environmental stresses are highly significant (Garcia-Peniche, 2004). Moreover, the high butter fat and casein content of milk from Jerseys adds a lot of flavour to the milk, in addition to increasing the range of products that can be made from it.

Despite all these advantages, Jersey cattle are not widely used in Malawi. This is partly because it is difficult to source diary breeding stock in general (Banda et al 2012), and Jersey breeding stock in particular. Besides, very little research has been done on the production performance of Jersey cattle in the different agro-ecological zones in Malawi. This study aimed at documenting the performance of Jersey cattle at Naming'omba Tea and Coffee Estate, which is a potential source of breeding stock for smallholder farmers.

Materials and methods

The study area

Production and reproduction data were collected from records kept routinely from 1996 to 2012 at the dairy unit of Naming'omba Tea and Coffee Estate. The unit is an extra-agricultural activity for the Estate, whose major activity is growing of tea, coffee and macadamia nuts. It is located in the south-western part of Thyolo District (16° 10' 00" S, 35° 10' 00" E) in the Shire Highlands of the Southern Region of Malawi. The area receives substantial amounts of precipitation with a mean, minimum and maximum of 1335, 870 and 1859 mm, respectively. Temperatures range from 14 °C to 28 °C.

General cattle management

The general dairy cattle management routine at the farm was the same throughout the period covered by this study. Cows were let out to graze on the farm's pastures, but the lactating cows were given concentrates during milking. Cows were hand-milked twice, in the morning and in the evening. Breeding was through natural service. During the period for which data are available, only two bulls were used for breeding. However, the paternity of the calves could not be ascertained.

Data collected

Data were collected from 55 cows with a total number of 373 records (Table 1). All the available records were used. Data collected from the records included pedigree data, birth and calving dates and milk yield. Variables such as age at first calving and lactation length were computed from the raw data.

Table 1: Descriptive statistics of the cases included in the study

Variable	Number or levels	Total number of records	Mean number of records per level of variable	Median number of records per level of variable
Cows	55	373	4.91	3.50
Years	16	373	23.3	20.5
Lactations	10	373	31.1	26.0

Data analysis

Age at first calving was estimated using the following fixed model:

$$y_{ij} = \mu + t_j + \epsilon_{ij}$$

where

y_{ij} is the j^{th} observation,
μ is the underlying constant,
t_i is the fixed effect of the i^{th} year (i = 1996, 1997, 1998, …, 2009),
e_{ij} is the residual error.

Calving intervals were estimated using the following mixed model:

$$y_{ijkl} = \mu + c_i + t_j + l_k + \epsilon_{ijkl}$$

where

y_{ijkl} is the l^{th} observation,
μ is the underlying constant,
c_i is the random effect of the i^{th} cow (i = 1, 2, 3, …, 33)
t_j is the fixed effect of the j^{th} year (j = 1996, 1997, 1998, …, 2009),
l_k is the fixed effect of the k^{th} lactation (k = 1, 2, 3, …, 10),
e_{ijkl} is the residual error.

Lactation lengths were estimated using the following mixed model:

$$y_{ijklm} = \mu + c_i + t_j + l_k + s_l + \epsilon_{ijklm}$$

where

y_{ijklm} is the m^{th} observation,
μ is the underlying constant,
c_i is the random effect of the i^{th} cow (i = 1, 2, 3, …, 33)
t_j is the fixed effect of the j^{th} year (j = 1996, 1997, 1998, …, 2009),
l_k is the fixed effect of the k^{th} lactation (k = 1, 2, 3, …, 10),
s_l is the fixed effect of the l^{th} season (l = 1, 2, 3)
e_{ijklm} is the residual error.

