SM Online Scientific Resources

SM Journal of Reproductive Health and Infertility

Review Article

Status of Artificial Insemination; Its Constraints and Estrous Synchronization in Ethiopia

Mebrate Getabalew[1] and Tewodros Alemneh[2*]

[1]*Department of Animal Science, College of Agricultural and Natural Resources Science, Debre Berhan University, Ethiopia*

[2]*Woreta City Office of Agriculture and Environmental Protection, Ethiopia*

Article Information

Received date: Aug 15, 2019

Accepted date: Sep 02, 2019

Published date: Sep 05, 2019

***Corresponding author**

Tewodros Alemneh, Woreta City Office of Agriculture & Environmental Protection, South Gondar Zone, Amhara Regional State, Ethiopia, Tel: 251 9 20 49 98 20

Email: tedyshow@gmail.com

Keywords Artificial insemination; Estrus synchronization; Hormones; Reproductive biotechnologies; Body condition

Abstract

Assisted reproductive technologies particularly artificial insemination (AI) and estrus synchronization are operated to enhance the genetic improvement of cattle. Estrus synchronization is one of the potential tools for the reproductive improvement of livestock. It is the manipulation of the estrus cycle or induction of estrus to bring a large percentage of groups of females into estrus at a short and predetermined time period. Estrus synchronization of fertile cows can be accomplished with various hormones; such as, progesterone, prostaglandin, gonadotropin releasing hormone (GnRH), follicle stimulating hormone (FSH) and luteinizing hormone (LH). These tools remain the most useful and widely applicable reproductive biotechnologies available for dairy cow operations. It is obvious that the AI service in Ethiopia has not been successful to improve reproductive performance of dairy industry. Artificial insemination service in Ethiopia has been given little or no emphasis at the federal and regional levels for long time though it is a widely practiced animal biotechnology all over the world. The most important constraints associated to estrous synchronization in Ethiopia are: inadequate resource in terms of inputs and facilities; absence of incentives and rewards to motivate technicians; lack awareness of this technology by animal producers; shortage of feed resources; cost of semen and synthetic hormones; cost of a bull (a self-trained breeding technician), and lack of adequate transportation facilities. In general, incorporating a good management practice and selecting cows that have good body condition are the two most essential requirements for successful estrous synchronization and AI. Hence, the objective of this review is to assess the current status of artificial insemination; its constraints and estrous synchronization in Ethiopia.

Introduction

In Ethiopia, livestock production accounts for approximately 35 to 49% of the total agricultural GDP and 16 to 17% of foreign currency earnings. From the total cattle population, 98.95% are local breeds of cattle and the remaining are hybrid and exotic breeds. Ethiopia needs to work hard on improving the work of productive and reproductive performance improvements of cattle through appropriate breeding and related activities [1].

In Ethiopia, the domestic animal population is estimated to be 57.83 million cattle, 28.89 million sheep, 29.70 million goats, 60.51million chicken, 2.08 million horses, 7.88 million donkeys, 0.41 million mules, and about 1.23 million camels [1]. But, most of these livestock populations are native breeds/ecotypes (98.59 % cattle, 99.85 % sheep, 99.96 % goats, 94.33 chickens). Nevertheless, the productivities of these native livestock are low due to their genetic makeup, low level of inputs, and traditional management practice besides environmental stress [2].

In order to improve these local cattle, selection of the most promising breeds and cross breeding of these local breeds with highly productive exotic cattle has been a practical solution. Assisted reproductive technologies particularly artificial insemination and estrus synchronization are operated to enhance genetic improvement of cattle. Even though, some authors [3,4] have evaluated the efficiency of assisted reproductive technologies in different production systems of Ethiopia, well thought-out information is not lacking.

In Ethiopia, the productivity of livestock particularly milk and meat remains low due to poor management program, poor genetic potential, inadequate animal health service, location and breed differences and others [5]. Selection of the most promising breeds and crossbreeding of local breeds with highly productive exotic cattle has been considered a practical solution to improve the low productivity of local cattle [6].

