

Cattle Breeding Practice of the Community and Evaluation of Artificial Insemination (AI) after estrus Synchronization in Wondo Genet District, Sidama National Regional State, Southern, Ethiopia

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Abstract

The study was conducted from November 2018 to March 2020 in 60 households in Wondo Genet district of Sidama region of southern Ethiopia, with the objective to assess cattle breeding practices of the communities and evaluate AI after synchronization. The study was conducted using survey and estrus synchronization. 120 cows and heifers (local and crossbreds) have been injected with a single dose of prostaglandin. Natural pasture and crop residues were the major feed sources and river and ponds were the major water source for dairy cattle in the study area. The average daily milk yield was 1.39 ± 0.15 and 6.02 ± 0.93 liters for local and crossbred cows, respectively. The average lactation lengths for local and crossbred dairy cows were 7.2 ± 0.10 and 8.01 ± 0.12 months, respectively. The average ages at first services for local and crossbred dairy cows were 39 ± 0.35 and 29 ± 0.27 months, respectively. Natural mating, AI service, a combination of natural mating and AI service, and hormonal based estrus synchronization were the common mating methods in the study area. About 66.7% of the respondents in the study area have AI service regularly. According to survey results, only 26.7% of respondents were satisfied with hormonal estrus synchronization and the rest were not. Among 120 synchronized animals 89 (53 local and 36 crossbred) was responded to hormone PGF2 α . As a result, 80% estrus response was obtained. All cows and heifers responded was inseminated and at day 60 post 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 ($P < 0.001$) different effect on CR. However crossbred (67%), animal parity 3 (72.2%) animal with age 3-6 years (63.1%), with inseminated time 11-18 hrs (80.8) and animal inseminated with AIT 1 (57%) has high CR. It was concluded that the effectiveness of PGF2 α 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. Artificial insemination technicians should improve their skills through experience and additional training to increase efficiency and effectiveness.

Keywords: Artificial Insemination, Breeding, Dairy, Estrus synchronization

Introduction

Ethiopia is known to have a cattle population around 57.8million, 98.59% of them are indigenous breeds with very few hybrids (1.22%) and exotics (0.19%) and which 55.38% are female and 44.62% are male, respectively (CSA,2016). Cattle production together with the production of other livestock sectors, are known to be very important and essential components of agricultural sector contributing for meat, milk, cheese, butter, exporting commodities (live animals, hides, skins), draught power, manure, near-cash capital stock (Hundera 2004; Hasan *et al.*, 2016.)

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)

The introduction of reproductive techniques such as artificial insemination (AI) and estrus 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 characteristics of 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).

Currently world-wide research is focused on the development of methods that effectively synchronize estrus by decreasing the period over which estrus is detected, hence facilitating the use of fixed time AI (Alemsalem *et al.*, 2016). In Wondo Genet district where this study was conducted, even though the success rate is low artificial insemination was used for many decades to produce crossbred and improve milk production. Artificial insemination is commonly undertaken in urban and peri-urban of the areas where consumption of milk and milk products are reasonably high. Hence, to improve efficiency reproduction was initiated in 2014. However, research finding on breeding and husbandry practice and effectiveness of artificial insemination (AI) after implementation of estrus synchronization is scanty in the study area. Therefore, with the above back ground this study was undertaken with the objectives to assess cattle breeding practice of the community in the study area and assess efficiency of artificial insemination in relation to estrus synchronization.

Material 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° c and 12 ° 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 crossbred 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.

Sampling methods and sampling size

Sampling Techniques and sample size for Survey

This study was purposely conducted in Wondoganet district of Sidam zone of southern Nation, nationalist and people's regional state. Because of the synchronization program campaign were implemented by the Livestock and Fisheries Bureau of Southern Nations and Nationalities Peoples Regional State to improve the dairy cattle productivity and availability of good infrastructure and feed for the animals. The sample size was determined by the availability of artificially inseminated cows, thus four kebeles (the lower administrative unit in the country) were selected purposely. The kebeles are Abaye, Aruma, Chuko and Waterakechama. From each kebele 15 dairy cattle owners who participated in estrus synchronization and AI were selected purposely for the interview, with a total of sixty respondents from all kebeles.

A cross-sectional type of study design supported by data recording and observation were carried out from November 2016 to April 2017 with the objective of determining the success rate of artificial insemination following estrus synchronization and determining associated factors on pregnancy rate of cows/heifers.

