Advances in Biological Research 7 (2): 59-66, 2013
ISSN 1992-0067

DOI: 10.5829/idosi.abr.2013.7.2.72142

Assessment on Problems Associated with Artificial Insemination Services in West Gojjam Zone, Ethiopia

[1]Zerihun Baheriw, [2]Malede Birhan and [2]Tewodros Fentahun

[1]Department of Animal Production and Extension,
Faculty of Veterinary Medicine, University of Gondar, Ethiopia
[2]Department of Basic Veterinary Science,
Faculty of Veterinary Medicine, University of Gondar, Gondar, Ethiopia

Abstract: The study was conducted to assess the problems associated with artificial insemination service in 10 districts of West Gojjam Zone during October 2011 to May 2012. The study was performed by questionnaire survey on 15 Artificial insemination technicians (AIT) and 412 dairy cattle owners. The insemination services were performed on 410 cows and heifers in the selected districts. There was no statistically significant difference (χ^2 =12.988, P>0.05) in Weekends and holidays service usages. However, there was a significant difference among the study districts in shortage of AIT, shortage of input, distance from dairy owners home to artificial insemination (AI) service and inefficiency of AIT (p<0.05). The least service of artificial insemination in Weekends and holidays found in Mecha district (60%) whereas shortage of AIT were found in Sekela district (60%); shortage of input found in Sekela district (52.5%),, distance found in Gonji Kolela district (60%) and inefficiency of AIT found in Sekela (62.5%) districts. Dairy cattle owners responded that the cows and heifers were passing without breeding from AI and natural mating 126 (44.21%), used natural mating 118 (41.4%) and keep the next time AI 41(14.39%) from 285 (100%) non satisfaction owners in AI service due to different problem and was statistically significant (P<0.05). The inseminated cows and heifers were non-pregnant in different cases like age, breed, time of insemination and estrus detection and was statistically significant (P<0.05). The questionnaire surveys indicated that artificial insemination is not doing well in all the districts of the zone. Therefore, that artificial insemination service requires urgent measures to change the situation before collapsed totally and to achieve a success.

Key words: Artificial Insemination · West Gojjam Zone · Dairy Cattle · Questionnaire Survey

INTRODUCTION

With an average lactation length of 6 months and an average daily milk production of 1.44 liters per cow, the total milk produced during the year 2006/07 was recorded to be 2.634 billion liters [1]. In spite of the presence of large and diverse animal genetic resources, the productivity and off take rate remains low in many developing countries including Ethiopia for various reasons such as inadequate nutrition, poor genetic potential, inadequate animal health service and other management related problems [2]. In some countries, especially in the tropics, much of cattle production could be described as multi-purpose, with cows being used to provide milk, meat, clothing, fertilizer, fuel, draft power and sometimes for status or as a form of currency [3].

AI plays an important role to increase the yielding capacity of cows and is the appropriate and cheapest way of genetic improvement and the realization of breeding programs has to be well organized and excited in a very reliable way and AI is fully functional when it is corporated with good animal husbandry such as effective heat detection [4]. Artificial insemination, the most commonly used and valuable biotechnology has been used in Ethiopia over the last 30 years [5].

Corresponding Author: Malede Birhan, Department of Animal Production and Extension,
Faculty of Veterinary Medicine, University of Gondar, Ethiopia.

Reproductive problems related to crossbreed dairy cows under farmers' conditions are vast [6]. It is widely believed that the AI service in the country has not been successful to improve reproductive performance of dairy industry [7]. From the previous, few study [8] AI service is weak and even declining due to inconsistent service in the small holder livestock production systems of the Ethiopian highlands. The problem is more aggravated by wrong selection and management of AI bulls along with poor motivations and skills of inseminators [9]. Semen collected from a male animal consists of the secretions of the accessory sex glands and spermatozoa [10] and [11]. Laboratory assessment of semen quality is an essential procedure in many aspect of assisted reproduction in domestic species [12].

