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TRADITIONAL DAIRY HUSBANDRY PRACTICES VIS-A VIS ESTRUS SYNCHRONIZED AND ARTIFICIALLY INSEMINATION ON DAIRY CATTLE PERFORMANCES IN ETHIOPIA

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This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study was conducted with the objective to assess breeding and husbandry practices of dairy cattle and to evaluate estrus synchronization and artificial insemination (AI) services of dairy cattle. Data were collected using a semi-structured questionnaire, retrospective study, field monitoring and a participatory farmers' group discussion. A total of 180 respondents were randomly selected from the two districts (90 from each). For retrospective study; data were collected on productive and reproductive performance of 911 dairy cattle from record books of the AI centers for the 2017 to 2018 period. Field monitoring was conducted for 3 months on 80 cows. The dairy cows or heifers were selected purposively from kebeles and households. The data obtained from the survey were analyzed using (SPSS version 20) and the data from the retrospective study and field monitoring were analyzed using (SAS version 9.1). For quantitative data obtained from the field monitoring general linear model procedure of the statistical analysis system (SAS version 9.1) was used. The Natural pasture was the dominant feed source in highlands whereas non-conventional feed was the dominant feed source in midl-altitude [1-3]. Farmers keeping Holstein Friesian and jersey breeds gave slightly higher priority to milk production for cash income, whereas those keeping local cattle breeds gave higher priority to milk production for own consumption. The average age at first calving for native and crossbred cows was 56.48±0.88 and 48.66±8.07 months respectively. AI was the dominant mating system (70.0%) followed by the

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natural mating system (21.7%). The main reasons for the presence of less satisfaction on AI service were heat detection problem followed by disease, absence of AI technician's efficiency and distance of AI center [4-6]. Around half (48.3%) of the respondents have medium satisfaction with AI service and synchronization programs. The overall conception rate and number of service per conception were 77% and 1.3% respectively. For our findings, it can be concluded that selecting animals with appropriate age, body condition score (BCS) farmers' awareness to detect heat and on-time insemination were important factors for improving the efficiency of synchronization program.

Keywords: AI; breeding practice; dairy cattle; estrus synchronization; PGF2α.

1. INTRODUCTION

Agriculture is the major economic activity in Ethiopia and it accounts for about 42% of the national Gross Domestic products (GDP). Among the agricultural activities, livestock plays a significant role in the economy, social and cultural value and it link to the economy by generating income and satisfying the food needs of the people [7]. It is well-known that livestock products and by-products supply the wanted animal protein and energy to the improvement of the nutritional status of the people [8].

The cattle population of Ethiopia is ranked first in Africa and it is estimated at about 60.39 million. Out of this, the female cattle constitute about 54.68 % and about 98.24% of the total cattle in the country are local breeds and the remaining are hybrid (1.54%) and exotic (0.22%) breeds [7]. The zebu cattle are predominantly found in Ethiopia, which provide milk, meat, draught power and manure for fertilizers and fuel (FAO, 2010). The productivity of these zebu cattle is low due to their genetic makeup, low level of inputs, diseases and traditional husbandry practice [9].

In dairy cattle breeding, most of the dairy farmers in the highland, mid-altitude, and lowland areas of Ethiopia use natural mating and some farmers use AI. The farmers also preferred seasons for mating for their dairy cattle. These allow the calving falls during the wet season to take the advantage of abundant feed supply [10].

The reproductive performance of dairy cows is one of the important factors and it influences a herd's profitability [11]. In Ethiopia, dairy production is still in an extensive system and daily milk production of indigenous cows is 1.37 liters/day [7]. The introduction of reproductive techniques such as AI and oestrus synchronization solves the limiting factors of dairy sectors and facilitates the genetic improvement of the dairy herd [12].

Artificial insemination is a proven bio-technique and is used globally to improve the genetic makeup and to improve the productive performance of cattle [13]. However, the problems associated with AI includes technical limitation, lack of transport facility and poor quality of semen, poor heat detection, and unavailability of the service for working hours [14].

Estrus synchronization program is being practice for the past 25 years to make AI more and efficient. For successful synchronization good management, cows having regular estrous cycles, and in good BSC.

Unfortunately, the efficiency of the AI in dairy cattle in Ethiopia is lowest among the developing countries which might be due to poor heat detection and improper timing of insemination besides inadequate infrastructure and managerial constraints [15]. One of the ways to overcome the challenges of low conception rates and less efficient Artificial insemination service is by using hormones for estrous synchronization thus facilitating the practical use of artificial insemination that can positively influence the productive and reproductive efficiency of dairy cattle [16]. At the same time there is a lack of awareness and evaluation of mass synchronized and inseminated dairy cattle in the area. Also there is a lack of knowledge on infertility, misconceptions on estrus detection and AI in dairy cattle [17-19]. Thus, the present study was to assess breeding and husbandry practices of dairy cattle and to evaluate the management and performance of heat synchronized and artificially inseminated dairy cattle in two districts of Kembata Tembaro Zone.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in the Hadero-Tunto and Doyogena districts of the Kambata Tembaro zone in South Nation Nationalities and Peoples Region, Ethiopia. The geographical location of the zone is between the latitude of 7º10′ –7º50′ N and 37º34′-38º07′ E longitudes. The total population of the Kembata-Tembaro zone is 841,663 with its