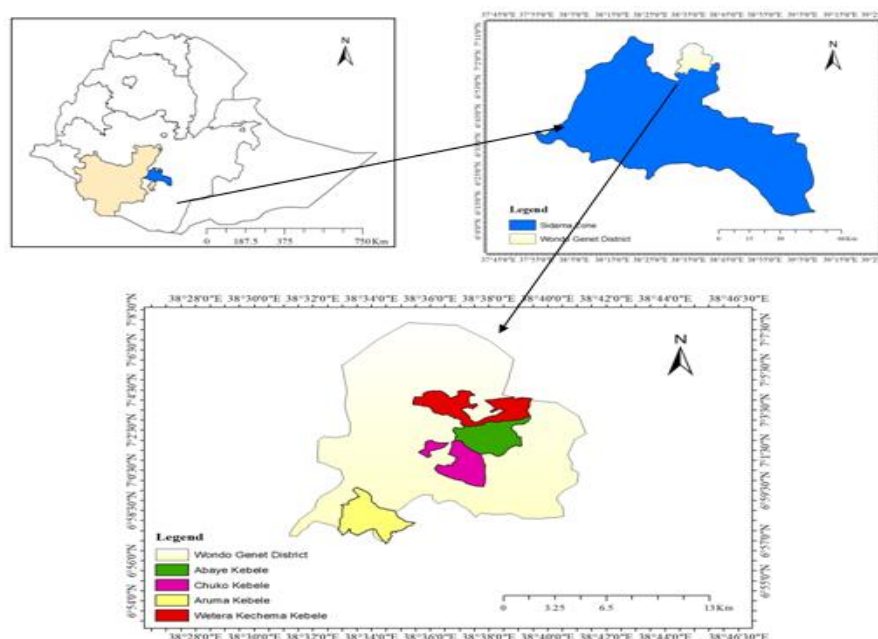


Figure 1. Map of study area

Sampling for Estrus Synchronization

In order to assess the effect of synchronization using PGF2 α (5 ml LutalyseTM) a total of 120 dairy (80 indigenous and 40 crossbreds) cattle were purposively selected from Abaye, Aruma, Chuko and Wotera-kechama kebeles of the district and treated with a single injection of PGF2 α . The cattle 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 PGF2 α administration.

Types of Data Collected and their Source

Both primary and secondary data were collected from both primary and secondary data source. The household survey was conducted using a set of semi-structured questionnaires. The questionnaires were pre-tested before final administration as it was crucial to ensure that the questionnaire being asked were socially appropriate and that the expected responses were within expected bounds. Focal group discussions were held in each (one pre kebele) kebele was selected district. The group was formed with (9-12) people and composed of youngster, women, village leaders and key informant who is socially respected and know the present and past social and economic status of the study area. Thus, respondents had their own dairy cow and explained diversified responses in the study area. Group discussion were focused on history of breeding practice of dairy cow, utility pattern of dairy cow and Artificial insemination service, status and major constraints of artificial insemination practice and service, major reproductive of dairy cow after AI and perception about their conception rate of AI practiced dairy cow.

Statistical Analysis and Statistical Packages Employed

Breeding practice

Breeding practice survey data were analyzed for descriptive statistics using frequency procedure and cross tabulation of SPSS version 20 was used. For quantitative data obtained from the survey general linear model procedure of statistical analysis system SAS 9.1(2003) was used to evaluate the effect of various performance related parameters of dairy cattle such as milk yield, lactation length, age at first calving, , calving interval, Reproductive life, Age at maturity of a male cattle and female.

Mass Estrus Synchronization and Single Shot of Prostaglandins

Proc freq 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 χ -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

Household Characteristics

The major household characteristics of the respondents are shown in Table 1 The majority of the respondents were males and training on dairy improvement should focus on male household of the study area. This result was relatively similar with the report of Fekede *et al.* (2013) and Bainesang (2015) in central highlands of Ethiopia with 84.4% and 16.6%; 90% and 15% male and female, respectively. However, the results of the current study in female proportion was lower than the report of Azage (2004) who reported 33% and 67% male and female headed household livestock keepers in Addis Ababa and lower than the report of Haile *et al.* (2012) in Hawassa city with the value of 70% and 30% for male and female, respectively. The difference might be due to the level of urbanization of the study area. The average family size of Abayekebeles is significantly different from the others.

The overall average age of the respondents was 43 years with ranging from 27-69 years (Table 4). There was significant difference in average ages of the respondents in the kebeles. The overall average family size of the responding households in all the study areas was 6.7 with 3.5 and 3.2 male and female, respectively.

