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Full Length Research Paper

Assessment of milk production and reproductive performances in urban and secondary town dairy production systems in Adama milk shed, East Shoa Zone, Oromia National Regional State, Ethiopia

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The study was conducted at Adama milk shed, Oromia regional state of Ethiopia, in March 1-30, 2012. The objective of the study was; to evaluate milk production and reproductive performances of crossbred dairy cows in urban and secondary town dairy production systems. A total of 145 farms having crossbreed cows, 62 from urban farms and 83 from secondary town farms were considered. Total herd size, number of milking cows in the farm and the specialized inputs that farms use, were used to stratify farms into small (less than 3), medium (3 to 10) and large farms (more than 10 cattle). Farm owners were interviewed using structured questionnaires. The results indicated overall mean daily milk yield (14.1±4.3L) and lactation length (10.9±0.1months). While, age at first mating, age at first calving, calving interval and days open were 20.4±0.3 months, 30.7±0.3months, 13.6±0.1months, and 101.6±2.3days, respectively. Mean daily milk yield was significantly (P< 0.001) varied between production systems, genotype, herd size and parity. Moreover, genotype exerted significant (P< 0.001) effect on the respective reproductive parameters. Further improvement of routine management activities and applying breed improvement strategies could be addressed to exploit the optimum level of milk production and reproductive performance of crossbred dairy cows.

Key words: Crossbreds, milk yield, reproductive, secondary town, urban.

INTRODUCTION

Ethiopia, one of the tropical and subtropical countries in Sub-Saharan Africa, has about 53.9 million cattle, 25.4 million sheep, 24.06 million goats and 0.9 million camels on which dairy production is based (CSA, 2012/13) excluding livestock population of three zones of Afar and six zones of Somali regions. However, despite its huge livestock population the current milk production per annum of the country is very low which has been estimated to be 3.2 million ton and growing at a rate of only 1.2% for indigenous and 3.5% for improved stock per year (Tsehay, 2002). Such a lower milk production performance is due to reduced lactation length, extended calving interval, late age at first calving, poor genetic makeup (Mukasa-Mugerewa, 1989; Yoseph et al., 2003) and shortage of livestock feeds both in quantity and quality, especially during dry season (Ahmed et al., 2010).

Taking into consideration the human population growth rate of about 2.9% per annum and the likely increase in demand for dairy products especially in the urban areas, milk production is expected to grow in Ethiopia at a rate of 3.8-4% annually until 2020 (Holloway et al., 2000).

Reproductive performance is often a major determinant of biological and economic efficiency of livestock production in tropics. Previous studies have shown that crossbred animals to have better reproductive and productive performances compared with indigenous stock (Kiwuwa et al., 1983; Yoseph et al., 2003). Their relative advantage, however, depends upon provision of adequate

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nutrition and better health management (Preston and Leng, 1989). Thus, further studies are required for a better understanding and knowledge of productive and reproductive characteristics. However, there is no such works done especially in Adama milkshed. Therefore, the objective of this study was planned to assess milk production and reproductive performances in urban and secondary town dairy production systems in Adama milkshed.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted on private urban and secondary town cross bred dairy farms in and around Adama city, east shoa zone, Oromia national regional state. Urban-sub system was represented by Adama city itself, while secondary town subsystem was represented by Melkasa, Wenji, Welenchiti and Mojo towns which are located at different distance and direction from Adama town.

Adama is located at 8o33`35``N - 8o36`46`` N latitude and 39o11`57`` E – 39o 21`15`` E longitude about 99 km south-east of Addis Ababa. It is one of the largest and fast growing towns in Oromiya Regional State with the total population of 260,611 (CSA, 2005). It is situated at an altitude ranging from 1400 to 2700 meters above sea level. The area receives an average annual rainfall ranging from about 600 to 1150 mm which is erratic in nature. There is a significant seasonal variation in the amount of rainfall. More than 67% of the mean annual rainfall occurs in the four rainy months: June, July, August and September. Some additional rains (about 23%) occur in the remaining dry months with mean monthly values of rainfall as low as zero millimetres. The minimum and maximum daily temperatures of the area are 12 and 33oC, respectively (NMSA, 2010).

