Non-Genetic Evaluation of Productive and Reproductive Traits for Pure Jersey Cattle at Wolaita Sodo Dairy Farm, South Ethiopia

Kassahun Abera[1], Yosef Tadesse[2]*, Zelalem Yilma[3], and Kefelegn Kebede[2]

[1]South Nations Nationalities Peoples Region, Gamo Zone Agriculture Main Department, Arba Minch, Ethiopia, Ethiopia.
[2]Haramaya University, School of Animal and Range Science, P.O.Box 138, Dire Dawa, Ethiopia.
[3]International Livestock Research Institute (Land O' Lakes), P.O.Box 5689, Addis Abeba, Ethiopia.

Abstract: This study was carried out to evaluate non-genetic effects on milk production and reproductive performance of Jersey cattle breed using general linear model procedure (SAS software version 9.4). The data was obtained from a state farm, located in Wolaita Sodo, south Ethiopia. The least-square mean values of production traits such as daily milk yield (DMY) and lactation length (LL) were 13.52± 0.16 kg and 352.89±0.94 days, respectively. In addition, the least-square means for reproductive traits of the age at first calving (AFC) and calving interval (CI) were 952.40± 0.99 days and 490.01±0.90 days, respectively. Season had highly significant ($p<0.0001$) effect only on daily milk yield. Calving year had a significant ($p<0.01$) effect on daily milk yield, lactation length, age at first calving, and calving interval, and dam parity also had significant ($p<0.01$) effects on daily milk yield, lactation length, and calving interval. This study concluded that there was high non-genetic effect of calving year, seasons, and parity on daily milk yield and all fixed factors affect lactation length except season. The major non-genetic factors that affect reproductive traits is calving year. Hence, improvement of productive and reproductive performance of the pure Jersey cattle population at Wolaita Sodo dairy farm is possible by providing better environment and management all the year round.

Keywords: *Cattle, Jersey, Production, Reproductive, Traits*

Introduction

The total cattle population of the country is estimated at 70 million of which, female cattle constitute about 56% and of this indigenous cattle breeds account for about 97.4%; while crossbreds and exotic breeds constitute about 2.6 % (CSA, 2021).

Cattle genetic improvement program in Ethiopia started before seven-eight decades to enhance milk production of local breeds. The first livestock development project (1958-1963) established Dairy Development Agency (DDA) concerned mainly with the development of commercial dairy farms in Addis Ababa (Fekadu, 1990). Then, Chilalo Agricultural Development Project (CADU) and Wolaita Agricultural Development Project (WADU) were established jointly by the Ethiopian, Swedish Governments and the World Bank, and initiated intensive small-scale dairy development in Ethiopia in 1967/68 (Kiwuwa *et al.*, 1983). Similarly, for the genetic improvement of cattle in Ethiopia, national artificial insemination centre was established around four decades ago using Semen of Holstein and Jersey breeds (Chencha and Kefyalew 2012).

Earlier studies (Cunningham and Syrstad 1987; Njubi *et al.,* 1992) in the tropics revealed that Jersey cows are characterized by small body size; adaptive to a range of environmental conditions; low maintenance requirement and others, and it has been selected by most of the tropical countries for research and development programs. Thus, this breed could be a good alternative for the Ethiopian highland and mid altitude environments for intensive and large-scale dairy farms with high fat percentage which is demanded by local consumers. Hence study on the reproductive and production performances of pure Jersey cows managed under the Ethiopian condition should be of much help to suggest future genetic improvement options. However, few detailed scientific studies on the performance of the breed was made for the past decade in the study area. Therefore, this study was carried out to evaluate the non-genetic effects on production and reproductive performance of Jersey cattle breed in the study area.

