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Status of Artificial Insemination Service in Ada'a Distric Oromia Regional State Ethiopia

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Abstract

The study was conducted in purposively selected seven areas of Ada'a district, with the objective of assessing the status of Artificial insemination service and constraints associated with the service in the study area. Structured questionnaires were prepared to interview farmers, artificial insemination technicians, animal health, and production professionals to collect data on the status of artificial insemination services and constraints associated with the service. Also retrospective data on mass insemination and insemination done by traveling on request was taken from district artificial insemination center record book. According to the data obtained from district artificial insemination technician s record book there is increase in number of insemination 2011 to 2015. The result of the study showed that; artificial insemination was efficiently used in cross bread 150 (69.77%) rather than local breed 65 (30.23%) in intensive farming system 145 (67.44%). The overall finding on the service per conception reveals that most of the cows were repeat breeder; 91 (42.33%) conceive on third insemination, 88 (40.93%) conceive on second time of insemination and only 36 (16.74%) were conceived on first insemination. Regarding time of insemination, 142 (66.05%) of livestock owners inseminate their cow at right time of insemination but, the rest 73 (33.95%) of households inseminate their cows in wrong time. The most outstanding constraints of artificial insemination service were lack of service in the vicinity, low efficiency, poor estrous detection systems, low efficiency of artificial insemination technician, and price for artificial insemination, lack of infrastructure and sex of calves in order of their importance.

Keywords

Intensive farming • Cross breed • Constraints • Insemination

Introduction

Agriculture (mainly crop and livestock production) is the mainstay of the Ethiopian economy employing approximately 85% of the total population. Livestock production accounts for approximately 30% of the total agricultural GDP and 16% of national foreign currency earnings [1].

To assemble the increasing demand for milk and milk products, productivity and reproductive potential improvement of dairy cattle in the course of appropriate breeding program needs great attention. Intensification of the dairy farm and development of market and infrastructures play vital role [2].

The total cattle population for the rural sedentary areas of Ethiopia is estimated at 53.99 million, of which 55.48% are female and 44.52% are male [3]. Out of the total female cattle population, only 0.94% and 0.11% heads are hybrid and exotic breeds, respectively. This suggests that the total number of both exotic and hybrid female cattle produced through the cross breeding in the country is quite insignificant indicating unsuccessful cross breeding through Artificial Insemination (AI) [4].

Through the improvement of dairy cattle productivity, the use of superior dairy breeds for crossbreeding is widely accepted with the aim of combining the production and adaptability of specialized breeds of exotic and local breeds, respectively [5]. Local dairy cattle breeds of the country, swank special adaptive traits for disease resistance, heat tolerance, ability to utilize poor quality feed and soundly fit with local farmers farming condition, which they have acquired through natural selection via countless generations. They therefore, need relatively less environmental modification to achieve better productivity. On the other hand, the temperate livestock breeds, have the genetic capacity for higher production, but their performance under the existing environment is not much and they are often not viable [6].

AI has been defined as a process by which sperm is collected from the male, processed, stored, and artificially introduced into the female reproductive tract for the purpose of conception [7]. Semen is collected from the bull, deep-frozen and stored in a container with Liquid Nitrogen at a temperature of minus 196 degrees Centigrade and made for use. Artificial insemination has become one of the most important techniques ever devised for the genetic improvement of farm animals. It has been widely used for breeding dairy cattle as the most valuable management practice available to the cattle producer and has made bulls of high genetic merit available to all [8].

Gebremedhin has listed many advantages of AI including prevention of reproductive diseases, control of inbreeding, minimizing the cost of keeping bulls for natural service and others. Besides, the availability of accurate breeding records such as breeding dates, pregnancy rates, inter-estrus intervals, and days to first service used to monitor fertility are other advantages of AI [9].

