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Research Article

Reproductive Performance of Arsi × Holstein Friesian Crossbred Dairy Cattle

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Abstract

The objective of this study was to evaluate the reproductive performance of Arsi-Holstein-Friesian crossbred dairy cows at Assela Model Agricultural Enterprise (AMAE). A retrospective study was carried out using data recorded from 1996 to 2011 to evaluate number of services per conception (NSPC), days open (DO), calving interval (CI), age at first service (AFS), and age at first calving (AFC). Fixed factors considered were year (16), season (3), parity (6) and blood level (4). Data of cows with complete information were considered, and a total of 855 records for NSPC, 678 records for DO, and CI, 177 records for AFS and AFC, were used. The overall least square means of CI, DO, AFS, AFC and NSC were 488, 209, 951, 1314, and 1.818, respectively. Season had no significant effect on reproductive performance of dairy cows. Year of calving showed significant influences ($p < 0.01$) on NSPC. Blood levels showed significant difference on CI and DO ($P < 0.05$) and AFS and AFC ($P < 0.01$). First parity showed higher ($p < 0.05$) values for CI and DO than third and above. The NSPC at 4th parity was shorter than the 6th. Except NSPC, blood levels had an economic importance in determining reproductive performance of dairy cows. Year had an important role in determining the reproduction performance of dairy cows indicating that the variation in feed availability and quality as well as variation in management through the years. Thus are, stabilizing environment, setting breeding program, and benchmarking parity is important to improve reproductive performance of the farm.

Keywords: Arsi; Assela; Crossbred; Holstein-Friesian; Reproductive

Introduction

The major economic activity of Ethiopia is agriculture. Livestock sector being part of agricultural activities plays an important role in the social, cultural and economic development of the agrarian community. Ethiopia is ahead of other African countries holding the largest livestock population estimated to be 59.5 million heads of cattle, 30.7 million sheep, 30.2 million goats, 8.43 million donkeys, 2.158 million horses, 0.409 million mules, 1.2 million camels, 59.49 million chicken and 5.90 million beehives [1].While livestock sector is mostly of smallholder farming system having several purposes, up to now contributes about 15% of export earnings, 16.5% of the national GDP, 30% of agricultural employment and 35.6% of the agricultural GDP [2,3]. Study by [4] reported that livestock contribute an important nutritional supplement to groups that are vulnerable, boost the pliability of smallholder households in time of shortage of food and help in the maintaining of traditional social safety nets. According to the reports of [1,5] the sub-sector plays an important role in contributing to the national economy thereby generating income for farmers, providing opportunities for job, ensuring food security, providing services, contributing to cultural, social, asset and environmental values, and sustaining livelihoods.

Despite the large numbers, the production and productivity per animal is very low [6]. This is because indigenous cattle have been naturally selected for years towards adaptive traits as tolerance and resistance to diseases, high fertility, unique product qualities, longevity and adaptation to harsh environments and poor-quality feeds. Attempts, to improve the productivity of cattle, have been made especially in the area of crossbreeding for the last five decades but with little success [6].

Ethiopia has a huge potential to be one of the key countries in dairy production for various reasons [7]. These include a large population of milking cows in the country estimated to be 10.7 million [8], a huge potential for production of high-quality feeds under rain fed and irrigated conditions, existence of a relatively large human population with a long tradition of consumption of [9]. In the design to improve milk and milk products and hence a potentially large domestic market [10], existence of a large and relatively cheap labor force and opportunities for export to neighboring countries and beyond.

The total consumption of milk in the developing countries is projected to increase from 64 million metric tons in 1993 to 391 million metric tons by the year 2020, which is 138 percent increase. Much of this increased demand will be in urban centers in which population is to grow at a rate of 5-6 from 1990-2025 [11]. Moreover, the trends of population increase; income growth and urbanization will fuel this tremendous growth in demand.

Milk yield is a product of animal genetic and environmental interactions [12]. Milk yield for specific genotype is the function of climate and its interactive influences on the quantity and quality of feeds, the presence of disease and parasite and the utilization of technology to alleviate nutritional, thermal and health limitations. Milk production systems in the tropics are diverse. At one extreme the systems are similar to those in most industrialized countries and are based on cows of high genetic potential given "high quality feeds" which includes fodder crops/silage, grain and protein concentrates [13]. Milk production per cow is extremely high and technological inputs are high. Even in some specialized large scale farms lactation milk yield of pure Holstein cows is far below their expected genetic potential [14].