Objectives:

- To assess and identify the major problems associated with the artificial insemination service in the study area.
- To inspire the owners to use artificial insemination service for a better improvement of livestock production and productivity.
- To generate information for the better application on the sector and to recommend and give feedback to decision makers to take appropriate actions on it.

MATERIALS AND METHODS

Study Area: Across-sectional study was conducted in 10 districts of West Gojjam zone: Bahir-Dar, Yilmana Densa, Gonji Kolela, Burie, Mecha, South Achefer, North Achefer, Dega Damot, Sekela and Jabi Tehnan. All the study areas were purposively selected because it was believed that these areas are the ones where an AI service is exercised and constitute wide range of agro- ecology.

Sample Size Determination and Sampling Procedures: The sample size was determined based on the expected prevalence of 50% and absolute desired precision of 5% at confidence level of 95% according to the formula provided by Thrusfield [13].

$$n = \frac{1.96^2 P_{\exp}(1 - p_{\exp})}{d^2}$$

Where

n = Sample size
P_{exp} = Expected prevalence
d = Desired absolute precision

Based on this formula, the total number of cows and heifers to be sampled was 384. However, to increase precision sample of 410 cows was taken. In the case of farmers, the total sample size was 412 and this size was fulfilled in this study without interruption. In addition, 15 artificial insemination technicians were included in the study.

RESULTS

From 412 dairy owners data was collected by questionnaires survey in ten (10) districts in West Gojjam Administrative Zone. A total of 285(69.17) were not satisfied in AI service and also 127(30.83) were satisfied through the use of AI service. There was statistically significant difference ($P<0.05$) among the study districts in Shortage of Artificial insemination technician (AIT), Shortage of input, Distance to AI service and inefficiency of AIT (Table 1). And also there was no significant difference in less access of Weekends and holidays service usages in the study districts ($P>0.05$). The least artificial insemination service usages in Weekends and holidays found in Yilmana Desna district (62.5%) and the least Weekends and holidays service usages were not found in Burie district (32.5%).

The greatest shortage of AIT present in Sekela district (60%) while the slight in Mecha district (27.5%). The chief value of shortage of input present in Sekela district (52.5%) and the slightest shortage of AIT present in Bahir Dar Zuria district (17.3%). The maximum distance to AI service present in Gonji Kolela district (60.0%) and the insignificant distance of AI service present in Bahir Dar zuria district (19.2%). The main of inefficiency of AIT was present in Sekela district (62.5%).

Results of Assessment of Problem from Dairy Owners: The results of cows and heifers pass without breeding from AI and natural mating in the study areas are presented in (Table 1). There was statistically significant difference among the study districts in pass without breeding from AI and natural mating ($P=0.00$). From 285 non-satisfied dairy farmers 126(44.21%) the cows and

heifers Passed without breeding from AI and Natural mating and also 159(55.79%) used natural mating and waiting the next time to use AI service.

The results of those used natural mating in the study areas are presented in (Table 2). There was statistically significant difference among the study districts in used natural mating (P=0.00). From 285 non-satisfied dairy owners 118(41.4%) the cows and heifers was used natural mating and also 167(58.59%) was pass without breeding from AI and natural mating and waiting the next time to use AI service.

There was statistically significant difference among the study districts which kept the next time to use AI service (P=0.00). From 285 non-satisfied dairy owners 41(14.39%) the cow and heifer was kept the next time to use AI service and also 244(85.61%) was pass without breeding from AI and natural mating and used natural mating (Table 3).

The Results of Problem in Inseminated Cows and Heifers: There was statistically significant difference among the study districts in age (P=0.00). The highest value of non-pregnant animals was presented in the age of ≤ 3year 58(56.86%) and also the least value of non-pregnant animal was presented in the age of >11 year 4(3.9%) from 410 inseminated cow and heifer (Table 4).