Lactation milk yield was analysed using the following mixed model:

$$y_{ijklmno} = \mu + c_i + t_j + l_k + s_l + \beta_1 a_m + \beta_2 b_n + \epsilon_{ijklmno}$$

where

$y_{ijklmno}$ is the o^{th} observation,
μ is the underlying constant,
c_i is the random effect of the i^{th} cow (i = 1, 2, 3, …, 33)
t_j is the fixed effect of the j^{th} year (j = 1996, 1997, 1998, …, 2009),
l_k is the fixed effect of the k^{th} lactation (k = 1, 2, 3, …, 10),
s_l is the fixed effect of the l^{th} season (l = 1, 2, 3)
a_m is age at first calving as a covariate
b_n is lactation length as a covariate
$e_{ijklmno}$ is the residual error.

All data were analysed using the IBM Statistical Products and Services Solutions (SPSS) Version 21 statistical package (IBM Corp 2012).

Results

Age at first calving and calving intervals

Heifers dropped their first calves when they were about 1065 days (35.5 months) old (Table 2), which implies that they got pregnant when they were more than two years old. The age at first calving was affected by the year in which the animal was born ($p = 0.001$). Age of cows at first calving widely fluctuated from 1996 to 2003 (Figure 1), with distinct peaks and troughs at almost regular intervals, and a slight upward trend. Calving interval (491 days) was very high but was not affected by any of the factors included in the mixed model.

Table 2: Least squares means and repeatabilities of age at first calving, calving intervals, lactation length and lactation yield

Parameter	Least squares mean		Repeatability	
	Estimate	Standard error	Estimate	Standard error
Age at first calving (days)	1065	18.6	-	-
Calving interval (days)	491	14.8	0.133	0.364
Lactation length (days)	307	7.67	0.422	0.156
Lactation yield (kg)	2704	85.2	0.271	0.119

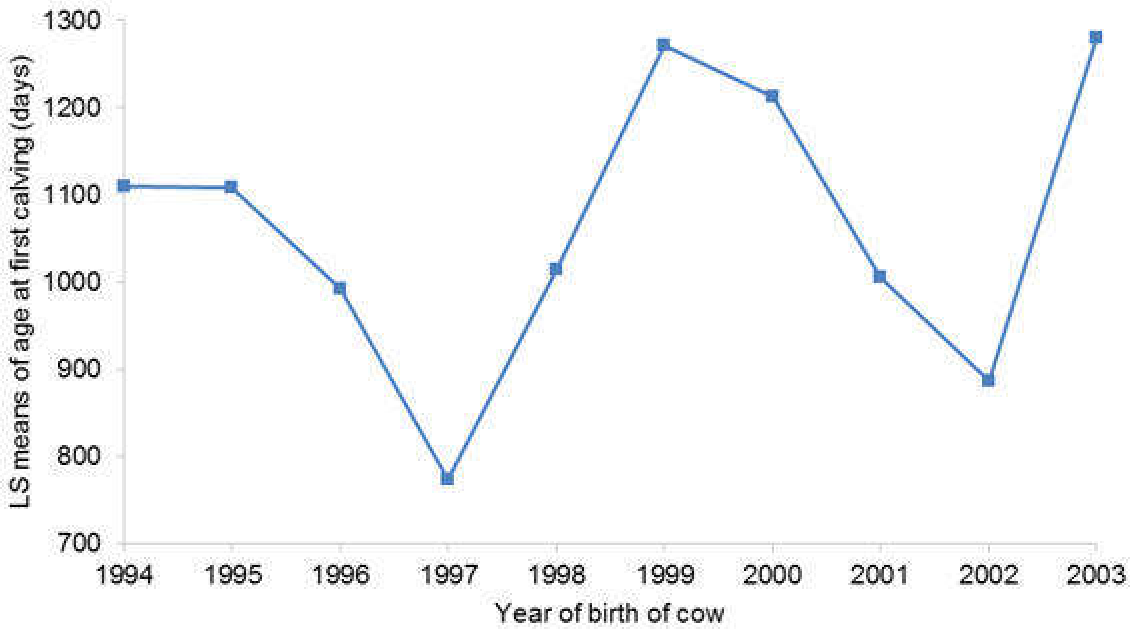

Figure 1: Age at first calving trends

Lactation lengths and yields

Lactation length was 307 days and was affected by parity ($p = 0.001$), year ($p = 0.0330$) and the interaction of year, calving season and parity ($p = 0.021$). There was a slight decline in length of lactation periods between 1996 and 2009 (Figure 2). There was also a slight increase in length of lactation periods with increasing parities (Figure 3).