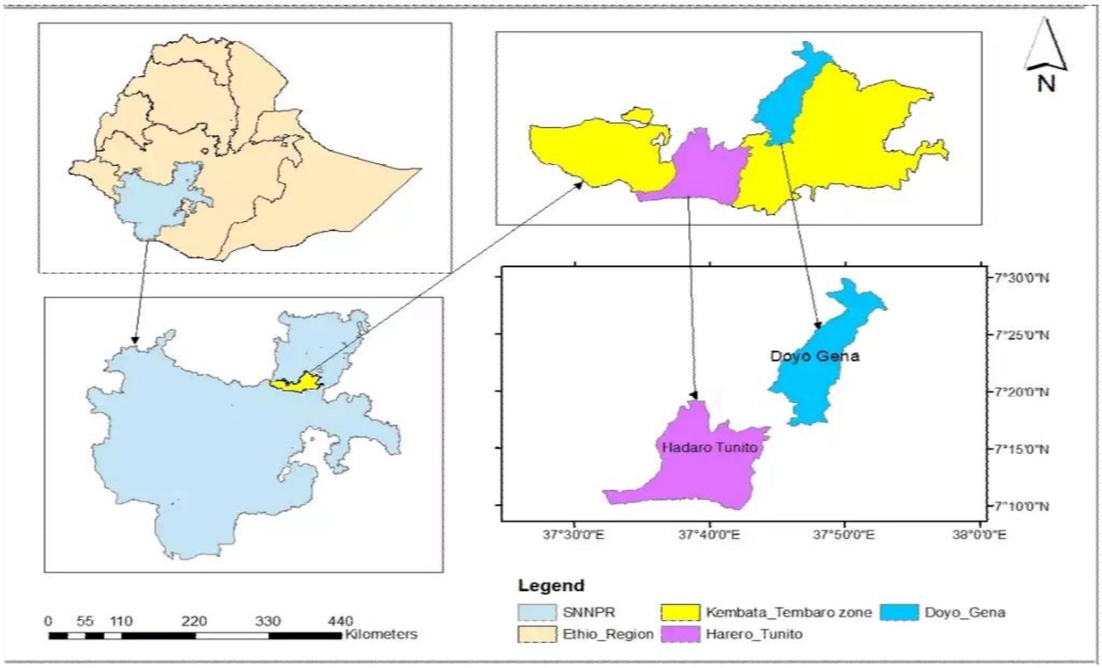

Fig. 1. Location Map of Study Areas

Table 1. Number of sampled households from each kebele

Kebele	Total households	Sample size
Sodicho	631	26
Tunto-01	589	25
Ha-chacho	812	34
Zararo	909	38
Amecho	718	30
Dinika	653	27
Total	4312	180

population density of 504.3 inhabitants per square kilometers [20].

2.2 Methods of Sampling

The districts were selected purposively based on agro ecological difference, availability of long lasted artificial insemination service, the number of synchronized dairy cows, the attitude of farmers to adopt estrus synchronization and mass insemination technology. From each district three kebeles were selected randomly. The total sample size was determined by the following formula [21].

$$\text{Total sample (n)} = \frac{z^2 p(1-p)}{e^2}$$

Where: - n = the sample size for research use.
Z = confidence level which is 95% (i.e 1.96)
p = proportion of households.
e = margin error (Which is 5%)

$$n = \frac{(1.96)^2 \times 0.865\,(1-0.865)}{(0.05)^2} = 180$$

2.3 Methods of Data Collection

2.3.1 Semi-structured Questionnaire

A semi structured questionnaire was prepared and during the interview process, every respondent included in the study was informed about the objective of the study before starting presenting the actual questions. Information on household characteristics, livestock holding, husbandry practices(feed source and feeding system, source of water and distance of water source from home, housing practices), breeding practice (mating system, selection criteria, trait preference), productive and reproductive performance of dairy cattle, major constraints of dairy cattle production were collected using structured and semi- structured questioners. The household survey was conducted on

180 households from both districts by using a set of a semi structured questionnaire. Relevant data were collected on: the purpose of livestock rearing, selection criteria and preferred traits, daily milk yield, lactation length, reproductive performance, source of breeding bull and mating system, awareness on heat detection, insemination and farmers acceptance related to mass synchronization, livestock feed types and housing system, source of water and distance of water from home, household structure and land holding size.

2.3.2 Group Discussion

Focus group discussions were held in each of the selected kebele by including youngsters, women, village leaders, and socially respected individuals who were known to have better knowledge of the present and past social and economic status of the study. These focus group discussions were conducted to strengthen the data obtained from the structured and semi-structured questionnaires. By using focus group discussion information like purpose of keeping dairy cattle, preferred traits, selection criteria of farmers for breeding dairy cattle, mating systems, and source of breeding bull were collected.

Primary and secondary data were collected from primary and secondary data sources using questionnaires, from the respective Districts' Office of Livestock and Fishery Development, and Field monitoring.

2.3.3 Secondary data collection

Secondary data were collected from the respective districts' offices of Livestock and Fishery Development.

The information for Mass Synchronization of Dairy Cows was obtained from records of AI centers of both districts. The data from inseminated dairy cows were collected for 2017 and 2018 from the AI log book. From the secondary data, the dependent variables like conception rate (CR) and the number of services per conception (NSPC) were evaluated. Thus, data pertaining to 911 cattle included in the synchronization program were used in the study. From this recorded data, Age at first service (AFS), Age at first calving (AFC), CR and NSPC were estimated.