It is obvious that the AI service in the country has not been successful to improve reproductive performance of dairy industry. According to some previous studies, it has been that AI service is weak and even declining due to inconsistent service in the smallholder livestock production systems of the country in general. The problem is more aggravated by lack of recording scheme, wrong selection procedures, and poor management of AI bulls associated with poor motivations and skills of inseminators [6]. Therefore, the objective of this review is to assess artificial insemination, estrous synchronization and its constraint in Ethiopia.

Status of Artificial Insemination Service in Ethiopia

According to CSA [1], from 57.83 million cattle populations in Ethiopia, only 1.22% (705,526) and 0.19% (109, 877) are hybrid and exotic breeds, respectively. The remaining, 98.59% of the total cattle populations are local breeds. In contrast, Kenya, with cattle population of about 12 million, has around three million crossbred dairy cows [3].

Artificial insemination as assisted reproductive technology had been going on for nearly fifty years. In comparison with its age, this indicates that the average milk yield change in dairy cattle population after AI introduced as assisted reproductive technology is negligible. Consequently, from enhancing access of genetically improved dairy cows for smallholder farmers and improvement of reproductive and productive performance of dairy industry point of view, it is widely believed that AI service in the country has not been successful [7] Table (1).

Table 1: Conception rate for first service (CRF) in some parts/regions of Ethiopia

Place	CRF (%)	Sources
At National Level	27.1	Desalegn et al. [8]
Tigray Regional State	32.08	Desalegn et al. [8]
SNNPR Region	33.3	Desalegn et al. [8]
Addis Ababa	40.2	Desalegn et al. [8]
Oromia Region	34.3	Desalegn et al. [8]
Amhara Region	20.3	Desalegn et al. [8]
Fogera Woreda	32.07	Desalegn et al. [8]

Constraint associated with AI service in Ethiopia

Interrupted AI service delivery: Most smallholder dairy farmers in many places of Ethiopia expressed no/low satisfaction for AI services delivery system. The most important reason for this is smallholder dairy farmers had not got the service regularly (without interruption) due to unavailability of AI technicians, discontinuation of the service on weekends and holidays and lack of inputs [3,8]. In addition, absence of incentives and rewards to motivate AI technicians had contributed to a very high turnover of AI technicians all over the country [3,8]. Hence, the government should notice the problem and design strategies to make the service available in off-working days. In addition, incentives and rewards should be facilitated based on the output of the inseminator (number of pregnant cow after insemination/inseminator.

Problem of heat detection and time of insemination: In Ethiopia heat detection has been performed and reported to Technicians by dairy cattle producer during the time of observing sign of heat like mounting on other animals, vulva discharge, bellowing, swelling, redness and mucus discharge of the vulva, restlessness and nervousness [10]. Woldu et al. [11] indicated that small holder farmers are engaged in various farm activities and is very difficult for them to detect proper time of heat. The dairy producer could detect the heat time but it might not match with appropriate time of insemination. This leads to the heat period of the cows and heifers passed away before the AI service have been delivered or inappropriate time of insemination that cause failure to conception or pregnancy.

Furthermore, Lemma [12] revealed that, since AI technicians are unable to get facilities and services like Car and fuel, farmers trek their cows for long distances (more than 28km round trip) to fetch for AI service. In contrast, Tegegne et al. [3] indicated that cows which shown heat are reported to the AI technicians by the owners and the technicians usually visit the farm to inseminate the cow. In general, identifying the right time of heat for insemination and on time providing of the AI service for the beneficiaries needs strong collaboration between stakeholders. Intensive training of sufficient Technicians and allocation of them at farmer's premises like developmental agents should minimize the failure due to inappropriate time of insemination.

Shortage of AI technicians and low output from the available technicians: In Ethiopia, AI is undertaken by one or two AI technicians at district level. They are mainly providing services for dairy cows in urban and/or peri-urban areas. Little or no AI services are available in rural areas [3]. According to Desalegne et al. [8], more than half of the AI technicians reported that they have good (not excellent and very good) technical know-how about the technology. This is due to absence of on trainings of Technicians and other incentives. Given the shortage of AI technicians and the low output of the available technicians, the impact of AI on the number of genetically improved dairy animals for fluid milk in and around urban areas is limited and genetic improvement of dairy animals in rural areas is almost negligible.