The productivity of dairy cattle depends largely on their reproductive performance and hence, efficient reproduction is very important economically [15]. Numerous genetic and environmental factors are known to affect reproductive performance of dairy cows [16]. Although the temperate dairy cattle have demonstrated their optimum performance in suitable climatic and production conditions, achieving the desired level of reproductive performance under the warm climate in tropical conditions is challenged by several problems [17]. More focused and known management factors such as estrus detection, timing of insemination, use of proper semen handling and insemination, quality and fertility of semen and breeding bulls, and the skills in early pregnancy diagnosis have been reported to affect the reproductive performance of dairy cows performance, an important caveat to consider is the need to evaluate the existing information so as to be able to plan.

Motivation for popularizing crossbreeding between high-yielding European dairy breeds and cattle breeds adapted to local environments was initiated in the national agricultural research system (NARS) of Ethiopia in the early 1970s. As compared to other dairy cattle genetic improvement strategies, this approach was believed to be the only feasible and quick way of increasing milk production in Ethiopia. The outcomes of the crossbreeding programs have been amply reported in several literatures with various outcomes [18].

However, the dairy cattle genetic improvement program started in Ethiopia in the early 1970s has never been subjected to periodic evaluation for the genetic and environmental trends. Thus, the effectiveness of this program is not clearly known. Moreover, no information is available on the status of the national dairy cattle genetic improvement program that guide policy makers, development planners and breeders to redesign appropriate breeding programs that respond to the current scenarios in Ethiopia. The purpose of this study was, to investigate reproduction performance of Arsi-Holstein-Friesian crossbred of different blood levels at Assela Model Agriculture Enterprise Dairy Farm. The objective of this paper was to evaluate the reproductive performance of dairy cows with different exotic blood level.

Materials and Methods

Description of the study area

The data were collected from Assela Model Agriculture Enterprise Dairy Farm, which is located in the Arsi Zone of the Oromia Region about 175 kilometers from Addis Ababa. The city has a latitude and longitude of 7°57′N39°7′E and 7.95°N39.117°E / 7.95; 39.117, with an elevation of 2430 meters above sea level, respectively and with the minimum and maximum temperature ranging from 5 and 18 °C, respectively, around the year [19].

Description of the farm

Assela Model Agricultural Enterprise (AMAE) was established in 1967/68 by Swedish International Development Agency (SIDA)

[20] as part of a project named Chilalo Agricultural Development Union (CADU). It was the first comprehensive package project established in Arsi Zone to transform traditional peasant agriculture to the modern ones [21]. Farmer extension services were an integral part of CADU's activities. The major components of the package programmes included fertilizers, improved seeds, farm credits, marketing facilities, better tools and implements, and improved storage facilities.

Source of data

Data on reproductive performance were collected from Assela Model Agriculture Enterprise (AMAE) Dairy Farm. After editing abnormality and outliers, 855 records for number of service per conception, 678 records for calving intervals and days open and 177 records for age at first service and age at first calving were utilized for statistical analysis.

Data collection method and study design

Data on birth dates, calving dates and dates of artificial insemination were collected. From the collected information, the following dependent variables of interest were derived:- age at first service (AFS) as the number of days from birth date to first service; age at first calving (AFC) as the number of days from birth date to first calving; calving interval (CI) is the interval in days between two consecutive calving; days open (DO) as the interval in days between calving and conception and number of service per conception (NSPC) as the number of services the cow required until she conceived. Records of animals with abnormal calving such as abortion and stillbirth were also ignored. Further, all parturition numbers were classified into parities; 1, 2, 3, 4, 5 and 6+. All parities 6^{th}+ were pooled together in parity sixth because only a few cows that were completed more than sixth lactations.

Data analysis

The General Linear Models (GLM) procedure of Statistical Package for Social Sciences (SPSS, 2007, (version 16.0) was used for data analysis. Mean of different traits were then tested by Duncan mean separation. Two statistical models were used during data analysis; model 1 for AFS, AFC, and model 2 for NSPC, DO and CI.