Materials and Methods

Description of the Farm and Population

The study was conducted at the Wolaita Sodo Jersey Cattle Dairy Farm in the Wolaita district in southern Ethiopia, which is located at 6°49'N latitude and 39°47'E longitude (WZFEDD, 2012). The farm is located at an altitude of 1990 meters above sea level. The average annual temperature in the area is 19°C; the mean annual rainfall is 1014 mm (NMA, 2012). The rainfall pattern is characterized by a bimodal, which includes a short dry season from October to February and a long rainy (wet) season that in most cases runs from March to September.

*Corresponding Author. E-mail: yosef.tadesse@gmail.com

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The Wolaita Sodo Jersey Cattle Dairy Farm was established by the Wolaita Agricultural Development Unit (WADU) in 1971, with imported 90 Jersey heifers and a bull by the Ministry of Agriculture (Habtamu *et al.*, 2009). A total area of 115 hectares, which include farmland and cultivated forage crops. Feeding management was practiced according to age, sex, and status which consisted milking cows, dry cows, calves, heifers, and bulls. The cows were milked by hand twice a day (morning and evening). Existing retrospective data on various production and reproduction parameters were used and the influence of non-genetic factors were evaluated. Among them, the traits considered include daily milk yield (DMY), lactation length (LL), calving interval (CI), and age at first calving (AFC); and the independent variables or fixed effects, such as calving year, calving season, and parity were taken into account.

Data Source and Traits Considered

A study was carried out based on retrospective data on the production and reproductive performance of Jersey cattle as affected by non-genetic factors. The retrospective data collected from the Wolaita Sodo Jersey Cattle Dairy Farm for 17 years (2000-2016) were used for this study and only data from cows with complete information were (Table 1).

The major data collected for fixed factors include calving date, dry-off date, calving seasons, and parity recorded during the reference years. Data was screened to avoid errors during data entry. Reliable data were filtered, cleaned, and organized using a Microsoft Excel spreadsheet. In this study, calving year, calving seasons, and parity were considered as non-genetic factors and the traits were AFC, CI, DMY, and LL.

Table 1. Average final number of records for each trait used for analysis

	Traits			
	DMY	LL	AFC	CI
No of records	3495	3495	795	2480

DMY= Daily milk yield; LL= Lactation length; AFC = Age at first calving; CI = Calving interval.

Description of Fixed Effects and Data Analysis

The non-genetic effects were classified into different sub-classes to quantify their effects on the production and reproductive performance traits. The fixed effects were calving years, calving seasons, and parity.

Calving year: Assuming factors such as climatic conditions, feeding, and overall management vary over the year, and year's effect was fitted by classifying the entire duration into 6-year groups. The groups are 2000 to 2002, 2003 to 2005, 2006 to 2008, 2009 to 2011, 2012 to 2014, and 2015 and 2016.

Calving season: Seasons are considered as one of the environmental factors that affect the expression of economic traits. Thus, based on the meteorological information that considered temperature, rainfall, and relative humidity, two calving seasons (the short rainy season was avoided because it may not be observed in some years due to La-Nina and El-Nino climate patterns observed in the study area) were identified namely the dry season (October, November, December, January, and February) and the rainy (wet) season (March, April, May, June, July, August, and September).

Parity: Each cow included in the study contributed a repeated number of lactation records. Parity was grouped into six classes (1, 2, 3, 4, 5, and ≥6). All records of parities above six were pooled with the 6th parity because the available numbers of a cow with parities greater than six were too few to constitute separate groups. The statistical models used for the production and reproduction traits are presented as follows:

Model 1: For production and reproductive traits: The statistical model for dependent variables such as DMY, LL, and CI used were as follows:

$$\mathbf{Y_{ijk} = \mu + DP_i + CY_j + CS_k + e_{ijk},}$$

Where:

Y_{ijk}= dependent variable (DMY, LL, AFC, and CI)

μ = overall mean

DP_i= effect of the i^{th} Dam Parity (i= 6 levels: 1, 2, 3, 4, 5 and ≥6)

CY_j = effect of Calving Year group (j=6 levels such as 2000-2016, 2003-2005, 2006-2008, 2009-2011, 2012-2014, and 2015-2016)