Lack of appropriate collaborations between the NAIC and stakeholders: Desalegne et al. [8] revealed that, absence of collaboration and regular communication between NAIC and stakeholders have greatly contributed for insignificant success of AI service.

Lack of breeding policy and absence of record keeping: Well-designed crossbreeding programs may lead to exploit desirable characteristics of the breeds or strains involved, and to take advantage of heterosis for technicians of economic relevance. In addition, lack of accurate, timely and reliable information on dairy sector accounted for inefficient service of AI centers. Some dairy records are available in Ethiopia, but they are limited to research institutions. The other reasons for inefficient AI service are poor infrastructure, managerial, financial constraints, poor semen quality, poor semen handling practices and poor insemination practices [13].

Status of Oestrous Synchronization in Ethiopia

Estrus synchronization in cattle

The history of estrous cycle synchronization and the use of artificial insemination in cattle are a testament to how discoveries in basic science can be applies to advance the techniques used for livestock breeding and management. Synchronization of estrus involves controlling the estrous cycle of the females, so that they can be breed at approximately the same time [14]. Synchronization of the estrous cycle has the potential to shorten the calving season, increase calf uniformity and enhance the possibilities for utilizing AI [15]. The objective of a synchronization program is to breed a high percentage of the females in a given group of heifers or cows in a short period, using either AI or natural service (bulls) [16]. The use of PGF2α for estrus control has been considered more applicable to tropical herds, possibly owning to problems with estrus detraction and irregularity of the estrus cycle [17].

Prostaglandin (PGF2α) hormone: Prostaglandin is used to synchronize estrus in dairy cattle operations to improve the efficiency of AI by inducing the regression of the corpus luteum and subsequently lead to the expression of estrus and ovulation with 2 to 5 days after their administration [18]. Pregnancy rate from 61.4 to 65% in cycling and up to 47% in anestrus cows are reported after a single injection of PGF2α [19]. Use of PGF2α is the first method of heat synchronization that depends on the presence of a functional CL particularly in the di-estrus stage of the estrous cycle (day 7 to 17 of the cycle). Each estrus cycle consists of a long luteal phase (1 to 17 days) where the cycle is under the influence of progesterone and a shorter follicular phase (18 to 21 days) where the cycle is under the influence of estrogen. This time of peak estrogen secretion can last from 6 to 24 hrs. With ovulation occurring 24 to 32 hours after the beginning of estrus [20] Figure (1).

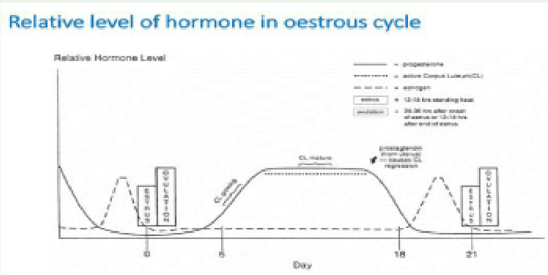

Figure 1: Level of different hormone in estrous cycle [20].

Estrus synchronization protocols: Different estrous synchronization protocols are available globally. Some commonly used estrous/ovulation synchronization protocols in dairy cattle includes use of prostaglandin (one shot method and two-shot method) and progestin and GnRH (Ovsynch and Cosynch) [14,20] Figure (2,3).

Advantages of GnRH use in Ovulation Synchronization allow for synchronized follicular growth and ovulation, not just the synchronization of estrus, induces ovulation and estrous cycles in non-cycling cows. These systems allow producers to artificially inseminate cows with little or no heat detection; eliminating the risk of injury for cattle that are mounting or displaying other estrus behavior [21].

varied with breeds, body condition of cows and skill of AI technicians. In SNNP region, exotic crosses had also higher (68.4%) conception rate than local cows/heifers (53.3%). However, in Oromia region, the local cows/heifers had higher (77.4%) conception rate than the exotic crossbred cows (68.8%) [23] Table (2).