Model 1: $Y_{ijk} = u + B_i + S_j + YR_k + e_{ijk}$

Where: Y_{ijk} = Age at first service and first calving of n^{th} cow born in k^{th} period of birth, j^{th} season of birth and of i^{th} exotic blood level.

u: Overall mean

B_i: The effect of i^{th} exotic blood level (i = 1…, 4)

S_j: The effect of j^{th} season of birth (j = 1…, 3)

YR_k: The effect of k^{th} period of birth (k = 1…, 16)

e_{ijkl}: Random residual error term

Model 2: $Y_{ijkl} = u + B_i + S_j + YR_k + P_l + e_{ijkl}$

Where: Y_{ijkl} = DO, NSPC, and CI of n^{th} cow in l^{th} parity, k^{th} period of calving, j^{th} season of calving and i^{th} blood level

u: Overall mean

B_i: The effect of i^{th} exotic blood level (i = 1…, 4)

S_j: The effect of j^{th} season of calving (1…, 3)

YR_k: The effect of k^{th} period of calving years (k = 1…, 16)

P_l: The effect of l^{th} parity (l = 1…, 6)

e_{ijkl}: Random residual error term

Results and Discussions

Results

Table 1 shows the calving intervals and days open for Arsi-Holstein Friesian of different blood levels. The overall mean values of calving intervals and days open were 488.6 and 209 days, respectively. Season had no significance ($P > 0.05$) effect on calving intervals and days open. Year revealed significant ($P < 0.05$) effect on calving intervals and days open.

Fixed variables	No.	Calving intervals (days)	Days open (days)
Overall	678	488 ± 6	209 ± 6
Season		NS	NS
Dry season (Oct-Jan)	269	489 ± 10	207 ± 10
Short rain season (Feb-May)	215	487 ± 11	210 ± 11
Long rain season (Jun-Sept)	194	486 ± 12	211 ± 11
Year		*	*
1996	53	436 ± 23^{abc}	160 ± 22^{ab}
1997	51	434 ± 23^{ab}	156 ± 22^{ab}
1998	53	446 ± 22^{abc}	167 ± 22^{ab}
1999	48	532 ± 23^{def}	253 ± 23^{cd}
2000	51	487 ± 23^{bcde}	209 ± 22^{bc}
2001	51	465 ± 23^{abc}	199 ± 22^{ab}
2002	47	452 ± 23^{abc}	171 ± 23^{ab}
2003	44	504 ± 24^{bcdef}	218 ± 24^{bcd}

2004	46	546 ± 25^{def}	265 ± 24^{cd}
2005	55	502 ± 22^{bcde}	223 ± 22^{bc}
2006	47	519 ± 24^{cdef}	234 ± 23^{bcd}
2007	42	498 ± 25^{bcde}	234 ± 24^{bcd}
2008	24	583 ± 31^{ef}	289 ± 31^{cd}
2009	21	549 ± 33^{f}	268 ± 33^{d}
2010	27	483 ± 30^{bcd}	201 ± 30^{bc}
2011	18	417 ± 35^{a}	135 ± 35^{a}

Table 1: Least square means (± S.E.) of calving interval and days open.

Within column least square means not carrying the same superscripts are significantly different. NS= not significant. *= significant (P < 0.05). There is no significant difference among mean values that share common superscript and vice versa

The least square means of calving intervals and days open are presented in Table 2. There was significant difference (P < 0.05) among blood levels in calving interval and days open. Calving interval and days open for cows with 62.5-68.75 and 75% exotic blood levels were shorter than that of cows with >75% exotic blood levels, whereas cows with 50% exotic blood level were intermediate. Calving interval and days open were significantly (P < 0.05) affected by parity. First parity showed higher (P < 0.05) values for calving intervals and days open than that of third and above, while second parity was intermediate.

Fixed variables	No.	Calving intervals (days)	Days open (days)
Overall	678	488 ± 6	209 ± 6
Blood levels		*	*
50%	65	493 ± 19^{ab}	216 ± 19^{ab}
62.5-68.75%	129	454 ± 14^{a}	177 ± 13^{a}
75%	122	455 ± 14^{a}	179 ± 14^{a}
>75%	362	519 ± 9^{b}	238 ± 8.5^{b}
Parity		*	*
1	144	523 ± 14^{b}	245.6 ± 13.5^{b}
2	120	486 ± 15^{ab}	205.4 ± 14.6^{ab}
3	109	485 ± 15^{a}	205.5 ± 15.1^{a}
4	89	456 ± 17^{a}	177.9 ± 16.2^{a}
5+	216	483 ± 11^{a}	204.7 ± 10.7^{a}

Table 2: Least square means (± S.E.) of calving interval and days open.