Artificial insemination, however, has disadvantages that include poor conception rates due to poor heat detection and inefficiency of AI technicians, dissemination of reproductive diseases and poor fertility rates if AI centers are not equipped with appropriate inputs and are not well managed. Other disadvantages include high cost of production (collection and processing), storage and transport of semen, as well as budget and administrative problems and inefficiency of Artificial Insemination Technicians (AITs) [10,11].

In Ethiopia Artificial Insemination was introduced in 1938 in Asmara, Northen part of Ethiopia, which was interrupted due to the second world war and restarted in 1952 [12]. In 1967 an independent service was started in Northen Arsi Region, Chilalo Awraja under the Swedish International Development Agency (SIDA). Zewdie has described that the technology of AI for cattle has been introduced at the farm level in the country over 35 years ago as a tool for genetic improvement [12].

In Ethiopia AI with frozen semen contributed significantly to the cross breeding and up-grading of cattle. The National Artificial Insemination Center was established in 1981 with the mandate to serve at national level. The efficiency of the service in the country, however, has remained at a very low level due to infrastructure, managerial, and financial constraints

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and also due to poor heat detection, improper timing of insemination and embryonic death [13].

The center operates well-equipped semen processing laboratory and liquid nitrogen processing plants. Semen collection was based on exotic and indigenous as well as crosses of these breeds namely Friesian, Jersey, Brahman, Boran, Barka, Fogera, Horro, Sheko and crosses of 50% and 75% Holstein-Friesian and indigenous bulls. Total semen produced to date is 300,000 doses with maximum collection of 42,000 doses from a single bull [13].

Cattle's breeding is mostly uncontrolled in Ethiopia making genetic improvement difficult and an appropriate bull selection criteria have not yet been established, applied and controlled [14]. Although artificial insemination, the most commonly used and valuable biotechnology has been in operation in Ethiopia for over 30 years, the efficiency and impact of the operation has not been well-documented [7,15]. Reproductive problems related to crossbreed dairy cows under farmers' conditions are immense [16]. It is widely believed that the AI service in the country has not been successful to improve reproductive performance of dairy industry [9].

Despite the wide application and success of AI throughout the developed world, the success rate in African and other developing countries is still low owing to a number of technical, system related, financial and managerial problems [14].

The major factors that determine AI efficiency are heat detection skills, fertility level of the herd, semen quality, efficiency of inseminators, quality semen from a bull, the detection of estrus in the female, and the ability to properly place the semen in the reproductive tract of the female, the efficiency, capacity and commitment of AI centers in procedurally and ethically producing, processing, handling and distributing semen; the commitments and efficiencies of AITs; presence of appropriate breeding policy along with proper control of indiscriminate cross breeding and other factors [17].

There are no comprehensive assessment and evaluation made on the status and constraints of AI service delivery so far at smallholder conditions in Ada'a district. For sustainable AI service, assessment of the ongoing and last achievements of AI activity is the essential gap. This highlight illustrates that, there is a need to collect, analyses, and interpret data on the efficiency of AI service and constraints associated with it.

Therefore, the general objective of this research is, to assess the status of AI service, and associated challenges to come up with applicable and workable recommendations.

Materials and Methods

Description of study area

Ada'a district is found in Oromia regional state, East Showa zone, and located 47 km south east of the capital city Addis Ababa and 55 km west of Adama, the capital of East Showa zone. The area lies with altitudes ranging from 1592-2937 meters (m) above sea level with an average of 1896 m. The district is characterized by sub-tropical climate and receives an annual rainfall of 854-1130 mm with an average of 919 mm. In general, the main rainy season occurs between mid-June and September, followed by a dry season that might be intercepted by the short rainy season in February and March. Mean annual temperature ranges from about 8–28˚C. There are 27 kebele administrations in Ada'a district in addition to 9 urban kebeles in Bishoftu municipality with 20,362 households in urban kebeles and 17,490 in Bishoftu town [18].