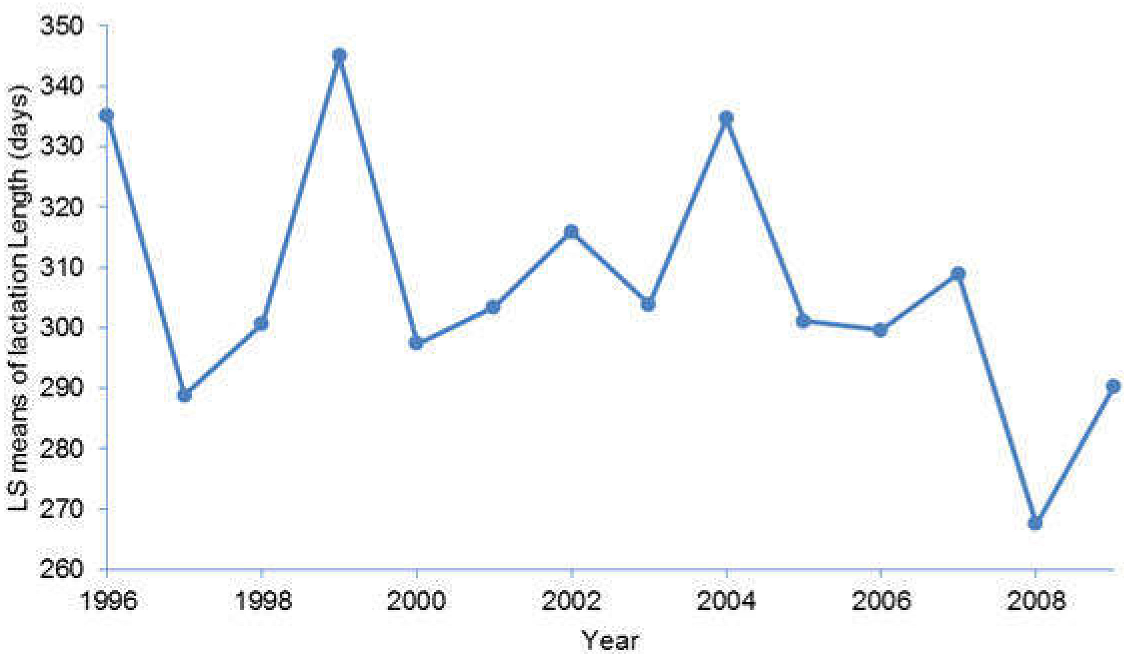

Figure 2: Lactation length trends

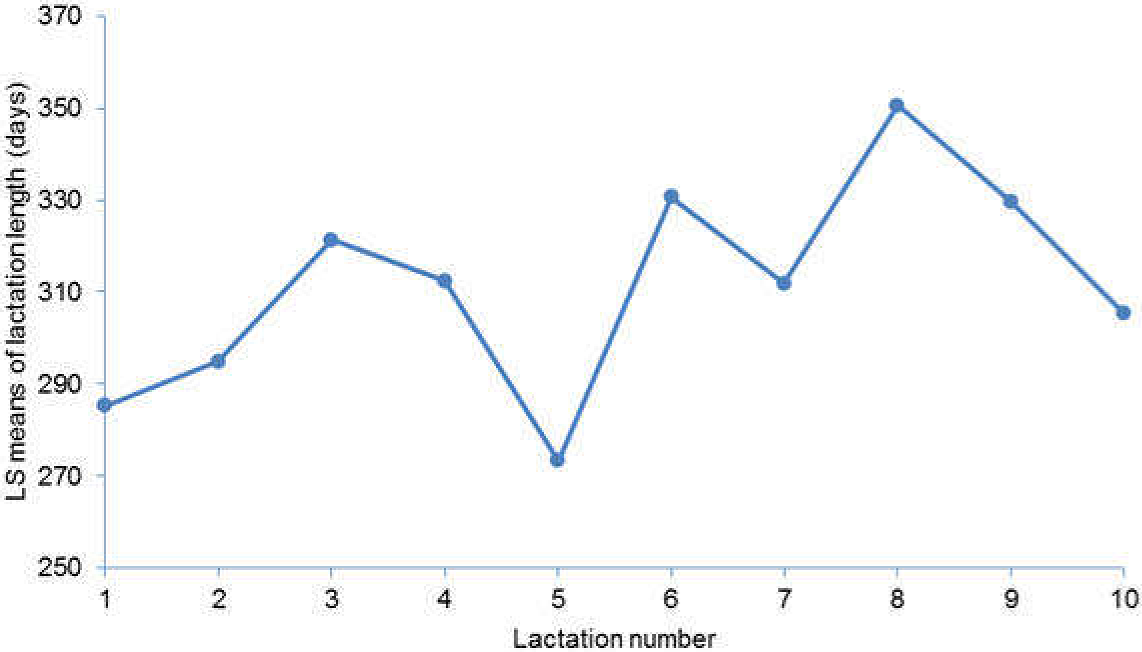

Figure 3: The effect of parity on lactation length.

Lactation yield was 2704 kg and was affected by parity ($p = 0.001$) and year ($p = 0.001$). There was a steady increase in milk yield from the first lactation