Review Article

Status of Assisted Reproductive Technologies for Genetic Improvement of Dairy Cattle in Ethiopia: Review

Ahmed Seid and Mohammed Aliy

Jimma University, Department of Animal Sciences, Jimma- P.O. Box 307, ETHIOPIA

***Corresponding author:** seidahmad5@gmail.com

Rec. Date:	Feb 09, 2017 08:33
Accept Date:	May 21, 2017 04:29
Published Online:	June 27, 2017
DOI	10.5455/ijlr.20170521042914

Abstract

This review is aimed to summarize and synthesize the fragmented information on effectiveness of assisted reproductive technologies (ARTs) for enhancing genetic improvement of dairy cattle in Ethiopia. Like most developing countries, artificial insemination (AI) is the first and most commonly used ARTs in Ethiopia because of its relative simplicity for application. It had been applied for nearly fifty years in Ethiopia. In order to enhance efficiency of AI service and improve heat detection problem of the dairy farmers, oestrous synchronization and mass artificial insemination (OSMAI) had also triggered as second reproductive technology and management. Even though the conception rate of conventional AI service which was 27 % improved to 39.3% for hormone treated dairy cows, the total number of cross breed cattle is estimated to be only 705,526 (1.22%) from 57.83 million cattle population of the country. Furthermore, currently, the average milk yield per cow per day at country level is about 1.37 liters and the average lactation period per cow is estimated to be about six months. This indicates that the access to genetically improved dairy cows for smallholder farmers and the reproductive and productive performance of dairy cows have continued with little change from natural mating. 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 AITs and low efficiency from the available technicians, lack of appropriate collaborations between service provider and other stakeholders and absence of herd recording system. In order to improve the effectiveness of the technologies and ultimately enhance access of smallholder farmers for improved dairy cattle, emphasis should be given on reviewed problems.

Key words: Artificial Insemination, Reproductive Technologies, Oestrous Synchronization

How to cite: Seid, A.and Aliy, M. (2017). Status of Assisted Reproductive Technologies for Genetic Improvement of Dairy Cattle in Ethiopia: Review. International Journal of Livestock Research, 7(7), 1-13. http://dx.doi.org/10.5455/ijlr.20170521042914

Introduction

The female contribution to reproductive success is limited by species-specific characteristics such as average litter size, frequency of estrus, and gestation length. In natural breeding, male contributions are restricted by the degree of proximity to fertile females and the ability to inseminate females with a sufficient number of normal sperm. Accordingly, individuals of both sexes are limited to carry the desired versions of genes or combination of genes. To help overcome some of these complications, various forms of Assisted Reproductive Technologies (ARTs) have been adopted in animal agriculture (Ngsoon, 2001). The application of ART enables the rate of genetic progress to be increased (Nicholas, 1996; Vivanco-Mackie, 2001). Some of these techniques increase the selection differential (artificial insemination and embryo transfer) while others accelerate progress by shortening the generation interval (juvenile in vitro embryo technology or JIVET). ART allow animals of high genetic merit to produce more offspring than would be possible by natural breeding (Chemineau and Cognié, 1991).

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 (CSA, 2016). However, most of these livestock populations are native breeds/ecotypes (98.59 % cattle, 99.85 % sheep, 99.96 % goats, 94.33 chickens). The distribution of native livestock populations across the different agro-ecologies of the country provides various options for tangible and non-tangible use of livestock products to the smallholder farmers and pastoral communities (CSA, 2016). Nevertheless, the productivity of the native livestock is low due to their genetic makeup, low level of inputs, and traditional husbandry practice besides environmental stress (Sebsibe, 2008; Azage *et al*., 2010). In order to improve the low genetic potential of local cattle, selection of the most promising breeds and cross breeding of these indigenous breeds with highly productive exotic cattle has been considered as a practical solution (Tadesse, 2008). Assisted reproductive technologies particularly artificial insemination and oestrus synchronization have been operated to enhance genetic improvement of cattle. Even though, some authors (Desalegne *et al.,* 2009; Azage *et al*., 2012; Hamid, 2012; Nuraddis *et al.*, 2014; Alazar *et al.*, 2015; Bainesagn, 2015; Debir, 2015; Destalem, 2015; Samuel, 2015; Tadesse, 2015; Tessema and Atnaf, 2015; Tewodros *et al.*, 2015; Ashebir *et al.*, 2016) have evaluated the efficiency of assisted reproductive technologies in different production systems of Ethiopia, well thought-out information is not available. Hence, this review is aimed to summarize and synthesize the fragmented information on efficiency of assisted reproductive technologies for enhancing genetic improvement of cattle in Ethiopia.