Study design

The research was conduct in seven (Denkaka-Ude, Dembi-kurkura, GendeGorba, Godino, Kality, Bishoftu and Hidi) purposively selected areas of Ada'a woreda. The questionnaire formal was prepared to interview livestock owners on purposively selected areas. By simple random sampling method interview 215 AI serviced and 105 natural service used up on merits and demerits of AI service. Questioner was also prepared for AITs and interview 11AITs on the status and constraints of AI service. The retrospective data were collected from record of woreda AI center covering the period from 2011 to 2015 on mass insemination and total AI done by traveling on request from inseminator's record book. Data on mass insemination includes number of cows/heifers with hormone therapy, insemination and pregnancy examination was recorded.

Questionnaire survey

Structured questionnaires were prepared to interview to a total of 320 farmers, attendants' and managers to collect data on the status of AI services and constraints associated with the service. During the interview process every respondent included in the study was briefed about the objective of the study before presenting the actual questions. Then the questions were presented to the respondents and some of the information collected through interview was supported by observation. In the survey information on the developed questionnaires included address of the owner's, breed of animal, technique of service, failure to conceive and constraints AI service. The questionnaire also included survey regarding the advantage of AI for herd owners related to genetic improvement, milk quality and quantity.

Data analysis

All data collected from interview of farmers, AI technicians, animal health, and production professionals was entered in to Ms-Excel after the completion of data collection. Then the analysis work was done using SPSS (SPSS Statistics 17.0) and the result was put in frequency and percentage (descriptive statistics).

Results

In the retrospective study, data were collected from records of mass AI service covering the period from 2013 to 2015. Artificial insemination records were obtained from the inseminator's record book of district artificial insemination center (Table 1).

Table 1. Retrospective data on mass insemination obtained from district AIC.

Year	2011	2012	2013	2014	2015
Animals with hormonal therapy	264	261	590	600	1675
Number of animals inseminated	264	261	590	600	1492
PDX	211 (140+ve)	214 (138+ve)	258 (217+ve)	180 (107+ve)	-

PDX: Pregnancy Diagnosis

According to the data obtained from district AITs record book there is increase in number of mass insemination from 2011 to 2015. It is evident from Table 1 that animals with hormonal therapy increased steadily from 264 in 2011 to 1675 in 2015. Number of animal inseminated and pregnancy diagnosis data from 2011 to 2015 is also depicted (Table 2).

Table 2. Retrospective data on AI service done in five consecutive years.

Year	2011	2012	2013	2014	2015
Number of animals Inseminated	1400	1675	1888	2830	3320

In Table 2 it is observed that AI done per year increased from 1400 in 2011 to 3320 in 2015.

Response of livestock owners and AI technicians

From Table 3 the assessment of efficiency of AI between breeds is shown. According to the respondents, AI was efficiently used in cross breed 150 (69.77%) than local breed 65 (30.23%). Again it was noted that natural service was used by most of the respondents 80 (76.19%) for local animals .And only 25 (23.8%) of respondents used natural service for cross breed (Table 3).

Table 3. Status of AI in regard to management system and breed.

Technique of service		Breed		Management system		
		Cross	**Local**	**Intensive**	**SI**	**Extensive**
AI	215	150 (69.70%)	65 (30.23%)	145 (67.44%)	51 (23.72%)	19 (8.84%)
NS	105	25 (23.80%)	80 (76.19%)	31 (29.81%)	7 (6.73%)	66 (63.46%)
Total	320	175	145	176	58	85

AI: Artificial Insemination, NS: Natural Service, SI: Semi Intensive

The assessment of AI in regard to different farming systems shows that, more than half 145 (67.44%) of the respondents were from the intensive management system followed by semi intensive and extensive farming system recorded as 51 (23.72 %) and 19 (8.84%), respectively.

Table 4 shows the effect of AI in conception rate and sex of calves born and also shows how the respondents got AI service. Out of 215 respondents 91(42.33%) respondents mentioned that their cows needed 3x service to conceive, 88 (40.93%) respondents told that their cows required two service per conception, while 36 (16.74) respondents recorded that single service was sufficient to conceive (Table 4).

