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Assessment on Milk Yield and Reproductive Performances of Crossbred Dairy Cattle in Selected Dairy Production Systems of Central Highlands of Ethiopia

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ABSTRACT

Background: Productive and reproductive performances are the most important parameters in the Ehiopian dairy sector. The objective of the current study was to assess milk yield, reproductive performances of crossbred dairy cattle and occurrence of reproductive health problems and veterinary services provider/s.

Methods: A cross-sectional study using semi-structured questionnaire was used to collect information from 160 randomly selected dairy farm owners found in urban and peri-urban areas of Assela, Bishoftu, Holetta and Sululta of the central highlands of Ethiopia.

Result: The higher average daily milk yields were 11.7 and 11.2 litres in urban and peri-urban Bishoftu. The average age at first service of crossbred dairy heifers was 18.8 months in urban and 19.1 months in peri-urban Bishoftu, respectively. The average age at first calving of crossbred dairy heifers was 27.8 months in urban Bishoftu and 28.1 months in peri-urban Bishoftu areas. The longest average age at first service (29.3 months) and age at first calving (38.3 months) were in peri-urban Assela. The number of services per conception was 1.4 in urban Assela and 1.3 in peri-urban Assela and these were shorter than the 1.65 from urban Bishoftu and the 1.85 of peri-urban Bishoftu areas. The average 168.0 days calving to conception interval from peri-urban Assela was the longest calving to conception interval in this study. The average calving intervals 14.9 and 13.9 months of peri-urban Assela and Sululta were relatively longer than the respective urban areas.

Key words: Crossbred, Dairy cattle, Milk yield, Reproductive performances.

INTRODUCTION

Livestock play a significant contribution at the farm household level and to the national economy. But its multidimensional role is often underestimated, largely due to the absence of adequate information at farm and national levels (Alary *et al*. 2011).

In Ethiopia, market-oriented urban and peri-urban milk productions are emerging as major suppliers of milk and milk products to the urban centers. The production systems possess both indigenous and crossbred dairy animals ranging from 50% to high grade Holstein Friesian breeds in small, medium and large sized farms. The productive and reproductive performances of dairy cattle are low due to inadequate and low quality feed resources, poor nutrition and health care management (Azage *et al*. 2013).

The important parameters that determine cattle reproductive and productive efficiency includes age at first service, age at first calving, average daily milk yield, calving to conception interval and calving interval (Dematawawa and Beger, 1998). The purpose of post-partum reproductive health in dairy cattle is for the uterus to be fully involutes and free of infection and for cows to be cyclic by the time they enter the breeding period, particularly after 50 to 60 days post-partum (Plazier *et al*. 1997).

As mentioned by Lobago *et al*. (2007), the success of dairy production in general and crossbreeding programmes in particular needs to be monitored regularly by assessing the productive and reproductive performance under the existing management practices. Therefore, the present study was designed to assess milk yield, reproductive performances, occurrence of reproductive health problems and veterinary services provider/s in the selected study areas.

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MATERIALS AND METHODS

Study areas

The study was conducted in Assela, Bishoftu, Holetta and Sululta towns' which are the main dairy production belt areas of the central highlands of Ethiopia.

Assela town is located in Oromia region, Central Ethiopia and the capital of Arsi zone. It is located at about 175 km Southeast of Addis Ababa at 7°57′N and 39°7′E with

an altitude of 2430 meters above sea level. Dairy farming using improved breeds is a common practice in urban and peri-urban areas (KARC, 2008).

Bishoftu is located at 45 km along the South East of Addis Ababa, the capital city of Ethiopia at 9°N latitude and 40°E longitude and at 1850 meters above sea level. The annual rainfall is 866 mm, of which 84% are in the long rainy season from June to September. The annual average temperature ranges from 12.3°C to 27.7°C with an overall average of 18.7°C (NMSA, 2010).

Holetta is among the places that are known to be potentially high for dairy production, located between 38.5° E longitude and 9.8° N latitude and an elevation of 2400 meters above sea level. It is situated in the central highlands of Ethiopia. The average annual rainfall and temperature is about 1200 mm and 18°C and the average monthly relative humidity is 60% (Million *et al*. 2010).