CS_k = effect of Calving Season (k=2 levels: wet and dry seasons)

e_{ijk} = random error

Model 2: For reproductive trait, age at first calving:

$$\mathbf{Y_{jk} = \mu + CY_j + CS_k + e_{jk},}$$

Where:

Y_{ijk}= dependent variable (AFC)

μ = overall mean

CY_j = effect of Calving Year group (j=6 levels :(2000-2016, 2003-2005, 2006-2008, 2009-2011, 2012-2014, and 2015-2016)

CS_k = effect of Calving Season (k=2 levels: wet and dry seasons)

e_{ijk} = random error

The General Linear Model (GLM) procedure of the Statistical Analysis System (SAS) software (2016) version 9.4 was used to analyze the influence of the non-genetic factors. The Tukey's-HSD test was used for mean comparison when significant difference at 5% ($P < 0.05$) exhibited among independent variables.

Results and Discussion

The Effect of Non-Genetic Factors on Production Performance

Daily milk yield: Increasing milk production is the ultimate goal of the dairy industry as it gives the way to attain milk self-sufficiency and maximize the profitability of the dairy industry. Thus, most genetic improvement programs of developing countries have focused on improving the production performance of dairy cattle.

Least-square means for fixed effects of calving year, calving season, and parity are summarized in Table 2. The overall least-square mean DMY of the Jersey breed was found to be 13.52 ± 0.16kg, which is higher than the value of 5.31 kg from the same breed and farm reported by Habtamu *et al.* (2009). Similarly, lower estimates (6.25kg and 6.37kg DMY) were reported by Nibo *et al.* (2021) for Jersey cows kept at Ada-Berga research center, Ethiopia. Similarly, Dessalegn *et al.* (2016) observed a lower DMY value of 7.1kg for crossbreed (Jersey × Zebu) dairy cattle. The higher value of DMY in the current study may be due to better management and environments in the farm and the study area. Besides, due to the reform undertaken by Ministry of Agriculture (MoA) to establish agricultural TVET College in 2001 and inclusion of Wolaita dairy farm in Wolaita TVET College, the dairy herd may get better attention and management, and selection (retain the best and cull the poor performer Jersey breed) may bring improvement on production and reproduction traits of this breed. This variation in different herds might have occurred due to differences in the availability and quality of feed, agroecology, and other management factors at farm level.

The effect of calving year: Year of calving had significantly ($p<0.05$) affected daily milk yield (Table 2). This result agrees with the study of Kefale *et al.* (2020) on Holstien Fresian (HF)×Boran crossbred cows. The highest milk yield was recorded during 2000 up to 2002 and 2012 up to 2014 period. The highest DMY during these periods may be related with low average maximum and minimum yearly temperature in the study area. With regard to comfortable zone for dairy cattle the study by Gutiérrez *et al.* (2022) explained that the thermo-neutral zone (TNZ) of dairy animals ranges from 5 to 25 ^{O}C. This shows that as the average annual temperature is reduced in the tropics, it would be comfortable to exotic dairy cattle. According to Aboye *et al.* (2022) average maximum and minimum yearly temperature of Sodo Zone around southern Ethiopia in 2000, 2001, 2011, 2012, and 2013 were below 30 ^{O}C and 17 ^{O}C, respectively.

On the other hand, the lowest DMY was recorded on cow calves from 2009 to 2011 and 2015 to 2016. The lower DMY may be related to higher average maximum and higher average minimum yearly temperature exhibited in 2009, 2013, and 2014 in the study area as observed in the study by Aboye *et al.* (2022).

Effect of dam parity: Parity significantly ($P<0.05$) affected DMY (Table 2). Higher daily milk yield was observed at parity 1 and 2 and lower was recorded at parity four. This implies the positive relation of parity and milk yield which is related with physiological development of heifers to older cows up to parity four. The Somatic Cell Count (SCC) increased with parity; as with age, cows lose their body condition and the udder tissues become more susceptible to invasion of microorganisms with high incidence of mastitis and as a result milk yield reduced (Sabek *et al.*, 2021). This result agrees with that reported by Gebregziabher *et al.* (2014) for the Jersey x Boran crossbred cows and Kefale *et al.* (2020) for the HF×Boran crossbred cows. This variation might be related to the natural lactation physiology (aging) and inconsistent management (feeding).