Sampling Procedures

Adama and four associated secondary towns (Melkasa, Wonji, Mojo and Wolenchiti) were purposefully selected based on their potential supply of milk and milk products to Adama town. In this particular study, the milkshed refers to the geographical location where milk is produced and transported into a specific market centre, in this case, the Adama town. Farms located at a distance seven to twenty three kilometres from Adama town was considered as secondary town farms because, whatever the amount of milk produced, farmers deliver to the nearby urban market Adama. These farmers use various transportation means to deliver their milk to marketing point. Further stratification was done based on herd size, number of milking cows that the farms had and the specialized inputs that the farms used. Farms owning less than 3, 3 to 10 and greater than 10 cows were clustered to small, medium and large farms, respectively. Accordingly, a total of 145 farms having crossbred (Friesian x Zebu) dairy cows; 62, 22, 20, 20 and 21 farms from Adama, Melkasa, Mojo, Wonji and Wolenchiti were considered, respectively. Stratified random sampling methods were used to identify target dairy farms.

Data Collection procedure

This study was conducted using primary data. Following identification of the dairy farms (experimental sites); structured questionnaires were developed, tested and used for the survey work. Data collection was carried out across the farms between March 1-30, 2012 to evaluate milk yield, lactation length, age at first mating, age at first calving, calving interval and days open in the milkshed. Each dairy farm was visited at least once during the study period. In the study intensively managed crossbred cows were prioritized into crosses (<62.5%) and high grades (above 62.5%) based on the record obtained from the farm.

Statistical Analysis

Production and reproductive parameters were analyzed using General Linear Model (GLM) procedures of SAS (SAS, 2009). Mean comparisons was done using the Least Significant Difference (LSD) for variables whose F-values showing a significant difference at P-value 0.05, 0.01 and 0.001. The model employed will be as follows:

$$Yijkl = \mu + Di + Hj + Lk + Gl + Pm + eijklm$$

Where: yijklm = Response variables (Production and Reproductive parameters), μ = Overall mean; Di = ith dairy production systems effect (Urban and secondary town), Hj= jth herd sizes effect (Small = 1-3, Medium= >3-10, Large> 10), Lk= kth locations effect (Adama, melkasa, Mojo, Wonji and Welenchiti), Gl = lth genotype effect (crosses and high grade), Pm = mth parity effect (2, 3, 4 and 5), eijklmn = residual effect.

RESULTS

Daily Milk Yield and Lactation Length

Mean daily milk yield and lactation length in urban and secondary town dairy production system in Adama milkshed is indicated in Table 1. Mean daily milk yield was varied significantly ($p<0.01$) between production systems, genotypes, herd size and parity. The overall mean daily milk yield per cow was 14.1±4.4L. The higher daily milk yield was found in urban production system (15.5 ± 5.2L) and high-grade Holstein cows (15.3 ± 4.1L)

Table 1. Mean ± (SD) daily milk yield and lactation length in urban and secondary town dairy production systems in the study area.

Variables	N	Milk yield /cow/day(L) Mean± (SD)	N	Lactation length (months) Mean± (SD)
Production systems				
Urban	6	15.5 ±5.2	62	10.9 ±0.1
Secondary town	18	13.7 ± 3.9	83	11.0 ±0.1
		***		NS
Melkasa	5	13.8±4.3	22	10.8^{b}±0.6
Mojo	4	13.4±4.2	20	11.1±0.6
Wenji	4	13.6±3.9	20	10.7±0.9
Welenchiti	5	14.3±4.7	21	11.4^{a} ±0.6
		NS		*
Genotype				
Cross	5	11.3^{b}± 3.6	19	10.9 ± 0.1
High grade	19	15.3^{a}± 4.1	126	11.1 ± 0.2
		***		NS
Herd size				
Small	10	14.8 ±4.4	60	10.9± 0.7
Medium	10	12.1^{b} ±4.3	60	10.9± 0.6
Large	4	15.6^{a}± 3.7	25	11.1± 0.7
		***		NS
Parities				
2	15	13.6^{b} ±0.1	90	11.1 ± 0.8
3	5	15.4^{a} ±0.2	32	11.2 ± 0.4
4	3	9.9^{c} ±0.2	17	11.0 ± 0.0
5	1	10.9±0.1	6	11.0 ± 0.0
		**		NS
Overall mean ± (SD)		14.1±4.3		10.9± 0.1

*=p<0.05, **=P<0.01, ***=P<0.001, NS= Non significant, SD= standard deviation, 2= second parity, 3=third parity, 4=forth parity, 5= fifth parity: Means in the same column with different subscript letters were significantly different, N=number, L=litres

and lower in secondary town production system (13.7±3.9L) and crosses (11.2±3.6L). However, there was no significant (P>0.05) variation of milk yield between secondary town locations. Average daily milk yield in large farms (15.6±3.7L) was significantly (p<0.01) higher than medium farms (12.9±4.3L). Moreover, average daily milk yield of cows with parity three was (15.4±4.4L) significantly (p<0.01) higher than cows with parity four (9.9±2.5L) and parity five (10.9±0.5L).