DOI 10.5455/ijlr.20170521042914

Assisted Reproductive Technologies (ARTs) in Ethiopia

In Ethiopia, genetic improvement of dairy cattle was assisted by artificial insemination (AI) and oestrous synchronization and mass artificial insemination (OSMAI). Like most developing countries, artificial insemination is the first and most commonly used ART in Ethiopia. It had been applied for nearly fifty years. OSMAI was operated as second reproductive technology and management. Embryo transfer (ET) was also started in Debrezeite research center but the technology has not become expanded due to different constraints (Tegegne *et al.*, 2016).

Artificial Insemination (AI)

Artificial insemination can be regarded as the first generation assisted reproductive technologies and it is the one that has made the greatest contribution to genetic improvement programs, mainly due to well-established methods for identifying males with the highest genetic merit (Evans and Maxwell, 1987; Chemineau and Cognié, 1991; Leboeuf *et al.,* 2000). In Ethiopia, AI was introduced in 1938 in Asmara, the then part of Ethiopia, which was interrupted due to the 2nd World War and restarted in 1952 (Yemane *et al.,* 1993). It was again discontinued due to unaffordable expenses of importing semen, liquid nitrogen and other related input requirements. Chilalo Agricultural Development Project (CADU), an integrated project established jointly by the Ethiopian and Swedish Governments, in Arsi region, initiated intensive small scale dairy development in Ethiopia in 1967/68 (Kiwuwa *et al*., 1983). This was followed by the Wolaita Agricultural Development Project (WADU) that was established in 1971 and funded by the World Bank (Hailemariam, 1994). Production of deep-frozen semen started at CADU in 1973. CADU in Assela, and WADU in Welaita, continued breeding and distributing crossbred dairy cows to farmers using artificial insemination services (Chencha and Kefyalew, 2012). Until the establishment of National Artificial Insemination Centre (NAIC) in 1981, Dairy Development Authority and CADU performed a total of 74,611 inseminations by importing semen and liquid nitrogen.

The current NAIC was established in 1981 to coordinate the overall AI operation at national level (Gebremedhin, 2005). NAIC is a government AI service provider organization to rural, peri-urban, and urban areas through the regional offices throughout the country so as to achieve an efficient and reliable artificial insemination service. Initially, service was based on production and use of fresh semen until the liquid nitrogen plant was installed in 1984. Bulls donated by the Cuban Government (25 Holstein and 10 Brahman) and imported 44,800 doses of Friesian and 2,000 doses of Jersey semen were the source of semen used for frozen semen technology (Chencha and Kefyalew, 2012). Semen collection was operated from exotic (Friesian, Jersey, Brahman), indigenous (Boran, Barka, Fogera, Horo, Sheko) and crosses of 50% and 75% Holstein-Friesian indigenous bulls. From the total semen produced, the major share is from Friesian (75.3%), followed by Jersey (10.5%). Holetta bull/dam farm was the base for nucleus bull-

 DOI 10.5455/ijlr.20170521042914

producing, testing and rearing (Getachew and Gashaw, 2001). From 1981 till 2015 a total of 6,247,857 semen doses were produced and 5189705 were distributed to beneficiaries by NAIC (FAISETD, 2016).

