International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
(A Peer Reviewed, Referred, Indexed and Open Access Journal)
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 9, Issue 6 -2022

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2022.09.06.011

Evaluation of artificial insemination (AI) after estrus synchronization of dairy cattle in Wondo Genet District, Sidama regional state of southern Ethiopia

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Abstract

The study was conducted from November2018to March 2020 in Wondo Genet district of Sidama regional state of southern Ethiopia, with the objective to evaluate AI after estrus synchronization. Among 120 synchronized animals 89(53local and 36crossbred) was responded to hormonePGF2α. As a result 80% estrus response was obtained. All cows and heifers responded was inseminated and at day 60pos insemination; pregnancy diagnosis made by trans-rectal palpation and the overall CR of 63% was obtained. All factors concerned like; breed, age, parity of cow/heifer, breed of bull and skills of AI technicians and time of insemination Have no ($P<0.001$) deferent effect on CR. However crossbred (67%),animal parity 3(72.2%7)animal with age3-6 years(63.1%),with inseminated time 11-18hrs(80.8) and animal inseminated with AIT 1(57%) has high CR. It was concluded that the effectiveness of PGF2α used to synchronize estrus in dairy cows/heifers was good and the overall conception rate (63%) was better which is greater than the national level conception rates (7.14 to 40.23) to first inseminations. The artificial insemination technicians should improve their skill through experience and additional training to increase efficiency and effectiveness.

Keywords: Artificial insemination, Dairy cattle estrus synchronization

Introduction

The cattle population of the country is dominated with indigenous zebu types, which are widely distributed across the diverse agro-ecologies of the country. It has been reported that indigenous cattle breeds account for about 98.8 % of the total cattle population of the country (CSA, 2011/12). Indigenous cattle have been naturally selected for years towards adaptive traits under harsh tropical environment and unique product qualities. These include resistance to diseases and parasites, longevity and adaptation to poor quality feeds and high fat milk (Aregawi, 2013). However, the productivity of local cattle is low due to their low genetic makeup, low level of input and tradition

husbandry practice beside environmental stress (Azage*et al.*, 2010). Due to poor productivity of indigenous cattle, the country is still importing a significant amount of dairy products (Tegegn and Zelalem, 2017). Hence, improvement in livestock resources should be achieved through the implementation of genetic improvement, in parallel with proper feeding, health care, and management of livestock Improvement in livestock resources have been achieved through the implementation of an efficient and reliable AI service, in parallel with proper feeding, health care, and management of livestock (Hamid *et al.*,2016).

The introduction of reproductive techniques such as artificial insemination (AI) and eustrus synchronization 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 the herd (Kouamo and Sawadogo, 2012; Debre *et al*., *2016*). Artificial insemination (AI) is a proven bio-technique, which is used globally to improve the genetic makeup of the cattle and thereby improve their production and reproductive traits (Noakes, 2009). However, the overall impact of AI can only be achieved when it is coupled with proper animal husbandry practices (Debre. *et al*., 2016). AI technology maximizes the use of outstanding males, dissemination of superior genetic material, improve the rate and efficiency of genetic selection, introduction of new genetic material by import of semen rather than live animals (Boa- Amponsem and Minozzi, 2006; Verma*et al*., 2012).

The success of artificial insemination scheme depends among others on its reliability and its technical results, which are to a large extent governed by the link among the inseminators and supervisor's dairy cattle management of farmers' estrus detection efficiency of the farmers and quality of semen (Aregawi, 2013*).* In addition, the successful extension of artificial insemination (AI) service is affected by different environmental and managerial factors such as agro-ecology, season of the year, sire breed, parity, artificial insemination delivery systems, quality of extension service, incentive, and absence of record (Haileyesus, 2008; Aliy,2015).