2.3.4 Field monitoring

To evaluate the effect of synchronization using PGF2α the total of 80 dairy cattle (40 cattle from each district) were purposively selected based on the absence of pregnancy, presence of functional corpus luteum (CL), age (4 to 9 years), parity (1^{st} to 5^{th} level), and BCS (2 up to 5 levels). A trans-rectal palpation examination was performed to confirm cows/ heifers with a functional Corpus Luteum. The cows were inseminated after they showed signs of heat that ranged between 24 to 120 hours post-PGF2α administration.

2.4 Data Management and Statistical Analysis

All collected data were fed to Microsoft Excel (2010). The qualitative data collected via survey questionnaire was processed in Microsoft Excel and analyzed for descriptive statistics using frequency procedure and cross-tabulation of (SPSS version 20.0) software. For analyzing quantitative data obtained from the retrospective study, the general linear model procedure of statistical analysis system(SAS version 9.1.2) software was used to evaluate productive and reproductive performance-related parameters of dairy cattle (daily milk yield, lactation length, Age at first calving, and age at first service). The variation between groups was considered significant when the P-value was less than or equal to 0.05. For evaluation of the effect of single-shot prostaglandin injection, the response variables were conception rate and estrus rate while the class variables used were body condition, breed of the dam, and parity, age, and time of insemination. Conception rate and service per conception were estimated from the proportion of pregnancies confirmed by the rectal palpation of the genital tract at day 90 of post insemination among the total number of cows (heifer) inseminated artificially with frozen semen in a specified period Sharifuzzaman *et al.*, [22**].**

Conception rate and number of service per conception were calculated as reported by Khatun et al., [23].

$$\text{Conception rate (CR)} = \frac{\text{The number of cows (heifers) pregnant}}{\text{The Number of cows inseminated}} \times 100$$

$$\text{Number of service per conception (NSPC)} = \frac{\text{total number of cows inseminated}}{\text{Total number of cows conceived}}$$

Indices were calculated to analyze the ranking of trait preference and efficiency of AI according to the method described by [24].

$$Index \;= \frac{5x1storder + 4x2ndorder + 3sx3rdorder + 2x4thorder + 1x5thorder\ individual\ purpose}{5x1st\ order + 4x2nd\ order + 3x3rd\ order + 2x4th\ order + 1x5th\ order\ overall\ purpose}$$

3. RESULTS AND DISCUSSIONS

3.1 Dairy Cattle Management Practices

3.1.1 Feed resources and feeding system

The results in (Table 2) indicated that feeding practices were not different across the agro- ecologies and seasons but improved forage showed significant differences (P<0.05) across agro-ecology and seasons. Based on focus group discussion, natural pasture was the dominant feed source- at highlands followed by crop residue and non-conventional feed whereas in mid-altitude non-conventional feed was the dominant feed source- followed by improved forage. Crop residue in the highlands was a major feed resource due to the fact that more arable lands are utilized for crop cultivation like wheat and barley. Improved forage feed utilization was higher during the dry season in a highland while, good contribution had been practiced during the wet season in mid-altitude attributed but in highland, the season is very cool that help to the exuberant vegetation to be grown. The improved forage types used in the study area were Elephant grass (*Pennisetnm purpureum*), Desho grass (*Pennisetum pedicellatum*) and green maize stover (*Zea mays L.*). Whereas, Non-conventional feeds such as; root, stem and leaves of enset and banana were used as animal feeds in the dry season. In mid-altitude the leave and stem of sugar cane was also used as feed source in the dry season. Wheat bran and wheat short were frequently used as supplementary feed in and around Hadero and Doyogena towns. This study was in agreement with the study of [25,26] in Adigrat, northern Ethiopia and in Burji woreda, Segen Zuria zone of SNNPRS respectively.

3.1.2. Housing management

The Housing system for dairy cattle is shown in (Table 3). The result indicated that around half of the respondents housed their animals in the night together with household members within one house. In some parts of the study area, the respondents housed their cattle separately according to the cattle type. This separate housing system was practiced mostly in urban and pre-urban areas. According to the respondents, cattle are housed together with the family because of fear of thieves, to protect animals from extreme environmental hazards, for ease of management practices such as feeding, watering, and milking. Some of the respondents housed their cattle together with the family because of the inability to build separate houses. This housing system was not similar with Misganu [27], who described that most of the farmers housing their dairy cattle in a separate house constructed from the wooden wall with iron sheet roof in Jimma Zone of Oromia Regional State. The result of this study was similar to the study of Debir [28] it indicated that most of the respondents prefer rearing the cattle within their own dwellings.