Educational level of the households was assessed to reflect the level of technology adoption. Thus, as about 3.3 %, 15%, and 60% of were illiterates, read and writing and attended primary and secondary school, respectively. The low average illiteracy percentage in this study area may be the result of availability of educational infrastructure in the two districts and it could increase adoption of the community on new livestock improvement technology

Table1. Household's characteristics of the study area

Respondents	Kebeles									
	Abeye (N=15)		Aruma (N=15)		Choko01 (N=15)		Woterakechama (N= 15)		Over all (N=60)	
Sex of respondents										
	No	%	No	%	No	%	No	%	No	%
Male	15	100	14	93	11	73	11	73	13	86.67
Female	0	0	1	6.7	4	27	4	27	2	13.33
Total	15	100	15	100	15	100	15	100	15	100
Family size and age of respondents										
Male	3.4		3.75		3.6		3.13		3.46	
Female	2.8		3.12		3.4		3.53		3.21	
Total family size	6.06		7		7.06		6.4		6.633	
Age	47.6		35.6		48.53		39.47		42.8	
Range for age (yrs)	38-56		32-42		27-75		27-63		27-75	
Education level of respondent										
	No	%	No	%	No	%	No	%	No	%
Illiterate	1	6.7	0	0	1	6.7	0	0	2	3.3
Read and write	3	20	4	27	0	0	2	13	9	15
Elementary (1-6)	2	14	6	40	8	53	6	40	22	36.7
Secondary (7-8)	2	13	4	27	3	20	5	33	14	23.3
High school (9-12)	1	6.7	1	6.7	2	13	2	13	6	10
Above college	6	40	0	0	1	6.7	0	0	7	11.7
Total	15	100	15	100	15	100	15	100	60	100

Livestock Composition and Herd Size

The average number of livestock holding reared by respondents were described in Table 2. Cattle was the dominant species of livestock which kept by all respondents followed by shoats (small ruminants).

Table 2. Types of livestock, average and herd size of study area

Livestock type	Abaye (n=15)	Aruma (n=15)	Chuko (n=15)	Wotara/k (n=15)	Mean Total
Total cattle	11.64	5.28	7.27	8.57	8.19
Local cow	1.7	1.7	1.1	1.1	1.4
Cross cow	3.7	0.2	1.7	2.5	2.03
oxen	0	0.19	0.2	0	0.1
Cross Bulls	0.14	0.19	0.07	0.27	0.17
Heifers	2.4	1.5	2.5	2.3	2.18
Calves	3.7	1.5	1.7	2.4	2.33
Sheep	2.9	1.7	3.2	2.5	2.58
Goats	0.5	0.5	0.5	3.2	1.18
Donkeys	0.7	0.8	0.6	0.5	0.65
Horse	0.5	0.5	0.4	0.5	0.48
Chickens	25.4	8.2	6.2	5.2	11.25

n=numbers of house hold in each kebeles

The average herd size per household of the study area was 5.8. The reason for smaller number of livestock kept in the current study area is due to shortage of grazing land in which most of the available land was used to produce cash crop like chat coffee and sugar cane. In addition, shortage of land due to population pressure may be other

cause. This result was somewhat similar with the result of Bainesang (2015) in central highlands of Oromia. However, it was smaller than the report of Debire (2016) from two districts of Sidama zone.

Purpose of Keeping Dairy Cattle

Livestock kept in the study area was for milk production, income source, manure, social value, and traction in their order of importance. As shown in Table 7, 66.7 and 40% of Abaye and watera-kechama kebeles respondents respectively kept their cattle for milk production whereas, 40% of Aruma kebele respondents kept their cattle for income source. The main reason of keeping cattle for milk production is due to the high demand of milk in this cash crop study area. This study was similar with Debir (2015) in high land and midland districts of Sidama zone. But the purpose of keeping cattle in the current study was different from Ayantu *et al.* (2012) in west Oromia region described that the Hrro cattle owners were keeping their cattle primarily for draught power followed by milk production.

