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Retrospecitive Study

Effect of Breed and Risk Factors Affecting Conception Rate to Artificial Insemination in Dairy Cows of Tullo District Western Haraghe, Ethiopia

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ABSTRACT

Aim
This study was conducted using the questionnaire method to assess the effect of breed and factors affecting conception rate on artificial insemination in dairy cows in Tullo district, Western Haraghe, Ethiopia.

Methods
A follow-up study design was conducted from December 2018 to June 2019 to determine the effect of breed and factors affecting conception rate to artificial insemination in dairy cows, taking breed, age, parity, body condition and timing of insemination as risk factors. The demographic factors were recorded by interviewing the owners. Most of the cows were examined for pregnancy diagnosis by rectal palpation of the genital tract at 60-80-days post-artificial insemination.

Results
Out of 114 artificially inseminated cows/heifers, 59 became pregnant, giving an overall first service conception rate of 51.8%. Although the breed, age, parity and body condition score did not affect the conception rate significantly, the pregnancy rate was better in the cross-breed (62.5%), in cows of 5-7-years of age (54.6%), in cows of parity 2-3 (59.2%) and in cows of good body condition score (57.7%). The conception rate in cows inseminated at 12-18-hours after the onset of estrus was significantly higher (62.3%) than those inseminated after 18-hours (31.2%) and before 12-hours (52.4%) after the onset of estrus. Therefore, cows with good body condition score (BCS) and artificial insemination (AI) service at 12-18-hours after the onset of estrus are the best choice of selection for obtaining the best result in the first service conception rate to AI in dairy cows/heifers.

Conclusion
This study reveals that the conception rate was influenced by the time of AI, so awareness should be given to cattle owners, as they should give AI for their cattle at optimum time within 12-18-hours after onset of heat sign.

Keywords
Artificial insemination, breed, conception rate, Tullo district.

INTRODUCTION

Animal production has an important role to play as food of animal origin representing approximately one-sixth of food energy and one-third of the human food protein on a global basis. In this ratio, the formidable role that milk and its products play in human nutrition has made scientists to play a pivotal role in developing technologies to improve the reproductive efficiency in dairy cattle, in turn to increasing the efficiency and profitability of milk production.[1] Among these technologies, artificial insemination has become one of the most important techniques ever devised for the genetic improvement of farm animals.[2] It is the manual placement of semen in the reproductive tract of the female by a method other than natural mating, and it is among the group of technologies commonly known as assisted reproduction technologies (ARTs), where by offspring are generated by facilitating the meeting of male and female gametes.[3] Semen collected from the bull is deep frozen and stored in a container with liquid nitrogen at a temperature of -196 °C made for use.[3]

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In Ethiopia, artificial insemination (AI) was introduced in 1938 in Asmara, then part of Ethiopia, which was interrupted due to the Second World War and restarted in 1952.[4] The National Artificial Insemination Centre (NAIC) was established in 1984 to coordinate the overall AI operation at the national level.[5]

The efficiency of AI service in the country, however, has remained at a very low-level due to the low accessibility of infrastructure, management (such as methods of husbandry, feeding, estrus detection, semen handling and transition cow management), and financial constraints, as well as poor heat detection, improper timing of insemination and death of embryos[6,7] Cattle breeding is mostly uncontrolled in Ethiopia, making genetic improvement difficult, and an appropriate bull selection criteria have not yet been established.[8] In the case of technical, financial and managerial problems.[9,10]

The total cattle population for the rural sedentary areas of Ethiopia is estimated at 55.03 million, of which 55.38% are females, of which 6,675,466 and 10,731,656 were dairy and milking cows, respectively.[11] With an average lactation length of 6-months and an average daily milk production of 1.67 litres per cow, the total milk produced during the year 2015/16 was recorded to be 3.06 billion liters.[12] This shows unsuccessful cross-breeding work. Therefore, Ethiopia needs to work hard on improving the work of productive and reproductive performance improvements of cattle through appropriate breeding and related activities.[12]