Efficiency of AI Service in Ethiopia

According to CSA (2016), from 57.83 million cattle populations in Ethiopia, only 1.22 percent (705,526) and 0.19 percent (109, 877) are hybrid and exotic breeds, respectively. The remaining, 98.59 percent 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 (Tegegne *et al.*, 2016). Moreover, the average milk yield per cow per day in Ethiopia is about 1.37 liters and the average lactation period per cow is estimated to be about six months (CSA, 2016). On the other hand, 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 was 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 (Sinishaw, 2005).

The conception rate of dairy cattle to first insemination at country level was 27% in the existing AI system (Desalegn *et al.*, 2009). However, the conception rate after the first insemination in different regions/parts of Ethiopia had shown significant variation (Table 1).

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

Place/Research Site	N	CRF (%)	Sources
At national level	375	27.1	Desalegne *et al.*, 2009
Tigray	70	7.1	Desalegne *et al.*, 2009
Tigray Regional State (Eastern And South-Eastern zone including Mekelle)	2056	32.08	Ashebir *et al.*,2016
SNNP Regional State (Siltie zone)	275	42.9	Hamid, 2012
SNNPR	84	33.3	Desalegne *et al.*, 2009
Addis Ababa	87	40.2	Desalegne *et al.*, 2009
Oromia	70	34.3	Desalegne *et al.*, 2009
Amhara	64	20.3	Desalegne *et al.*, 2009
North-West of Ethiopia (Fogera Woreda)	527	32.07	Tewodros *et al.*, 2015

N= number of cows/heifers inseminated

According to the report of Hamid (2012), the conception rate for first insemination of dairy cows/heifers in Siltie zone of south Ethiopia was 42.9%. In contrary, Ashebir *et al.* (2016) revealed that, the conception rate for first insemination of dairy cows/heifers in Tigray Regional State (Eastern and South-Eastern zone

 DOI 10.5455/ijlr.20170521042914

including Mekelle) of North Ethiopia was 32.08%. With such performance, the AI system has led to the country to having only about 705,526 (1.22%) cross breed cattle (CSA, 2016).

Problems Associated with AI Service in Ethiopia

Interrupted AI Service Delivery

According to many authors (Nuraddis *et al.*, 2014; Alazar *et al.*, 2015; Tessema and Atnaf, 2015), most smallholder dairy farmers in many places of Ethiopia expressed no/low satisfaction for AI services delivery system. The most important reason for this was smallholder dairy farmers had not got the service regularly (without interruption) due to unavailability of AITs, discontinuation of the service on weekends and holidays and lack of inputs (Desalegne *et al.*, 2009; Azage *et al.*, 2012; Nuraddis *et al.*, 2014; Alazar *et al.*, 2015; Tessema and Atnaf, 2015). 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 (FAISETD, 2007; Desalegne *et al.*, 2009; Azage *et al.*, 2012). 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 etc.).

Discrepancy between Time of Heat Detection and Appropriate Time of Insemination

In Ethiopia heat detection has been performed and reported to AITs by dairy cattle owners during observing sign of heat like mounting on other animals, vulva discharge, bellowing, swelling, redness and mucus discharge of the vulva, restlessness and nervousness (Nuraddis *et al.*, 2014). Hamid (2012) reported that, observation of the estrus signs and bringing the animals for AI solely rests on dairy cattle owners. However, Woldu *et al.* (2011) indicated that small holder farmers are engaged in various farm activities and is quite difficult for them to detect proper time of heat. The dairy owners 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 given or inappropriate time of insemination that cause failure to conception. Furthermore, Desalegne *et al.* (2009) and Alemayehu (2010) revealed that, since AITs are unable to get facilities and services like motor bicycles and fuel, farmers trek their cows for long distances (more than 28km round trip) to fetch for AI service. In contrast, Tegegne *et al.* (2016) 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 AITs, adequate provision of

  DOI 10.5455/ijlr.20170521042914

inputs and allocation of them at farmer's premises like developmental agents could reduce the failure due to inappropriate time of insemination.