Effect of calving season: DMY was significantly ($p<0.05$) affected by the fixed effect of calving season. This implies that forage availability and herd management were different between wet and dry seasons. In the present study, DMY recorded during the wet season was lower than that recorded during the dry season (Table 2). The variation might be attributed to management fluctuations among seasons and the availability of feed. During the main rainy season, cows are confined in the houses due to the heavy rain as well as waterlogging. The pasture land is therefore protected from grazing. However, the pasture grown on the waterlogged land will be harvested after the rainy season and fed to animals as hay in the dry season. The current result was consistent with Lim *et al.* (2021) in Korea and stated that in Jersey cows, milk production was significantly lower in autumn (19.75 kg/d) and winter (19.90 kg/d) season than that of spring (21.22 kg/d) and summer season (20.96 kg/d). This may be because milk production is directly related with temperature of each season. The result was controversial with the finding of Santosa *et al.* (2019) that indicate non-significant effect of season on DMY of Indonesian dairy cattle. The non-significant effect of seasons on DMY may be the management carried out well, and forage may be available throughout the year, so that the detrimental effect in different seasons does not affect milk production of the cows in the herd.

Lactation length: Lactation length is an important production trait as it influences the total milk yield. In most modern dairy farms, a lactation length of 305 days is commonly accepted as a standard. This standard permits calving every 12 months with 60 days of the dry period. The 12-month interval has been considered "Ideal" for many years. If a cow milked longer than 305 days, its yield for the first 305 days is taken as the lactation yield (Chen *et al.*, 2023). Some cows are not milked for a full 305 days because they go dry or the lactation is terminated for several reasons. These short records are projected to a 305-day equivalent.

Overall, least-square means of lactation length for the Jersey breed of the cow for the present study was 352.89 days (Table 2). This finding was higher than 318.42 days reported by Habtamu *et al.* (2009) for the same Jersey breed in Wolaita area, and 336.17 days reported by Direba (2015) for Jersey cows in central Ethiopia. However, the result of the present study is lower than the value (376.89 days) reported by Ahmed and El Zubeir (2013) for Holstein Frisian cows under a hot climate in Sudan. Wondifraw *et al.* (2012) also reported 365 days lactation length for pure Holstein Frisian and its crossbred (Holstein Frisian×Jersey) cows. This variation might occur due to environmental effects and management conditions (feeding, health control and heat detection, and timely heat detection and insemination of heifers).

Factors previously identified as being associated with lactation length in dairy cows include parity (Hossein-Zadeh, 2012), inadequate milk yield in late lactation (Weber *et al*., 2015), and poor fertility (Tiezzi *et al*., 2012; Weber *et al*., 2015).

The effect of calving year: Lactation length was significantly ($p<0.05$) affected by the fixed effect of calving year (Table 2). This result is similar to Direba (2015) for Jersey cows and Kefale *et al*. (2020) for HF×Boran crosses. The longest LL was recorded for cows born during calving year groups 2012 to 2014 but similar with other groups except 2009-2011; while the shortest was observed during calving year groups 2009 to 2011 and 2015 to 2016. The lower and higher LL in different year groups are related to the temperature of the study area as observed on DMY in different groups. This implies that as temperature decreases LL may increase together with DMY in that specific group. In this regard, Kamble *et al*. (2014) in India indicated that as temperature decreases, lactation milk yield and lactation length increase in Buffalo.

