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# Evaluating the Efficiency of Artificial Insemination Following Estrus Synchronization of Dairy Cattle in Southern Region, Ethiopia: The Case of Dale District

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**Abstract**
The aim of this study was to determine the success rate of artificial insemination following oestrus synchronization and determining associated factors on pregnancy rate of cows/heifers in Southern Ethiopia. A sum of 171 cows/heifers was synchronized with PGF2α.and as a result 97.7% synchronization rate was obtained. All sampled cows inseminated at standing estrus using frozen semen of Holstein Frisian. Pregnancy diagnosis was carried out at day 90 post AI by rectal palpation and a pregnancy rate of 60.4% was obtained. The average number of services per conception was 1.75. The optimum conception observed among the cows inseminating between 9 to 14 hours (71.6%) after the onset of estrus. Cows/heifers with body condition score (BCS) 6 showed higher ($P<0.05$) pregnancy rate when compared to BCS of 5.5 and 5. Similarly, cows/heifers with BCS of 4.5 had lower conception rate. Cows aged 5 to 7 and 3 to 4 had comparable high pregnancy rate while, cows aged 8 to 9 had significantly lower pregnancy rate. The rate of conception was varied ($P<0.05$) across the bulls from 53.9% to 69.9% among the bulls. In conclusion, factors such as time of insemination, body condition score, age, genotype and bull ID have significant effect on pregnancy.
**Keywords:** artificial insemination, body condition, pregnancy rate, synchronization, time of insemination, Dale

## Introduction

Livestock play a significant role in the economic, social and cultural value in Ethiopia. It constitutes an essential link of the economy through the generation of income and the satisfaction of the food needs of the people. Reproductive performance of cow and heifer is one of the most important factors that influenced the profitability of the dairy sector. In Ethiopia, dairy production is still in extensive system and the average daily milk production of indigenous cows is 1.37 liters/day (CSA, 2014). The introduction of reproductive techniques such as oestrus synchronization and artificial insemination (AI) are becoming instrumental to solve the effects of these limiting factors as well as to make possible the application of more intensive systems of production and to facilitate the genetic improvement of the productive characteristics of the herd (Kouamo and Sawadogo, 2012).

Synchronization of estrus involves manipulating or controlling the estrous cycle of females, so that they can be bred at approximately the same time (Rick and Gene, 2013). AI is recognized as the best biotechnological technique for increasing reproductive capacity and has received widespread application in farm animals (Mukasa-Mugerewa, 1989). From other African country, Kouamo *et al.* (2009) indicated that AI after synchronization was identified as the tool of choice for a better productivity of the local Gobra zebu in Senegal through a national campaign. Despite the wide application of AI and its success throughout the developed world, the success rate in Ethiopia is still low 46.7% by Belachew (2003) and 27% by Desalegn (2008) owing to a number of technical, financial and managerial problems (Azage *et al.,* 1995, Cited in Woldu *et al.*, 2011).

## Materials and Methods

### Study design and methodology

The study was implemented in Sidama zone at Dale woreda, Southern Ethiopia. The study area was selected purposely because of its high number of dairy cattle and for its strategic location in Dilla-Hawassa milk shed. Participatory approach was used during the implementation of the program with integrated efforts of Hawassa Agricultural Research Center, ILRI (IPMS), South Agricultural Research Institute (SARI) and Bureau of Agriculture (BoA). Moreover, farmers in the study area were fully participating in selection of cows, detecting estrus and reporting observed signs to the nearest AI stations.

