

# Reproductive Efficiency of Crossbred (HF x Zebu) Dairy Cows under Artificial Insemination Service in Eastern Zone of Tigray, Northern Ethiopia

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**Abstract**—The current study was carried out to investigate the reproductive efficiency of cross bred (HF x zebu) dairy cows in urban and peri-urban areas of Adigrat, North Ethiopia. For this purpose, four years (2010 up to 2013) relevant retrospective data documented in Adigrat AI center were taken for the analysis. Overall mean values of number of service per conception (NSPC), conception rate to first service (CRFS) and calving rate (CR) of urban and peri-urban areas of Adigrat were  $1.67 \pm 0.04\%$ ,  $64.6 \pm 1.06\%$  and  $54.8 \pm 1.35\%$  respectively. Production system and year had shown significant effect ( $p < 0.05$ ) on number of service per conception (NSPC). Lowest values ( $1.60 \pm 0.04\%$ ) and ( $1.58 \pm 0.07\%$ ) were recorded in urban production system in the period of 2013 respectively. On the other hand, Year and season had shown apparent ( $p < 0.05$ ) effect on conception rate to first service (CRFS) and calving rate (CR). The highest values ( $69.0 \pm 0.68\%$ ) and ( $66.8 \pm 0.86\%$ ) of conception rate to first service (CRFS) were recognized in the period of 2013 and during the rainy season in order. Moreover, better value of calving rate (CR) was obtained in the year 2013 ( $60.2 \pm 1.40\%$ ) and during rainy season ( $57.3 \pm 1.77\%$ ). Positive improvement was recognized along the study periods and during rainy season too. Hence, mean value of number of service per conception and conception rate at first service of Adigrat area was found within the recommended values for profitable dairy cows. Whereas, mean value of calving rate was found below 63.4-76.9% as reported for crossbred dairy cows in different parts of the country.

**Keywords:** AI center, AI service, crossbred dairy cows, Reproductive efficiency

## 1. INTRODUCTION

Ethiopia is categorized first among the sub-sahara African countries and one of the largest in the world in livestock population. Cattle population of Ethiopia is about 53.9 million, of which about 98.95% are local breeds and 1.05% improved dairy breeds [8]. According to [1], the remarkable power of heat tolerance, resistance to parasites and withstanding most environmental stress and able to produce as well as reproduce under harsh tropical environment are the distinctive characters of Ethiopian livestock resources. Despite this desirable quality,

the reproductive and productivity potential remains marginal, due to low genetic potential for their functional traits [4] and coupled with poor husbandry and low nutritional management. On the other hand, a rapid population growth (3% annually), increased urbanization and expected income growth [15] in the country accelerated the gap between demand and supply for dairy products. The gap in demand and supply for milk and milk products is extremely high in urban and peri-urban areas of the country in general and in urban and peri-urban areas of Adigrat in particular. To narrow the existing gap, efforts have been made on crossbreeding of indigenous animals with improved exotic breeds through Artificial insemination, bull services and by introducing Holstein Frisian dairy cows so as to increase milk production and thereby meet the increased demand for dairy products in the country [18]. As a result, significant numbers of dairy producers have been shifted towards crossbred (HF × Zebu) dairy cows all over the country in general and in urban and peri-urban areas of Adigrat in particular. Even though the number of crossbred dairy cows in the study area has been increasing from time to time, no studies have been conducted to investigate the current efficiency of reproductive parameters of crossbred dairy cows in Adigrat area. Therefore, the current research was initiated with the objective of assessing the reproductive efficiency of cross bred (HF x Zebu) dairy cows under artificial insemination services in urban and peri-urban areas of Adigrat, Northern Ethiopia

## 2. MATERIAL AND METHODS

### 2.1. Description of Study Area

This study was done in urban and peri-urban areas of Adigrat, Eastern zone of Tigray, Ethiopia. Adigrat is found at 898 km far towards North of Addis Ababa, the capital city of Ethiopia and 125 km north of Mekelle city. Adigrat is the administrative town of Eastern Zone of Tigray and Ganta-

Afeshum district. Adigrat is located at 14.20° North latitude and 39.29° East longitude. The town is surrounded by G/Afeshum woreda with mean annual rainfall of 500 to 600 mm where most of it occurs from mid-June to August and the altitude ranges from 1500 - 2500 m.a.s.l. The annual temperature of the town is also ranges from 18 to 20°C [7].