Sululta district is one of the six districts of Oromia Special Zone Surrounding Finfinne of Oromia National Regional State. The district's capital town, Chancho, is 40 kms away from Addis Ababa towards the North-west. It lies on the geographical coordinates of 9°11′0″ N latitude, 38° 45′0″ E longitude and with an elevation of 2500 meters above sea level. The average annual temperature in Sululta is 14.7°C with an average rainfall of 1119 mm (SDAO, 2012).

Study design, sampling procedures and sample size determination

A cross-sectional study involving purposive selection of study areas, but a random selection of dairy farms from the urban and peri-urban (around the towns) were conducted. The study areas were purposively selected as they have high potential of dairy production. The sampling frame of Kebles and dairy farms were obtained from respective district livestock and agriculture development offices. Depending on the frame lists and information obtained, two Kebles from each production system were purposively selected based on the availability of crossbred dairy animals and dairy production experiences. Dairy farms were then randomly selected from each Keble and questioned about their farm information. Before the actual survey, a pre-test survey was conducted to collect general background information about the areas.

The sample size was determined based on the formula given by Arsham (2007) for survey studies:

$$N = 0.25/SE$$

Where,

N= Sample size; SE= Standard error. Accordingly, by considering a standard error of 3.95% with 95% CI as follows, $N = 0.25/(0.0395)^2 = 160$; A total of 160 dairy farms were selected.

Data collection

A comprehensive open-ended and close-ended type semi-structured questionnaire was prepared and used to collect farm information. The collected data during the actual interview were supported by farm observations, including records and discussions. Information about average daily milk yield and reproductive performances of crossbred dairy cows in urban and peri-urban dairy production systems were collected. Additional information about the occurrence of reproductive health problems and veterinary service providers in the areas were also gathered. Milk yield was the only assessed productive parameter because describing lactation length, lactation milk yield and lactation length using survey data could lead to biased information. The reproductive parameters mainly addressed were age at first service, age at first calving, number of services per conception, calving to conception interval and calving interval of crossbred dairy cattle.

Data analysis

The collected survey data were analyzed using Statistical Package for the Social Sciences (SPSS, 2011) version 20. Descriptive statistics cross-tabulation such as percentage and mean with standard deviation were used to present the results.

RESULTS AND DISCUSSION

Milk yield

The average daily milk yield of crossbred dairy cows was higher in Bishoftu, urban Sululta, Holetta and urban Assela. Relatively lower daily milk yield was reported in peri-urban Assela and Sululta (Table 1). The lower milk yield in peri-urban areas might be due to differences in management practices and feed availability problems. The 8.5 liters average daily milk yield in peri-urban Sululta in the present study was similar with Belay *et al*. (2012) who reported 8.52 liters/day/cow for crossbred dairy cows in Jimma town. The current average milk yield per cow was slightly lower than Nigusu and Yoseph (2014) who found 14.1 liters/day/cow in urban and secondary town dairy production systems in Adama milk shed. This difference could be resulted from lack of proper feeding, housing and other management practices. The current average milk yield reported in urban (11.7 liters) and peri-urban (11.2 liters) Bishoftu was similar to the average daily milk yield of 11.6 liters for crossbred dairy cows with >50% blood levels in Bishoftu town (Dessalegn *et al*. 2016).

Reproductive performances of crossbred dairy cattle

Age at first service (AFS)

The mean age at first service of dairy heifers was shorter in urban and peri-urban Bishoftu town followed by urban Assela, peri-urban and urban Holetta. The longer age at first service was in urban Sululta, peri-urban Sululta and Assela (Table 1). In the present study, the age at first service in urban and peri-urban areas ranges from 18.8 to 29.3 months. Under small scale dairy production in urban and per-urban areas in Gondar, Nibret (2012) reported an overall mean AFS of 15.4 months for crossbred dairy cows which was lower than the current results. The variation could be related to breed and management differences. However, the AFS in urban and peri-urban Sululta of this study was in line with Belay *et al.* (2012) in Jimma town who stated age

at first service of 24.30±8.01 for crossbred dairy cows. The average age at first service in urban (18.2 months) and peri-urban (19.1 months) Bishoftu of the current study were also consistent with Dessalegn *et al*. (2016) who revealed average AFS of 18.7 months for crossbred heifers in Bishoftu and Akaki towns.