There was statistically significant difference among the study districts in breed (P=0.013). The majority of non-pregnant animal were local breed 93(91.17%) while 9(8.83%) were cross from 102 non-pregnant animal of the total (410) inseminated cow and heifers (Table 5).

The majority of non-pregnant animal were found due to the lack of estrus detection 74(72.54%) in 102 non-pregnant animals from 410 inseminated cow and heifer and also the slightest value of non-pregnant animals were in good estrus detection 28(27.45%) in

Table 1: Artificial Insemination Used in Different Times and Condition.

	WHS		SAIT		SI		DAIS		EAIT	
Location	Total	No	Total	Yes	Total	Yes	Total	Yes	Total	NE
Bahir-Dar	52	22(42.3)	52	16(30.79)	52	9(17.3)	52	10(19.2)	52	17(32.69)
Yilmana Densa	40	25(62.5)	40	17(42.5)	40	10(25.0)	40	21(52.5)	40	13(32.5)
Gonji Kolela	40	19(47.5)	40	23(57.5)	40	16(40.0)	40	24(60.0)	40	13(32.5)
Mecha	40	24(60.0)	40	11(27.5)	40	17(42.5)	40	18(45.0)	40	14(35.0)
South Achefer	40	20(50.0)	40	12(30.0)	40	15(37.5)	40	18(45.0)	40	16(40.0)
North Achefer	40	19(47.5)	40	18(45.0)	40	12(30.0)	40	21(52.5)	40	10(25.0)
Burie	40	13(32.5)	40	14(35.0)	40	13(32.5)	40	21(52.5)	40	9(22.5)
Jabi Tehnan	40	18(45.0)	40	19(47.5)	40	10(25.0)	40	20(50.0)	40	9(22.5)
Sekela	40	18(45.0)	40	24(60.0)	40	21(52.5)	40	14(35.0)	40	25(62.5)
Dega Damot	40	14(35.0)	40	15(37.5)	40	18(45.0)	40	23(57.5)	40	13(32.5)
Total	412	192(46.)	412	169(41)	412	141(34)	412	190(46.2)	412	139(33.37)
χ^2	12.988		19.531		20.003		24.555		21.525	
P-Value	0.163		0.021		0.018		0.004		0.011	

Key: SAIT= Shortage of AI technicians, SI= Shortage of inputs, DAIS= Distance to AI service, EAI= efficiency of AI technicians and NE= number efficiency, WHS=Weekends and holiday service.

Table 2: Pass without breeding from AI and natural mating.

	Pass without breeding from AI and Natural mating				
Satisfaction	No	Yes	Total	χ^2	P-value
Non-satisfied	159(55.79)	126(44.21)	285	80.88	0.000
Satisfied	127(100)	0(0)	127		
Total	286(69.42)	126(30.58)	412		

Table 3: One-way analysis of variance in the use of natural mating for cow and heifers.

	Used Natural Mating				
Satisfaction	No	Yes	Total	χ^2	P-value
Non-satisfied	167(58.59)	118(41.40)	285	73.687	0.000
Satisfied	127(100)	0(0)	127		
Total	294 (71.35)	118(28.65)	412		

Table 4: Waiting AI service for cow and heifer

	Waiting the next time used AI service				
Satisfaction	No	Yes	Total	χ^2	P-value
Non-satisfied	244(85.6)	41(14.39)	285	19.196	0.000
Satisfied	127(100)	0(0)	127		
Total	375(91.0)	39(9.4)	412		

Table 5: Inseminated cow and heifers in non-pregnant and pregnant case in different age group.

	Age(year)							
Inseminated cows/heifers	≤3	3-6	7-9	10-11	>11	Total	χ^2	P-value
Non-Pregnant	58(56.8)	10(9.8)	21(20.6)	9(8.8)	4(3.9)	102	469	0.00
Pregnant	66(21.4)	52(16.9)	94(30.5)	62(20.1)	34(11.0)	308		
Total	124(30.)	62(15.12)	115(28.04)	71(17.31)	38(9.3)	410		

Table 6: Inseminated cow and heifer in non-pregnant and pregnant.

