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Evaluating the Efficiency of Artificial Insemination Following Estrous Synchronization on Cows in Konta, Special Woreda, Southern Ethiopia

[1]*Seblewengel Ayichew,* [1]*Derese Damene and* [2]*Wahid M. Ahmed*

[1]Woliata Sodo University, School of Veterinary Medicine, Ethiopia
[2]Department of Animal Reproduction & A.l, Veterinary Research Division,
National Research Centre, Giza, Egypt

Abstracts: A cross sectional study were used to determine the conception (pregnancy) rate of artificially inseminated cows and the associated risk factors, to assess the effectiveness of artificial insemination of frozen semen from different species of bull from purpose fully selected kebeles based on the synchronization program campaign implemented by the Livestock and Fisheries Bureau of Southern Nations and Nationalities Peoples Regional State to improve the dairy cattle productivity in Konta special Woreda (KSW) from December to June 2016/17, using the records of the age, parity and body condition of sampled cow. Estrous synchronization was followed by artificial insemination of frozen semen bulls (Holstein, Jersey and Borena) and pregnancy diagnosis was carried out at day 90 post AI by rectal palpation. A total of 384 cow/heifers were selected using simple random sampling method based on feed availability, age (3 to 8 years), 2nd to 5th parity, and body condition scoring from different localities. The present results revealed 57.29 % conception (pregnancy) and 17.45%, number of service per conception rate (NSPC). The conception rate of 39.7%, 42.57% and 59.46% was observed in the Holstein, jersey and Borena bulls frozen semen, respectively. About 72.4% in cows of 3-4 years, 43.6% in cows of 4-6 years and 20.8% in cows of 6-8years efficiency of artificial insemination was recorded. Based on body condition scoring (BCS), 69.11% and 16.59% was recorded in good and very good body conformation, respectively. It was 76.67, 25.4 and 15.75 in cows of body weight 120-140, 141-160 and 161-180kg, respectively. There was significant variation in age, body condition, body weight and peasant (PA) with effectiveness of artificial insemination. No significant variation was observed between species of frozen semen for insemination and conception rate. In conclusion, effectiveness of artificial insemination might be lower due to various factors including failure of estrus detection, poor management, inadequate nutrition and poor quality of semen. Awareness should be created to detect heat sign of cows to the professionals and animal owners.

Key words: Artificial Insemination · Conception Rate · Cows · Konta · Synchronization

INTRODUCTION

Livestock constitutes an essential link and a significant role for the Ethiopia economy through the generation of income and satisfaction of the food needs of the people, in the economic, social and culture value [1]. Among livestock, the total cattle population for the rural sedentary areas of Ethiopia is estimated to be 43.12 million, of which 55.41% are females. In spite of the presence of large and diverse animal genetic resources, the productivity (meat and milk) of livestock remains low in many developing countries including Ethiopia for various reasons such as inadequate nutrition, poor genetic potential, inadequate animal health services and other management related problems. Reproductive performance of cow and heifer is one of the most important factors that influenced the profitability of the dairy sector [1].

In Ethiopia, dairy production is still in extensive system and the average daily milk production of indigenous cows is 1.37 liters/day [2]. The introduction of reproductive techniques such as estrus synchronization and artificial insemination (AI) are becoming instrumental to solve the effects of these limiting factors as well as to

Corresponding Author: Seblewongel Ayichew, Woliata Sodo University, School of Veterinary Medicine, Ethiopia.

make possible the application of more intensive systems of production and to facilitate the genetic improvement of the productive characteristics of the herd [3].

Artificial insemination (AI) has been defined as a process by which sperm is collected from the male, processed, stored, and artificially introduced in to the female reproductive tract for the purpose of conception [4]. Artificial insemination 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].

Although, Artificial insemination, the most commonly used and valuable biotechnology has been used in Ethiopia over the last 35 years and its extension was supported by several governmental and non-governmental organization, the efficiency of the service has remained at a very low level due to infrastructures, managerial and financial constraints and also due to poor heat detection, improper timing of insemination and embryonic death. AI after synchronization was identified as the tool of choice for a better productivity in Senegal through a national campaign [5].