Effect of parity: Lactation length was significantly ($p<0.05$) influenced by parity, which agrees with the finding of Sindros *et al*. (2004); Direba (2015), and Kefale *et al*. (2020). The longest lactation length was observed in parity 5 and the lowest in lactation 3, which might be related to growth physiology that is related to high demand of feed at early age than later age. Hence, the feed used for milk physiology may be used for growth at early age, and may be related to natural lactation physiology (adaptation through aging) of the cow.

Effect of calving season: As shown in Table 2, calving season did not show a significant effect on LL ($p>0.05$). This implies that dairy cows received similar feeding and other management factors throughout the year. Similar results with non-significant effect of seasons on LL were reported by Chavan (2001) and Afzal *et al*. (2007). However, Auradkar (1999) and Komatwar *et al*. (2010) reported a significant effect of season on lactation length. The variation in different herds might be due to management (availability of feed) variation among dairy farms across seasons.

Table 2. Least square means (± SE) of daily milk yield (DMY) and lactation length (LL).

Effect and Level	N	DMY LSM±SE(kg)	LL LSM±SE (days)
Overall	3495	13.52 ± 0.16	352.89 ± 0.94
Calving season			
Wet	1456	12.37 ± 0.27	351.11 ± 1.62
Dry	2039	13.86 ± 0.23	353.84 ± 1.37
P-value		<0.0001	0.1823
Parity			
1	953	13.68^{a} ± 0.31	356.09^{ba} ± 1.85
2	872	13.73^{a} ± 0.33	350.28^{ab} ± 1.95
3	631	13.20^{ab} ± 0.37	346.99^{b} ± 2.25
4	392	11.75^{b} ± 0.48	348.17^{ab} ± 2.83
5	263	12.97^{ab} ± 0.58	360.08^{a} ± 3.47
≥6	384	13.37^{ab} ± 0.48	353.21^{ab} ± 2.87
P-value		<0.05	<0.01
Calving year group			
2000-2002	595	14.09^{ab}± 0.40	352.49^{ab} ± 2.39
2003-2005	392	13.22^{abcd} ± 0.46	350.83^{ab} ± 2.89
2006-2008	566	13.23^{bc} ± 0.41	356.56^{ab} ± 2.43
2009-2011	406	11.47^{d} ± 0.47	346.18^{b} ± 2.83
2012-2014	702	14.83^{a} ± 0.35	359.34^{a} ± 2.11
2015-2016	774	11.85^{cd} ± 0.35	349.43^{b} ± 2.09
P-value		<0.001	<0.01

N= Number of observations; DMY= Daily milk yield; LL = Lactation length; Least square means (LSM) with different superscripts with the same fixed effect indicate the statistical difference.

The Effect of Non-Genetic Factors on Reproductive Performance

Age at first calving: Age at first calving is an economically important trait that determines the age when an animal begins its economic return from milk production. It determines the beginning of the cow's productive life and influences her lifetime productivity (De varies and Marcondes, 2020).

The overall least square means for AFC of the Jersey breed cows in this study was 952.40 days (Table 3). The lowest AFC value observed in this study might be attributed to improved management and the better adaptation of the Jersey breed to the prevailing tropical environment or climatic condition, and effective heat detection. The result also indicates that recently born animals (2006-2014) tend to reach AFC at younger ages compared with the elder ones, which might relate to variations in overall management conditions over the years and genetic improvement. This result is comparable with the value (972.3 and 873 days) for the same cattle breed reported by Yosef (2006) and Opoola (2020) in Ethiopia and Zimbabwe, respectively. However, AFC obtained in the present study is lower (1035.21 days) than that reported by Habtamu *et al.* (2010) for Jersey breed cows kept at Wolaita Sodo Jersey Dairy Farm. Such better AFC of Jersey cows in the current study of tropical area might be attributed to factors such as good adaptation of the environment, nutrition and other management practices that helps to express its genetic potential. This implies the better performance of Jersey breed in the tropics. The current result is consistent and adaptability of the breed is confirmed with the average AFC value of 897 days reported by Deriba *et al.* (2015) and 988.5 days reported by Nibo *et al.* (2021) for Jersey cows in central Ethiopia.