Objective

To assess efficiency of artificial insemination in relation to estrus synchronization in the study area

Materials and Methods

Description of study area

The study was conducted at Wondo Genet district, Sidama zone, southern Ethiopia. The district was located at 270 km South of Addis Ababa and 14 km southeast of Shashemene and 34 km far from Hawassa to east direction. The geographical coordinate of the district is 70 19'N and 38 ^{0} 38'E with an altitude of 1780 meters above sea level. The mean annual minimum and maximum rainfall are 709 mm and 2062 mm respectively. The district has a mean maximum and minimum temperature of 26^{o} c and 12 ^{o} C respectively. Wondo Genet has a bimodal rainfall distribution with short rains occur during March-May and the long rains in July-October. The district has 41244 local breed, 10694 cross breed cattle with a total of 51938 cattle. It also has 22736 heads of sheep and 12018 heads goats. It covers an area with a wide altitudinal range of 1600 to 1950 m. a.s.l.

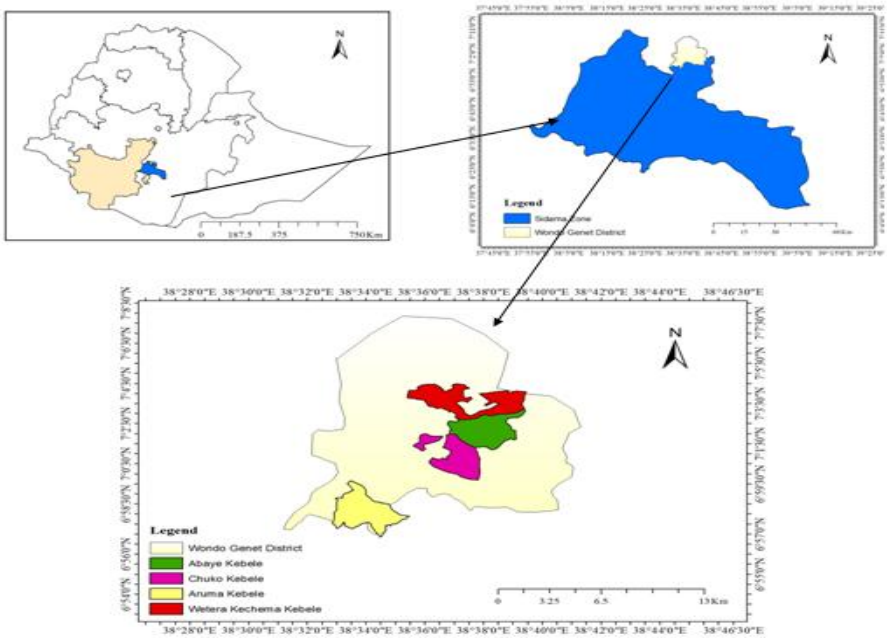

Figure 1. Map of study area

Sampling methods and sampling size

In order to assess the effect of synchronization using PGF2α (5 ml Lutalyse™) a total of 120 dairy (80 indigenous and 40 cross breeds) cattle's were purposively selected from Abaye, Aruma, Chuko and Wotera-kechamakebeles of the district and treated with a single injection of PGF2α. The cattle's were selected based on the availability of feed, age(3 to 9 years), parity (1st to 4th level), health status, non-pregnancy status during synchronization and BCS (1 to 9 scale).The cows were inseminated artificially after they showed signs of standing estrus (heat) that ranged between 24 to 120 hours post PGF2α administration.

Types of Data Collected and their Source

Both primary and secondary data were collected from both primary and secondary data source.

Statistical Analysis and Statistical Packages Employed

Procfreq procedure of SAS 9.1(2003) was used to analyze data obtained from mass synchronization and prostaglandin evaluations. The effect of, age, parity, BCS, dam breed, bull, year and others to conception rate and number of services per conception were investigated using x2–test of kruskal-wallis test option. The result was summarized and presented by percentages. To test significance level 0.001 was used for variables.

Models for evaluation of mass synchronized dairy cattle were presented as follows.

