Efficiency of Artificial Insemination in Dairy Cows in and around Kombolcha Town, South Wollo, Ethiopia

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Abstract

Artificial insemination (AI) is the manual placement of semen in the reproductive tract of the female by a method other than natural mating. Cross-sectional study was conducted from December 2018 to April 2019 in and around kombolcha, south wollo, Ethiopia with the aim of determining the efficiency of AI in dairy cows and to identify constraint associated with artificial insemination. A total of 300 cows were included in the study to assess efficiency of artificial insemination. Data was collected based on owners' willingness by structured questionnaire. Descriptive statistics such as percentages and frequency distribution were used to determine the efficiency of pregnancy with different variables and the association of pregnancy with different factors has been tested using multiple logistic regressions. The highest conception rate was found to be 75.5% in cross breeds, 80% in >6 years age, 74% within 6hr of insemination, 75.2% in primiparous and 40.7% in good BCS cows. The multiple logistic regression revealed among the different problems and constraints associated with the efficiency; there were no a significant difference in conception rate between breed, age, parity number and body condition score of the cows (p>0.05).Whereas there was a significant difference in conception rate between time of AI specifically between within six hr. and after 12 hr. of insemination (p<0.05). In conclusion, the most important constraint associated with efficiency of AI is delayed time of insemination. To reduce the problem owners of dairy cows should be trained about the detection of estrus and other factors that may reduce the efficacy of the AI should be studied.

Keywords: Artificial insemination; Dairy cows; Constraints; Efficiency

Introduction

Ethiopia is one of the most populated countries in Africa and has the largest livestock population in Africa, estimated to be 59.5 million cattle, 60.9 million sheep and goat, about 1.2 million camels and 59.5 million chickens [1]. Agriculture mainly crop and livestock production is the mainstay of the Ethiopian economy employing approximately 85% of the total human population. Livestock production accounts for approximately 35-49% of the total agricultural GDP and 16 to17% of national foreign currency earnings [2]. However, the dairy industry is not developed like other East African countries.

The total cattle population for the rural sedentary areas of Ethiopia is estimated at 55.03 million of which 55.38% are females [3]. Out of the total female cattle population 98.95% are local breeds and the remaining are hybrid and exotic breeds. With an average lactation length of 6 months and an average daily milk production of 1.67 liters per cow, the total milk produced during the year 2015/16 was recorded to be 3.06 billion liters

[1]. This suggests that the total number of both exotic and hybrid female cattle produced through the crossbreeding work for more than four decades in the country is quite insignificant indicating unsuccessful crossbreeding through Artificial insemination (AI). The country has made great effort to improve the productivity of local breeds through AI program to crossbreed locally adapted cattle breeds with improved exotic dairy breeds [4].

Artificial insemination 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 [4]. 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 used 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 [4,5].

The present National AI Center was established in 1984 to coordinate the overall AI operation at national level [6]. However, the success of such programs is not satisfactory due to numerous factors, including substandard nutrition, poor husbandry practice and infrastructure status. Thus, dairy producers have challenging complaint about a poor reproductive performance in animals using AI [7]. Ensuring the success of the AI program, regular supervision should be taken by evaluating the reproductive performance of the dairy cow under the prevailing management and environmental conditions since dairy cattle are important sources of food and income for smallholders, especially in urban and peri-urban areas of Ethiopia. Herd profitability is majorly determined by dairy cows reproductive performance which is a major determinant for overall productivity of dairy production systems by affecting the efficiency of milk production, the number of calves produced per cow and lifetime milk production [8].

Major reproductive performance factors encompass both herd-level management factors such as methods of husbandry, feeding, estrus detection, semen handling and cow-level factors such as age, body condition score (BCS), post parturient problem, disease events, milk yield, and genetics [9,10]. Studies in tropical countries showed that performance of smallholder dairy cattle being affected by various factors such as genotype, geographical location, and season of calving, suckling status, parity and BCS [11-14].

The efficiency of the AI service in the country has remained at a very low level due to infrastructure, managerial, and financial constraints as well as poor heat detection, improper timing of insemination and embryonic death [15]. Cattle breeding are mostly uncontrolled in Ethiopia making genetic improvement difficult and an appropriate bull selection criterion have not yet been established, applied and controlled [16].