	Bread				
Inseminated cow and heifer	Local	Cross	Total	χ^2	P-value
Non-Pregnant	93(91.17)	9(8.8)	102	6.217	0.013
Pregnant	248(80.51)	60(19.48)	308		
Total	341(83.17)	69(16.83)	410		

Table 7: Inseminated cow and heifers in non-pregnant and pregnant case.

	Estrus Detection				
Inseminated cow and heifer	Absence of estrus detection	Good estrus detection	Total	χ^2	P-value
Non-Pregnant	74(72.54)	28(27.45)	102	0.000	247.79
Pregnant	5(1.62)	303(98.38)	308		
Total	79(19.26)	331(80.73)	410		

Table 8: Inseminated cow and heifers in non-pregnant and pregnant case.

	Timing of insemination					
Inseminated cow and heifer	Sign of Estrus up to 10 hrs	10hrs-18hrs	18hrs-24hrs	Total	χ^2	P-value
Non-Pregnant	34(33.33)	21(20.58)	47(46.07)	102	11.54	0.003
Pregnant	135(43.83)	87(28.24)	86(27.92)	308		
Total	169(41.22)	108(26.34)	133(32.44)	410		

Table 9: Inseminated cow and heifer in non-pregnant and pregnant animal in study area

	Inseminated cow and heifer				
Origin	Non-Pregnant	Pregnant	Total	χ^2	P-value
Bahir-Dar	17(18.48)	75(81.52)	92	14.729	0.099
Yilmana Densa	15(21.43)	55(78.57)	70		
Mecha	13(25.49)	38(74.50)	51		
North Achefer	6(20.00)	24(80.00)	30		
South Achefer	9(26.47)	25(73.53)	34		
Burie	6(20.00)	24(80.00)	30		
Jabi Tehnan	8(33.33)	16(66.66)	24		
Gonji Kolela	9(25.00)	27(75.00)	36		
Sekela	13(52.00)	12(48.00)	25		
Dega Damot	6(33.33)	12(66.66)	18		
Total	102(24.88)	308(75.12)	410		

102 non-pregnant anima from 410 inseminated cow and heifers; there was statistically significant difference among the study districts in estrus detection (P=0.00) (Table 6).

There was statistically significant difference among the study districts in timing of insemination (P=0.003). The major number of non-pregnant animals were found in the late estrus sign (18 hrs-24 hrs) 47(46.07%) in 102 non-pregnant animals from 410 inseminated cow and heifer and also the least number of non-pregnant animals were in the good estrus sign (10 hrs-18 hrs) 21 (20.58%) in 102 non-pregnant anima from 410 inseminated cow and heifer (Table 7) above.

Results of pregnant and non-pregnant animal from inseminated case: The greatest number of non-pregnant animals were found in Sekela district 13 (52%) from 25 (100%) inseminated cows and heifers and also the smallest number of non-pregnant animals were presented in Bahir-Dar *zuria* district 17(18.48) from 92(100%) inseminated cows and heifers (Table 9) below. There was no statistically significant difference among the study districts (P=0.099).

Nearly all (12%) of the AI technicians responded that they never got on job trainings and other incentives at all. About 2/3 (66.6%) of the AI technicians were not giving service on the weekend while others did so on personal agreements (33.4%). Most of the AI technicians complained that liquid nitrogen is not readily available (65%) and the rest (35%) had no problem in getting liquid nitrogen.

More than three fourth of the AI technicians (56%) believed that there is a risk of indiscriminate insemination while the others either did not have any idea about the problem (44%) or believed it can be controlled. Seventy-five percent of the AITs revealed that farmers are willing to pay more fees for the services provided they get reliable and quality services. On the other hand, 92 % of them revealed that they do not get necessary supports by the respective district zonal and regional bureaus of agriculture to perform their duties appropriately. Similarly, 79 % said that AI service delivery is not consistent in their respective areas.