The conception rate was influenced by cattle rearing systems (intensive *vs.* extensive), the purpose of rearing cows, and poor heat detection rate to AI.[13] Furthermore, the parity, breed, body condition, time of insemination, and age of the cows inseminated were also found to affect the conception rate to AI.[14]

The effects of age, parity and breed of the cows on conception rate and number of services required per conception are poorly documented with respect to Ethiopia despite having a many dairy and draught farms. In the study area, the success rate of AI and factors affecting the conception rate have not yet been determined and documented. Therefore, the current study was undertaken with the following objectives: To estimate the conception rate to AI with frozen semen, and determine the effect of breed, age, parity, body condition scoring and time of insemination on conception rate.

MATERIALS AND METHODS

Study Area

The study was conducted in Tullo district, Oromia Regional State, Ethiopia, from December 2018 to June 2019. Tullo district is located in the West Hararghe zone of the Oromia regional state. The district has a daily mean temperature ranging from 18 °C to 26 °C and a mean annual rainfall ranging from 550 mm to 800 mm. The agro-ecological zones of the district are highland (dega) 40%, medium high land (Weyna dega) 57% and kola 3%. The district has an altitude ranging from 1500 meters to 2500 meters above sea level and the relative humidity ranges between 22 and 65%. The livestock populations of the district are 125,915 cattle, 37,973 goats, 13,177 sheep, 171,499 poultry, 5,905 donkeys, 338 horses and 274 mules.[15]

Study Population

The study population was represented by smallholder dairy owners who were beneficiaries the of artificial insemination service, and all animals were artificially served during the study period in Tullo district. In the rural areas, mainly local Zebu breeds are found grazing on communal land under a traditional extensive animal husbandry system, while cross breed cows (HF×Local Zebu, Jersey×Local Zebu) were housed and fed with a cut and carry system.

Study Design

A follow-up study design, was carried out to determine the rate of conception and the effect of breed and other major factors affecting the conception rate to artificial insemination in dairy cows from December 2018 to June 2019 in Tullo district, West Hararghe zone. A retrospective study was also used to collect data from AI service records from 2015 to 2018. In the follow-up study, 114 animals were followed at the Tullo District veterinary clinic and house hold level by telephone calls to AI technicians.

Study Methodology

Semi-structured questionnaires were prepared in a format predesigned to collect relevant data on the status of the animal, AI services and interviews with to owners of each cow/heifer receiving AI services during the study period and with AI technicians directly involved in the inseminations were made. Individual animal data, such as age, body condition, parity, breed, and time of AI from onset heat, were recorded, and the conception rate of inseminated animals was determined. The body condition score (BCS) of inseminated cows was determined by estimation according to the methods described by Nichonlson et al[16] and the ages of cows were determined by the statement of Cringoli et al.[17] The cows were inseminated between 6-24 h of onset of heat; history obtained from the owners. A standard semen handling and insemination procedure recommended by International Atomic Energy Agency (IAEA)[18] was used to inseminate the studded cows/heifers. All inseminated cows were checked for the presence or absence of oestrus signs in the next cycle post-AI by telephone call-up to the owners. Only first-service pregnancies were was included in this study. Most of the animals under this study were subjected to pregnancy diagnosis per rectum after 60-90-days post-AI, some by visiting the owner's house and some at the Hirna Veterinary Clinic, where animals are brought by the owners.