About 171 (native and crossbred) cows/heifers were selected based on feed availability, age (3 to 9 years), zero (heifers) to 5$^{th}$ parity were selected. Body condition score (BCS) Nicholson and Butterworth (1986) 1 (under condition) to 9 (over condition) scales at the start of synchronization was also used. An intramuscular injection of hormones products (5 ml of Lutalyse or 2 ml of Estrumate) were used for estrus synchronization. Farmers closely monitored their cows and reported the heat sign at the right time and thereby AI technicians confirmed heat by rectal palpation. Cows noted in heat in the morning were inseminated in the afternoon and those

identified in the afternoon were inseminated the next morning. Two inseminators were assigned for insemination. Frozen semen (-196°C) bulls (Holstein) was brought from Kality National Artificial Center, Ethiopia. At day 90 post AI, pregnancy diagnosis was made by trans-rectal palpation method.

**Data analysis**

The data generated processed in Microsoft Excel and SPSS software for the statistical analysis. All qualitative data were analyzed using non-parametric methods namely by $\chi^2$ test. The efficiency of estrus synchronization & their associations with conception rate were analyzed using $\chi 2$. The variation between groups was considered significant at $P<0.05$. As suggested by Sharifuzzaman *et al.,* (2015) number of service per conception (NSPC) and conception rate (CR) is manipulated as:

$$NSPC = \frac{\text{Total number of service}}{\text{Total number of cows conceived}}$$

$$CR = \frac{Numberofcows/heifers\ pregnant}{Numberofcows/hefers\ inse\ \min ated} * 100$$

**Result and Discussion**

**Synchronization and pregnancy rate**

The result of estrus response following administration of PGF2α is shown in table 1. Out of synchronized, most of the cattle (local and crossbred cows/heifers) responded PGF2α and the rate of oestrus response was 97.7% with no significant difference among the native and crossbred cattle. Erin (2008) revealed that there has been limited research conducted to determine if genotype influence the effectiveness of PGF2α initiates lutleolysis. Estrus response rate obtained in the current study was higher than that reported by Diskin *et al*. (2001) and Bekana *et al.* (2005). Body condition score, age of the cow, nutrition, season, anoestrus and disease, could attribute the differences in estrus response among the studies. The result indicated that the average number of hours to estrus was 13 to 154 hrs from the time of injection of PGF2α. The time between induced estrus is inconsistent, but generally it varied from two to five days that too depending on the stage of follicular wave at the time of $PGF_2\alpha$ (Holm *et al.,* 2008).

**Number of Service per Conception (NSPC)**

In this study, overall mean NSPC was 1.75 (Table 2). The NSPC of the current study was higher than those reported 1.3 for crossbred cows in Gondar (Nibret, 2012), 1.52 from Assela town (Hunduma, 2012), 1.54 for Fogera cattle (Giday, 2001). However, it was lower than 2.2 for Eastern low lowland Crossbred hat reported by (Emebet and Zeleke, 2007). The variation could be due to accuracy of heat detection, appropriate timing of insemination, insemination technique, BCS and quality and quantity of semen. Yifat *et al*., (2009) also indicated that appropriate timing of insemination, heat detection efficiency and insemination technique could be attributed to lower or higher NSPC.

**Conception rate**

The overall first service conception rate was 60.4%, which is higher than that of 27% reported by Desalgn (2008), 46.7% (Belachew 2003) and 54.3% Abonou (2007). However, the current result of conception rate was slightly lower than 62.86 % (Sharifuzzaman *et al*., 2015) in Bangladesh. The variation in conception among the studies could be appropriate timing of insemination, accuracy of heat detection, body condition of the animal, nutrition and management, early embryonic death, insemination techniques, skill of inseminator and quality and quantity of semen. Similar studies were made by Mollal (2011) and Shikder (2011) conception rate depends mainly on skill of the inseminator, accurate estrus detection, quality and quantity of spermatozoa in semen, proper semen thawing procedure, placement of semen in the uterus, calving to service interval and herd size.