Despite the wide application of AI and its success throughout the developed world, low scientific studies have been conducted to assess its performance and the success rate in Ethiopia except 46.7% by Belachew [6] and 27% by Desalegn [7] owning to a number of technical, financial and managerial problems [8], cited in [9]. On the other hand, Belachew [6] reported that the efficiency of heat detection by smallholder farmers was less than 65% and nearly a third of insemination were carried out during the wrong time with respect to estrus. in a limited scale study in the wet zone need country area, the conception rate(CR) was lower than expected and suggested that this was most likely due to poor heat detection by the farmers and delays in getting the cow to be served. Two consultancy reviews [6] and Desalegn [7] have also highlighted the poor performance of the AI service at national level. The annual report of 2015/2016 for Konta special district livestock and fisheries offices indicated that AI started in 1995. [5]. There was no any published evidence which indicated the reasons to its, efficiency, conception rate and performance in the area. Therefore, the present study was accomplished with the objectives: to determine the number of service per conception and conception rate and the associated risk factors of dairy cattle served with AI after estrus response following administration of PGF2α.

MATERIALS AND METHODS

Study Area: Konta special woreda is located about 464 km south of Addis Ababa and 372 km west from Hawassa. The woreda has taken area of 250376 hector. The mean annual rain fall ranges from 500 mm - 2200 mm (KSWAO, 2003). Mixed agricultural production system is practiced in both highlands and lowlands. The topography of woreda is not flat and the soil is mainly clay and sandy loam type. Oxen are kept for farming, meat and mainly dairy cows kept for their milk and manure. An extensive grazing area which is about 9.5% of the total area is used for herding the oxen, cattle, donkey, goat and sheep. Average livestock population size is estimated as 98,262 cattle, 24,614 sheep 24,214, goats 588 donkeys 533, 521 horse and 43,074 poultry (KSWAO, 2003).

Study Population: The cows used for this study were local zebu (Bos indicus) which was managed under small holder mixed crop livestock farming system where cows were allowed to graze freely during the day and house at night. The age of cows were considered as 3 to 8 years; 2^{nd} to 5^{th} parity; and the body condition scoring was also grouped based on Nicholson and Butterworth [10] as 1 (under condition) to 8 (over condition) and these scores finally included under two body condition scores. The age of the animals was estimated by means of their dentition as described by Kelly [11].

Study Design: A cross sectional study design was carried out from December to June, 2016/17 on 384 randomly selected cows in purposefully selected peasant association of konta special woreda based on the synchronization program campaign implemented by the Livestock and Fisheries Bureau of Southern Nations and Nationalities Peoples Regional State to improve the dairy cattle productivity in Konta special Woreda (KSW). The study was conducted from these three PAS to determine the conception (pregnancy) rate of artificially inseminated cows and the associated risk factors, to assess the effectiveness of artificial insemination**.**

Sample Size Determination: The sample size was determined based on the expected prevalence of 50% and absolute precision of 5% at confidence level of 95% according to the formula provided by Thrusfield [12]. This is calculated by using the following formula:

$$N=\frac{1.96^2\ [Pexp-\ (1-Pexp)]}{d^2}$$

whereas;
N: required sample size
P_{exp}: Expected prevalence
D: Desired absolute precision (5%)

Therefore, based on the above formula, the total numbers of cows/heifers were 384.

Sampling Method: Three peasants PA'S (ameya, chida and mareka) were selected purposively from konta special woreda because of the synchronization program campaign were implemented by the Livestock and Fisheries Bureau of Southern Nations and Nationalities Peoples Regional State to improve the dairy cattle productivity. Among cow/heifers synchronized with PGF2α and showed estrus response, 384 cow/heifers were selected using simple random sampling method based on feed availability, age (3 to 8 years), 2nd to 5th parity, and body condition scoring and different localities were selected.