The overall average lactation length in months for crossbred cows in urban and secondary town farms in the milkshed was 10.9 ± 0.1 and 11.0 ± 0.1, respectively. Production systems, genotype, herd sizes and parities had no significant (P>0.05) effect on lactation length. Yet, mean lactation length in Welenchti (11.4±0.6) was significantly (P<0.05) higher than lactation length of cows in Melkasa (10.8±0.6).

Age at First Mating and Calving

As the result of the study (Table 2) indicated, production system had no significant (p>0.05) effect on the respective parameters. However, the analysis of variance showed that genotype (P< 0.01) exerted a highly significant effect on average age at first mating and age at first calving. The overall (Lsmean ± SE) of age at first mating was 20.4±4.1 months. The average value for age at first mating for crossbred heifers (26.6±0.3) was higher than high-grade Holstein heifers (19.5±0.9). Age at first mating for Holstein x Zebu heifers under small herd sizes (21.4±0.6 months) was significantly (p<0.05) longer than large herd sizes (18.8±0.7 months). High-grade Holstein heifers (29.8 ± 0.9) appeared to calve significantly (P < 0.001) earlier than crossbreds (36.7 ± 0.3 months). The overall (Lsmean ± SE) age at first calving was 30.7± 4.1

Table 2. Lsmean ± (SE) reproductive traits of dairy cows in urban and dairy secondary town production systems in the study area.

Variables	N	AFM (months)	AFC (months)	CI (months)	DO (days)
Production system					
Urban	62	24.2±0.3	34.4 ±0.3	14.0±0.1	2.3±0.1
Secondary town	83	22.8±0.9	32.9±0.9	13.9±0.2	1.7±0.2
Significance		NS	NS	NS	NS
Genotypes					
Crosses	62	26.6^{a} ±0.3	36.7^{a} ±0.3	14.6^{a}±0.2	100.8±4.8
High grade	83	19.5^{b} ±0.9	29.8^{b} ±0.9	13.4^{b}±0.1	96.4±2.3
Significance		**	**	*	NS
Herd size					
Small	60	21.4^{a}±0.6	31.6^{a}±0.55	13.8±0.2	108^{a}±3.8
Medium	60	20.2 ±0.5	30.4±0.50	13.4±0.1	97±3.41
Large	25	18.8^{b}± 0.7	29.1^{b}±0.68	13.3±0.2	97.2^{b}± 5.3
Significance		*	*	NS	*
Parity					
2	90			13.6±1.1	100.3±25.5
3	32			13.6±1.1	101.6±27.6
4	17			13.6±1.2	110.0±30.9
5	6			13.3±0.8	95±22.6
Significance				NS	NS
Overall	145	20.4± 0.3	30.7± 0.3	13.6 ± 0.1	101.6 ±2.3

AFM =age at first mating, AFC=age at first calving, CI= calving interval, DO= Days Open,*=p<0.05,**=P<0.01, NS= Non significant, Lsmean= least square mean, SE=standard error, Means in the same column with different subscript letters were significantly different, N=number

months. Age at first calving in small farm sizes (31.6±0.6 months) was significantly (p<0.05) higher than large size farms (29.1±0.7 months).

Calving Interval and Days Open

Analysis of variance showed that genotype had significant (P<0.001) effect on calving interval of cows. The overall Lsmean ± (SE) calving interval in the current study was 13.6 ± 0.1 months. Calving interval for high grade Holstein cows (13.4 ±0.1 months) was significantly (P<0.05) lower than crossbreds (14.6±0.1 months). Yet, production system, herd size and parity had no significant (p>0.05) effect on calving interval. Days open in small herd size (108 ± 3.8) was significantly (P<0.05) higher than large herd size groups (97.2 ± 5.3 days). However, parity had no significant (p>0.05) effect on days open.