In the current study, AFC was significantly ($p<0.05$) affected by calving year. This implies the influence of milk yield in previous periods of growth years of calves on AFC. As calves grow using high milk production of cows, AFC would be lower. The higher DMY as observed in the previous section is related to temperature and in turn, it affects the growth of calves and AFC. In this regard, Tamboli *et al.* (2022) indicated positive correlation of LL and AFC, and first lactation total milk yield and AFC. The influence of calving year observed in this study is in line with the finding of several authors (Yossef, 2006; Gader *et al.*, 2007; Million *et al.*, 2010; Direba, 2015) for Jersey cows. The lowest value of AFC was observed during (2009-2011), whereas the highest value of AFC was recorded during (2000-2002) (Table 3). A non-significant ($P>0.05$) effect of calving season on AFC was reported in this study and in previous studies (Belay and Chakravarty, 2014; Getahun *et al.* 2019). However, the present study disagrees with that of Chenyambuga and Mseleko (2009) in Tanzania who reported a significant effect of season. The variation might be attributed to differences in management conditions among seasons and countries.

Table 3. Least square means (±SE) in days for reproductive traits: age at first calving (AFC) and calving interval (CI).

Effect and Level	AFC		CI	
	N	LSM±SE	N	LSM±SE
Overall	795	952.40 ± 0.99	2480	490.09 ± 0.90
R^2		0.42		0.38
RMSE		57.9		53.11
Calving season				
Wet	334	951.86 ± 1.67	995	488.23 ± 1.44
Dry	461	950.12 ± 1.42	1485	491.41 ± 1.16
P-value		0.4128		0.0527
Parity				
1	-		671	489.40^{bc} ± 1.76
2	-		620	488.77^{c} ± 1.85
3	-		449	490.41^{abc} ± 2.14
4	-		279	484.76^{c} ± 2.69
5	-		187	499.99^{ab} ± 3.29
≥6	-		273	500.05^{a} ± 2.72
P-value				<0.0001
Calving year group				
2000-2002	135	963.02^{a} ± 2.47	422	487.09^{bc} ± 2.23
2003-2005	89	960.28^{ab} ± 2.99	278	496.52^{ab} ± 2.74
2006-2008	129	944.09^{c} ± 2.51	402	494.68^{ab} ± 2.30
2009-2011	92	928.35^{d} ± 2.93	288	499.31^{a} ± 2.69
2012-2014	160	949.84^{bc} ± 2.18	498	491.59^{abc} ± 2.00
2015-2016	190	960.35^{a} ± 2.16	592	484.18^{c} ± 1.98
P-value		<0.0001		<0.0001

AFC = Age at first calving; CI= Calving interval; N= Number of observations, R^2=R-square, RMSE = Root of mean square error; Least square means (LSM) with different superscripts within the same fixed effect indicate the presence of significant difference among mean squares.

Calving interval (CI): Calving interval is a fertility trait that refers to the period between consecutive calvings and is a function of open period and gestation length. A longer calving interval could reduce the number of lactation initiated over a cow's productive life and the total number of heifers in the herd which is essential for herd replacement (Middleton *et al.*, 2019).

Calving interval is an important factor in measuring the breeding efficiency and directly correlates with the economics of milk production. Reproduction in dairy cows with regular and shorter calving intervals (365-420 days) is a key feature for the rapid multiplication of breeding stocks (Temesgen *et al.*, 2022). However, studies in urban and peri-urban areas of several East African countries have reported long calving intervals (406 to 562) for dairy cattle (Gillah *et al.*, 2012). Long calving interval is a common problem in urban and peri-urban areas, which is linked to poor body condition and mineral deficiency especially inorganic phosphorus (Swai *et al.,* 2005). The long mean calving intervals result in low calf crop and low level of production.