Shortage of AITs 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 (Tegegne *et al.*, 2016). According to Desalegne *et al.* (2009), 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 job trainings 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.* (2009) 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 Herd Recording System

Well-designed crossbreeding programs may lead to exploit desirable characteristics of the breeds or strains involved, and to take advantage of heterosis for traits of economic relevance (López-Villalobos, 1998). 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. Crossbreeding with exotic breeds without keeping records clearly is a major factor contributing to the erosion of locally adapted AnGR (Köhler-Rollefson, 2004). The other reasons for inefficient AI service are poor infrastructure, managerial and financial constraints (Shiferaw *et al*., 2003), poor semen quality, poor semen handling practices and poor insemination practices (Negussie, 1992; Bekana *et al*., 2005).

Opportunities for Enhancing the Efficiency of AI Services

Farmer's Willingness to Pay More Fees For the Service

According to Desalegne *et al.* (2009) and Nuraddis *et al.* (2014), smallholder dairy farmers confirmed their willingness to pay more fees for the service provided they get reliable, efficient and effective services.

 DOI 10.5455/ijlr.20170521042914

Involvement of the Private Sector to Deliver AI Service

AI service is mainly being provided by the NAIC established under Ministry of Agriculture (MOA) for the production and distribution of semen and liquid nitrogen based on the request of regional agricultural development bureaus. NAIC supplies its products and services to farmers at a highly subsidized rate that is 4 ETB per dose of semen and 15 ETB per insemination. While establishing facilities for the production and storage of semen is reasonably feasible anywhere, it is far more difficult to implement and efficiently maintain field AI service activities. This holds true to the past experiences of Ethiopia.

Previously, except small number of individual AI technicians located in Addis Ababa, Bahir Dar and Gondar, there were no private sectors that provide the AI service. Currently, ALPPIS which is the private organization has begun importation and distribution of quality semen (female sexed and unsexed) and AI equipment. ALPPIS also provides consultancy services and trainings to AI technicians, farmers and development workers.

Livestock Genetic Improvement as One of the Major Targets of Growth and Transformation Program (GTP) II

One of the major targets of GTP II is to increase the number of cattle with improved genetics to 4,902,000 in 2019/20 by increasing field artificial insemination efficiency by reducing number of services per conception from 2.4 in 2014/15 to 2 by 2019/20, increasing the number of liquid nitrogen production centers from 21 in 2014/15 to 30 by 2019/20 and increasing the annual artificial insemination service delivery capacity from 1.75 million in 2014/15 to 5.2 million by the end of the plan period (2019/20).

Oestrous Synchronization and Mass Artificial Insemination (OSMAI)

The history of estrous cycle synchronization and the use of artificial insemination in cattle is a testament to how discoveries in basic science can be applied to advance the techniques used for livestock breeding and management (Beal, 2002). Synchronization of estrus involves manipulating or controlling the estrous cycle of the females, so that they can be breed at approximately the same time (Rick and Gene, 2013). Synchronization of the estrous cycle has the potential to shorten the calving season, increase calf uniformity, and enhance the possibilities for utilizing AI. In addition, synchronization of estrus contributes to optimizing the use of time, labor, and financial resources (Alemayehu, 2010).

In Ethiopia, hormonal oestrus synchronization was triggered as a solution for efficient AI service delivery system and as additional opportunities to enhance access of smallholder farmers to genetically improved dairy cows with in short period of time in areas where dairy development is feasible (Tegegne *et al.*, 1989). The Improving Productivity and Market Success (IPMS) and Livestock and Irrigation Value Chains for Ethiopian Smallholders (LIVES) projects with partners expanded oestrus synchronization and mass insemination of cows in different milksheds in Tigray, Amhara, Oromia and Southern Nations