Table1. Estrus response, response interval after PGF2α, NSPC and conception rate

| **Genotypes** | N | Estrus response (%) | Response interval after PGF2α (hrs) | | Inseminated cows/heifers | NSPC | CR (%) |
|---|---|---|---|---|---|---|---|
| | | | 13 to 72 (%) | 72 to 120 (%) | | | |
| **Local** | 101 | 96.6 | 67.3 | 32.7 | 98 | 1.85 | 54 |
| **Crossbred** | 70 | 98.8 | 56.6 | 43.5 | 69 | 1.44 | 69.6 |
| **Overall** | **171** | **97.7** | **62.9** | **37** | **167** | **1.65** | **60.4** |

N=number of synchronized cows/heifers, NSPC= number of service per conception, CR=conception rate

**Factors affecting conception rate in dairy cattle**

Some of the main factors affecting conception rate of dairy cattle were time of insemination, genotype, body

condition scores, age, parity, bull Id and AI technicians. The detail is presented in table 2. .

**Effect of genotype**

First service conception rate was significant (P<0.05) difference among crossbred (69.6%) and indigenous (54%) dairy cattle (Table 2). Higher conception rate was observed in crossbred as compared to native cattle. The variation in conception among native and crossbred cattle could be due to genotype, heat detection accuracy and farmers' biasedness to manage crossbred better than the local cattle. The findings is similar to that of Woldu *et al.,* (2011) that farmers tend to give more emphasis in close follow up of their crossbred cattle than indigenous. Some other possible reasons reported for the lower proportion of indigenous cow conceiving at first insemination are that the Zebu does not exhibit overt estrus signs like crossbred cattle (Azage, 1989, Mukasa-Mugerwa *et al.,* 1991). Estrus manifestations have been known to be short, erratic and mostly less evident or silent heat further requiring a meticulous observation and timely insemination to result in successful pregnancy (Hamid, 2012).

**Effect of Parity**

As shown in Table 2, there was no significant difference in first service pregnancy rate among the parity groups; however, the conception rate is higher among the primiparous cows when compared to that in the multiparous cows. The non-significant differences in the conception rate among the different parities could be accurate selection of dairy cattle, BCS, semen quality and quantity. However, it was inconsistent with other studies who reported that the conception was better among the cows at the second parity (Mukasa-Mugerwa *et al.,* 1991, Grimard *et al.,* 2006 and Khan *et al.,* 2008).

**Effect of body condition**

The association between BCS and conception rate at first service AI was a significant (P<0.05) difference (Table 2). BCS 6 cows/heifers had higher pregnancy rate when compared to BCS of 5.5 and 5. Similarly, BCS 4.5 Cows/heifers had lower pregnancy rate (Table 2). The result indicated that pregnancy rate had increased as the body condition of the animals increased which is in line with findings of DeRouen *et al.* (1994) that revealed cows with a body condition score six or seven has higher pregnancy rate compared to cow with a body condition score of four or five. Good BCS especially during the mating period has been confirmed to have a positive impact on CR (Mukasa-Mugerwa, 1989).

**Effect of age**

The association between age and conception/pregnancy rate at first service AI was significant (P<0.05) difference among age groups. High pregnancy rate was observed in cows aged 5 to 7 years and started to decline after 8 to 9 years age (Table 2). The current result is similar with the report of Buck *et al.,* (1976) that was reported from Botswana in which conception rate was maximum in 6 to 7 year old cows and declined with increase in age. Gebregziabher (2005) reported that the reduced probability of conception to first service with increased age could partly to attribute to the exposure of the cows to different reproductive diseases and another group of authors also indicated that embryonic mortality with increase in age can affect conception rate (Humblot,1988; Weller *et al.,*1992). In young animals requirement of nutrients for continued growth and lactation place additional demand on the animal which may influence conception (Goshu, 2005). This age related difference might be due to delayed resumption of ovarian activity after calving.