up to the ninth one, after which it started to decline (Figure 4). There was a general downward trend in milk yield between the years 1996 and 2010 (Figure 5), with noticeable peaks and troughs in between.

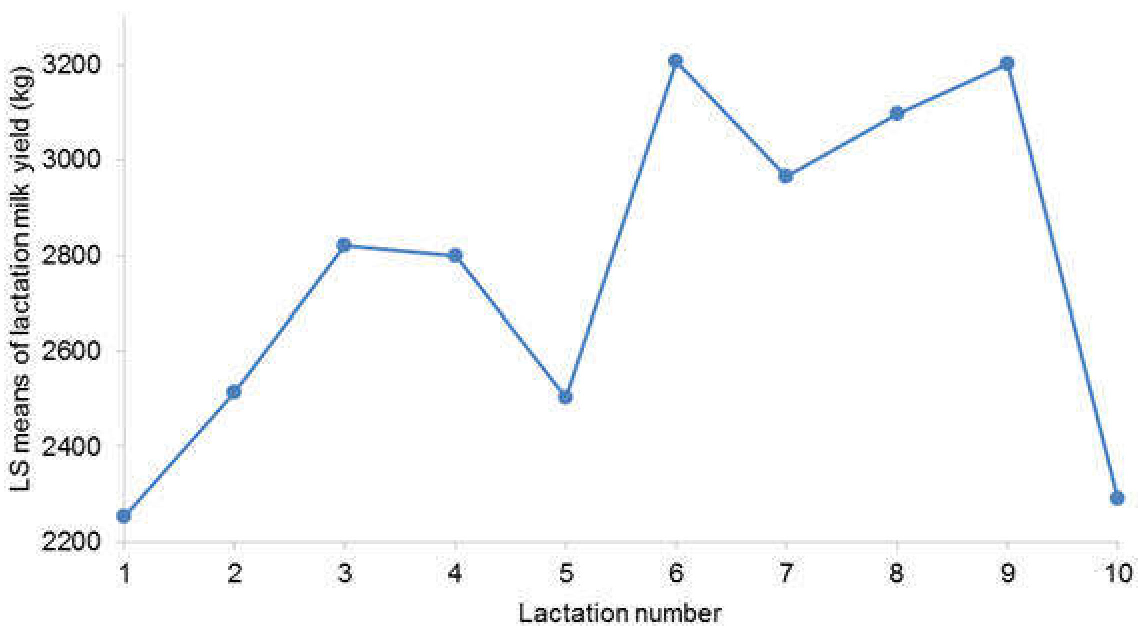

Figure 4: The variation of lactation yields between different lactations.

