

EVALUATION OF THE REPRODUCTIVE PERFORMANCE OF CROSSBRED (HF X ZEBU) DAIRY COWS IN URBAN AND PERI-URBAN DAIRY SYSTEM IN ADIGRAT, NORTHERN ETHIOPIA

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Abstract: This investigation was conducted to evaluate the reproductive performance of cross bred (HF x zebu) dairy cows in urban and peri-urban areas of Adigrat, North Ethiopia. The study involved retrospective study. All pertinent retrospective data covering the period 2010 to 2013 were collected from record books of Adigrat AI center for the analysis. Mean age at first service of urban and peri-urban production systems were 24.4 ± 0.26 and 26.5 ± 0.32 months, respectively and total value was averagely found as 25.5 ± 0.21 months. The longer value was registered in peri-urban area. In addition, 4.2 months extended age at first service was observed in the year 2010 over the year 2013. Mean age at first calving of urban and peri-urban areas were found 33.9 ± 0.26 and 35.6 ± 0.32 months, respectively and the overall mean value was met as 34.8 ± 0.21 months. Production system and year had shown effect ($p < 0.05$) on age at first calving. The highest and lowest results were registered in 2010 and 2013 in their order. Mean inter service interval of urban and peri-urban was found 24.7 ± 0.40 and 26.0 ± 0.39 days, respectively. The overall mean value of inter service interval was 25.4 ± 0.28 days. Production system and year had also shown difference ($p < 0.05$) on inter service interval. Therefore, crossbred dairy cows in urban area had better reproductive performance than peri-urban production system. Moreover, progressive trend in reproductive performance was observed over the study period.

Keywords: Crossbred dairy cows, Reproductive efficiency, Reproductive performances.

Introduction: Ethiopia possesses the largest livestock population compared to any other country in Africa [11]. Livestock, especially, cattle are one of the important sources of livelihood for most producers though, the dairy industry is not developed like east African countries such as Kenya, Uganda and Tanzania. The contribution of livestock production to the farmers' income is up to 80% [2]. Cattle population of Ethiopia is about 53.9 million of which about 98.95 % is local breeds while the rest are improved dairy breeds [8].

Livestock resources of the country are characterized by remarkable power of heat tolerance, resistance to parasites, disease and withstand most environmental stress and able to produce as well as reproduce under harsh tropical environment [1]. However, they have low genetic potential for their functional traits [6]. On the other hand, there is an increasing demand for dairy products mainly due to rapid population growth (3% annually), increased urbanization and expected income growth [16]. Similarly, in urban and peri-urban areas of Tigray region in general and around Adigrat area in particular, the demand and consumption of milk and milk products is extremely high as a result of fast urbanization, establishment of several public and non-governmental institutions and high consumption rate. To curve this demand, crossbreeding of indigenous animals with improved exotic breeds has been introduced for more than 5 decades to increase milk production and thereby meet the increased demand for dairy products in Ethiopia [19].

Currently, the government of Ethiopia together with NGOs are making various efforts to improve dairy productivity through breed improvement programs using synchronization and artificial insemination, conventional artificial insemination (AI), provision of bull services with improved dairy bulls and distribution of crossbred F₁ heifers particularly to the smallholder dairy farmers found in urban and peri-urban areas of the country where the demand for dairy products is high. As a result, quite significant number of crossbred (Holstein Frisian × zebu) dairy cows has been distributed to farmers across all over the country in general and in urban and peri-urban areas of Adigrat in particular. Despite the distribution of crossbred dairy cows to the study area, there are limited and not well organized systematic studies conducted to assess the reproductive efficiency of crossbred dairy cows in urban and peri-urban area of Adigrat area. It is the need of the hour to generate relevant information on the reproductive performance of dairy cows (crossbred) which is instrumental for the profitability of dairy production. Thus, the primary aim of this investigation was to assess the reproductive performance of cross bred dairy cows in urban and peri-urban areas of Adigrat, Tigray, Ethiopia

Description of Study Area: The study has been conducted in urban and peri-urban areas of Adigrat, Tigray, Ethiopia. Adigrat is located at 14.20° North latitude and 39.29° East longitude. It is found at a distance of about 898 Km North of Addis Ababa, the capital city of Ethiopia and 125 km north of Mekelle city which is the capital of Tigray Region and is on

the main road to Wukro, Adwa and Axum towns. Adigrat is the administrative town of Eastern Zone of Tigray and Ganta-Afeshum Wereda. The town is enclosed by G/Afeshum rural wereda. Adigrat town receives mean annual rainfall of 500 to 600 mm where most of it occurs from mid-June to August. The annual temperature of the town ranges from 18 to 20°C. The town is within the Woina-Dega Zone where the altitude ranges from 1500 - 2500 m.a.s.l [7]. Adigrat is one of the biggest towns with high potential for milk production and consumption in the northern part of the country. There are different factors which put pressure for increased milk production and consumption in the study area like high population density which is estimated to be 86,094 with annual population growth rate of 4.6%, availability of many public institutions like Adigrat University, Colleges, different factories and military camps, relatively advanced and long lasted Artificial insemination (AI) and well organized veterinary service delivery systems and also the establishment of Wolwalo and Enderta union commercial animal feed processing plants in Adigrat town and Mekelle city respectively.