Conception rate are estimated from the proportion of pregnancies confirmed by rectal examination of genital tract at day 60 of post insemination among the total number of cows/heifers inseminated artificially with frozen semen at a specified period (khatun*et al.*, 2014*)*.

$$\text{Conception rate} = \frac{\text{No. of cows/heifers pregnant}}{\text{No. of cows/heifers inseminated}} \times 100$$

$$\text{Number of services per conception} = \frac{\text{Total number of services}}{\text{Total number of cows conceived}}$$

Results and Discussion

Farmer's perception on Estrus Synchronization and Mass Insemination

The involvement and participants' satisfaction with mass synchronization and problems with the existing AI service in the study area are presented in Table 15. The result from interview and group discussion reveals that 65% of the respondents were participated in hormonal assisted estrous synchronization. The result of this study indicated that only a quarter of the respondents were satisfied with the technology. The respondents described that their perception about hormonal estrous synchronization is determined by pregnancy rate achieved rather than rate of response to hormone treatment. Hence, the interview and focal group discussion of this study realized that the low conception rate after synchronization brought the perception of the farmers to be lower about the technology. However, there were few respondents reporting very good or complete satisfaction. The major reasons given by the farmers for the low performance are feed problem, inappropriate season, semen problem; failure to detect heat, poor semen quality/problem in semen handling, performance of the inseminator and low awareness of farmers on the technology (brought sterile and non-cyclic animals for PGF2α treatment). On the other hand, farmers' perceptions on estrous synchronization technology vary with production systems or geographic locations. The current study also agrees with Solomon *et al.*(2016) reported that farmers in peri-urban area had better perception than rural farmers. Another problem explained by the respondents was that the technology was provided in campaign without any selection of households and animals. According to some respondents even they were not aware of about time when hormone estrous comes and hormone should apply.

Table1**.** Participation and satisfaction of hormonal estrus synchronization in the study area

Participate in HSSY	kebeles				Total
	Abaye (%)	Aruma (%)	Choko (%)	w/kn (%)	
yes	53.3	66.7	66.7	73.3	65.0
no	46.7	33.3	33.3	26.7	35.0
Satisfied in Serv	40.0	46.7	0.0	20.0	26.7
Not satisfied	60.0	53.3	100.0	80.0	73.3
Problem of AI service					
Repeat breeder	40	33.3	26.7	13.3	28.3
Heat detection	20	33.3	20	33.3	26.7
AI service not available on time	13.3	13.3	33.3	33.3	23.3
Lack awareness	26.7	20	20	20	21.7

Where HSSY= hormonal estrus synchronization, W/K = woterakachama

Efficiency of Estrus Synchronization and Mass Insemination (OSMI)

Estrus synchronization

4.10.1. Estrus synchronization

The results on estrus response rate, interval to estrus after PGF2α, NSPC and conception rate are presented in Table 16. The result indicated that out of 120 (80 local) and 40 cross bred cow and heifers 89, (53 local) and (36 cross bred) cattle's were responded to PGF2α hormone and the rate of response were 80%. Estrus response rate obtained in the current study (80%) was lower than that reported by Debir(2016) which was 97.7%.

In this study from 89 cattle's responded to PGF2α, 76 of them become pregnant, thus the overall conception rate was 63%, which is higher than Dastalam (2015) andAbiyotand Eyob,(2019) who reported CR of 37.95% and 46.2%CR respectively.But, it was closely agreed with Debir (2016) which was 60.4%.The variation in conception among the studies could be AI delivery system, nutrition and management, accuracy of heat detection, appropriate timing of insemination, insemination techniques, and quality and quantity of semen. Similar study was made by Debir (2016) conception rate depends mainly on time of insemination, genotype, body condition scores, age, parity, bull ID and AI technicians. Report of bureau of livestock and fishery development of the study area shows that from 2216 synchronized and mass inseminated cows, only 217 was pregnant with CR of 9.79%, which is lower than action research. This result was also similar with that of Solomon *et al.* (2016) described that there was high variation between conception rates under the action research and the regular development intervention. There was no significant (P<0.001) difference in conception rate among the local (59%) and crossbred (67%) cow/heifers, and higher CR was observed in cross breed when compared with local breed. The variation in conception among crossbred and native cattle could be due to the genotype, heat detection, and semen quality and quantity and insemination time. 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. Mukasa.,*et al*. (1991)

The current study result shown that, time interval from treatment to estrus response was significantly (0.001) different between local (71.96±0.38) and cross breed (66.6±0.29) cows/heifers. Time interval to response in the current finding was higher than that of Debir (2016) who reported with value of 66.3 and 50.10 respectively.