Table 2. Feeding practice of sampled households in dry and wet season

Feed sources	Agroecology	Seasons Dry (%)	Wet (%)	p- value
	Highland(Doyogena)	52.7	53.2	0.231
Pasture land	Midaltitude (Hadero- Tunto)	47.3	46.8	
	Highland(Doyogena)	52.6	55.4	0.096
Crop residue	Midaltitude (Hadero- Tunto)	47.4	44.6	
Non-conventional	Highland(Doyogena)	56.3	48.1	0.052
feed	Midaltitude (Hadero- Tunto)	43.7	51.9	
Improved forage	Highland(Doyogena)	56.0	49.3	0.046
	Midaltitude (Hadero- Tunto)	44.0	50.7	
Supplementary	Highland(Doyogena)	47.5	55.0	
feed	Midaltitude (Hadero- Tunto)	2.5	45.0	0.227

Table 3. Animal housing system

How do you keep cattle	Agro ecology				Total	
	Hadero		Doyogena			
	N	%	N	%	N	%
separately according to the cattle breed	35	38.9	36	40	71	39.5
together with all native and crossbred cattle	12	13.3	5	5.6	17	9.4
together with family members within one house	43	47.8	49	54.4	92	51.1

N= number of respondents

Table 4. Source of water and distance of watering point from village

	Agro ecology				Total	
source of water for dairy cattle	**Mid-altitude**		**High land**			
	N	**%**	**N**	**%**	**N**	**%**
pond/dam	26	28.9	28	31.1	54	30.0
river	50	55.6	26	28.9	76	42.2
Rain water	13	14.4	36	40	49	27.2
pipe water	1	1.1	0	0	1	0.6
The distance of watering point from village						
Watered at home	39	43.3	68	75.6	107	59.4
<1km	42	46.6	21	23.3	63	35
1-5km	9	10	0	0	9	5
>5 km	0	0	1	1.1	1	0.6

N= number of respondents, Km=kilo meter

3.1.3 Source of water and distance of watering point from village

The water source for dairy cattle is shown in (Table 4). The findings indicated that most of the respondents used the river as the first source of water in the dry season followed by pond and pipe water. The respondents also used rainwater in the wet season. This result indicated that,- there is a high number of small rivers in the study area. The result of this study was in accordance with the previous reports [28,27] Sidama zone SNNPR, and Jimma Zone of Oromia Regional State respectively. The distance of the watering point from the village is presented in Table 7. The result revealed that most of the respondents water their cattle at home and some of the respondents water their cattle at a distance of <1km from their home. This indicated that there was available water source (small rivers) near their village. Even though the distance of water source near to their home (<1km), the frequency of watering was once a day.

3.2 Purpose of Keeping Cattle in the Study Area

The farmers keep cattle for different purposes. They keep their cattle for milk, traction, selling live animals (income generation) together. However, farmers attached greater importance to milk, meat, and traction together and milk, meat, traction, and selling live animals than any other stated reason (Table 5). From group discussion, farmers keeping Holstein Friesian and Jersey breeds give slightly higher priority to milk production for cash income, whereas those keeping local cattle breeds give higher priority to milk production for home consumption in both Hadero-Tunto and Doyogena districts. The farmers used their bulls for multiple purposes like for mating, traction, and selling them by fattening at a later age. Some of the respondents also keep Holstein Friesian and Jersey breeds for selling calves at an early age. This is for income generation purposes. The purpose of keeping dairy cattle in this study was in accordance with previous reports (Bainesagn 2015, Destalem 2015, Debir 2016, and Sharew 2018). , the primary reason for rearing cattle is milk followed by traction, and selling live animals [29, 30,28].

Table 5. Purpose of keeping cattle by the respondents

Purpose of keeping	**Agro ecology**					
	Mid-altitude Hadero-Tunto		**High land Doyogena**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
For milk	12	13.3	4	4.5	16	8.9
For milk and meat	2	2.2	3	3.3	5	2.8
For milk and traction	12	13.3	0	0	12	6.7
For meat and traction	0	0	1	1.1	1	0.6
For milk, meat and traction	32	35.6	67	74.4	99	55.0
For milk, meat and selling	2	2.2	0	0	2	1.1
For milk, traction and selling	10	11.2	2	2.2	12	6.6
For milk, meat, traction and selling	20	22.2	13	14.5	33	18.3
Total	90	100	90	100	180	100

N= number of respondents

3.3 Reproductive and Productive Performance of Dairy Cattle

The productive and reproductive performance of dairy cattle is shown in (Table 6). The result showed that the average age at first service for local breed dairy heifer was 47.40±8. 00 and the average age at first service for crossed dairy heifer were 39.52±8.70. The average age at first service was significantly different ($p<0.05$) across breeds. There was a significant difference ($p<0.05$) within crossed breed among two agro-ecologies. This implied that the best genotype in one environment is not the best in another environment. Thus, the environment had more effect than gene effects in the dairy animals. In addition, exotic breeds were originated in a temperate zone and well adapted to cold environment. Due to this reason, Holstein Friesian and Jersey cross was better in highland than mid-altitude. The average age at first service for local males was 45.39±4.67 and the average age at first service for crossed male was 40.74±4.20. Age at first service for males was significantly different ($p<0.05$) between breeds. There was a significant difference ($p<0.05$) within breed among the two agro-ecologies.

Age at first calving for local cows/heifer was 56.48±0.88 and age at first calving for crossed heifer was 48.66±8.07. There was a significant difference ($p<0.05$) between agro- ecologies. AFC obtained for local cattle in this study was longer than (49.08 months) result of Destalem [30] in the central zone of Tigray, northern Ethiopia. Similarly, the result of AFC for local heifer of this study was longer than results of Menal *et al.* (2011) with the report of age AFC for Fogera cattle was 50.8 (months). AFC for the cross breed cattle was longer than previous reports (Belay *et al.* [32], Demissu [32]). They reported the AFC of Horro X Jersey, Fresian X Zebu cattle at about 42.2 and 36, months respectively. But the AFC for a local heifer was shorter than the result of Ayantu et al. [33].