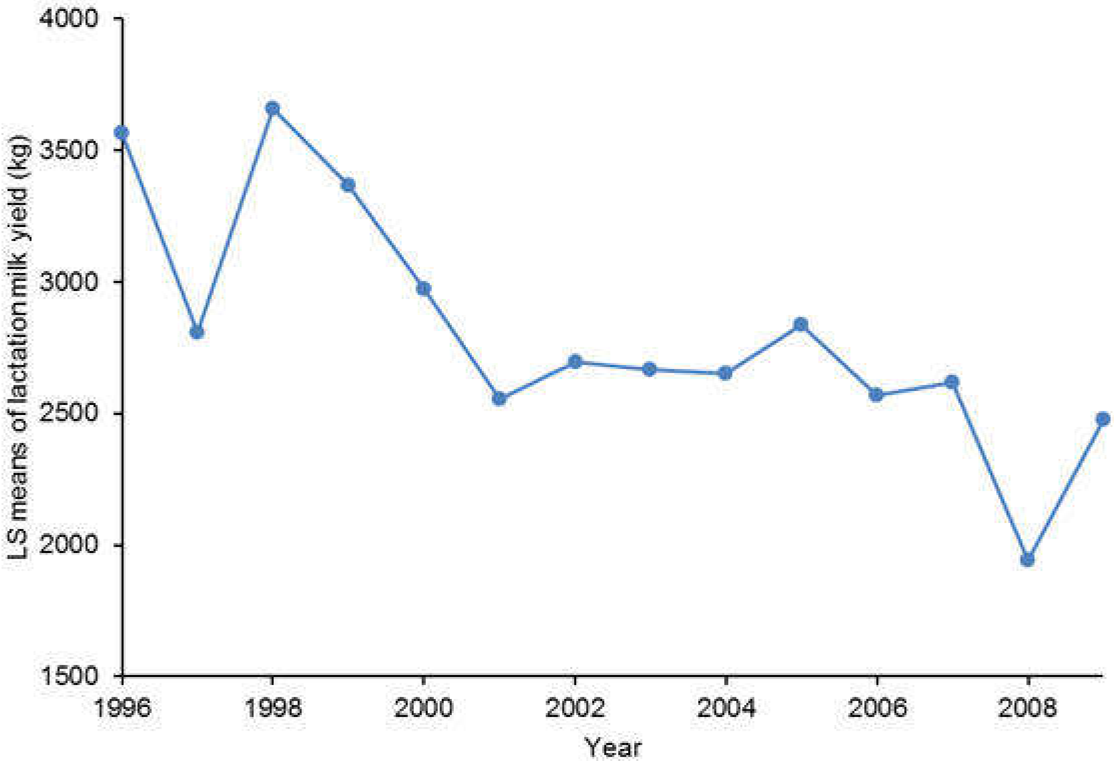

Figure 5: Lactation yield trends

The correlation between lactation length and lactation yield (r = 0.70) was significant (p = 0.001). This implies that milk production was reasonably sustained even over longer lactation periods.

Repeatability of calving intervals, lactation length and lactation yields

The repeatability of calving interval was low, with a high standard error. The repeatabilities of lactation yield and length were low to moderate, respectively.