Ninety nine percent of the AITs revealed that they are neither satisfied nor happy with their jobs as AITs because of the very little attention given to it by all responsible bodies. Ninety seven percent, of the farmers who participated in the Questionnaire surveys bitterly revealed that, they do not get reliable and consistent AI service at all and 46.7%, 41% and 34.2% of them explained the reasons for that as absence of service on weekends and holidays, shortage of AITs and shortage of inputs respectively. In relation to this, 44.2% of them said that they pass the estrus without breeding the cow while 41.4% said that they use bull/ natural mating at times where they do not get the AI service and 14.4% keep the next time to use AI service. The study has clearly confirmed that 69.17% of all the farmers participated in the study areas showed dissatisfaction with the overall AI service. In many places, it was observed that farmers trek their cows for more than 28km round trip to fetch for AI service (with or without success). This is happening in many areas and the reason is AITs are unable to get facilities and services like motor bicycles, fuel, etc.

DISCUSSIONS

Assessment of problems associated with artificial insemination services in West Gojjam zone was conducted on 412 dairy owners and 15 artificial insemination technicians(AIT) supported by questionnaire survey in ten (10) different districts. The research showed that from 412 cattle owners 285 (69.17%) were not satisfied in different ways in the use of AI service during the time of weekends and holidays, this was due to shortage of AIT, shortage of input, distance from AI service and inefficiency of AIT and number of AI service may vary from one to other districts. On the other hand, 127 (30.83%) were satisfied in AI service, this result agrees with the reports of Dessalegn [9].

In all the study districts, there was statistically significant difference in shortage of AIT ($P<0.05$) this might be due to the cattle population and AI service delivery were not synchronized. This agrees with the reports of Dessalegn [9]. Among the study districts, Sekela was the list AI service users which accounts about (40%) from the total study population whereas the better AI service users were found at South Achefer which was (70%). There was statistically significant difference among the study districts in shortage of input ($P<0.05$) this might be due to uneven distributions and production of semen in both National Artificial Insemination Center (NAIC) and Amhara Regional Administrative State Artificial Insemination Center (ARASAIC).

There was statistically significant difference among the study districts in distance to AI service ($P<0.05$) because the dairy owners live far from the AI service center. The maximum distance from dairy owners home to AI service were found in Gonji Koela districts (60%)

and the least distance from dairy cattle owners home to AI service were found in Bahir-Dar *zuria* districts (19.5%). however, other districts were not significantly different among the study districts. There was a significant variations in inefficiency of AITs ($P<0.05$) this was due to lack of intensive training and shortages of skills and experience. The result agrees with the reports of IAEA [14]. The highest value of inefficiency of AITs was found in Sekela districts (62%) and similar results of least values of inefficiency of AITs were found in both Jabi Tehinan and Bure districts which account (22.5%).

There was difference among the study districts in pass without breeding from AI and natural mating, used natural mating and waiting the next AI service because, the assessment indicate that there were shortage of input, shortage of AITs and less service were given in weekends and holidays. This result agrees with the reasons identified as problems of AI by IAEA [14] and Zewdie *et al.* [15].

There was statistically significant difference ($P<0.05$) among the study districts in estrus detection because there were high failures in both dairy owners and AITs in failure of estrus detection for insemination [14] and [16]. The maximum number of non-pregnant animal, 74 (72.54%) were found in the failure of estrus detection from the total non-pregnant cow and heifer inseminated. There was statistically significant difference ($P<0.05$) among the study districts on time of insemination and the result were indicative, late and before time of insemination results in failure of conception or repetition of insemination per cows and heifers. Animal should be inseminated within 24 hours of heat because late and early insemination may affect the conception rates of both heifers and cows [17]. The major number of non-pregnant animal were found in the late estrus at (18 hrs-24 hrs) 47(46.07%) from the total non-pregnant animals were inseminated.