Table 3. Purpose of keeping cattle in the study area

Purpose of keeping	Lists Kebeles				Mean (%)	Rank
	Abaye (%)	Aruma (%)	Chuko (%)	Watarakachama (%)		
Milk production	66.7	53.3	33.3	40	48.33	1
Source of income	26.7	40	26.7	20	28.35	2
Manure	6.7	6.7	20	6.7	10.03	3
Social value	0	0	1	3	1	5
Power/traction	0	0	13.3	13.3	6.65	4

Source of Cattle Feeds and Feeding System

As shown in Table 8 the feed source and feeding system were different across kebeles. Hence, natural forage and free grazing were the common feed resource and feeding system respectively in kebeles (Aruma and Woterakechama). In Abaye and Chuko kebeles Cut carry, cut and carry, crop residue, and natural pasture in their order of importance were the common feed resources while in Aruma and Waterakechama natural pasture was the common feed source followed by crop residue. Industrial by products were the other source of feed used as supplementation in the study area. Cut and carry was common feeding system kebeles (Abaye and Chuko) while free grazing was common for kebeles (Aruma and Woterakechama). Respondents utilized free grazing in Aruma and Woterakachama due to the presence of few communal grazing lands. But due to shortage of grazing land in Abaye and chuko kebeles their feeding system was cut and carries. During wet season, in both areas there was no shortage of feed. Most of the farmers responded that during this season natural pastures were dominant and free grazing was common. The Abaye and chuko farmers buy the grass from others peoples and freely graze their cattle during this season. During dry season crop residue was common.

During dry season, crop residue was the main source of cattle feed in study area. Most of the respondents in study areas supplied feeds for their animals in different groups of animals by considering age, conception, and milk production. Almost all the respondents provide supplementary feed for lactating and pregnant cows, and new born calf.

Table 4. Source of Dairy Cattle feed and feeding system of the study area

Source of feed	Lists of kebeles				Total (%)	χ^2
	Abaye (%)	Aruma (%)	Chuko (%)	Waterakechama (%)		
Natural pasture	26.7	66.7	33.3	40	41	0.532
Crop residue	60	20	53.3	40	43.3	
Industrial by product	13.3	13.3	13.3	20	15	
Feeding system						
Cut and carry	40	66.7	33.3	73.3	53.3	0.27
Free grazing	60	33.3	66.3	26.7	46.7	

Source of Water and Watering Frequency of Dairy Cattle

As indicated in Table 9, water source of cattle was different in different kebeles and from season to season of the study area. River was the main source in all study kebeles during wet season while pipe and pond water were common sources of water during dry season in all the study kebeles. This indicates that dairy animals were provided clean pipe water during dry season. The current study was different from Destelam (2015) in northern Tigray who reported 21.1, 50 and 28.9% of households' respondents gave water for their dairy cattle from pond, river, and pipe, respectively. Majority of the household revealed that the water obtained from the river was not clean. Sometimes the sources of water from pond and river for dairy cattle could be one of the causes for disease incidence. Watering frequencies were similar in all kebeles and watering frequency may be increased for dairy cattle that produced high milk production.

Regarding the housing system (Table 10), most of the respondents in Abaye and waterakechama were used separate house for their cattle and only few respondents in Chuko and Aruma were use communal dwellings. Separate house can not only protect the animals from the vagaries of nature but also protect them from thefts and predators. This separate housing condition in the current study was different from result reported by Asrat *et al.* (2012) reported that animals were housed together with the family in fear of thieves in Boditti district, southern Ethiopia. In the current study area, most of the respondents use concrete floor for their cattle house and few respondents use earthen floor. They have feeding and watering trough which made from concrete and wood. They also use the house for keeping cattle half of a day and for the whole night separately.

Table 5. Water source and watering frequency

Water Source	Lists of Kebeles									
	Abaye (%)		Aruma (%)		Chuko (%)		W/kachama (%)		Overall mean (%)	
	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS
River	93	6.7	67	20	70	13	60	0	70	10
Pond	0	27	6.7	20	6.7	33	10	13	13	28
Pipe	6.7	47	20	53	20	33	20	33	13	42
Stream	0	20	6.7	6.7	3	20	10	33	3	20
Watering frequency/day										
Once	67	40	73	20	60	67	53	20	63	37
Twice	0	53	6.7	80	27	33	13	80	12	62
Once/two days	33	6.7	20	0	13	0	33	0	25	1.7

WS=wet season DS= dry season

Milk Production Performance of Dairy Cattle and Lactation Length

The daily milk yield and lactation length of local and crossbred cows of the study area are indicated in Table 11. The average daily milk yield was significantly ($P < 0.001$) different between breeds. The average daily milk yield of local dairy cow was higher in Abayekebele than the other contemporaries and the Average daily milk yield of crossbred cattle was higher in Chuko followed by Abaye and Waterakechama. The average daily milk production of crossbred in the study area was 6.02 liters with maximum of 9.59 liters. But the average daily milk of local breed was lower and this indicates that still local breed cattle need more genetic improvement for milk production.