Table2 . Estrus response rate, response interval, NSC and conception in dairy cattle

	Genotype		**overall mean**	**SL**
	Local breed (N=80)	Cross breed (N=40)	**(N=120)**	
Interval to estrus (hrs)	71.96±0.38	66.6±0.29	71.96±0.34	***
Estrus rate (%)	69	90	80	*
Conception rate (%)	59	67	63	NS
NSC	1.7	1.5	1.6	NS

****= p<0001, *=P<0.01, NS =Non significant, NSC= number of services per conception, hr= hour*.

Factors Affecting First Service Conception Rate in Synchronized Dairy Cattle

The results as presented in Tables 17, shown that first conception rate in study area were affected by genotype, parity, BCS, age of the cow, time of insemination, and the bull itself. There was no significant (P< 0.001) deference beet when conception rate among the deference parity groups, cows/heifer in parity 2(78.25%) and 3(69.3%) groups shows high CR than other parity groups.The absence of significant differences between parities in conception rate in this study was consistent with the study of Tatek, *et al* (2011). In the current study CR of 0 parties (heifers) was lower (57.9%) than the other report due to factors such as time of insemination, skill of technician and heat detection. In this study age of the cows from 3-5 years and 6-8 years have high CR. The lower CR for cows older than 8 years is due to poor body condition,

inefficient utilization of nutrition and inadequacy of hormonal secretion in the cows with increase in age which leads to decline in fertility in the cow.The results are in accordance with Jashim*et al.* (2015) stated that among the age group, the highest conception rate was in between 3.5-5 years with the value of 77.8% and cows with age group more than 9 years have significantly decreased and a decline in fertility.

The current result had shown that there is no significant (P> 0.001) deferent in conception rate with BCS. But the highest conception rate was registered at BCS 3 followed by BCS 4 and this may be due to the good body performance of cows/heifers which could decrease the recovery time of uterus and it became ready for conception. This result agreed with Bainesang (2015) who reported that the highest CR was at BCS 3 and 4 with 92.3 and 84.2% respectively. For conception to occur, insemination must take place at the correct stage of the cow's estrus cycle since ova remains viable for about 12 - 18 hrs after ovulation. MartinezRH, (2000); CartmillJA.*et al*. (2001). First service conception rate of the current result had no significant (P > 0.001) difference among the time of insemination and was done between 4 hrs - 10 hrs, 11 hrs - 18 hrs, 19 hrs - 24 hrs. But the current finding showed that conception was not relatively similar among the above insemination times, 33.6%, 80.8%, and 52.8% respectively after the onset of estrus. Time of insemination of the current study show that the highest CR (80.8) was registered between 11hrs-18hrs, and agree with the report of Abdul Jaffar*et al*. (2004) indicated that first service conception rate was higher between insemination time 11 to 14 hrs (60.3%) and lower above and below this range.This is because ovulation occurs 10 to 14 hours after the cessation of behavioral signs of estrus. Similar studies were made by Diskin (2018) and Debir*et al. (*2016) showed that conception rate was high when insemination was done between 13 to 72 hours after the onset of estrus. But the Time insemination of the current study contradicts the report of Abyotand Eyob,(2019)indicated that the time of insemination was done between 4 hrs - 10 hrs, 10 hrs - 16 hrs, 16 hrs - 22 hrs and > 22 hrs, showed that conception was relatively similar among the above insemination times, 45.1%, 48.2%, 45.3% and 46.6% respectively after the onset of estrus.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.