Regarding sex of calves born, 45(20.93%) respondents noted that the sex of calves was male and 32 (16.74%) respondents recorded sex of calves as female. The remaining 138 (62.63%) respondents told that both male and female calves were born.

Table 4 also shows that the way how the respondents got AI service.83.73% of respondents got service by calling to the AITs and 14.88% of the respondent serviced their animals at fixed centre. Only about 1.4% of respondents got service in daily round.

Regarding time of insemination the data gained from the study revealed that, if the cow shows estrus sign in the morning, 35 (16.28%) of the respondents inseminate their cows at early stage that is before or afternoon.142 (66.05%) of respondents inseminate their cows on the same day during evening. And the rest 38 (17.67%)of the respondents inseminate their cows on the next day.

Table 5 reveals different factors affecting conception of the animal. Amongst this, the time of insemination 61 (28.37%) was highest followed by heat detection problem 47 (21.86%), management problem 31 (14.42%), disease 26 (12.09%), sperm quality and unskilled technician 25(11.63% each) also contributed towards the failure of conception rate (Table 5).

Table 6 shows the major constraints of AI service. According to the 215 respondents 27.44% of respondents mentioned lack of service in the vicinity as a problem. 25.12% respondents told low efficiency of AI ,24.65% of respondents were not aware about AI service ,while 10.70% of respondents recorded expensive cost of AI, lack of infrastructure (7.44%) and sex of calve (4.65) as constraints (Table 6).

From Table 7 it is observed that out of 11 AITs only one technician was having more than 10 years' experience. 7 technicians had experience between 1to 5 years, whereas, 3 technicians had 5to 10 years of experience (Table 7).

Table 4. Effect of AI in conception rate, sex of calves born and service delivery.

Technique of service	**Conception rate**			**Sex of calves**		**Service delivery**		
	1x	**2x**	**3x**	**M**	**F**	**TR**	**DR**	**SP**
AI	36 (16.74)	88 (40.93)	91 (42.33)	45 (20.93)	32 (14.88)	180 (83.72)	3 (1.4)	32 (14.88)

Table 5. Factors affecting conception rate.

Factors affecting conception	**Number of respondents**	**Percent (%)**
Insemination time	61	28.37
Heat detection	47	21.86
Management problem	31	14.42
Genital tract disease	26	12.09
Unskilled technician	25	11.63
Sperm quality	25	11.63
Total	215	100

Table 6. Major constraints of AI services.

Constrains of AI	Number of respondents	Percentage
Lack of service in the vicinity	59	27.44
Low efficiency	54	25.12
Lack of awareness	53	24.65
Expensive cost	23	10.7
Lack of infrastructure	16	7.44
Sex of calve	10	4.65

Table 7. Status of AI technician's with regard to their work experience.

AITS work		
Number of AIT	**Experience year**	**Percentage**
7	1-5	63.64
3	5-10	27.27
1	>10	9.09
11	Total	100

Discussion

This study was conducted to assess the status of AI service in Ada'a district. Now days the use of AI service is increasing from time to time. Although the use of AI is on increase, there are constraints associated with AI service. Therefore the study was conducted to identify the problems and to come up with workable recommendations.

According to the data obtained from district AITS record book there is increase in number of mass insemination from 2011 to 2015. Mass insemination was started in 2011 in Ada'a district. Most of the time inseminations were conducted in peri urban and rural areas of the woreda. The data indicated in Table 1 shows the total number of AI done in consecutive five years. There is increase in the number of animals inseminated and conceived. Pregnancy diagnosis in most of areas was not conducted because of budget problem and in areas where pregnancy diagnosis was carried out most of the farmers did not bring their cows for pregnancy diagnosis. Most of AI is done during 2015 but pregnancy diagnosis was not conducted because of time constraint. Mass insemination helped to increase the use of AI service by creating awareness and viewing the advantage of AI.