The present study was similar with the result of Debir (2016) which is about 1.54 liter for local cow but higher for crossbred. The present study was smaller with the report of Bainesang(2015) with average daily milk yield of 2 and 8.98 liter for local and crossbred dairy cows, respectively. This difference may be due to genetic difference and level of management.

The lactation length of local and crossbred dairy cattle in the study area was 7.21 and 8.01months, respectively. The present study was similar Baineseng (2015) for local breed with overall mean lactation length of 7.64 months but lower than crossbred with value of 10.08 months. Debir (2016) in sidama zone reported similar lactation length for

local breed cow with 7.38 months but higher for crossbred (9.83 months). The lower average lactation length in the current study may be attributed to genetic and environmental factors.

Table 6. Average daily milk yield and lactation length of local and crossbreds in the study area

Milk yield			
Kebele		Breed	
Abaye	4.24	Local	1.38 ^b
Aruma	2.00	Cross	6.02 ^a
Chuko	5.07	p-value	< 0.001
Watera/k	3.50	SL	***
p-value	0.108		
SL	NS		
Lactation length (in months)			
Kebele		Breed	
Abaye	7.80	Local	7.21 ^b
Aruma	7.53	Cross	8.01 ^a
Chuko	7.66	p-value	< 0.0001
Watera/k	7.46	SL	***
p-value	0.445		
SL	NS		

Reproduction Performance of Dairy Cattle

The reproductive performances of dairy cattle in the study area are shown in Table 12. The current result show that there was significant (< 0.001) different between breeds in age at first service (AFS), age at first calving (AFC) and calving interval (CI) and hence AFS, CI of local cows and AFS of local bull were higher than crossbred. This is because crossbred has high feed conversion efficiency and as a result, they grow faster than the local breed and reach at puberty earlier and conceive with less delay. The result of the present study reveals that both age at first service and age at first calving were smaller than the result of Debir (2016). But it is higher than that of Ahmed *et al.* (2017) with average AFS 22.6 months for Ethiopian zebu cattle.

Table 7. Reproductive performance of local and crossbred cattle in different kebeles of the study area

Effect=BREED				
AFSM (months)	ASFF (months)	AFC (months)	CI (months)	
Cross	34.55 ^b	29.60 ^b	38.60 ^b	11.82 ^b
Local	42.57 ^a	39.07 ^a	48.02 ^a	13.33 ^a
CV	4.61165	7.09184	5.66938	15.7595
SL	***	***	***	***
Effect=KEBELE				
	AFSM (months)	ASFF (months)	AFC (months)	CI (months)
Abaye	37.07 ^c	34.47 ^a	43.37 ^{ba}	12.2
Aruma	38.73 ^b	35.80 ^a	44.80 ^a	12.4
Chuko	40.03 ^a	34.27 ^{ba}	43.27 ^{ba}	12.37
W/K	38.40 ^b	32.80 ^b	41.80 ^b	13.33
CV	4.61165	7.09184	5.66938	15.7595
SL	***	***	***	NS

Where ASFF= Age at first service for female. AFSM = Age at first service for male. AFC= Age at first calving. CI= calving interval. W/K= waterakeachemakebele.

Breeding Practice of Cattle in the Community

Mating System and Source of Breeding Bull

The mating system and source of breeding bull in the study area are presented in Table 13. Natural mating, AI

service, natural mating combination with AI, natural mating with hormone and AI with hormone were the different methods of mating system identified in the current study area. The mating systems in the current study were consistent with Bainesang (2015) and Debir (2016) in West Shoa and Sidama zones, respectively. However, majority of the respondents in the study area were practiced natural mating and few practiced AI with estrous synchronization. Due to unsuccessful conception of AI service, most of the respondents mate their cross and local bred cows using crossbred sire through natural mating. The present study was different from Dastalem (2015) in which AI is the dominant mating/breeding practice in central zone of Tigray.