Hosted@www.ijlr.org DOI 10.5455/ijlr.20170521042914

Nationalities and People's (SNNP) regions. As scaling up strategies, Ministry of agriculture, Agricultural Bureau of Tigray, Amhara, Oromia, SNNP region had taken the responsibilities of implementing hormonal oestrus synchronization and mass AI in 2011. From 2010/11 up to 2014/15, about 611,203 cows were synchronized and inseminated (Tegegne *et al.,* 2016). The hormone used for the treatment of dairy cattle was PGF2α (33.5 mg of dinoprost tromethamine per 5 ml of solution, equivalent to 25 mg of PGF2α; Lutalyse®; Pharmacia and Upjohn Company, Pfizer, New York, USA) except in Tadesse (2015) where synchromate was used (Gizaw *et al.,* 2016).

Efficiency of Oestrous Synchronization and Mass Artificial Insemination (OSMAI) in Ethiopia

According to Odde (1990), methods of evaluation of synchronization systems include estrous response (percentage of females showing estrus of those treated), synchronized conception rate (percentage of females conceiving of those inseminated), synchronized pregnancy rate (percentage of females conceiving of the total treated), and pregnancy rate at various stages of the breeding season. In Ethiopia, efficiency of OSMAI in dairy cattle have evaluated in four different regions namely Oromia, Amhara, Tigray and SNNP (Azage *et al.*, 2012; Hamid, 2012; Destalem, 2015; Tadesse 2015; Bainesagn, 2015; Samuel, 2015; Debir, 2015; Tewodros *et al.*, 2015). However, variation was observed in the performance of oestrous synchronization across the regions (Gizaw *et al.,* 2016). Furthermore, farmers expressed low satisfaction with the service provided under development intervention by the regular extension of regional Bureau of agriculture, since; they obviously evaluate the technology based solely on successful breeding leading to calf production (Gizaw *et al.*, 2016).

Oestrous Response of Hormone Treated Dairy Cattle

In all regions in which synchronization of oestrous implemented as reproductive technology and management, oestrus response result under development intervention by the regular extension service of the regional Bureau of agriculture has shown comparable result obtained under the condition of action research. The country achieved 77.0% oestrus response under the regular service and 89.3% under research condition. However, different oestrus response results were recorded across regions (Gizaw *et al.*, 2016).

According to Debir (2015) and Samuel (2015), the oestrus response of synchronized dairy cattle in Sidama zone of SNNP region and west Gojjam zone of Amahara region was 90% and 88.9%, respectively, under research condition. Similarly, Azage *et al*., (2012) reported that, the oestrus response of synchronized dairy cattle in Awassa-Dale Milkshed and Adigrat-Mekelle Milkshed were 97.7% and 100%, respectively, under IPMS project work. However, different oestrus response results were reported between synchronized dairy cattle in Sidama zone of SNNP region (87.2%) and west Gojjam zone of

Hosted@www.ijlr.org DOI 10.5455/ijlr.20170521042914

Amahara region (66.2) under regular extension service (Debir,2015; Samuel, 2015). Oestrus response of cows/heifers to hormonal treatment could be varied with different breeds, body condition of cows and skill of AI technicians. However, some authors (Bainesagn, 2015; Debir, 2015; Destalem, 2015), had revealed that the oestrus response of different breeds found in Oromia, SNNP and Tigray region were not considerably different. But, even if the difference were not notable, exotic crossbred cows/heifers responded more for the hormone treatment than local cattle. This could be due to the fact that oestrus duration in exotic breeds is longer than local breeds, so response to hormone treatment is higher. Bainesagn (2015) reported that, in South Shoa zone of Oromia region, cows/heifers with body condition score of 3 and 4 had higher rate of oestrus response (92.3% and 84.2%, respectively) compared to cows/heifers with body condition score of 2 (76.3%). With respect to skill of technicians, 27.5% variation in oestrus response was recorded among cows palpated by different AIT.