In Table 2 it is evident that AI service increased from 2011 to 2015. This implies that livestock owners understand the benefit of AI. The data indicated in this table was done by woreda AITs in urban and peri urban areas of the woreda by traveling on request. The total number of inseminations undertaken annually does not exceed 40,000 [19].

AI service in Ada'a district is given by four service providers: public sectors service providers operated by woreda AIC, private AI service delivery enterprise, Ada'a dairy cooperative and farmer AIT [20]. The district AIC cover the most part of service provision in the area. It mainly works on synchronization in rural areas in daily round. In addition to synchronization, they also give service in urban and peri urban areas by traveling on request. There are four AITs in the woreda.

Ada'a dairy cooperative is one of the service giving units in the woreda which started its operation in 2003 by its own AITs. The cooperative give service for its members in and around Bishoftu. It also gives training on AI to increase awareness of the members at six month interval. The cooperative have one AIT.

The private and farmer AIT also play a great role in providing the AI service. Farmer AITs were trained by the woreda AITs to give service in rural areas. There are two farmer AITs working in rural area and two private AITs in urban and peri urban area.

The assessment of efficiency between breeds was noted by classifying service provided animals in to local, and cross breeds; from these dairy cows local and cross breeds using AI service were 30.23% and 69.77% respectively. According to the respondents AI was efficiently used by cross breeds than local breeds. Cross breed cow were owned by urban and peri urban farmers mostly, whereas, local breeds were owned by rural farmers. Most of the respondents having local breeds use natural service. This is because they do not know whether AI service given for local breeds, they are afraid that their cows may face difficulty at delivery (dystocia) and due to many engagements they do not monitor heat period. The result of this study was similar with the result of Woldu et al., who found, AI service users at the urban areas closely monitor the heat symptoms of the animals. On the other hand, farmers living in rural areas prefer natural mating than AI for rearing cattle and monitoring of heat in such system is quite difficult for the farmers as they are engaged in various farm activities [21].

In the present study, the status of AI service with regard to different farming systems i.e. intensive, semi intensive and extensive recorded was 67.77%, 23.72% and 8.84%, respectively. According to the survey majority of the livestock owners practice intensive management system especially for cross breeds because cross breed cows were unable to resist direct sun light and unable to walk longer distance. They use AI service because of their proper follow up of heat detection, timely insemination and they have awareness about AI.

The overall findings on the service per conception revealed that most of the cows were repeat breeder, i.e., 42.33% conceived on third insemination, 40.93% conceived on second time of insemination and only 16.74% were conceived on first insemination. The conception rate to first inseminations was within the range of Dessalegn who found the conception rates to first inseminations ranging from 7.14 to 40.23%. The number of services per conception is an indicator of reproductive efficiency/conception rates [22].

The factors leading to failure of conception were associated with problems like management problems (14.42%), heat detection problem (21.86%), time of insemination (28.34%), unskilled technician (11.63%), lack, sperm quality (11.63%) and genital tract diseases (12.09%).The present study also correlate with the findings of Bekana who observed high numbers of services per conception, poor semen quality, poor semen handling practices and poor insemination practices. Other reasons were such as discontinuation of incentives to AI technicians, season of breeding; management factors in relation to estrus detection, timing of insemination and skill of pregnancy diagnosis were also indicated by other reports [23].

20.93% of the respondents explained that the sex of calves born by AI were male, whereas, 14.88% of respondents said that the calves born were female. However, the remaining 64.19% of AI beneficiaries replied that, sex problem was not the major constraints of AI service. This result was relatively close with the result. In Ethiopia there is often complaint that AI causes imbalance between female and male ratio of calves born in which the latter exceeds in percentage which is against the interest of most of the beneficiaries [24,25].

From observational study of the researcher, male calves were frequently observed than females in the majority of AI beneficiaries household. But when considering the interest of AI beneficiary for sex partiality, femaleness was more attractive than maleness. Most AI beneficiaries would like to have female calf for reproduction and production purpose rather than male calf. Keeping male crossbred calf for breeding and other purpose is considered as a loss due to cost of feed, health related problems and housing limitation [26].