**2.1.1 Sampling technique and data collection**

Adigrat area was purposively selected due to the existence of high population of crossbred dairy cows, relatively well established artificial insemination and veterinary services. Dairy production systems of the study area was further stratified in to urban and peri-urban where 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 and urban refer to keeping of dairy cows within the city/town. Relevant retrospective data required for the analysis were taken from Adigrat AI service center for both production systems as it is the only center for both urban and peri urban production systems. Retrospective data regarding the parameters covered the periods from 2010 up to 2013. The cows whose exotic blood level ranged from 50-75% were included in the analysis. The parameters estimated in the current study were defined as follows:

1. Conception rate at first service (CRFS) (n=2486) was calculated through impelling the percentage of cows/heifers that become pregnant at the first insemination after calving. Cows that become pregnant by the first service designated were reported as 100% CRFS, whereas, cows required more than one service became pregnant 0% CRFS.
2. Number of services per conception (NSPC) (n=4048 inseminations u=1915 and peri-urban=2133) is the number of services be it natural or artificial required for successful conception. Only cows that conceived and confirmed were considered.
3. Calving rate (CR) (n=1362 births) was determined as number of calf born per cow per year

**2.1.1 Statistical Analysis**

General linear model procedure of [19] was used for analysing the data collected from the study area and means were compared using Turkey’s adjustment.

**3. RESULTS AND DISCUSSION**

**3.1. Reproductive performance of crossbred dairy cows**

**a) Number of service per conception (NSPC)**

The number of services per conception (NSPC) is the number of services (natural or artificial), required for successful conception. The optimum recommended number of services per conception for profitable dairy cows ranges from 1-1.7 [10]. The overall mean number of services per conception of crossbred dairy cows in the study area was 1.67±0.04% (Table 1). The finding was consistent with the values 1.6-1.67% reported for the same breed in different part of the country by different authors [6], [17]. However, it was lower than 1.74-2.2% reported for similar breed in Ethiopia [3], [12] and [9]. This study showed that number of services per conception was influenced (p<0.05) by production system where it was higher for peri-urban compared to urban dairy system. This could be due to the reason that urban beneficiaries had better awareness and skills on proper heat detection, better access for AI and better nutritional management. On the other hand, year had shown significant (P<0.05) effect on number of services per conception in the study area. Highest number of services per conception was recorded in the year 2012 as compared to earlier and latter service years. This might be due to the shift from conventional AI service to estrus synchronization and mass AI program implemented in the entire region during the study 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. Season had not shown significant effect (P>0.05) on number of service per conception.

**Table 1: Average number of service per conception of crossbred dairy cows in Adigrat, Northern Ethiopia**

Variables	NSPC (n=4153 inseminations)
Overall mean	1.67± 0.04
Effect of production system	*
Urban	1.60±0.04 <sup>b</sup>
Peri-urban	1.73±0.04 <sup>a</sup>
Effect of year	*
2010	1.72±0.09 <sup>a</sup>
2011	1.62±0.05 <sup>ba</sup>
2012	1.75±0.05 <sup>a</sup>
2013	1.58 ± 0.07 <sup>b</sup>
Effect of season	Ns
Dry season	1.72±0.04
Rainy season	1.59±0.06

NSPC = number of service per conception; \*= significant difference

**b) Conception rate to first service (CRFS)**

As [14] reported, the conception rate to first service (CRFS) is the ratio of animals confirmed pregnant at the first service to the number of cows bred. Conception rate to first service provides a useful figure of the conception rate for a herd. The overall mean conception rate to first service of this study was 64.6±1.06 per cent (Table 2).