Although artificial insemination, the most commonly used and valuable biotechnology [4] has been in operation in Ethiopia for over 30 years, the efficiency and impact of the operation has not been well-documented [17]. It is widely believed that the AI service in the country has not been successful to improve reproductive performance of dairy industry [18]. From the previous studies, it has been found that AI service is weak and even declining due to inconsistent service in the smallholder livestock production systems of the Ethiopian highlands [19]. The problem is more aggravated by lack of recording scheme, wrong selection procedures and poor management of AI bulls associated with poor motivations skills of inseminators and inability to give the AI service timely. There was a scarcity studies conducted in relation with the efficiency of AI in dairy cows in the current study area. Therefore, this study was conducted with the following objectives:

a. To assess the efficiency of AI service in and around kombolcha.

b. To identify constraints associated with the efficiency of AI.

Materials and Methods

Description of the Study Area

A cross sectional study was conducted from December 2018 to April 2019 in and around Kombolcha, South Wollo, Ethiopia. Kombolcha is located in North East part of Ethiopia at distance about 375Km far from Addis Ababa. Geographically, kombolcha is located at an altitude ranging from 1500m-1840 meter above sea level (m.a.s.l). The mean annual average rainfall is 750-900mm with a mean minimum and maximum temperature of 11.7 and 23.9 °C, respectively. The area receives a bimodal rainfall where the short rainy seasons are between March and May while the long rain season extends from June to end of September. The relative humidity of the area varies from 23.9-79% [20].

Study Population

The study populations were artificially inseminated cows kept under extensive and intensive husbandry system in and around Kombolcha.

Study Design

A cross-sectional study was conducted from December 2018 to April 2019 in and around kombolcha, south wollo, Ethiopia with the aim of determining the efficiency of AI in dairy cows and to identify constraints for artificial insemination. The data were collected based on questionnaire survey based on willingness of artificially inseminated dairy cows owners'.

Sample Size Determination and Sampling

The sample size was determined by the availability of artificially inseminated cows. A total of 300 cows were included in the study to assess efficiency of artificial insemination. Samples were collected based on owners' willingness by structured questionnaire. The owners were asked about time of insemination, date of first service and subsequent services, parity number of cows, BCS, age and breed of cows.

Data Management and Analysis

The collected data were entered into Microsoft Excel Sheet and analyzed through Statistical Package for Social Sciences (SPSS) Version 20. Accordingly, descriptive statistics such as percentages and frequency distribution were used to determine the efficiency of pregnancy with different variables and the association of pregnancy with different factors has been tested using multiple logistic regressions. A value of $p<0.05$ was considered significant.

Results

Efficiency of AI in relation with age, breed, time of AI, parity number and the body condition of cows has been assessed. Higher percentage of crossbreed cows (75.5%) becomes pregnant compared with local breeds (72.9%). From the age categories the highest post AI conception rate was recorded for those having age range of above 6 years (80%) followed by age of 3 to 6 years (72%) and <=3 years age (71.1%) (Table 1). The association of pregnancy

with different factors has been tested using multiple logistic regressions. There were no a significant difference in conception rate between breed, age, parity number and body condition score of the cows (p>0.05).Whereas there was a significant difference in conception rate between time of AI specifically between within six hr. and after 12 hr. of insemination (p<0.05) (Table 2).

Table 1: Efficacy of pregnancy with different variables.

Variable		No. of cows	Pregnancy Positive	Efficacy of Pregnancy (%)
Breed	Local	96	70	72.9 %
	Cross	204	154	75.5 %
	Overall breed	300	224	74.67 %
Age	<= 3 year	90	64	71.1 %
	3- 6 year	100	72	72 %
	>6 year	110	88	80 %
Time of AI	Within 6 hr.	122	91	74.5 %
	Within 12 hr.	119	84	70.5 %
	After 12 hr.	79	49	62 %
Parity no.	Primiparous	125	94	75.2 %
	Multiparous	175	130	74.3 %
BCS	Good	76	31	40.7 %
	Moderate	224	74	33 %

Table 2: Association of pregnancy with different factors using multiple logistic regressions.