The bull ID also had not significantly (P > 0.001) influence conception rate. But it indicated that the effect of bulls on pregnancy varies from 28.7% to 78%.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. Not only the bull itself influence the conception rate under AI service, but also the way semen collected, processed, transported, handled and inseminated Dabir., *et al*. (2016). Even though there is no significant (P > 0.001) deferent in CR between AIT, Cattle treated by AIT 1 were conceived more than the other technicians and this indicates that efficiency of artificial insemination technicians affect conception rate.

Generally this study show that if appropriate selection of cattle done and carefully handled hormone assisted synchronization done, artificial insemination of dairy cattle was more efficient.

Table 3 . Factors affecting first service conception rate (CR)

	Dairy cattle Breeds		Overall mean	
	Local CR (%)	Cross CR (%)		P-value
	59.5	65	62.25	
Parity				
0	44.4	71.4	57.9	
1	65	55	60	
2	54.5	85.7	78.25	0.44
3	78.6	60	69.3	
4	50	50	50	
Age of the cow				
3-5yrs	65.9	60.3	63.1	
6-8yrs	51	53.3	52.2	
Above 9yrs	49	33.3	41.2	
Body Condition Score				
2	44.4	59	51.7	
3	70.6	75	72.8	0.054
4	63.2	68	65.6	
Times of insemination				
4-10	33.6			
11-18	80.8			0.90
19-24	52.8			
Semen (semen from different bulls)				
1	67.9			
2	78			0.23
3	69.3			
4	28.7			
Artificial Insemination Technicians				
	Consumption/service	CR (%)		
1	21/37*	57		
2	24/46*	50		0.021
3	20/38*	53		

Conclusion and Recommendation

In this cross-sectional study the effectiveness of PGF2α used to synchronize estrus in dairy cows/heifers was good (80%) and the better overall conception rate (63%) which is greater than the national level conception rates (7.14 to 40.23) to first inseminations was obtained. However, different factors such as cow breed, BCS, parity, time of insemination and bull ID were influenced conception rate. Higher conception rate was observed in crossbred and animals with good body condition. Different conception rates were recorded among different considered factors. The average number of services per conception (NSC) of action research result was lower than the mass artificial insemination done by bureau of agriculture.

The appropriate time of insemination was 12 to 18 hrs after the onset of estrus. Appropriate animal selection, especially the dairy cow or heifers which had good body condition performance (appropriate age, BCS, parity), heat detection efficient, management system, technician and farmers' awareness to detect heat

and on time bringing cattle for insemination should be considered for effective synchronization and efficient to artificial insemination. Based on the above conclusions the following recommendations are forwarded

- Improving estrus detection method, proper time of insemination and appropriate animal selection should be considered before implementing estrous synchronization and AI.
- Improving estrus detection method, proper time of insemination and appropriate animal selection should be considered before implementing estrous synchronization and AI.

The artificial insemination technicians should improve their skill through experience and additional training to increase efficiency and effectiveness.

- The efficiency of estrus synchronization and AI could be improved significantly if proper synchronization and AI practices were followed before the starting of the breeding program.

The efficiency of estrus synchronization and AI could be improved significantly if proper synchronization and AI practices were followed before the starting of the breeding program.

- Further study on site of semen deposition, insemination season; and on the quantity, quality and preservation of semen should also be conducted.

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Website: www.ijarbs.com

Subject: Veterinary Sciences

Quick Response Code

DOI:10.22192/ijarbs.2022.09.06.011

How to cite this article:
Edao Shanku. (2022). Evaluation of artificial insemination (AI) after estrus synchronization of dairy cattle in Wondo Genet District, Sidama regional state of southern Ethiopia. Int. J. Adv. Res. Biol. Sci. 9(6): 109-117.
DOI: http://dx.doi.org/10.22192/ijarbs.2022.09.06.011