The overall least-square mean of CI for the Jersey breed cattle in this study was found to be 490.01days (Table 3), which is comparable with the value of 497 days reported by Deriba *et al.* (2015), 494.16 days reported by Million *et al.* (2010) for Jersey breed at Ada-Berga farm. However, the value observed in the present study is longer than 450.09 days reported by Habtamu *et al.* (2011) for Jersey cows and 476.35 days reported by Effa *et al.* (2011) for Jersey crosses with Boran and Jersey breeds with the value of 450.09 days (Habtamu *et al.*, 2010). As can be observed, the 490 days CI recorded in the present study is well over the ideal calving interval of 365 days expected on commercial dairy farms. Based on the evidence obtained in this study, it appears that longer CIs might be related to artificial or human factors and environmental factors with substandard management practices such as failure to detect heat, inadequate nutrition before and after calving, and low level of animal health management. Estimate of longer CI than the current study were also reported by Yosef (2006) and Direba (2015) with the value of 500 and 497 days for Jersey breed in the central Shoa dairy farm, respectively. Similarly, Kefena *et al.* (2011) reported 528 days CI for 75% Jersey crosses with Boran breed. Such variations in CI among various reports might have occurred due to breed genetic potential, seasonal availability and quality of feed, climate, and other management factors such as heat detection, the skill of AI technicians, and quality of semen used for insemination. Besides, length of days open and number of services per conception also affect CI.

The effect of calving year: Analysis of variance revealed that CI was significantly affected by the fixed effects of calving years ($p<0.05$). This implies that as lactation milk yield increases the next calving interval would be higher, this is because of the negative energy balance of high milk production which elongate the recovery period of uterus. The result is in line with the findings of several authors for Jersey breed (Yosef 2006; Gader *et al.*, 2007; Million *et al.*, 2010; Direba, 2015). The lowest CI (484.18 days) was observed for cows calved during 2015-2016 (Table 3); while the longest CI (499.31 days) was observed for cows calved during (2009-2011). The longest CI from 2009-2011 may be due to the higher milk production of the cows in 2007 and 2008. The differences in calving intervals could be explained by variations in overall animal husbandry practices such as feeding and animal health management.

The effect of calving season: Calving season had no significant effect on CI ($p>0.05$) which is in agreement with the report of Mekuriaw *et al.* (2009) and Habtamu *et al.* (2009), however, disagrees with that of Million *et al.* (2010), who reported significant ($p > 0.001$) effect of calving season on CI.

The effect of dam parity: Similar to the present finding, the significant effect of parity on CI was reported by several researchers (Million and Tadelle, 2003; Goshu *et al.*, 2007; Mekuriaw *et al.*, 2009; Million *et al.,* 2010; Menale *et al.*, 2011) in Ethiopia. Chenyambuga & Mseleko (2009) in Tanzania also reported a significant effect of parity on CI on the Jersey breed. Contrary to the current finding, Mulindwa *et al.* (2006) in Uganda reported a non-significant ($p > 0.05$) effect of parity on CI. In the current study the longest CI was obtained with cows in advanced parities (≥6) and the shortest CI was recorded for cows in their fourth parity (Table 3). Generally, CI tended to decrease as the party advances till the fourth then tended to increase as the parity advances beyond (Table 3). This could be associated with improvements in the overall reproductive management at the center in later years. As depicted by Sammad *et al.* (2022), prolonged first CI (the period between the first two parties of a cow) could be physiologically desirable to allow cows to replenish their fat reserves depleted during lactation and prolong days open beyond the body for involution of the reproductive organ as this allows them to put on weight before the next calving.

Conclusion

In general, from this study, the production performance and reproductive performance of pure Jersey dairy cows are affected by non-genetic factors. Calving year and parity have significant effects on all traits except AFC. Improving the traits of milk production requires raising the level of management and health problems. This study recommends that milk production and reproduction performance in the study area is less than expected from this improved breed, so management intervention (feeding, health care, milking management, and time of milking) should be undertaken on the farm.

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Conflict of Interests

The authors declare that they have no competing interests.

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