For optimum economic benefits, it is needed to have shorter calving intervals to achieve higher lifetime productivity of the female animal [34]. In this study calving interval (CI) for local and crossed cows/heifer was 1.56±0.05 and 1.42±0.06 years respectively. There was a significant difference ($p<0.05$) between breeds. The results of this study on CI were shorter than the previous study by Hunduma *et al [*35] with a CI of 372.8 days under smallholder conditions in Ethiopia. But the results of this study on CI were longer than the study by Nibret [36] with a calving interval of crossbred dairy cows in Gondar town, which was 12.9 months under Small Holder Conditions. However, CI tends to decrease as the exotic blood level increases. This might be attributed to genetic differences between the indigenous and exotic breeds and less attention given in management to the indigenous breeds as compared to exotic breeds. The longer CI indicative that, poor nutritional status, poor breeding management and artificial insemination service, longer days open, diseases, and poor management practices.

The average days open of local and cross dairy cattle was 9.94±0.58 and 6.57±0.42 months, respectively. The average days open of local and cross cow in both districts was significantly ($p>0.05$) different. The result of this study with reverence to days open was longer than the study of Sharew [37] in which the average estimated day’s open of local and HF cross was 6.12±3.285 and 5.12±3.775 respectively. The result of this study with respect to days open was shorter than the study of Belay *et al.* [31] with the average estimated day’s open of local and HF cross was 6.12±3.285. Feed shortage, silent estrus, and lack of proper heat detection might have contributed significantly to the long days open reported in this study. The Average days open in this study is in agreement with the result of Destalem [30] for local and cross dairy cattle the DO was 10.94±0.49 and 6.87±0.62 days receptively in the central highland of Ethiopia.

There was a significant difference ($p<0.05$) between local and crossed breeds on average milk yield per day and local dairy cattle gave 1.8±0.64 and 7.4±1.03 for the cross breed. Previous Studies [9,34] explained that daily milk yield (DMY) in a dairy cow is influenced by both genetic and environmental factors. The Average lactation length of local and crossed dairy cattle was 8.84±1.5 and 8.23±1.7 respectively. The lactation length was significantly different ($p<0.05$) within cross breed among the two agro-ecologies. This variation in lactation length with in cross bred was due to having shorter days open of cross bred in high land.

The frequency of milking was three-times per day at the early lactation period and two times per day at late lactation period which is at early morning, day time (half of the day) and late evening for three time lactation frequency and at early morning and late evening for two time lactation frequency. The results were in agreement with the study conducted by Destalem [30] on the Tigray region of northern Ethiopia.

Table 6. Reproductive and productive performance of dairy cattle

Factor	AFSF (month)	AFSM (month)	AFC (month)	CI(year)	DO(month)	DMY (liters)	LL (months)
Cattle type							
Local	47.40±8[a]	45.39±4.67[a]	56.48±0.88[a]	1.56±0.05[a]	9.94±0.58[a]	1.8±0.64[b]	8.23±1.7[b]
Cross bred	39.52±8.70[b]	40.74±4.20[b]	48.66±8.07[b]	1.42±0.06[b]	6.57±0.42[b]	7.4±1.03[a]	8.84±1.5[a]
Agro ecology*breed							
Local High land	48.11±7.96	45.87±2.6 6	56.97±3.98	1.54±0.04[a]	10.77±0.57[a]	1.63±0.52[b]	8.86±1.7
Local Mid altitude	46.68±8.04	44.91±6.01	55.98±3.96	1.45±0.07[b]	7.25±0.85[b]	1.96±0.7[a]	8.82±1.3
Cross High-land	37±7.33[b]	39.91±2.60[b]	44.86±8.4[b]	1.31±0.06[b]	6.44±0.8[b]	7.3±0.83[b]	8.63±1.5[a]
Cross Mid-altitude	42±9.18[a]	41.57±5.26[a]	48.24±8.07[a]	1.67±0.07[a]	10.36±0.79[a]	7.45±1.2[a]	7.82±1.7[b]

Where, AFC=age at first calving, AFSF =age at first service for female,
AFSM= age at first service for male,
CI =calving interval, DO=days open,
DMY= daily milk yield, LL=lactation length,
P<0.05a, b, values across column for a trait

Table 7. Mating system and Source of breeding bull

	Agro-ecology							
Mating system	**Mid altitude(n=90)**		**Highland (n=90)**		**Average(n=180)**		**X^2**	**P value**
	N	**%**	**N**	**%**	**N**	**%**	**16.76**	**0.0001**
only AI	57	63.3	69	76.7	126	70.0		
Natural mating	20	22.2	19	21.1	39	21.7		
both AI and natural mating	13	14.5	2	2.2	15	8.3		
Source of breeding bull							16.76	0.0001
Own	34	37.8	55	61.1	89	49.4		
village/neighbors	40	44.4	15	16.7	55	30.6		
Kebele center	16	17.8	20	22.2	36	20		

N=number of respondents

3.4 Breeding Practices

3.4.1 Mating system and Source of breeding bull

The results pertaining to the mating system and source of the breeding bull is presented in (Table 7). The Mating system and source of the breeding bull were highly significantly different (p<0.01) between the agro ecologies. The result showed that AI was the common practice of mating in the study area followed by the natural mating system. According to the respondents and focus group discussion the reason for use of AI service in both study areas is due to the closeness of the AI station to their village. The results also indicated that 61.1% of the respondents in a highland owned bull for mating and 44.4% of the respondents in mid-altitude depended on bulls reared by their neighbors/ Village. This might be because of access to good performing mating bulls for farmers and the improved bull station in each kebeles of both districts. This improved bull (HF and Jersey breed) at the kebele center was managed by the animal and fisheries' resource development office of respective districts.