Sampling Technique and data collection: Adigrat area was selected purposively based on the existence of long lasted artificial insemination and veterinary services and population of crossbred dairy cows. The study area was further stratified in to urban and peri-urban dairy production systems. In this study, peri-urban dairying refers to the production systems located at the outskirts of the town at approximately 15 km radius from the municipality boundary of the city. Whereas, urban refer to keeping of dairy cows within the city/town. All pertinent retrospective data required for the analysis of reproductive performances in both urban and peri-urban production systems were taken from AI certificates and inseminator's record books of Adigrat AI service center as this is the only center for both production systems.

The study covered all retrospective data recorded from 2010 up to 2013. Meanwhile, only cows with complete information and their blood level ranged from 50-75% were included in the analysis. The parameters estimated in the current study were defined as follows:

- Age at first service (AFS) where (n=1000) was calculated as the number of days from birth to the date of first service
- Age at first calving (AFC) (n=1000) was determined by the number of days from birth to the date of first calving
- Inter service interval (ISI) (n=1000) was defined as the number of days between two successive

services through lactation of cow with repeated services.

Statistical Analysis: Data collected from the study area has been analysed using the General Linear Model procedure of SAS [21]. Means were compared using Turkey's adjustment. Model for analysis of reproductive efficiency parameters was, $y_{ij} = \mu + F_i + Y_{j+e_{ij}}$

Results and Discussion: Reproductive Performance of Crossbred Dairy Cows:

Age at first service (AFS): Age at first service (AFS) is age at which heifers attain body condition and sexual maturity for accepting service for the first time [18]. The least square mean (\pm se) age at first service of dairy cows in urban and peri-urban areas of Adigrat were 25.5 \pm 0.21 and 23.6 \pm 0.51 months, respectively (Table 1). This result is in agreement with the values of 24.30 \pm 8.01 months in Jimma reported by [22] and 24.9 \pm 3.8 in Asella reported by [13]. It is also in line with [14] in Mekelle, Ethiopia who reported 25.2 \pm 1.1 months.

Table 1: Average ages at first service of crossbred (HFX Zebu) dairy cows in Adigrat Area, North Ethiopia (LSM \pm SE)

Variables	N	AFS (months)
Overall mean	1000	25.5 \pm 0.21
Effect of production system		*
Urban	500	24.4 \pm 0.26b
Peri-urban	500	26.5 \pm 0.32a
Effect of year		
2010	250	27.8 \pm 0.37 ^a
2011	250	25.9 \pm 0.42 ^b
2012	250	24.5 \pm 0.43 ^{bc}
2013	250	23.6 \pm 0.38 ^c

a-c means in the same column for the same effect with different superscripts are Significantly different ($p < 0.05$); SE=Standard Error.

Age at first service for crossbreds (HFXZebu) was significantly ($p < 0.05$) affected by production system where cows in peri-urban area had longer age at first service than those in urban (longer by 2.1month). This could be attributed to better nutrition in the latter than former production system since dairy cows in urban were supplemented with agro-industrial by products. In consistent with the present findings, [20] reported that well-fed heifers grow faster, served and conceive earlier as compared to their contemporaries managed poorly. Similarly, [4] reported that age at first service was longer for crossbred cows in peri-urban areas than in urban areas. The analysis of variance also showed that age at first service was significantly ($p < 0.05$) influenced by year of birth (Table 1). Age at first service was shorter for heifers born in the year 2013 than those in 2010.

The variation could be attributed to progressive change in herd management such as improved feeding, housing, health, accuracy of heat detection and reproductive management during the latter than earlier years. Heifers need to be fed adequately for better growth performance, early initiation of estrus and younger age at first service and calving. Different factors contributed for delayed age at first service such as environmental factors, nutrition which determines pre-pubertal growth rates, reproductive organ development and onset of puberty and subsequent fertility [9]. Evidences shows that dietary supplementation of heifers during their young age will reduce the interval from birth to first services [5] probably because heifers that grow faster cycle earlier and permit easier estrus detection.