Discussion

Age at first calving and calving intervals

Age at first calving of 1065 days (35.5 months) was comparable to 1035 days (34.5 months) reported by Lemma et al (2010). This could be acceptable for such an extensive system of production, although Jersey cattle raised in temperate regions are known to be capable of dropping their first calves at about 24 months (Hare et al 2006). The fluctuation in the age at first calving by year of birth of cows may be due to variations in amount of feed in those years. A good growing environment at the beginning of the life of a heifer may have a positive impact on the time of its sexual maturity, which would reduce the heifer's age at first calving. However, the correlation between the rainfall in the years the cows were born and their age at first calving (r = -0.607, n =10) was not significant (p = 0.063). Annual rainfall changed from between 1200 mm and 1400 mm between 1996 and 1998 to between 800 mm and 1200 mm between 1998 and 2003.

The calving interval (491 days) was within the expected range for extensive dairy systems. Among smallholder dairy farmers in Malawi, calving intervals are estimated at 405–549 days (Banda et al 2012). Lemma et al (2010) reported calving intervals of 450 days for Jersey cattle in Ethiopia. With lactation periods of 307 days, the cows at Naming'omba Tea and Coffee Estate remained open for far too long, and improvements can be made to reduce the calving interval. The increase in length of lactation periods with increasing parities was not supported by longer calving intervals. This may imply a real increase in the number of days the cows were in lactation within the same production period before the onset of the next lactation period.

Lactation lengths and yields

The length of lactation periods (307 days) was close to 305 days recommended for commercial dairy operations. The lactation yield in this study (2704 kg), translating to an average of about 8.81 kg per cow per day for the whole lactation period of 307 days. This figure was slightly higher than those reported by other researchers for comparable lactation periods of 305 days. Milk yields among smallholder farmers in Malawi is around 8 litres per cow per day (Tebug et al 2012), with lactation periods of less than 305 days. This translates to about 2576 kg (for a 305-day lactation at 1.03 kg per litre of milk). This implies that the Jersey cattle at Naming'omba Tea and Coffee Estate are producing slightly above the average of dairy genetic resources being utilised in Malawi. Dairy breeds that are used in the region and elsewhere perform similarly. Hayman (1974) reported yields of 1944 ± 81.7 kg and Baruah et al (1997) found that under a comparable production system, milk yields could go up to 2029±21.8 kg. Msanga et al (2000) reported mean milk yields of 2332 litres for 331-day lactations in crossbred dairy cattle in a smallholder farming system in north-eastern Tanzania. However, Jersey cattle can produce an average of between 3500 kg and 5000 (Missanjo et al 2013)

The trend of lactation yield based on parity is similar to the one reported by Wakhungu, Inyangala and Mosi (2007) in Ayrshire cattle in Kenya, with peak milk yield at parity 6, and noticeable decline in yield by lactation 9. This implies that it may not be reasonable to keep Jersey cows beyond 9 lactations, although they are believed to have longer production lives than other dairy breeds.

The fluctuating trends in lactation yield by year may be due to droughts that were experienced at regular intervals since 1998, with relatively more stable rains since around 2006. The general decline in milk yield may be part of a trend reported by Chagunda et al (1995) in Holstein dairy cattle at Ndata Farm (which is located near Naming'omba Tea and Coffee Estate) from 1985 to 1994. However, there is also a possibility that variations in management may have led to the declining lactation yield.

Repeatability of calving intervals, lactation length and lactation yields

The repeatability of lactation yield was lower than that reported by Missanjo et al (2013) considering all lactations, but comparable to repeatability for third and later lactations. The repeatability of lactation yield was also comparable to that reported by Roman, Wilcox and Martin (2000). The repeatability of calving intervals and lactation yield were not large enough to justify early selection of cows based on a few records. However, the high repeatability of lactation lengths suggests that even with a few records, the farmer can make decisions about which cows will remain in lactation longer than others.

Conclusion

- The performance of Jersey cattle at Naming'omba Tea Estate is comparable to the performance of dairy breeds that are in common use in Malawi, although there is room for the farm to improve the productivity of its herd. The use of Jersey cattle for dairy production may be promoted in Malawi.

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