Within column least square means not carrying the same superscripts are significantly different, *= significant (P < 0.05), NS: Not Significant.

The least square means of age at first services and calving for Arsi-Holstein-Friesian cows are presented in table 3. The overall least square means for age at first services and calving were 951 and 1314 days, respectively. In this study season had no significant (P > 0.05) effect on age at first services and age at first calving. There was significant (P < 0.05) difference among years in age at first services and age at first calving.

Table 4 summarizes the effects of blood levels on age at first services and age at first calving. There was significant (P < 0.01) difference in age at first services and calving among the blood levels. Cows with 50% exotic blood level reached age at first services earlier than that of cows with 62.5-68.75%, 75%, and >75% exotic blood levels. The age at first calving for 50% and >75% exotic blood levels were significantly shorter than that of 62.5-68.75% exotic blood levels, whereas cows with 75% exotic blood levels were intermediate.

The effects of season and year on number of services per conception are summarized in table 5. The overall least square mean of number of services per conception was 1.82. There were no significant (P > 0.05) differences in number of services per conception among the seasons. There were significant (P < 0.01) differences in number of services per conception among years. Numbers of services per conception for the 2009 was significantly lower than that of the years 1997, 2000, 2001 and 2005. Furthermore, numbers of service per conception for 1998 was lower than that of 2000, 2001 and 2005, whereas the other years were intermediate.

Table 6 summarizes the effects of blood levels and parity on number of services per conception. Blood levels had no significant (P0.05) effect on number of services per conception. Number of services per conception for 4th parity was shorter than that of the 6th and above, whereas the other parties were intermediate.

Fixed variables	No.	Age at first services (days)	Age at first calving (days)
Overall	177	951±16	1314±67
Season		NS	NS
Dry season (Oct-Jan)	68	950±26	1254±110
Short rain season (Feb-May)	64	979±26	1459±112
Long rain season (Jun-Sept)	45	927±29	1233±125
Year		*	*
1996	13	924±53[abcd]	1986±230[b]
1997	18	776±43[a]	1098±186[a]
1998	12	803±59[a]	1082±252[a]
1999	14	939±53[abc]	1241±226[ab]
2000	12	908±51[abc]	1150±218[a]
2001	6	862±73[ab]	1152±314[a]
2002	7	958±76[abc]	1261±326[ab]
2003	16	954±55[abcd]	1255±238[ab]
2004	9	915±67[abc]	1257±286[ab]
2005	10	1030±62[bcde]	1329±266[ab]
2006	7	936±77[abc]	1152±333[a]
2007	2	1102±121[cde]	1396±523[ab]
2008	5	1189±80[e]	1496±346[ab]
2009	17	1110±50[de]	1396±216[ab]
2010	20	943±50[abc]	1254±213[ab]
2011	9	918±63[abc]	1214±271[ab]
Within column least square means not carrying the same superscripts are significantly different (P < 0.05). *= significant (P<0.05).There is no significant difference among mean values that share common superscript and vice versa			

Table 3: Least square means (± S.E.) of age at first services and age at first calving.

Fixed variable	No.	Age at first services (days)	Age at first calving (days)
Overall	177	951±16	1314±67
Blood levels		***	***
50%	12	853±57[a]	1150±246[a]
62.5-68.75%	25	969±39[b]	1557±166[b]
75%	29	966±36[b]	1278±155[ab]
>75%	111	953±20[b]	1250±87[a]
Within column least square mean not carrying the same superscripts are significantly different *** = significant (P<0.01)			

Table 4: Least square means (± S.E.) of age at first service and age at first calving.

Fixed variables	No.	Number of services per conception
Overall	855	1.82 ± 0.032
Seasons		NS
Dry season (Oct-Jan)	311	1.80 ± 0.05
Short rain season (Feb-May)	283	1.77 ± 0.06
Long rain season (Jun-Sept)	261	1.89 ± 0.06
Years		***
1996	66	1.85 ± 0.12^{abc}
1997	69	1.88 ± 0.12^{bc}
1998	65	1.61 ± 0.12^{ab}
1999	62	1.84 ± 0.12^{abc}
2000	63	1.99 ± 0.12^{c}
2001	57	2.09 ± 0.12^{c}
2002	54	1.83 ± 0.13^{abc}
2003	60	1.73 ± 0.12^{abc}
2004	55	1.78 ± 0.13^{abc}
2005	65	2.12 ± 0.12^{c}
2006	54	1.76 ± 0.13^{abc}
2007	44	1.68 ± 0.14^{abc}
2008	29	1.73 ± 0.17^{abc}
2009	38	1.48 ± 0.15^{a}
2010	47	1.73 ± 0.15^{abc}
2011	27	1.73 ± 0.17^{abc}

Table 5: Least square means (± S.E.) of number of services per conception.