Variable		OR	95%CI	P-value
Breed	Cross	Reference		
	Local	1.15	0.64-2	0.643
Age	<= 3 year	Reference		
	3-6 year	1.06	0.55-2	0.861
	>6 year	1.58	0.81-3	0.176
Time of AI	Within 6 hr.	Reference		
	Within 12 hr.	1.32	0.67-2	0.418
	After 12 hr.	0.45	0.26-1	0.029
Parity No.	Primiparous	Reference		
	Multiparous	1.003	0.58-1	0.989
BCS	Good	Reference		
	Moderate	0.75	0.43-1	0.329

Discussion

In the present study, 300 cows were assessed for efficiency of conception rate after AI and to identify constrains that decrease efficiency of AI. Based on breed there was no significance difference in the efficiency of conception rate in the present study, but it is slightly higher in the crossbreed cows. This may be because Zebu cows normally have a tendency for lower first conception rate than crossbreds or exotic breeds [21,22]. Some of the possible reasons for lower proportions of indigenous cows conceiving at first insemination are that the Zebu does not exhibit overt estrus signs like the crossbreds and/or exotic breeds. Estrus in the Zebu tends to be shorter and is often subdued. Furthermore, Zebu cows often refrain from repeated mounting. Estrus detection is therefore more difficult to determine in Zebu than in Bostaurus cattle because of these many physiological and managerial problems [22].

The conception rate of cows in the present study were 64(71.1%) in cows with age of <3 years, 72(72%) in cows with age of 3-6 years, 88 (80%) in cows with ages of above 6 years. These findings were in agreement with Howlader [23] who were reported that 71.93% in the ages of <3 years dairy cows, 85.49% in the ages of 4.6-6 years of dairy cows and 74.52% in the ages of >6 years of dairy cows but higher than Alem & Sarader [24] reports who reported 33.33%, 38.5% and 29.8% efficiency in <3 years, 4.6-6 years and >6 years dairy cows respectively.

The higher conception rate of cows in the present study was presented within six hr. of insemination 91 (74.5 %). This finding

was higher than the 65% conception in cows inseminated within 6hour of showing oestrus [23]. While the least value of pregnant animal were presented in after 12 hours of insemination 49 (62 %). Howlader [23] also reported that the conception rate was higher when the cows were inseminated in the middle of oestrus. The difference may be due to difference in the ability of the inseminator to correctly inseminate and difference in the management of the semen. Cows should be inseminated within six hours of heat to increase the chance of conception because late insemination may affect the conception rates of both heifers and cows [24,25].

The conception rate of cows was 130 (74.3%) in multiparous cows whereas it was 94 (75.2%) in primiparous cows in the present study. These results were higher than the previous reports by Alem & Sarader [26] which was 60.00% in primiparous cows and 66.7% in multiparous cows. There is no difference in conception rate between parity in the present study whereas in a study reported by Alexandra [27] conception rate was higher in multiparous cows. Mureda and Mekuriaw also found that the number of services per conception was significantly different in (Holstein Friesian x Zebu) dairy cows kept in different production systems in Eastern lowland of Ethiopia.

A higher number of non-pregnant animals 150 (67 %) were found in moderate body condition cows and less number of non-pregnant animals 45 (59.3 %) were found in good body condition cows. The efficiency of conception rate of inseminated cows were 74 (33 %) in moderate body condition and 31 (40.7 %) in good body condition cow. This finding was lower than the previous study reported by Alam and Sarader (2010). They reported that pregnancy rates of cows of good BCS were (50.0%) followed by 35% in cows in moderate BCS. The difference may be due to difference in the estrous detection ability of owner and AI technicians and time of insemination.

Conclusion and Recommendations

The present study revealed that the conception rate after AI was moderate. There was no big difference in conception between breed, age group and body condition. The highest conception rate was achieved in within six hours of insemination after the cow starts showing the heat signs. According to this study the most important constraint decreasing the efficiency of AI is delayed time of insemination.

Therefore, based on the above conclusions, the following recommendations are forwarded:

a. The enhancement in insemination skills of AI became mandatory requirements for enhancing the efficiency of AI.

b. AI should be performed at the right time after onset of estrus in order to minimize failure of artificial insemination;

c. Owners of dairy cows should be trained about the detection of estrus.

d. Other factors that may reduce the efficacy of the AI should be studied.

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