The outcome of the assessment of AI technicians regarding their technical knowledge was 15.2%, 39.8 %, 23% and 22%, respectively for excellent, very good, good and poor. This finding indicates that most of the technicians do not get on job trainings and shows there is some of indicating a need for upgrading the capacity of technicians through giving proper trainings particularly for those who were under the category of the poor technical expertise. These findings are in agreement with the suggestions [18].

The study had found an alarming result with motivations of the AI technicians in which 99% of them have indicated that they are not motivated to work as AI service due to associated problems and constraints. The situation is closely associated to the discontinuation of in-service trainings and incentive mechanisms [9]. Furthermore, the outcome of the study revealed that there is no appropriate collaboration and communications among dairy farmers in which the ARASAIC failed to do which consequently contributed to the unsuccessfulness of the service. As far as the constraints associated with the AI service at regional levels is concerned, 56% of ARASAIC personnel indicated that lack of breeding policy and herd recording scheme, inefficient management at regional level and lack of clearly defined share of responsibilities among dairy farmers were identified as the most important constraints. Similarly, 15.3% of the ARASAIC personnel and 86% of the AI technicians indicated low attention/lack of ownership and follow-up, inadequate manpower and lack of commitment, lack of attention and incentives to AI technicians, limitation of inputs and facilities and structural problems as other major reasons. These findings are correlated with the suggestions by Zewde [18].

The very high repeat breeding condition in the study districts is believed to be a serious problem. The problem of repeat breeders was also mentioned by farmers and hence needs to be seriously addressed. High numbers repeat breeders are the results of problems associated with 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 related to estrus detection, timing of insemination and skill of pregnancy diagnosis were also indicated by other reports like [19, 20].

CONCLUSION

According to the results of this study, AI service in West Gojjam zone has been given little or no emphasis at the zonal or districts levels. The most important constraints associated with AI in west Gojjam zone includes loss of structural linkage between AI center and service giving units, absence of collaboration and regular communication between dairy owner and AI technicians, lack of breeding policy and herd recording system, inadequate resource in terms of inputs and facilities and absence of incentives and rewards to motivate AI technicians.

Based on the above conclusions the following recommendations are forwarded: The zonal body responsible to coordinate and monitor AI service, herd

recording and also livestock breeding programs needs to be established and be very well organized in human and material resources; Professional associations should critically work in close collaborations with the Zonal of Agriculture and Rural Development in formulating policies and implementation strategies; Trainings should be given at federal and/or zonal level to AIT to prevent artificial insemination failure; The private sector should be encouraged to be involved in the AI service sector but with strict control by an active breeding policy; The federal, zonal and district should encourage the AIT and farmers. The AITs should have regular communication with dairy owner and Federal, zonal and district agricultural and rural development offices. The AI service provision should be restructured in such a way that it responds well to the breed improvement programs of the country.