Within column least square means not carrying the same superscripts are significantly different, NS= not significant, * = significant (P < 0.05), *** = significant (P < 0.01). Mean values that share common superscript had no significant difference and vice versa.

Fixed variables	No.	Number of services per conception
Overall	855	1.82 ± 0.03
Blood levels		NS
50%	77	1.82 ± 0.10
62.5-68.75%	154	1.92 ± 0.07
75%	151	1.77 ± 0.07
>75%	473	1.79 ± 0.05
Parity		*
1	177	1.85 ± 0.08^{ab}
2	144	1.73 ± 0.08^{ab}
3	120	1.87 ± 0.08^{ab}
4	109	1.75 ± 0.09^{b}
5	89	1.76 ± 0.10^{ab}
6+	216	1.90 ± 0.06^{a}

Table 6: Least square means (± S.E.) of number of service per conception.

Within column least square means not carrying the same superscripts are significantly different, NS=is not significant, *= significant (P < 0.05).

Discussions

Days open

Days open of 200 and 205 days were reported by [22,23] for Boran crossbred and HF, respectively, which agrees with the current study. On the other hand, days open of 151, 148 and 155.7 days were reported by [24- 26] for Fogera and F1 Fogera-Friesian crossbred, HF, Zebu-HF crossbred, respectively, which is shorter than the present study.

The lack of effect of season on days open agrees with the study by [25] on Holstein Friesian dairy cows in Ethiopia. According to [27] animals that gave birth during long rain season had shorter days open than that of animals which gave birth during dry and short rain seasons, which is not consistent with the current finding. The variations among year of calving on days open agree with the study by [23,27,28]. This could be due to the variation of management among years, i.e., variation in feed availability, health care, housing, etc.

The estimated mean values of days open by exotic blood levels were longer than that of [29] who reported 133, 137 and 138 days for Friesian-Zebu, Jersey-Zebu and Friesian-Jersey-Zebu crossbred, respectively. According to [23], cows with higher exotic blood levels had longer days open than that of cows with 50% exotic blood levels which agree with the current result. Study by [24] reported that mean days open for pure Fogera and F1 Friesian X Fogera were about 151 and 151 days, respectively. The same author reported 361 days open for ¾ Friesian X Fogera crosses, which is longer than the current study for all studied blood levels.

Parity number significantly influenced days open, which is in agreement with earlier reports [29,30,31], cows in the first parity have been found to have longer days open than cows in the later parities. Similar results were reported by [23,32] who reported similar trend of days open tending to decrease with advancement in age. This could be due to physiological stress experienced by the first calvers in early lactation and delayed calving to first service intervals and hence long days open.

Days open influence is partly attributed to factors such as increased breeding cost, increased risk of culling and replacement costs, and reduced milk production [33]. Days open affect lifetime production, calving intervals and generation interval [34]. Days open should not exceed 80 to 85 days, if a calving interval of 12 months is to be achieved [35,36]. This requires re-establishment of ovarian activity soon after calving and high conception rates.

The variations in days open among literatures might be due to nutritional deficiencies, which might interfere with ovarian function, thereby prolonging the DO [37]. The effect of low level of nutrition on extended postpartum period due to weight loss was noted by [38]. Moreover, [39] reported that increasing the level of protein supplementation from low (2 kg/day) to high (4 kg /day) reduced postpartum interval from 159 to 100 days. Cows that are over conditioned at calving or those that lose excess body weight are more likely to have a prolonged interval to first oestrus, which could result in longer days open [40].

Calving interval

Calving intervals of 412 days, 459 days, 421 days, and 446 days were reported by (29, 41, 42 and 25) for crossbred in and around Zeway, Zebu-HF crossbred in central highlands, and HF in Ethiopia, respectively, which is shorter than the current study. Moreover, 582, 505, 561 and 641 days were reported by [26,27,43,44] for Zebu elsewhere, HF in Pakistan, HF in rift valley of Ethiopia and crossbred in Jimma Town, respectively, which is longer the present findings.