Age at first calving (AFC): Age at first calving (AFC) is the age at which heifers calve for the first time [18]. The overall mean of age at first calving was 34.8 ± 0.21 month (Table 2). This is low as compared to 39.6 ± 0.4 value reported by [4] for the same breed in Eastern Zone of Tigray. On the other hand, the mean age at first calving obtained in the current study is higher than 29.3 months as reported by [3] for Tunisian Holstein Friesian cows and 27.2 months reported by [17] for HF cows in Pakistan. Production system had significant ($p < 0.05$) effect on age at first calving in the study area. Dairy heifers in urban production system had shorter age at first calving than those in peri-urban. This could probably be due to the difference in management and feeding systems between urban and peri-urban production systems. It has been well documented that dietary supplementation of heifers during their growth will reduce the interval from birth to age at first calving [5]. In the current study, the effect of year was apparent ($p < 0.05$) where cows calved during the year 2010 had longer age at first calving than those calved during the other years; which, however, cows calved in the year 2013 had shorter age at first calving. The variation could be attributed to change in herd management and awareness of households in nutritional management of dairy cows. According to [12], the reduction in age at first calving will decrease the raising costs and shorten the generation interval and subsequently step-up the number of lactations per head.

Table 2. Average age at first calving of crossbred (HFXZebu) dairy cows in Adigrat Area, North Ethiopia (LSM \pm SE)

Variables	N	AFC (months)
Overall mean	1000	34.8 ± 0.21
Effect of production system		*

Urban	500	33.9 ± 0.26^b
Peri-urban	500	35.6 ± 0.32^a
Effect of year		
2010	250	37.0 ± 0.38^a
2011	250	35.1 ± 0.43^b
2012	250	33.9 ± 0.44^{bc}
2013	250	33.0 ± 0.38^c

^{a,c} means in the same column with different superscripts are significantly different ($P < 0.05$); Means with the same superscript are not significantly different ($P > 0.05$).

Inter service interval (ISI): Inter service interval (ISI) is the interval of days between two successive services. Inter-service interval helps in evaluating estrous detection efficiency and an embryonic mortality. The estrus cycle has been defined as the time interval between the beginnings of one estrus to the onset of subsequent estrus [23]. The overall mean inter service interval (ISI) for Holeistain Friesian crossbred dairy cows with repeated breeding was 25.4 ± 0.28 days (Table 3). The value was shorter than 39.8 and 27.8 days reported by [15] and [4] for crossbred (HFXZebu) cows in and around Arsi-Negelle and Eastern Zone of Tigray, Ethiopia, respectively. In this study the percentage of cows within 18-24 days inter service interval was 56.9 %, which was less than 60% recommended by [10]. Year and production system exerted significant ($p < 0.05$) on inter-service interval in the study area. Longer inter-service interval was observed in the years 2010 and 2012, which might be due to lack of awareness of beneficiaries on proper heat detection, lack of AI technicians, inappropriate feeding, health and overall management in 2010 compared to 2013. Whereas the unexpected longer inter-service interval for the year 2012 in the study area could be due to the shift from conventional AI to estrus synchronization and mass AI (OSMAI) program implemented in the entire region during the period. Since the implementation modality of the program requires campaign, less attention was given for conventional AI service. This resulted in lack of proper time of insemination, communication gap between AI technicians and producers, lack of service on weekends and holidays. Production system had also significant ($p < 0.05$) effect on inter-service interval where animals in peri-urban production system had longer inter-service interval than those in urban. This might be due to differences in feeding and management.

Table 3: Average Inter service interval of crossbred (HFXZebu) dairy cows in Adigrat area, North Ethiopia (LSM \pm SE)

Variables	N	ISI Days)
Overall mean	1000	25.4 ± 0.28
Effect of production system		*

system		
Urban	500	24.7±0.40 ^b
Peri-urban	500	26.0±0.39 ^a
Effect of year		*
2010	250	27.2±0.65 ^a
2011	250	24.8±0.48 ^b
2012	250	25.6±0.54 ^{ab}
2013	250	23.8±0.52 ^c

^{a,c} means in the same column with different superscripts are significantly different ($P < 0.05$); Means with the same superscript are not significantly different ($P > 0.05$).

Se=Standard error, ns= non-significant

Conclusion: Document Modification From the findings of the current study, the reproductive performance and efficiency of reproduction of crossbred dairy cows in urban production system of Adigrat area is better advanced as compared to peri-urban production system. Year had also shown

significant effect on the reproductive parameters of age at first service, age at first calving and inter-service in the study field. This suggested that, there is an overall progressive improvement on crossbred dairy management and feeding practices from time to time. The variation between the production systems shows there is an opportunity for further improvement with strategic management and improved feeding system.

Recommendation: From view of the above conclusion, since most reproductive traits have a low heritability, it is evident that most progress can be achieved by paying more attention to management factors, especially improving the level of nutrition, estrus detection efficiency, record keeping and animal health care by ensuring a sustainable extension service to bridge the existing gaps so as to improve the reproductive performance of crossbred dairy cows in urban and peri-urban areas of Adigrat.

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