In the study area there were different source of breeding bull. As shown in Table 13 source of breeding bulls for most respondents were bull from neighborhood with payment. As Respondents explained if there was no breeding bull in their kebele they search from other kebeles even from other district. In the study area most of the respondents used controlled natural mating with bull except Arumakebele. In this kebele uncontrolled mating was common due to interaction of different house hold herds in the communal grazing

Table 8. Mating system and the source of breeding bull

Mating systems	Lists of kebeles				overall mean (%)
	Abaye (%)	Aruma (%)	Chuko (%)	W/kachama (%)	
Natural Mating (cross)	40	13.3	40	33.3	31.7
AI and Natural mating	46.7	46.7	26.7	40	40
AI only (exotic)	6.7	13.3	20	13.3	13.3
AI with hormone	6.7	13.3	6.7	6.7	6.7
Natural with hormone	0	13.3	6.7	6.7	8.3
	source of breeding bull				
Their own	13.3	33.3	13.3	6.7	16.7
Neighbor freely	26.7	6.7	20	0	13.3
Neighbor with payment	33.3	40	40	66.7	45
Private freely	20	13.3	13.3	13.3	15
Private with payment	6.7	6.7	13.3	13.3	10

AI= Artificial inseminations. W/kachama= wotarakachama

Farmers' Awareness on AI and AI Service Delivery

The awareness, participation, and time of AI service in the study area are presented in Table 14. Majority of the respondents have knowledge and information about importance of AI but most of them did not know the critical time of standing heat of cow. In most respondents can (66.7%) have gotten AI service regularly but after 1st AI service the respondents which were the owner of the animal shift the mating to natural mating due to unsuccessful conception of the first AI service. The inefficiency of AI services is due to problem of heat detection, ineffectiveness of AI technicians, and unavailability of the service in weekends and holidays, shortage of inputs and a combination all. Solomon *et al.* (2016) reported the same reason as of the present study. From the survey reveals that they have information about the importance of AI technology but they have no information about critical time of stand heat. From most respondents took their animals to AI service center when the AI technician was available followed by immediately after heat detected on the cow. Hence, most of the respondents shift their mating method from AI to natural mating in next consecutive heat.

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 PGF2 α 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.

Table 9. Use, Participation and Time of AI Service in the study area

AI service	kebeles				overall mean (%)
	Abaye (%)	Aruma (%)	Chuko (%)	w/kachama (%)	
Get AI service regularly					
yes	53.3	73.3	73.3	66.7	66.7
no	46.7	26.7	26.7	33.3	33.3
If not get service on time					
Other 21 day	6.7	46.7	33.3	6.7	25
Using natural mating	93.3	53.3	66.7	86.7	75
Participate in of AI					
yes	80	73.3	46.7	93.3	73.3
no	20	26.7	53.3	6.7	26.7
Time of service					
Morning s/d	13.3	6.7	0	0	5
Afternoon of s/d	33.3	26.7	13.3	13.3	21.7
Morning of n/d	13.3	33.3	0	26.7	18.3
Afternoon of n/d	6.7	6.7	6.7	40	13.3
AIT available	33.3	26.7	46.7	46.7	38.3

AI= artificial insemination. AIT= Artificial insemination technicians. S/D= same day. N/D= next day.

Table 10. 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

The results on estrus response rate, interval to estrus after PGF2 α , 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 crossbred) cattle were responded to PGF2 α 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 PGF2 α , 76 of them become pregnant, thus the overall conception rate was 63%, which is higher than Dastalam (2015) and Abiyot and 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 crossbred 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 ($p<0.001$) different between local (71.96 ± 0.38) and crossbred (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.

Table 11. Estrus response rate, response interval, NSC and conception in dairy cattle

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

***= $p<0.001$, *= $P<0.01$, 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 Table 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 Tatak *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 become 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 (Martinez, (2000); Cartmill *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 1 hrs-

18hrs, and agree with the report of Abdul gaffer *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 (2001) and Debiret *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 Abyot and 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 12. Factors affecting first service conception rate (CR)

Dairy cattle Breeds		Cross	Overall mean	P-value
Local	CR (%)			
	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	0.054
3	70.6	75	72.8	
4	63.2	68	65.6	
Times of insemination				
4-10	33.6			0.90
11-18	80.8			
19-24	52.8			
Semen (semen from different bulls)				
1	67.9			0.23
2	78			
3	69.3			
4	28.7			
Artificial Insemination Technicians				
	Consumption/service	CR (%)		
1	21/37*	57		0.021
2	24/46*	50		
3	20/38*	53		

Conclusion and Recommendations

Proper animal selection, heat detection efficiency, farmers' awareness to detect heat and on time bringing of cattle for insemination should be satisfactorily considered for effective synchronization. In this cross-sectional study the effectiveness of PGF2 α 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.
- 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.
- Further study on site of semen deposition, insemination season; and on the quantity, quality and preservation of semen should also be conducted.

Contribution by authors

All the authors contributed equally to writing the manuscript. The final manuscript was read by all others and consented to publication.

Conflict of Interests

There is no conflict of interest.

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