REFERENCES

1. CSA, Central Statistics, 2006. Agency, Federal Democratic Republic of Ethiopia Agricultural Sample Survey 2006/07, volume II, Report on livestock and livestock characteristics. Statistical Bulletin 388. Addis Ababa, Ethiopia, 9-10: 25-27.
2. Ethiopian Agricultural Sample Enumeration (EASE), 2003. Statistical report on Farm Management Practice, livestock and farm implements part II. Results at the country level. Addis Ababa, Ethiopia, pp: 219-232.
3. Ball, P.J.H. and A.R. Peters, 2004. Reproduction in cattle.3rd ed. Black well Publishing, pp: 40-50.
4. Noakes, D.E., T.J. Parkinson and G.C.W. England, 2009. Veterinary Reproduction and Obstetrics. 8th ed. China, Sounders Elsevier, pp: 750-760.
5. Webb, D.W., 2003. Artificial Insemination in Cattle. University of Florida, Gainesville. IFAS Extension, DS 58: 2-5.
6. Bekele, T., 2005. Calf Sex Ratios in Artificially Inseminated and Natural Mated Female Crossbred Dairy Herd. In: proceedings of the 13th annual conference of the Ethiopian Society of Animal Production. Addis Ababa, Ethiopia, pp: 225-230.
7. Sinishaw, W., 2005. Study on semen quality and field efficiency of AI bulls kept at the National Artificial Insemination Center. MSc thesis, Addis Ababa University, Faculty of veterinary Medicine, Debre Zeit. Ethiopia, pp: 13-17.
8. Dekeba, A., W. Ayalew, P.B. Hedge and Z. Taddese, 2006. Performance of the Abernossa Ranch in the production of Ethiopian Boran x Holstein crossbred dairy heifers in Ethiopia. In: Ethiopian Journal of Animal Production, 6: 30-4.
9. Dessalegn, G.G., 2008. Assessment of problems/constraints associated with artificial insemination service in Ethiopia. Thesis of MSc Addis Ababa University, Faculty of Veterinary Medicine Debre Zait, pp: 1-43.
10. Joe, B.H., W.F. John and T.W. Scoot, 2004. Applied animal reproduction.6th ed. Pearson prent hall. U.S.A., pp: 183-193.
11. Foote, R.H, 2012. The history of artificial insemination department of animal science, Cornell University. Available online at http://www.academicjournals.org
12. Petrunlkina, A.M., 2007. Determination of sperm quality and fertility in domestic specie. Cited by co related articles. Available at www.preproduction on line org/cri/content/full/134/1/3.
13. Thrusfield, M., 2005. Veterinary epidemiology. 3rd ed. Blackwell Science Ltd., Oxford, Great Britain, pp: 182-198.
14. International Atomic Energy Agency (IAEA), 2005. Improving artificial breeding of cattle and buffalo in Asia Guidelines and recommendations. A manual prepared under the framework of an IAEA Technical Cooperation Regional RCA Project on Improving Animal Productivity and Reproductive Efficiency", with technical support of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. Vienna, Austria, pp: 1-27.
15. Zewdie, E., A. Mussa, G.M. Melese, D. Haile-Mariam and B.M.A.O. Perera, 2006. Improving artificial insemination services for dairy cattle in Ethiopia. In: Improving the reproductive management of smallholder dairy cattle and the effectiveness of artificial insemination services in Africa using an integrated approach. International Atomic Energy Agency (IAEA), pp: 17-19.
16. Michel, A.W., 2010. Heat detection, natural service and artificial insemination. Babcock institute for international dairy research and development dairy essentials university of consin Madison, pp: 1-4.
17. Allen, B., L. Scott, L. Ron and C. Matt, 2010. Timed-Artificial Insemination in Beef Cows: What are the Options? Purdue Beef Team, Department of Animal Sciences. Purdue University, pp: 1-14.

18. Zewde, E., 2007. Artificial insemination and its implementation. Ethiopian Society of Animal Production (ESAP). Addis Ababa, Ethiopia, pp: 7-14.
19. Denbarga, Y., 2005. A Study on reproductive performance of crossbred dairy cows I smallholder dairy farms in South East Shoa Zone of Oromia Region, Ethiopia. MSc Thesis. Addis Ababa University, Faculty of Veterinary Medicine.
20. Shiferaw, Y., B.A. Tenhagen, M. Bekana and T. Kasa, 2003. Reproductive performance of crossbreed dairy cows in different production systems in the central highlands of Ethiopia. Tropical Animal Health Production, 25: 551-561.
21. Mishamo Sulayeman and Abebe Fromsa, 2012. Lameness in Dairy Cattle: Prevalence, Risk Factors and Impact on Milk Production, Global Veterinaria, 8(1): 01-07.