3.4.2 Trait preference of respondents for dairy cows/heifers

The trait preference of the respondents is shown in the (Table 8) and (Table9), respectively. The result indicated that almost all of the respondents (93.3%)

prefer trait of milk first followed by the trait of disease resistance, coat color, good temperament and high growth rate in the Hadero-Tunto district. Also, 92.2% of the respondents select milk trait first for selecting calves of next generation followed by the trait of breeding ability, high growth rate, and trait of good temperament in Doyogena district. This indicated that most of the farmers rear their cattle for dairying purposes.

During group discussion with farmer's selection of dairy cattle with high milk production was applied to achieve the need for milk for home consumption and to receive additional income by selling butter. In the study area selling raw milk on market was considered asocial taboo. Thus churning of milk is undertaken usually by locally available materials. The local cattle with high quality and quantity of butter are preferred more. This study is consistent with Demissu [32] under smallholder Horro cattle owners in central Ethiopia where milk is only used for home consumption and selling milk is considered asocial taboo.

3.4.3 Trait preference of respondents for breeding bulls

The trait preference - for breeding male's v is shown in -Table 10-. The findings indicated that trait preference was based on multiple traits and not only based exclusively in the dominance of a single trait. The preferred traits for selecting breeding bull were size or appearance followed by color, family history, libido, presence of horn, disease resistance and scrotal circumference. The result of this study was consistent with the study of Misganu [27] explained that ranking of trait preference in the Jima zone of the Oromia region based on multiple traits and family history and size/appearance is a significant trait for selecting a breeding bull. The other trait preference of male animals was libido which is sexual urges of male animals during mating with female animals in the herd. These findings indicated that the ranking of trait preference of breeding male was, mostly based on size/appearance followed by Coat color and family history for milk but scrotal circumference and Disease resistance was the least preferred in the study area.

Table 8. Trait preference - for dairy cows/heifers in the study area (Mid-altitude)

Parameters	Agro ecology Mid-altitude(Hadero-Tunto)								
	rank 1	rank 2	rank 3	rank 4	rank 5	rank 6	rank 7	Total rank	Index
trait of milk production	93.3	4.5	2.2	0	0	0	0	1	0.25
trait of breeding ability	0	8.9	53.3	18.9	6.7	4.4	7.8	3	0.15
trait of high growth rate	1.1	30	23.3	27.8	7.8	8.9	1.1	2	0.16
trait of feeding behavior	0	6.7	3.3	7.8	34.4	18.9	28.9	6	0.09
trait of good temperament	1.1	12.2	7.8	8.9	32.2	31.1	6.7	5	0.12
trait of coat color	1.1	10	5.6	4.4	11.1	34.4	33.3	7	0.09
trait of disease resistance	3.3	27.8	4.4	32.2	7.8	2.2	22.2	4	0.14

Table 9. Trait preference = for dairy cows/heifers in the study area (high land)

	Agro ecology High land(Doyogena)								
Parameters	rank 1	rank 2	rank 3	rank 4	rank 5	rank 6	rank 7	Total rank	index
trait of milk production	92.2	3.3	0	2.2	0	0	2.2	1	0.24
trait of breeding ability	2.2	23.3	30	34.4	7.8	2.2	0	3	0.17
trait of high growth rate	2.2	33.3	51.1	7.8	4.4	1.1	0	2	0.19
trait of feeding behavior	0	2.2	5.6	12.2	25.6	34.4	20	6	0.09
trait of good temperament	2.2	2.2	2.2	8.9	42.2	35.6	6.7	5	0.10
trait of coat color	0	1.1	2.2	5.6	13.3	21.1	56.7	7	0.06
trait of disease resistance	1.1	34.4	8.9	6.7	6.7	5.6	14.4	4	0.15

Table 10. Trait preference - for breeding bulls –

Parameters	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Total rank	Index
size/appearance	167	7	2	2	0	0	2	1	0.2
family history for milk	2	29	75	48	13	6	7	3	0.13
Coat color	3	57	67	32	11	9	1	2	0.14
Disease resistance	3	8	8	18	54	48	44	6	0.07
Presence of horn	3	13	9	16	67	60	12	5	0.09
SC	1	10	7	9	22	50	81	7	0.06
Libido	4	56	12	55	13	7	33	4	0.11

SC=scrotal circumference

Table 11. Satisfaction level of farmers on management of cows/heifers in artificial insemination service before and after the introduction of the oestrus synchronization program

	Doyogena				Hadero- Tunto							
Level	**Before**		**After**		**Before**		**After**		**Total**		**X^2**	**P-value**
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**14.24**	**0.003**
Low	6	19.4	16	27.1	17	48.6	29	52.7	68	37.8		
Medium	21	67.7	31	52.6	16	45.7	19	34.6	87	48.3		
High	4	12.9	12	20.3	2	5.7	7	12.7	25	13.9		