Study Methodology: An intramuscular injection of hormones products (5 ml of Lutalyse or 2 ml of Estrumate) were used for estrous synchronization. Then farmers closely monitored their cows and reported the heat sign at the right time. Cows noted heat in the morning was inseminated in the afternoon and those identified in the afternoon were inseminated the next morning. Frozen semen (-196°C) bulls (Holstein, Jersey and Borena) was brought from Kality National Artificial Center, Ethiopia. At day 90 post AI, pregnancy diagnosis was made by trans-rectal palpation method.

Data Analysis: All collected data were entered in to the Microsoft excel 2007 window and SPSS software for the statistical analysis. The efficiency of artificial insemination and the association between conception rate and its determining factors such as BCS, age, body weight, PA'S and was analyzed using chi- square test. The variation between groups was considered significant when the P-value < 0.05. The conception rate and numbers of services per conception was calculated according to the method suggested by Sharifuzzaman *et al.* [13].

Number of service per conception (NSPC) and conception rate (CR) were estimated by dividing the Total number of service on Total number of cows conceived for determining the NSPC: and the CR was determined from the equation: (Number of cows/heifers pregnant/Number of cows/heifers inseminated)*100

RESULTS

Number of Service per Conception (NSPC): An overall mean NSPC of 2.91 (384/220) was observed. The NSPC among different factors like location bases, bull species, age group, body condition and weight have shown great variation as shown in Table 1 below.

Conception Rate/CR (%): In the current study, the overall conception rate was 57.29 %. The CR (%) among different factors like location bases, bull species, age group, body condition, body weight and species of frozen semen (Bull Id) has shown great variation as shown in the table below. The conception rate was lower 23.33 % in cows/heifers weighted 120-140 Kg and higher (60.3%) in cows/heifers inseminated with Holstein bull semen.

Table 1: The effect of different factors affecting NSPC and CR of cows (n=384)

Factors		Inseminated cows	Conception	NSPC	CR (%)
Bull/semen type	Holstein	199	120	1.65	60.3
	Jersey	148	85	1.74	57.43
	Borena	37	15	2.46	40.54
Age group	3-4 years	87	24	3.62	27.58
	5-6 years	171	97	1.76	56.72
	7-8 years	126	99	1.27	78.57
Body condition scores	Very good	193	161	1.2	83.41
	Good	191	59	3.23	30.89
Body weight (Kg)	120-140	150	35	4.28	23.33
	141-160	126	94	1.34	74.6
	161-180	108	91	1.18	84.2
Location	Ameya	146	91	1.60	62.32
	Chida	126	60	2.1	47.61
	Mareka	112	69	1.62	61.6

Table 2: Associations of peasant association with conception rate

		Conception rate			
Risk factors	Category	Positive	Negative	Df	p- value
PA	Ameya	91	55	2	0.028
	Chida	60	66		
	Mareka	69	43		

Table 3: Variation of conception rate with age

		Conception Rate			
Risk Factors	Category	Positive	Negative	Df	p- value
age	3 -4yrs	24	63	2	0.0001
	5 -6yrs	99	27		
	7 -8yrs	97	74		

Table 4: The association of Body condition scoring with conception rate

		Conception rate			
Risk Factors	Category	Positive	Negative	Df	p- value
body condition	good	59	132	1	0.0001
	very good	161	32		

Table 5: The association between body weights with conception rate

		Conception rate			
Risk Factors	Category	Positive	Negative	Df	p- value
Body weight	120 – 140kg	35	115	2	.0001
	141 -160 kg	94	32		
	161 – 180kg	91	17		

Table 6: The association between Bull Id with conception rate

		Conception Rate			
Risk Factors	Category	positive	negative	Df	p- value
Bull Id	HF	120	79	2	.083
	Jersey	85	63		
	Borena	15	22		

Association of Conception Rate with Different Risk Factors: Analyses made to look at the association of Conception rate with different risk factors and the findings are presented as follows:

Peasant Association: Conception rate (pregnancy rate) had significant variation with the peasant association ($p<0.05$) and it is higher in Mareka PA (Table 2).