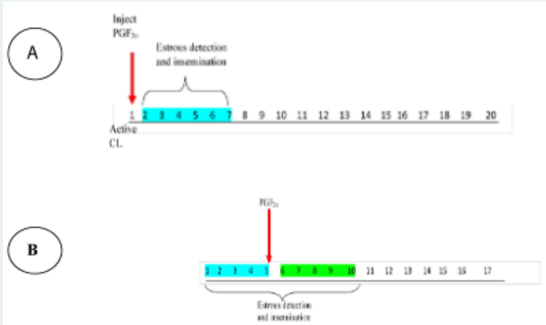

Figure 2: One shot Prostaglandin injection [14].

A: a single injection of prostaglandin is given to cyclic females, and then these females as breed as they express heat.

B: The owners detect estrus for 5 day and breed each cow as she exhibit estrous.

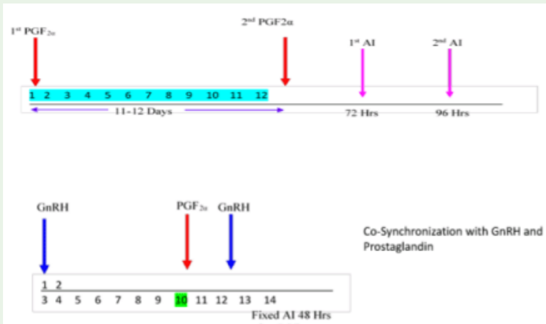

Figure 3: Two shot Prostaglandin injection [14].

Table 2: Oestrous Response and Conception rate results from Single shot Hormonal Oestrous Synchronization in Action Researches

Research Site / Area	Number of Cows Treated	Oestrus Response (%)	Conception Rate (%)	Source
Sidama	126	89.7	58.4	Legesse [22]
Awassa-Dale Milkshed	175	97.7	57.7	Tegegne et al., [3]
Adigrat-Mekelle Milkshed	193	100	61.7	Tegegne et al., [3]
Fogera Woreda	93	98.92	26.88	Alemneh et al., [9]
West Shoa Zone	130	72.3	57.44	Worku [23]

Number of services per conception and conception rate: As most of authors reported, the conception rate and number of service per conception results in different parts of Ethiopia are dissimilar. Legesse [22] reported that the conception rate and number of service per conception of synchronized and mass inseminated dairy cattle in Sidama Zone of SNNP region are 58.4% and 1.7%, respectively. Conception rate of hormone treated and inseminated cows/heifers

Conclusions

Despite the existence of Technicians particularly AI services over the last five decades in Ethiopia, smallholder farmers have not benefitted adequately from milk production primarily due to unavailability of improved dairy animals. The main reasons for this insignificant change were interrupted AI service delivery system, discrepancy between time of heat detection and appropriate time of insemination, shortage of Technicians and low output from the available technicians, lack of appropriate collaborations between service provider and other stakeholders and absence of herd recording system. Multiple ovulation and embryo transfer (MOET) could be an additional asset to increase access to improved dairy genetics to smallholder farmers. The objective of a estrous synchronization program is to breed a high percentage of the females in a given group of heifers or cows in a short period, using either AI or natural service, but its result is low in Ethiopia because of different reason listed and discussed in above.

Acknowledgments

Authors' gratefully thanks to Debre Berhan University Staffs, Librarians, and the Community for their material and logistic supports.