Data Analysis

The data collected using the questionnaire were checked for errors, incomplete and inconsistencies were corrected when possible and removed otherwise. After complete check-up, the data were coded and entered into Microsoft Excel and transported to STATA Version 12. Descriptive statistics such as frequency or percentage were used to summarize the data as needed. The chi-square (χ^2) test was computed to determine the association of risk factors with target

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Table 1. *Conception Rate to AI and Effect of Breed and other Factors on Success Rate*

	No. Inseminated	No. Conceived	Conception Rate (%)	χ^2	*p* value
Breed					
Local	90	44	48.9		
Cross breed	24	15	62.5	1.4058	0.236
Total	114	59	51.8		
Parity					
<2	46	21	45.6		
2-3	49	29	59.2	1.9155	0.384
>4	19	9	47.4		
Total	114	59	51.8		
Body Condition					
Poor	18	9	50		
Medium	70	35	50	0.4756	0.788
Good	26	15	57.7		
Total	114	59	51.8		
Age					
<4-years	41	21	51.2		
5-7-years	55	30	54.6	0.5615	0.755
>8-years	18	8	44.4		
Total	114	59	51.8		
Time of Insemination					
Before 12-hours	21	11	52.4		
12-18-hours	61	38	62.3	8.1058	0.017
After 18-hours	32	10	31.2		
Total	114	59	51.8		

variables of interest. The variation between variables was considered significant when the *p* value was less than 0.05.

RESULTS

Out of 114 artificially inseminated cows/heifers, 59 became pregnant, giving an overall first service conception rate of 51.8%, of which 48.9% were local cows and 62.5% were crossbred cows respectively with a non-significant difference. Out of a total of 21 cows/heifers, 11 (52.4%) were found to be pregnant when AI was performed during the period of less than 12-hours after the onset of estrus. A total of 61 animals, 23 (37.7%) were found to be non-pregnant when AI was performed during the period of 12-18-hours after the onset of estrus, and 38 (62.3%) were pregnant. Out of 32 cows/heifers, what showed signs of and inseminated at >18-hours from the onset of estrus, 10 (31.2%) were pregnant. Statistical association showed that there was a significant difference ($p<0.05$) between the time of insemination and the conception rate to AI. However, parity and BCS did not show a significant association with the conception rate to first service (Table 1).

Retrospective data obtained from an artificial insemination service recording book from year 2015-2018 showed an increasing rate of conception to AI. High numbers of conceived animals 82(47.1%) were recorded by the year 2018, and at the least 32 (27.4.4%) were recorded by 2015. There was statistically significant difference with good improvement from year-to-year (Tables 2 and 3).

Table 2. *Retrospective Data on Conception Rate to AI from 2015-2018 in Dairy Cows*

Year	No. Inseminated	No. Conceived	Conception Rate (%)	χ^2	*p* value
2015	117	32	27.4		
2016	132	40	30.3		
2017	144	63	43.8	17.0592	0.001
2018	174	82	47.1		
Total	567	217	38.3		

Table 3. *Retrospective Data on Differences in Conception Rate to AI from 2015-2018 Dairy Cows*

	No. Inseminated	No. Conceived	Conception Rate (%)	χ^2	*p* value
Breed					
Local	449	168	37.4		
Cross breed	118	49	41.5	17.0592	0.001
Total	567	217	38.3		

DISCUSSION

The present study was carried out to determine the conception rate to AI and the effect of factors such as animal breed, parity, age, body condition and time of insemination on the first service conception rate of cows/heifers in Tullo District.

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The overall first service conception rate in cows/heifers that received AI using frozen semen was 51.8%. This is in agreement with a previous study performed by Haque et al,[19] Shamsuddin et al,[13] Khan et al[14] and Mollah[20] who found pregnancy rates of 52.6%, 54.9%, 57.3% and 55.1% respectively, in cows which were lower than the findings reported by Shiferaw et al[21] and Jemal et al,[22] 86.4% and 63-71%, respectively. Factors that may cause differences in the conception rate may be the sexual health status of the female reproductive organs, proper maintenance of the liquid nitrogen level in the container and faulty technique of using frozen semen in AI practice.

The present finding showed that (48.9%) local breed cows/heifers were conceived, whereas (62.5%) cross breed cows/heifers were conceived. Although, the results of this study showed that the conception rates of crossbred cows were higher than those of locally bred cows, the breed and conception rates were not statistically significant (p>0.05). Some of the possible reasons for lower proportions of indigenous cows conceiving at first insemination are related to the difficulty of detecting estrus signs in Zebu cattle.