Table 12. Reasons for absence of high levels of satisfaction with AI service (mid altitude)

Reasons	**Agro ecology Mid- altitude (Hadero-Tunto)**							
	rank 1	**rank 2**	**rank 3**	**rank 4**	**rank5**	**rank 6**	**index**	**rank**
Heat detection problem	77.8	15.6	5.6	1.1	0	0	0.27	1
AIT efficiency	5.6	10	41.1	25.6	16.7	1.1	0.17	4
Distance of AI center	13.3	5.5	4.4	22.2	46.7	7.8	0.14	5
Absence of AIT	1.1	23.3	28.9	28.9	17.8	0	0.17	3
Disease problem	2.2	44.4	18.9	21.1	8.9	4.4	0.19	2
Other problem	0	1.1	1.1	2.2	8.9	86.7	0.06	6

Table 13. Reasons for absence of high levels of satisfaction with AI service (high land)

Reasons	**Agro ecology High land(Doyogena)**							
	rank 1	**rank 2**	**rank 3**	**rank 4**	**rank5**	**rank 6**	**index**	**Rank**
Heat detection problem	78.9	6.7	8.9	3.3	0	2.2	0.26	1
AIT efficiency	8.9	16.7	33.3	34.4	4.4	2.2	0.20	4
Distance of AI center	1.1	10	8.9	7.8	72.2	0	0.12	5
Absence of AIT	5.6	31.1	26.7	28.9	6.7	1.1	0.18	2
Disease problem	5.6	35.6	22.2	22.2	14.4	0	0.19	3
Other problem	0	0	0	3.3	2.2	94.4	0.05	6

3.5 Satisfaction Levels of Farmers on AI and Reasons for Absence of High Satisfaction with AI Service

3.5.1 Satisfaction levels of farmers on AI

The levels of satisfaction by the farmers on AI service are showed in Table 11-. The Satisfaction level of AI beneficiaries was highly significantly different ($p<0.01$) before and after the introduction of the oestrus synchronization program -. The overall satisfaction of farmers for AI before and after the introduction of the oestrus synchronization program was 37.8, 48.3, and 13.9% low, medium, and high respectively. The majority (48.3%) of AI service beneficiaries had good/medium perceptions of AI. This might be due to creation of awareness of AI service. During group discussion with farmers the major reasons for the absence of high level of satisfaction on AI were failure of response for hormone treatment due to low efficiency of AIT, low dose of hormone, and injection of expired hormone. Thus the farmers had developed a lack of trust in inseminators and developed ambiguity on the efficiency of AI after synchronization. This result is in accordance with previous reports Destalem, 2015.

3.5.2 Reasons for absence of high levels of satisfaction with AI service

The Reasons for the absence of high levels of satisfaction with AI service are presented in -Table 12 and Table 13. The result indicated that the main reason in the study area was heat detection followed by disease problem, absence of AIT, AIT efficiency, and distance of AI center for the home. During group discussion, they informed that the main reason for the failure of AI was the heat detection problem due to silent ovulation. This finding was in accordance with that observed by Belay *et al.* [31] who reported the feed shortage, silent estrus and lack of proper heat detection might have contributed considerably to the long days open reported in cows in Jimma Town, Oromia, Ethiopia. Our result was also similar with the reports of Azage *et al.* [38]. The low percentages of conception rate were associated with heat detection problems by farmers, distance from AI service centers, and poor husbandry practice employed by the respondents [38].

3.6 Factors affecting conception rate and the number of services per conception of cows with estrus synchronization and Mass Insemination (OSMI).

3.6.1 Effect of districts and breed on conception rate and NSPC

The effects of district and breed on conception rate and the number of services per conception are shown in Table 14-. The result indicated that there was a significant difference ($p<0.05$) between districts on conception rate. The conception rate in the Doyogena district was higher than the Hadero-Tunto district. The reason for this variation might be - awareness creation about estrus synchronization in the Doyogena district. Our result is in accordance with previous reports – [30]. The experience, commitment and acceptance of the technology by AI technicians might be attributed to the difference in conception rate in Ahferom, Adwa, and Laelay michew district in the Tigray region of northern Ethiopia.

The conception rate and NSPC of crossbreds- were relatively higher than local breed. This difference might be attributed to the difference in management practice. Cross breeds were given more attention than local breed because of their higher milk yield. This study was consistent with the previous report study of -Destalem, (2015). They stated that Friesian cross cows/heifers were relatively higher than that of local cows in northern Ethiopia and Crossbreds breed Conception rate is higher than local breeds in Tanzania respectively.