The absence of season effect on calving intervals was consistent with the study by [45,46] for Friesian cows under Sudan tropical conditions and different grades of Zebu x Friesian crossbreds under semi-arid conditions in Kenya, respectively. According to [27] animals which gave birth in short rain season had longer calving intervals than animals which gave birth in dry and long rain season. Moreover, in Iranian significance effect of season of calving-on-calving intervals was reported for Holstein [47].

The variation in calving intervals among year was consistent with the study by [25,27]. Year effect on calving intervals in the tropics has been reported to be indirect due to dynamic climatic changes which are frequently associated with disease pattern and changes in management by farmers [48]. Moreover, nutritional conditions that vary yearly have major effects on calving interval [50,51].

Shorter calving intervals for local Arsi and Zebu was reported than the present study for 50 and >75% exotic blood levels [53]. Nevertheless, it was comparable with 62.5-68.75 and 75% exotic blood levels reported by the same authors. Moreover, they reported shorter calving intervals for 50% Jersey-Arsi, Friesian-Arsi and Exotic-Arsi blood levels than the current result, whereas 50% Friesian- Zebu was comparable. The calving interval of 50% exotic blood levels was comparable with the study by [23] for the same blood levels. shorter calving intervals for 75% Friesian-Arsi, Friesian-Zebu and Exotic-Arsi blood levels was reported than the current result, whereas, they reported comparable result for 75% Friesian-Local blood levels [53]. Shorter calving intervals for 25-75% exotic blood levels of Kenana-HF crossbred in Sudan was reported than the current blood levels studied [46]. According to [53] Arsi-Friesian crossbred cows with >75% exotic blood levels had longer calving intervals which agrees with the current study.

The difference among parity on calving intervals was consistent with [25,27,46,54]. The decrease in calving intervals between the first and subsequent parities was consistent with earlier studies by [25,54,55,56]. The longer calving intervals for the first parity were reported by [32,43,46,57,58]. The prolonged calving intervals for first calvers has been reported to be physiologically necessary to allow animals to replenish their fat reserves depleted during lactation and this allows them to put on weight prior to the next calving [59].

In general, prolonged calving interval is associated with nutritional conditions that vary seasonally and yearly [49,50,51]. Similarly, longer calving intervals is mainly attributed to the result of longer days open obtained which could be related to environmental factors, mismanagement practices like poor housing [60], poor nutrition or failure to detect heat [61].

Age at first services and calving

The age at first services of 603,768, 888, and 729 days were reported by [26,62-64] for Zebu-Holstein-Friesian crossbred in different parts of Ethiopia, respectively, which is shorter than the current study. However, age at first services observed in this study was shorter than 1104 days and 991 days reported by [27,65] for Zebu-HF crossbred and pure Holstein Friesian, respectively.

The mean age at first calving in the current study was longer than 1014 days, 1086 days, 963 and 1104 days reported by [26,29,52,64] for Arsi, Zebu-HF crossbred in Eastern lowland of Ethiopia, in and around Zeway and in Jimma Town, respectively. Moreover, age at first calving of 1230 days, 1265 days were reported by [27,66], in that order, which is shorter than the present result. However, it was comparable with the study of [27,67] (1320 days) for local Sudanese breeds. On the other hand, age at first calving in this study was shorter than the study by [51] (1350 days), [68] (1638 days) and [43] (1590 days) for Boran, Fogera and Highland Zebu in Ethiopia, respectively. Ages at first calving in Ethiopian cattle were reported to be longer for Zebu than for crossbreds [43,69].

The lack of variation among seasons on age at first services was reported by [25,56,65,70], which is consistent with the current study. Nevertheless, [23,24] reported significant effect of season of birth on age at first calving. According to [27] animals that are born during long rain season and dry season reached age at first service and calving earlier than that of animals born during short rain season.

The difference among year on age at first services and age at first calving were reported by [27,56]. Moreover, [23,71] reported significant effect of year on age at first calving in their study under smallholder production system in Tanzania. However, [46] reported insignificance effect of year on age at first calving for different grades of Zebu-Friesian crossbred under semi-arid conditions in Sudan.