Age at first calving (AFC)

As indicated in Table 1, in the current study the shorter average age at first calving was reported in Bishoftu followed by Holetta and urban Assela, respectively. But the average age at first calving was longer in urban and peri-urban Sululta as well as peri-urban Assel. In urban and peri-urban Sululta as well as peri-urban Assela of the present study, the average age at first calving (AFC) were 34.4, 34.9 and 38.3 months, respectively. Comparable to these results, Hunduma (2012) in Assela and Mandefot (2017) in and around Wolaita Sodo town reported age at first calving of 34.8±4 and 37.5±0.6 months for crossbred dairy cows. Dessalegn *et al*. (2016) reported that the mean±SD age at first calving (AFC) for crossbred dairy cattle in Bishoftu and Akaki were 27.0±3.7 and 26.9±5.4 months, respectively, which were similar with the current results in urban and peri-urban Bishoftu town.

Number of services per conception (NSC)

In this study, the average numbers of services per conception were higher for peri-urban and urban Bishoftu, peri-urban Holetta, peri-urban Sululta and urban Holetta. Lower number of services per conception were recorded in urban Sululta, peri-urban and urban Assela, respectively (Table 1). The relatively higher number of services per conception might be attributed to the improper time of insemination, quality of semen, the skill of the inseminator and cows related factors which could affect the success rate of insemination. Nuraddis *et al*. (2011) reported mean NSC of 1.29 for crossbred dairy cows in North Gondar town which was comparable to the number of services per conception in peri-urban Assela and urban Sululta of the current study. The numbers of services per conception of 1.6 reported by Belayneh (2012) for Holstein crossbred dairy cows in North Shewa Zone was also similar with the current NSC in peri-urban Holetta and Sululta as well as urban Bishoftu areas.

Calving to conception interval (CCI)

The interval from calving to conception was shorter in urban Holetta, urban Bishoftu and peri-urban Holetta than urban Sululta, urban Assela, peri-urban Bishoftu, Sululta and Assela, respectively. The calving to conception interval in peri-urban Assela was longer than the other areas (Table 1). The average 101.5 to 136.6 days calving to conception intervals in the current study of all the study sites was longer than the CCI of 85.6 days (Hunduma, 2012) from Asella town and the 93.11 days (Niraj *et al*. 2014) from Gondar town. Zewdie *et al*. (2011) reported days open of as long as 197 days and 194 days in Debre-berhan and Sebeta, respectively and was inagreement with the higher calving to conception interval from peri-urban Assela of the present study. The differences could be attributed to poor and inadequate nutrition, genetic variations, poor heat expression and detection and other management variations.

Calving interval (CI)

In the present study, the calving interval in months was relatively shorter in urban Bishoftu, urban and peri-urban Holetta and urban Sululta. But it was relatively longer in urban Assela, peri-urban Sululta, Assela and Bishoftu (Table 1). The current calving intervals from urban Holetta, urban Bishoftu and urban Sululta were comparable with the calving intervals of crossbred dairy cows reported in Bishoftu and Akaki towns which were 13.0±2.1 and 13.8±1.9 months (Dessalegn *et al*. 2016). However, study from North Showa indicated that crossbreds of unknown exotic inheritance have a calving interval of 660 days (Mulugeta and Belayneh, 2013) which was higher than the current results. The differences might be attributed to poor nutrition and management practices, breed type, longer days open, poor breeding system and disease.

Table 1: Average daily milk yield and reproductive performances (Mean±SD) of crossbred dairy cows.