Table 14. Effect of districts and breed on conception rate and NSPC

Parameter	N	NPT	PPT	CR%	NSPC	X^2	P value
District							
Doyogena	456	96	360	78.94	1.27	1.101	0.037
Hadero-Tunto	455	109	346	76.04	1.31		
Breed							
Holstein cross	84	15	69	82.14	1.27	2.039	0.045
jersey cross	584	129	455	77.91	1.28		
Local	243	61	182	74.89	1.33		

Where; N= Number of cows, NPT= negative pregnancy test, PPT =positive pregnancy test, CR= conception rate, NSPC= number of service per conception

3.6.2 Effect of age on Conception Rate and Number of Service per Conception (NSPC)

The effects of age on CR and NSPC are presented in Table 18. The result indicated that the CR increases with age from 4 until - age 7 years but decrease starting from age group of 8 years. The highest CR was observed on cattle with 7 age followed by age 6. The lowest CR was observed in cattle with the age of 9. This indicated that the CR is lowest at the early age of dairy cattle. This is because feed or nutrition is not only used for reproductive purposes rather it is first and foremost used for growth after body maintenance. CR was also lower at the advanced age of cattle. This is because of a decrease in ovulation rate due to a lack of gonadotropin release from the pituitary. This result agrees with the result of Destalem [30] in which increasing CR with the increase of age from age 2 until 7 but decreases with age group more than 8 years.

3.6.3 Effect of parity on Conception Rate (CR) and Number of Service per Conception (NSPC)

The effects of parity on CR and NSPC are indicated in Table 18. The CR and NSPC with different parities ranged from 46.2 to 93 and 1 to 5.9 respectively. The cows inseminated at parity 2 scored the highest CR and lowest NSC. The cows inseminated at parity 1 scored the lowest CR and highest NSC.

The result of this study indicated that the CR increase as the numbers of parity increases and decreases at late parity. This study was similar with Destalem [30]. It stated that cows that received insemination at parity 2 showed the highest conception rate (41.48%) and lowest NSPC (2.41) and cows that received insemination at parity 4 showed the lowest conception rate (32%) and the highest NSPC (2.73).

3.6.4 Effect of Body Condition Score (BCS) on CR and NSPC

The effect of BCS on CR and NSC is shown in - Table 18. The highest CR scored the cows with a BCS of 5 and the lowest CR scored the cows with a BCS of 2. This indicated that the BCS is associated with the nutritional status of the cows. The cows with higher nutritional status return to estrus sooner than cows having lower nutritional status. Cows which had good, very good, and excellent body conditions may have a higher conception rate than cows which poor body conditions of dairy cows. The result of this study agrees with the study of Destalem [30] who indicated that Body condition score (BCS) is an indicator of the nutritional status of the cow and exerts a mark influence on fertility.

Table 15. Factors affecting conception rate and number of service per conception of Estrus Synchronization and Mass Insemination (OSMI)

Parameter	N	PPT	NPT	CR	NSC	X^2	P- value
Age						**40.179**	**0.0001**
4	234	45	189	19.23			
5	140	28	112	20.00			
6	201	63	138	31.34			
7	141	47	94	33.33			
8	46	11	35	23.92			
9	144	11	133	7.6			
Parity						**36.053**	**0.0001**
1	195	90	105	46.2	2.2		
2	132	123	9	93	1		
3	111	95	16	85.6	1.17		
4	301	183	118	60.8	1.64		
5	151	89	62	58.9	1.7		
BCS						**149.469**	**0.0001**
2	192	102	90	53	1.9		
3	294	235	59	79.9	1.25		
4	258	237	21	91.9	1.08		
5	167	156	11	93.4	1.07		
Insemination Time (hrs)							
24 to 48	167	67	100	40	2.49	38.789	0.0001
48 to 72	39	11	28	28	3.54		
72 to 96	442	82	360	19	5.39		
96 to 120	263	45	218	17	5.84		

Where; N= Number of cows, NPT= negative pregnancy test, PPT =positive pregnancy test, CR= conception rate, NSPC= number of service per conception

3.6.5 Effect of insemination time on CR and NSPC

The effect of time of inseminations on CR is shown in Table 24. The conception rate - was highly significantly (P<0.001) different among the time of inseminations. The current finding showed that the CR was highest when insemination was done between 24 to 48 hours after the onset of estrus. Insemination done between 48 to 72 hours had a higher conception rate as compared to after 72 hrs time insemination. However, a lower conception rate was observed when insemination was done between 72 to 96 hours and 96 to 120 hours after the onset of estrus.

The onset on set of estrus was determined by different physiological signs such as redness and swelling of vulva, discharges from vagina, decreasing feed intake and milk losses and etc. This - happened when the time increases, the heat period becomes decreases, so the conception rate may become low. The result - was in accordance with study of the Debir [28]. They reported a high -conception rate - when insemination was done between 13 to 72 hours after the onset of estrus, and a low conception rate - when insemination was done between 72 to 120 hours after the onset of estrus in Sidama zone at Dale woreda, Southern Ethiopia.

This finding was also in accordance with the Sinishaw [39]. They reported that animals should be inseminated between 24 hours after the onset of heat because late and early insemination may influence the CR of both the heifers and cows. Success in insemination timing is dependent upon a good heat detection program, nutrition and good cattle owner management.

4. CONCLUSIONS

It can be concluded that the main objective of breeding dairy cattle was the production of milk from crossbred cattle for income generation and milk from local cattle for home consumption. In addition, the breeding bull are for traction, mating, and selling by fattening at the end of using for traction power. Artificial insemination was the dominant mating system in Hadero-Tunto while natural mating was the dominant mating system in the Doyogena district. –Further, the uses of -technologies such as AI and oestrus synchronization improves the productive and reproductive performance of dairy cattle. However, selecting animals with appropriate age, BCS, parity), and efficient heat detection - for insemination were important factors for improving the efficiency of the oestrus synchronization program.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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