Shorter age at first calving was reported for local Arsi breeds [52]. In addition, they reported shorter age at first calving for 50% Jersey-Arsi, HF-Arsi and Zebu-HF and 75% HF-Arsi, Zebu-HF and Exotic-Arsi exotic blood levels than the current study. Shorter age at first calving was reported for 50% exotic blood levels than the current study [72]. Moreover, they reported shorter calving intervals for 85.75% HF-Local exotic blood levels than this study. In addition, shorter age at first calving was reported for 75% exotic blood levels [72]. In this study age at first calving for >75% exotic blood levels were comparable with [27,66] for HF. On the other hand, [46] reported longer age at first calving for 50, 62.5 and 75% exotic blood levels in Sudan than the current result.

Different factors advance or delay age at first service and calving. The highest estimated age at first services and calving would possibly be the result of poor post management like feeding, housing and health care. Improvement in post weaning nutrition is important factor in achieving a decrease in age at puberty and at first calving [73]. An increase in protein intake resulted in a decrease in age and increase in weight at puberty [50]. Substantial evidence exists that dietary supplementation of heifers during their growth would reduce the interval from birth to first services and calving [74] probably because heifers that grow faster cycle earlier and express overt estrus.

Number of service per conception

Overall least square mean values of NSPC of the current study was comparable with the estimates for different breed groups at Abernossa Ranch (1.7) [75], Stella private dairy farm (1.72) [76], Holeta Research Centre (1.72) [77], smallholder dairy farms (1.6) [78], and Holstein-Friesian cows at Alage Dairy farm (1.69) [27]. However, current NSPC was lower than the study by [79] (2.6).

Lack of effect of season on NSPC was reported by [25,68,76,80,81] which is consistent with the current result. Nevertheless, effect of season of services on number of services per conceptions was reported [27,82]. Moreover, [79] indicated that cows served for the first time during rainy season had numerically higher services than those cows that were inseminated for the first time during other seasons. This is probably due to the inability to detect estrus signs and the subsequent failure of services, as a result of confinement of the cows in-housed during the rainy season. However, [75,77] found a significantly less number of services per conception in the wet season. The lack of effect of season on NSPC might be due to supplementary feeding practice in the farm, which makes the effects of seasonal variation in forage developments and feed availability minimal.

The variation among year of services on NSPC were reported by [27,75,76,83] which is consistent the current result. However, [69,84] reported a non-significant effect of calving year on NSPC. The differences observed in NSPC among years of services could be related to the variation in feeding and management practices [76]. In addition to that, the annual variability in number of NSPC might be due to inconsistencies associated with insemination time, management practices followed over the years and the occurrence of occasional feed shortages.

[80] reported 4.55, 3.49 and 2.01 number of services per conception for 50%, 75% and >75% exotic blood levels at Cheffa dairy farm, respectively, which is significantly higher than the current result. Furthermore, the current NSPC was lower than the study by [85] which was 2.4-2.6 for local Arsi breeds, whereas [86] reported lower number of services per conception for 50% Arsi/Boran crossbred.

In this study the NSPC at 6th+ parity was comparable with the value (2.07) reported by [25], but lower than the value (2.19) reported by [87]. There was no significance difference in NSPC from the 1st via 3rd parity, which agrees with the current study [70]. Whereas, [23] reported that lower NSPC for the 1st parity, while higher for the 4th parity. The highest NSPC at latter parity may be due to impaired reproductive organ, like retained placenta and metritis, which can have distressing effect on reproductive efficiency in lactating dairy cows, with reduced conception rates and extended intervals to pregnancy [88]. Furthermore, higher NSPC in aged animal due to the ability of older cows to gain weight and condition quickly after calving [30].

Conclusion and Recommendation

In conclusion, the reproductive performance of Arsi-HF crossbred in this study was better as compared with that of pure Zebu breeds. However, the reproduction performance of Arsi-HF crossbred in this study was far below the expected genetic potential of animals in the tropical environment elsewhere. This may be attributed to poor feeding, housing health care and breeding management. In the current study, year had an important role in determining the performance of dairy cows indicating that the variation in feed availability and quality as well as variation in management through the years.

Prolonged age at first services, age at first calving and calving intervals obtained from this study indicates problems associated with nutritional and management conditions during early growth period of the animals. On the other hand, the long days open may indicate poor heat detection, less supervision of animals, service irregularities. As it is being called, the farm may not qualify to be a profitable enterprise under the existing condition but needs further detail assessment of cost benefit analysis. To express their expected genetic potential, the animals may need improved feeding, housing, health care and breeding management.

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Conflict of Interest

There is no interest of conflict.

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