Age: Age was significantly associated with conception rate of the inseminated cows. It is higher at the age of 7-8 yrs (Table 3).

Body Condition Scoring: Cows under very good management condition had higher conception rate than good condition. There was significant association of conception rate with body condition scoring (Table 4).

Body Weight: The rate of the cow to conceive varies with body weight of the cows in the present study. It is higher at the higher body weight. There was significant association between conception rate and body weight of the cow (Table 5).

Bull Id: There was no significant association with in the type of frozen semen and the conception rate of the cow but it is higher in bull from Holstein Frisian (HF) (Table 6).

DISCUSSION

Out of 384 cows/heifers inseminated, an overall mean NSPC of 1.74 (384/220) and 57.29% (220/384) conception rate were found. The NSPC of the current study was higher than those reported of 1.3 for cross bred cows in Gondar [14], 1.52 from Assela town [15], 1.54 for Fogera

cattle[16], However, it was relatively closer to 1.75 for dairy cattle from Dale district [17], and lower than that of 2.2 reported for Eastern low lowland Crossbred that reported by [18]. The variation could be due to accuracy of heat detection, appropriate timing of insemination, insemination technique, BCS and quality and quantity of semen [19]. They also indicated that appropriate timing of insemination; heat detection efficiency and insemination technique are necessary for improving NSPC.

In the current study, the overall service conception rate was 57.29%. The CR (%) among different factors like location bases or the peasant association which are no awareness, bull species, age group, body condition and weight showed great variations. The conception rate was lower 23.33% in cows/heifers weighted 120-140Kg and higher (60.3%) in cows/heifers inseminated with Holstein bull semen. Similar studies of Mollal [20] and Shikder [21] mentioned that conception rate depends mainly on skill of the inseminator, accurate estrus detection, quality and quantity of spermatozoa in semen, proper semen thawing procedure, placement of semen in the uterus, calving to service interval and herd size.

The association between BCS and conception rate was significant ($P<0.05$) and the BCS of very good cows/heifers had higher pregnancy rate when compared to BCS of good. The result indicated that pregnancy rate increased as the body condition of the animals increased which is in line with findings of DeRouen [22] that revealed cows with a body condition score six or seven has higher pregnancy rate compared to cow with a body condition score of four or five. Good BCS especially during the mating period has been confirmed to have a positive impact on CR [23].

The association between age and conception/pregnancy rate was also significant ($P< 0.05$) difference among age groups where the reduced probability of conception to service with increased age could partly to attribute to the exposure of the cows to different reproductive diseases [24]. In young animals requirement of nutrients for continued growth and lactation place additional demand on the animal which may influence conception [25]. This age related difference might be due to delayed resumption of ovarian activity after calving.

It is indicated that effect of bulls on pregnancy rate could vary from 47.61% to 62.32%. The difference in conception among bulls could be due to quality and quantity of semen, disease and management of the bull, breed of the bull, and attributes of semen quality and quantity have shown to have significant effects on conception rate [26]. Several factors such as diseases, climatic conditions of the place where the bulls are reared, nutrition and management of the bulls also influence the fertility among the bulls [27]. Studies by Gebregziabhe [24] have also indicated that not only the bull itself influences the conception rate under AI service, but also the way of semen collected, processed, transported, handled and inseminated.

CONCLUSION

In this cross- sectional study effectiveness of artificial insemination of cow and conception rate of cows was highly observed using the number of service per conception (NSPC) and number of conception per number of service (CR). The conception rates (pregnancy rate) were 57.29% and number of service per conception rate was 17.45%. There was statistically significant variation of conception rates (pregnancy rate) with age groups, body condition score, body weight of the cow and the different peasant associations. Effectiveness of artificial insemination might be lower due to various factors including failure of estrus detection, poor management, inadequate nutrition and poor quality of semen.

Based on the above conclusion, the following recommendations are forwarded.

- Strategic use of artificial insemination should be strength to improve livestock production.
- Awareness should be created to detect heat sign of cows for the professionals and animal owners.
- Further studies should be conducted in the study area in order to improve feasibility of artificial insemination.

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