Variables	Study areas							
	Assela		Bishoftu		Holetta		Sululta	
	U	PU	U	PU	U	PU	U	PU
	n=20	n=20	n=20	n=20	n=20	n=20	n=20	n=20
ADMY, liters/day	9.3±4.4	7.8±4.3	11.7±2.8	11.2±1.8	10.4±2.6	10.5±2.2	10.8±3.7	8.5±2.3
	n=19	n=10	n=20	n=20	n=20	n=20	n=20	n=17
AFS, months	21.6±4.9	29.3±10.9	18.8±2.2	19.1±5.3	21.9±6.1	21.8±5.4	25.4±7.1	25.9±7.2
AFC, months	30.6±4.9	38.3±10.9	27.8±2.2	28.1±5.3	30.5±6.2	30.5±5.4	34.4±7.1	34.9±7.2
	n=19	n=20	n=20	n=20	n=20	n=20	n=20	n=20
NSC	1.4±0.6	1.3±0.4	1.65±0.5	1.85±0.61	1.5±0.6	1.6±0.61	1.3±0.3	1.6±0.5
	n=18	n=18	n=20	n=20	n=20	n=20	n=20	n=18
CCI, days	127.5±36.7	168.0±78. 1	107.6±27.3	128.3±42.4	101.5±26.4	108.6±25.5	123.2±39.3	136.6±64.2
CI, months	13.7±1.3	14.9±3.1	12.9±0.8	13.6±4.4	12.7±1.1	13.0±1.0	13.3±1.1	13.9±2.0

N = Number of respondents; U= Urban; PU= Peri-urban; ADMY= Average daily milk yield; AFS= Age at first service; AFC= Age at first calving; NSC= Number of services per conception; CCI= Calving to conception interval; CI= Calving interval.

Table 2: Dairy cattle reproductive health problems and veterinary services providers.

Variables (%)		Study areas							
		Assela		Bishoftu		Holetta		Sululta	
		U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20	U n=20	PU n=20
Occurrence of Reproductive Problem	Yes	45	45	95	70	70	90	40	50
	No	55	55	5	30	30	10	60	50
	Overall	100	100	100	100	100	100	100	100
Source of Veterinary Services	Government	35	10	0.0	0.0	85	45	35	65
	Private	50	90	100	95	5	35	60	15
	Both government and private	15	0.0	0.0	5	10	20	5	20
	Overall	100	100	100	100	100	100	100	100

N= Number of respondents; U= Urban; PU= Peri-urban.

Reproductive health problems and source of veterinary services

The majority of the respondents in Bishoftu, Holetta and peri-urban Sululta stated the occurrence of reproductive health problems in their dairy farms. The respondents in urban Holetta and peri-urban Sululta mentioned that government veterinary clinics were the main source of veterinary drugs and services. However, dairy farmers in urban and peri-urban Bishoftu, Assela, urban Sululta and Assela got veterinary drugs and services from private clinics (Table 2). Retrospective study in central Ethiopia by Hadush *et al*. (2013) showed 44.3% of the cows had major prepartum and post-partum reproductive problems which were consistent with the occurrence of reproductive health problems reported in Assela and urban Sululta but lower than the other areas of the present study. The variations could be attributed to malnutrition and management system related factors.

Comparable to this result, the questionnaire survey as well as group discussions reported by Tariku *et al*. (2015) in Ada'a district showed that veterinary service providers were classified into public and private. Private veterinary clinics were the main veterinary service providers in urban and peri-urban Bishoftu, peri-urban Assela and urban Sululta areas of the present study. However, not in line with a study done by Girma (2008), who reported that public veterinary service was–the main veterinary service provider in the peri-urban and rural areas of Ada'a district while the urban areas receive veterinary service mainly from private veterinary service providers.

CONCLUSION

Overall, the better average daily milk yield was in Bishoftu, Holetta and urban Sululta dairy farms. The shortest and longest age at first service of dairy heifers was in Bishoftu and peri-urban Assela. The number of services per conception was greater in Bishoftu than other areas. Additionally, calving to conception interval was *longer* in peri-urban Assela. The occurrences of reproductive health problems and private veterinary service providers were stated in most of the study areas. It could be concluded that the average daily milk yield of crossbred dairy cattle in the study areas was lower than that indicated in some literature and as well the key reproductive indicators were longer.

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