**Table 2: Average conception rate to first service (CRFS) of crossbred (HFxZebu) dairy cows in Adigrat, Northern Ethiopia**

Variables		CRFS
Overall mean	N=2486	64.6±1.06%
Effect of production system		Ns
Urban (n=1198)		65.3±1.33
Peri-urban (n=1288)		64±1.71
Effect of year		*
2010		61.3±2.05 <sup>b</sup>
2011		65.7±1.82 <sup>ab</sup>
2012		62.4±1.54 <sup>b</sup>
2013		69.0±0.68 <sup>a</sup>
Effect of season on CRFS		*
Rainy season		66.8±0.86 <sup>a</sup>
Dry season		62.5±1.66 <sup>b</sup>

Ns = not significant; N= Number of observation

This result was in consistent with the conception rate of 65% reported by [13] and 61.7% reported by [5] for oestrus synchronized cows in Adigrat and Mekelle milk shed. But it was higher than 58.6% and 54.15% reported for the same breed in urban and rural areas of Adami Tullu and North Gondar Zone, respectively [12]. The value of conception rate at first service of the current study was higher than that of [2] and [9] who reported 41.6% in Iran and 45.9% in eastern lowlands of Ethiopia, respectively. This result was even better than the recommended value 45-60% [11] indicating that there was better access and efficiency of AI service, relatively improved feeding and management practices, in the study area. In the study, production systems did not show significant ( $P>0.05$ ) difference in conception rate at first service. On the other hand, year had significant ( $P<0.05$ ) effect on conception rate at first service. High conception rate to first service was found in the years 2013 and 2011. Whereas, lower conception rate at first service were recognized during the years 2010 and 2012. This might be due to an increased awareness in improved animal feeding, heat detection, access to AI service and overall management for reproductive improvement of dairy cows. With the special case, in the year 2012, lower conception rate at first service was observed was due to the shortage of AI technicians for on time inseminations as the AI technicians were engaged on the new program known as synchronization in and out of their premises. This result indicated us to what extent AI technicians play role in enhancing reproductive efficiency of dairy animals. Season had also shown significant ( $P<0.05$ ) effect on conception rate at first service (Table 2). Better value of conception rate at first service was registered in rainy season as compared to dry season indicating that, nutrition was not a problem in the rainy season. Therefore, supplementation is necessary during other seasons of the year.

### c) Calving rate (CR)

According to [15], Calving rate was defined as the number of calves born per 100 services and is the most appropriate measure of fertility. The overall annual mean calving rate in the current study was 54.8±1.2% (Table 3). [9], [12] had reported higher results to the present investigation 63.4 to 76.9% for crossbred dairy cows in different parts of the country. The main reason behind low annual calving rate was due to the fact that there was high tendency of selling pregnant dairy cows and heifers in the study area owing to the encouraging high price for pregnant animals. Moreover, poor follow up and profiling of calved cows and heifers, abortion and stillbirth could have also contributed to low calving rate.

**Table 3: Mean annual calving rate of crossbred dairy cows in Adigrat, Northern Ethiopia**

Variables	Calving rate (n=1362 births)
Overall mean	54.8±1.35
Effect of production system	Ns
urban	55.1±2.39
peri-urban	54.6±1.66
Effect of year	*
2010	50.8±0.05 <sup>b</sup>
2011	55±0.50 <sup>b</sup>
2012	53.4±1.05 <sup>b</sup>
2013	60.2±1.40 <sup>a</sup>
Effect of season	*
Dry season	52.4±1.14 <sup>b</sup>
Rainy season	57.3±1.77 <sup>a</sup>

Ns = not significant; n= Number of observation

The present study also showed that year had significant ( $p<0.05$ ) effect on annual calving rate where it was higher during the year 2013 compared to earlier years. This could be the result of change in management over the years. However, calving rate was not influenced ( $p>0.05$ ) by the production system. On the other hand season had shown significant ( $p<0.05$ ) effect on calving rate whereby, better result was observed in the rainy season (Table 3). This might be due to availability of better feed, water and climatic condition during the rainy season as compared to dry season.

## 4. CONCLUSION

It can be concluded that number of service per conception and conception rate at first service for crossbred dairy cows in urban and peri-urban areas of Adigrat was found to be within the recommended values for profitable dairy cows. Whereas, mean value of calving rate of Adigrat area was found to be below the average values reported for crossbred dairy cows in different parts of the country. On the other hand, conception rate at first service and calving rate was found better during rainy season compared to dry season and there was positive progress during the study period. This might be due to an increased in awareness and skill on heat detection, better

access to AI technician/service, improvement in dairy management and access to green fodder during rainy season may have attributed to the improved fertility in the study area

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