References

1. CSA (Central Statistical Authority). Agricultural Sample Survey Statistical Bulletin. Central Statistical Authority, Addis Ababa. 2016
2. Tegegne A, Gebremedhin B, Hoekstra D. Livestock Input Supply and Service Provision in Ethiopia: Challenges and Opportunities for Market Oriented Development. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 20. ILRI (International Livestock Research Institute), Nairobi, Kenya. 2010.
3. Tegegne A, Estifanos A, Tera A, Hoekstra D. Technological Options and Approaches to Improve Smallholder Access to Desirable Animal Genetic Material for Dairy Development: IPMS (Improving Productivity and Market Success) Experience with Hormonal Oestrus Synchronization and Mass Insemination in Ethiopia. "Resilience of agricultural systems against crises" Göttingen. 2012. 19-21.
4. Ashebir G, Birhanu A, Gugsa T. Status of Artificial Insemination in Tigray Regional State, "Constraints and Acceptability under field Condition". J Dairy Vet Anim Res. 2016; 3: 91-95.
5. Tesfaye A, Alemayehu L, Tefera Y, Endris A. Factors affecting the reproductive performance of smallholder dairy cows in two regions of Ethiopia. Livestock Res Rur Dev. 2015; 27.
6. Gebremedhin D. Assessment of problems/constraints associated with artificial insemination service in Ethiopia. Ababa University. 1-34.
7. Sinishaw W. Study on semen quality and field efficiency of AI bulls kept at the National Artificial Insemination Center. 2005.
8. Medhin D, Bekana M, Tegegne A, Belihu K. Status of artificial insemination service in Ethiopia. In: The 17th Annual Conference of the Ethiopian Society of Animal Production (ESAP). 2009; 87-104.
9. Alemneh T, Mogess W, Marew G, Adera Z. Study on the Conception Rate of Dairy Cows Artificially Inseminated During Natural Heat and by Synchronization in Fogera Woreda, North-West of Ethiopia. African J Basic Appl Sci. 2015; 7: 291-297.
10. Nuraddis I, Reta H, Abidu M. Assessment of Problems Associated with Artificial Insemination Service in Selected Districts of Jimma Zone. J Reprod Infertility. 2015; 5; 37-44.
11. Woldu T, Giorgis Y, Haile A. Factors affecting conception rate in artificially inseminated cattle under farmers' condition in Ethiopia. J Anim Bio. 2011; 5: 334-338.
12. Lemma A. Factors Affecting the Effective Delivery of Artificial Insemination and Veterinary Services in Ethiopia: Ada'a Case. Presentation by Alemayehu Lemma (Addis Ababa University) to the Ethiopian Fodder Roundtable on Effective Delivery of Input Services to Livestock Development Addis Ababa, 22 June 2010.
13. Shiferaw Y, Tenhagen BA, Bekana M, Kassa T. Reproductive performance of crossbred cows in different production systems in the central highlands of Ethiopia. Trop Anim Health and Prod. 2003; 35: 551-561.
14. Rick R, Gene D. Synchronizing Estrus: In Beef Cattle. University of Nebraska–Lincoln Lincoln, NE 68588 | 402-472-7211.
15. Lamb G. Estrus Synchronization protocols for cows. North Florida Research and Education Center, Marianna, Florida. Proceedings, Applied Reproductive Strategies in Beef Cattle January 28- 29, 2010; San Antonio, TX.
16. Noseir W. Ovarian follicular activity and hormonal profile during estrous cycle in cows. The development of 2 versus 3 waves. Reprod Biol Endocrinol. 2003; 50.
17. Azage T, Warnick AC, Mukassa-Mugerwa E, Ketema H. Fertility of Bos indicus and Bos indicus x Bos taurus crossbred cattle after estrus synchronization. Theriogenology. 1989; 31: 361-369.
18. Murugavel K, Yanize JK, Santolaria M, Lopez B, Lopez-Gatius F. Prostaglandin based estrus synchronization in Post-Partum dairy cows. An update. Int J App Res Vet Med. 2010.
19. Perry GA, Dalton JC, Geary TW. Management Factors Influencing fertility in Synchronized and Natural breeding Program. Applied Reproductive strategies conference proceedings. 2010.
20. Williams SW, Stanko RL, Amstalden M, Williams GL. Comparison of three approaches for Synchronization of ovulation for timed artificial insemination in Bos indicus-influenced cattle managed on the Texas gulf coast. J Anim Sci. 2002; 80: 1173-1178.
21. Juan Pablo SL. Ovarian and Hormonal Events during Synchronization of Ovulation and Timed Appointment Breeding of Bos indicus-Influenced Cattle Using Intravaginal Progesterone, GnRH and Prostaglandin F2α. D.V.M., Universidad de Antioquia, Medellín, Colombia. 2005.
22. Legesse D. Assessment of Breeding Practices and Evaluation of Mass Estrus Synchronization of Dairy Cattle in Sidama Zone, Southern Ethiopia. MSc thesis, department of animal and range science, Hawassa College of Agriculture, school of graduate studies, Hawassa. 2016.
23. Worku B. Assessment of Breeding Practices and Evaluation of Estrus Synchronization and Mass Insemination Technique in Dairy Cattle in West Shoa Zone. MSc thesis, Haramaya University, Haramaya, Ethiopia. 2015.