Number of Service per Conception and Conception Rate

According to all authors (Destalem, 2015; Tadesse 2015; Bainesagn, 2015; Samuel, 2015; Debir, 2015), there had been high variation between conception rates under the action research and the regular extension services. The average conception rates across regions were 39.3% and 59.2% under the regular service and research condition, respectively. The reasons for the higher conception rate under research condition could be intensive follow-up on hormone treated cows to detect heat by farmers, minimizing stress conditions on the cow and timely insemination. On the other hand, there was little opportunity for a close follow-up under the regular service due to the work load on the AI technicians who had inseminated a large number of cows.

As most of authors reported, the conception rate and number of service per conception results in different parts of Ethiopia were dissimilar. The conception rate and number of service per conception in central zone of Tigray region was 37.95% and 2.63 respectively (Destalem, 2015). In contrary, Debir (2015) reported that the conception rate and number of service per conception of synchronized and mass inseminated dairy cattle in Sidama zone of SNNP region were 58.4% and 1.7, respectively. Conception rate of hormone treated and inseminated cows/heifers varied with breeds, body condition of cows and skill of AI technicians. As Destalem (2015) indicated that, body condition score (BCS) of cows had significant effect on conception rate and cows with BCS of 4 showed higher conception rate and lower number of service per conception than BCS of 3 and 5. However, conception rates of oestrus-synchronized and inseminated cows/heifers did not show considerable variation among breeds. In Amhara region, conception rates of hormone treated and inseminated Holstein-Friesian, Jersey crosses and local cows/heifers were 70.4, 78.2 and 71.5%, respectively (Samuel, 2015). Similarly, conception rates of Holstein-Friesian, Begait local and a non-descript local cows/heifers in Tigray region were 38.4,

  DOI 10.5455/ijlr.20170521042914

39.7 and 37.7%, respectively (Destalem, 2015). 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%) (Bainesagn, 2015).

Some authors (Destalem, 2015; Debir, 2015; Bainesagn, 2015) reported that, conception rate of hormone treated and inseminated cows/heifers affected by skill of AI technicians, bull efficiency and age of cows.

Table 2: Oestrousresponse and conception rate results from single shot hormonal oestrous synchronization from action research

Research site/area	Number of cows/heifers treated	Oestrus response (%)	Conception rate (%)	Source
West gojam zone of Amhara region	126	88.9	60.3	Samuel (2015)
Sidama zone of SNNP	126	89.7	58.4	Debir (2015)
Awassa-Dale Milkshed	175	97.7	57.7	Azage *et al.*,2012
Adigrat-Mekelle Milkshed	193	100	61.7	Azage *et al.*, 2012
North-West of Ethiopia (Fogera Woreda)	93	98.92	26.88	Tewodros *et al.*, 2015
West Shoa Zone	130	72.3	57.44	Bainesagn, 2015

Embryo Transfer (ET)

In Ethiopia, the first calf from embryo transfer was born in 1991 at the then international livestock center for Africa Debre Zeit Research Station. The study was led by Azage Tegegne and involved two young Italian veterinarians, Roberto Franceschini and Sandro Sovani. The first Borana calf produced was named 'RAS', representing the first letter of the names of the three scientists. This was followed by production of eight pairs of identical twins using embryo splitting technology. Work continued until the mid-1990s, but after that the technology has not become expanded due to different constraints (Tegegne *et al.*, 2016).

Conclusions

Despite the existence of AITs 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. In order to increase the efficiency of AI service through minimizing heat detection problem of the farmers and access to improved dairy genetics to smallholder farmers, OSMAI of farmer owned indigenous cows were practiced. However, the conception rate results obtained especially from regular extension services were inadequate like conventional AI services. 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 AITs and low output from the available technicians, lack of appropriate collaborations between service provider and other stakeholders and absence of herd recording

Hosted@www.ijlr.org DOI 10.5455/ijlr.20170521042914

system. Innovative approaches like providing the AI service in off-working days, facilitating incentives and rewards for the technicians based on the productivity of the inseminator, intensive training of sufficient AITs and allocating them at kebele level like developmental agents could improve the efficiency of the AITs for genetic improvement of cattle in Ethiopia. Furthermore, concerted effort from all concerned stakeholders should be applied to solve identified problems associated with AI services. Multiple ovulation and embryo transfer (MOET) could be an additional asset to increase access to improved dairy genetics to smallholder farmers.