The awareness of AI beneficiaries' on time of insemination depended on sign of heat of dairy cattle. All dairy owners included in the study were found to have good knowledge of important heat signs such as bellowing, mounting, vaginal discharge, decrease feed intake, decrease milk production and restless but, it was observed that dairy owners consider continuous bellowing and mounting as prominent indicators of the proper

time for insemination. If the cow shows oestrus signs at morning most of the owners (55.81%) inseminated on the same day during evening which is the right time of insemination. However, if the cow showed heat at morning, 29.30% of the respondent inseminated their cows at early stage, and the rest 14.88% of the respondents inseminated their cows on the next day, which is wrong time of insemination. In general, more than half of the respondents inseminated their cows at the right time but the rest inseminated at wrong time.

In the cow, maximum fertility has been achieved if inseminated from mid estrus to the end of estrus [24-26]. If the animals are inseminated at proper stage of heat, the chances of conception are more; if the animals are inseminated at early or late stage of heat, the chances become bleak [25].

Although, farmers used different methods of heat detection, they were incapable of differentiating the time of insemination based on PM-AM rule due to poor perception about times of insemination. Therefore, the beneficiaries exposed to loss of time, money and energy to perform AI at the center repeatedly. Hence, in addition to artificial insemination technician's efficiency, the perception of cattle owners have to be considered enough for better understanding of insemination time of their cows [27].

Table 4 shows that the way how the respondents got AI service. 83.73% of respondents got service by calling to the AIT and 14.88% of the respondent serviced their animals at static point in rural areas especially from clinic or other collection area. Only about 1.4% of respondents got service in daily round i.e. farms having their own AIT.

The major constraints of AI delivery system presented in their order of importance were lack of service in the vicinity, low efficiency, poor estrous detection systems, efficiency of AIT, price for AI, lack of infrastructure and sex of calves. According to Hayleyesus, the major AI service constraints ranked as, efficiency of AITs, heat detection systems, availability of AI service, perception of AI users about AI, distance from local AIC and price for AI the order of their importance. Though the result of this study by their order was different from Hayleyesus, both exploit major constraints of AI service. Also this study was agree with the study of Damron except for their order who found heat detection; AITs efficiency and fertility level of the herd were the most severe problems of AI service delivery [28,29].

Conclusions and Recommendations

According to the results of this study, AI service in Ada'a district has been progressively increasing during the last consecutive five years because of the awareness of farmers about the advantage of AI. AI was efficiently used by cross breeds than local breeds in intensive management system. The overall findings on the service per conception revealed that most of the cows were repeat breeder. AI causes imbalance between female and male ratio of calves born in which the latter exceeds in percentage which is against the interest of most of the beneficiaries. Regarding time of insemination, more than half of the respondents inseminated their cows at the right time but the rest inseminated at wrong time. The most outstanding constraints of AI service were lack of service in the vicinity, low efficiency, poor estrous detection systems, efficiency of AIT, price for AI, lack of infrastructure and sex of calves in the order of their importance.

Based on the above conclusion the following recommendations are forwarded:

• Efficiency of AI technicians should be increased by regular training and awareness creation in order to avoid failure of conception due to technician problem.

• AI technicians should practice good semen handling and semen evaluation before going to inseminate is necessary.

• In order to provide adequate service in all areas of the district especially, to rural areas, there should be enough number of AIT and AIC.

• Appropriate record keeping system should be practiced at the district level.

• Transportation facilities, including fuel and maintenance should be sufficiently available to avoid interruption of the service causing the cattle owner to lose time of insemination.

• Regular supervision, inspection of field service work at various levels should be under taken systematically and regularly.

• Regular awareness creation of the farmers should be oriented to keep healthy and productive animals to present the cows or heifers seen in heat for insemination or to be inseminated at the right time.

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