**Effect of insemination time**

First service conception rate of the current result was significantly (P<0.05) different among the time of insemination. The current finding showed that conception was highest when insemination was done between 9 to 14 hours (71.6%) after the onset of estrus, however lower conception rate was observed when insemination was done between 19 to 24hrs (12.5%) after the onset of estrus (Table 2). The result further indicates that conception rate was decreased as the time of insemination increased. Time of insemination of the current study was similar with the report of Miah *et al.(*2004) indicated that first service conception rate was higher between insemination was done 11 to 14 hrs (60.3%) after onset of estrus. Studies by Das *et al.* (1990) also indicated that the conception significantly varied (P<0.05) when the cows were inseminated in early, middle and late estrus, respectively (58.8, 69.7 and 33.7%) respectively. Study by Sinishaw (2005) also indicated that animal should inseminate within 24 hours of the onset of heat because late and early insemination may influence the CR of both the heifers and cows.

The variation in conception rate among different studies could be due to inaccuracy of heat detection, time and season of insemination, skills of the AI technician.

**Bull ID**

Bull Id had significantly (P<0.05) influenced conception (Table 2). It indicated that effect of bulls on pregnancy rate could vary from 53.9% to 69.9%. The difference in conception among bulls could be due to quality and

quantity of semen, disease and management of the bull. Shamsuddin *et al.* (2001) also indicated that breed of bull, and attributes of semen quality and quantity have shown to have significant effects on conception rate. Several factors such as diseases, climatic conditions of the place where the bulls are reared, nutrition and management of the bulls also influence the fertility among the bulls (West, 2003). Studies by Gebregziabher (2005) have also indicated that not only the bull itself influences the conception rate under AI service, but also by the way of semen collected, processed, transported, handled and inseminated.

Table 2: The effect of different factors affecting pregnancy rate of cows/heifers (n=167)

| Factors | N | CR (%) | P-value |
|---|---|---|---|
| **Cattle type** | | | |
| **Indigenous cow** | 98 | 54 | * |
| **Crossbred cow** | 69 | 69.6 | |
| **Parity** | | | |
| **Zero (heifers)** | 49 | 58.3 | **NS** |
| **1** | 38 | 73 | |
| **2** | 37 | 66 | |
| **3** | 26 | 58.8 | |
| **4** | 17 | 52.6 | |
| **BCS** | | | |
| **4.5** | 19 | 44.4 | * |
| **5** | 104 | 57.4 | |
| **5.5** | 12 | 66.7 | |
| **6** | 32 | 81.8 | |
| **Age** | | | |
| **2.5 to 4** | 42 | 65.8 | * |
| **5 to 7** | 95 | 66.7 | |
| **8 to 9** | 30 | 41.4 | |
| **Time of insemination(hours)** | | | |
| **4 to 9** | 70 | 59.6 | ** |
| **9 to 14** | 53 | 71.6 | |
| **14 to 19** | 36 | 57.3 | |
| **19 to 24** | 8 | 12.5 | |
| **Bull ID** | | | |
| **10-202** | 85 | 69.9 | * |
| **10-218** | 82 | 53.7 | |

Where n=number of inseminated cow/heifers, CR=conception rate, *P<0.05, **P<0.01 values across column significant, NS=non-significant.

**Conclusion and the way forward**

Proper animal selection (appropriate age, BCS, parity), heat detection efficient, farmers' awareness to detect heat and on time bringing cattle for insemination should be duly considered for effective synchronization. The effectiveness of PGF2α used to synchronize estrus in dairy cow/heifers had taken 13 to 154 hours and the rate of estrus response was 97% after hormone injection. The overall first service conception rate in this study was 60.4%. However, the different factors such as time of insemination, genotype, BSC, age of the animal and bull itself were influenced pregnancy. Moreover, number of service per conception (NSPC) in indigenous dairy cattle was higher as compared to crossbred dairy cattle. In conclusion, it is a paramount importance to consider age, parity, time of insemination, genotype, and bull efficiency for improving the reproductive performance of dairy cattle. The authors recommended that, development practitioners who aimed to improve dairy cattle productivity should give attention to genetic and non-genetic factors in commencement of synchronization.

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