The present study demonstrates parity as a non-significant (p>0.05) influencing factor in the conception rate of cows/heifers. This is in agreement with a previous study performed by Haque et al.[19] In contrast to the present study, Belete et al[23] showed that there was a statistically significant (p<0.05) association between the conception rate and parity of cows. In the present study, more of the cows belonged to 2-3 parities, which may be considered the parity of grown cows. Although no significant variation in the conception rate of cows was obtained among different parity groups, obtaining a lower conception rate (45.6%) in 0-1 parity cows supports the earlier finding reported by Khan et al.[14]

The results of the present study revealed that the body condition of the animals did not significantly affect the conception rate. The finding of this study disagreed with Shamsuddin et al,[13] who reported a higher pregnancy rate in cows with good BCS than in cows with poor BCS. Nevertheless, the findings of this study agreed with those of Kaziboni et al,[24] who also noted no appreciable difference in conception rate among different body conditions of cows kept by smallholder farmers in Zimbabwe. Generally, cows with good BCS are more responsive to hormonal stimulation than their poor BCS counterparts resulting in a good pregnancy rate. However, the reason for obtaining no variation in conception rate between BCS in the present finding may be due to the small difference in body condition of cows/heifers included in this study.

The cows/heifers aged <4, 5-7 and >8-years had conception rates of 51.2%, 54.6% and 44.4% after the first service to AI, respectively.

The present study indicated that no significant variation in conception rate among different age group of cows. Agreement to the current finding, there is a report that fertility is the highest in cows between four and nine years of age and declines after 10-years of age.[25] Contradict to our results, Fonseca et al[26] reports, age of animals significantly affect conception rate, that the conception rate decrease as age of animals increase, the older cows might have more chance to get subclinical uterine infection resulting in lower conception rate.

The present study showed that the first service conception rate in cows/heifers is influenced by the time interval between oestrus and insemination, as indicated by a significantly higher conception rate (62.3%) in cows that received insemination at 12-18- hour intervals than in those that received insemination at <12-hours and >18-hours, which were 52.4 and 31.3% conception rates, respectively. This is in agreement with a the previous study performed by Gonzalez[27] which reported the highest conception rate when insemination was performed 12-18-hours after the onset of oestrus, which means that the afternoon inseminated in the following morning. As Dessalegn,[28] Tessema et al[29] reported, fertilization is highly dependent on the interval from insemination to ovulation. When cows are inseminated early, the aged sperm may not be capable of fertilizing the ovum. When insemination is late, fertilization and the formation of viable embryos may not be possible because of an aging egg. It tended to be higher in animals that were inseminated at the optimum time within 12-18-hours after the onset of the heat sign, which supports earlier findings reported by Gonzalez.[27]

Retrospective data obtained from the artificial insemination service recording book from 2015-2018 indicated that there is consistency in the number of animals inseminated and the conception rate. High numbers of inseminated animals (174) were recorded by 2018, and the lowest numbers (117) were recorded by 2015, with conception rates of 47.1 and 27.4%, respectively. In line with this finding, Sisay et al[30] reported that there was a consistent increase in the number of animals inseminated and calves born. This indicates that there is a consistent increment in farmers' awareness of the advantage of AI over natural service and that there might be an improvement in AI technicians, experience from year-to-year.

CONCLUSION AND RECOMMENDATIONS

The conception rate of cows/heifers to first service AI may not be affected by factors such as breed, parity, age, and body condition and may be affected by the time of insemination. According to the results of this study, the first service conception rate was not significantly influenced by breed, BCS, parity or age. However, the time of insemination had a profound impact on the conception rate of cows. The conception rate (CR) was found to be lower in animals that inseminated very early after onset of estrous and very late more than 18-hours of estrous. The highest CR was recorded within 12 to 18-hours. Therefore, to improve the CR, one should consider all factors related to the cow, and AI should be performed at the proper time of insemination after the onset of oestrus (12-18-hours) to increase the first service conception rate.

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