DISCUSION

Overall mean daily milk yield obtained for crossbred cow was by far higher than national average: 6.48L (Feleke and Gashaw, 2001), 9.5L and 6.1L of large and small urban farms, respectively (Staal and Shapiro, 1995). Kelay (2002) also reported that daily milk yield of crossbred cows in small, medium and large farms were 8.97L, 10.5L and 13.9L, respectively, in Addis Ababa. Significantly higher daily milk yield in the milkshed in general and in large farms in particular might be due to higher exotic blood level of the cow and energy intake from concentrate feeds in the farm. Higher daily milk yield reported in the current study in cows of parity 3 is similar to (Epaphras et al., 2004) reported for cows in 4th and more parity were no longer better producers compared to those in their 3rd parity. The older age may contribute to reduced milk production through high turnover rate of active secretary cells.

Longer mean lactation length of crossbred cows was reported from Assela research station (Enyew et al., 2000). The average lactation length of crossbred cows in urban and secondary town farms in the current study, was higher than urban (9.97) and peri urban (10.1 months) farms reported in west Shoa Zone (Deresse, 2009). The difference in lactation length is attributed to extended milking program without drying off to increase annual milk output, loss of heat detection practices and

insemination aids in this study. However, the current value had almost comparable lactation length with crossbreds in North Shoa (11.1 ± 4.8 months) (Mulugeta and Belayneh, 2013).

The average value for age at first mating for crossbred heifers was higher than high-grade Holstein heifers. Similarly, Nigussie (2006) indicated that, high-grade Holstein Heifers in Mekele city were ready for mating ($p<0.001$) earlier than crossbred heifers. A higher overall (Lsmean ± SE) age at first mating of (30.9 □ 5.7 months) was reported for different levels of crosses (Exotic x Local) in Assela livestock research station (Enyew et al., 2000). The average age at first mating obtained in Cheffa state farm, South Wollo, (Goshu and Hagde, 2003), was 32.9 months for crossbred (Holstein x Zebu). Age at first service for Holstein x Zebu heifers under small herd sizes was significantly ($p<0.05$) longer than large herd sizes.

Average age at first calving of crossbred heifers, higher than the values of 34 months reported for Bos taurus x Bos indicus crossbreeds (Mukasa-Mugerwa, 1989), was lower than the F1 Frisian x Fogera crosses, 44 □ 0.6 months at Metekel ranch (Addisu and Hagde, 2003), Frisian x Arsi crosses, 42.5 □ 6.2 months at Asella research center (Enyew et al., 2000) and 44 □ 13.47 months reported for Zebu and their crossbreds with Frisian reported from Bako (Chernet et al., 2000). Shorter age at first mating could be an implication for better exotic blood level of high-grade heifers, expressed in reaching puberty earlier than the crossbred heifers. Furthermore, it is also important to observe that high grade heifers gave birth to their first calf earlier than the crossbreds.

Longer calving interval (15.8 □ 0.5 months) in Holstein Frisian cows was reported at Alemaya University farm (Kurtu, 2003). Yet, the result in the current study was comparable to 14.7 months of F1 Frisian x Arsi crosses at Asela research centre (Enyew et al., 2000) and 14.1 months crossbred cows at Awassa (Ike, 2002). However, the current result was higher than 13.3 months of F1 Frisian x Barca crosses at Debrezeit research centre (Taddesse and Dessie, 2003). The differences in the reproductive performance of crossbred cows might be attributed to the existing differences in nutritional and reproductive managements among the dairy producers. Differences in management might have accounted for the observed differences on DO in the herd groups.

CONCLUSION AND RECOMMANDATION

From the result of this study, it can be conclude that better reproductive performances were recorded, namely age at first mating (20.4±0.3 months) and age at first calving (30.7±0.3 months) were found to be better ($p<0.01$) when compare to the various previous research reports. Moreover, calving interval (13.6±0.1 months) and days open (13.6±0.1 days) were also found to be good in all dairy farms across the study areas. As a result their productive performance mainly in terms of milk yield (14.1±4.3 litres) was also found to be by far better ($p<0.001$) than the other research reports conducted in different areas of the country although the production performance of each cow in different farms varies based on the variation in management and the exotic blood levels. Therefore, it can be recommended that dairy farmers had better to improve the routine management activities and apply breed improvement strategies so as to further exploit the optimum level of reproductive and production performance of dairy cows.

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