References

1. Alazar Woretaw, Bemrew Admassu, Anmaw Shite and Saddam Mohamme (2015). Assessment of Problems Associated with Artificial Insemination Services in Dairy Cattle in Debretabour Town, Ethiopia. *Journal of Reproduction and Infertility 6 (2)*: 48-55
2. Alemayehu Lemma (2010). 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.
3. Ashebir G, Birhanu A, Gugsa T (2016). Status of Artificial Insemination in Tigray Regional State, "Constraints and Acceptability under Field Condition". *Journal* of *Dairy*, *Veterinary* & *Animal* Research *3(3)*: 00078.
4. Azage Tegegne, Awet Estifanos, Asrat Tera, Dirk Hoekstra (2012). 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
5. AzageTegegne, Berhanu Gebremedhin and Hoekstra D (2010). 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.
6. Bainesagn Worku, (2015). 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.
7. Beal WE. (2002). Estrous Synchronization of Cyclic and Anestrous Cows with Synchro-Mate-B. In: field MJ Sand RS, Yelich JV. (eds.), Factors Affecting Calf Crop: *Biotechnology of Reproduction*, CRC press, London.2002; pp36-42.
8. Bekana M., Gizachew A., and Regassa F., (2005). Reproductive Performance of Fogera Heifers Treated with Prostaglandin F2a for Synchronization of Estrus. *Tropical Animal Health and Production 37*, 373-379.
9. Chencha C and Kefyalew A. (2012). Trends of Cattle Genetic Improvement Programs in Ethiopia: Challenges and Opportunities. *Livestock Research for Rural Development 24*
10. Chemineau, P., Cognié, Y., (1991). Training Manual on Artificial Insemination in Sheep and Goats. FAO, Rome, Italy.
11. CSA, (2016). Federal Democratic Republic of Ethiopia, Central Statistical Agency (CSA) Agricultural Sample Survey, Volume II, Report On Livestock And Livestock Characteristics (Private Peasant Holdings). *Statistical bulletin, 583*, June 2016, Addis Ababa, Ethiopia.
12. Debir Legesse, (2015). Assessment of Breeding Practices and Evaluation of Mass Estrus Synchronization of Dairy Cattle in Sidama Zone, Southern Ethiopia. MSc thesis, department of animal

 DOI 10.5455/ijlr.20170521042914

and range science, Hawassa college of Agricuture, school of graduate studies, Hawassa University, Hawassa, Ethiopia.
13. Desalegn G, Medhin, Bekana M, Tegegne A, Blihu B. (2009). Status of Artificial Insemination Service in Ethiopia. A paper presented at the 17th Annual Conference of the Ethiopian Society of Animal Production (ESAP), held at the Head Quarters of the Ethiopian Institute of Agricultural Research (EIAR), Addis Ababa, Ethiopia, pp. 87-104.
14. Destalem G/Michael, (2015). Breeding Practice and Estrus Synchronization Evaluation of Dairy Cattle in Central Zone of Tigray, Northern Ethiopia. MSc thesis, Jimma University, Ethiopia.
15. Evans, G., Maxwell,W.M.C., (1987). Salamon's Artificial Insemination of Sheep and Goats. Butterworths, Sydney, Australia.
16. FAISETD (Field AI service Extension and Training Department) (2007). Millennium Report. National AI Center, Addis Ababa.
17. FAISETD (Field AI service Extension and Training Department) (2016). Semen Production and Distribution Report. National AI Center, Addis Ababa.
18. GebreMedhin D. (2005): All in One: A Practical Guide to Dairy Farming. Agri-Service Ethiopia Printing Unit, Addis Ababa. Pp. 15-21.
19. Getachew Felleke and Gashaw Geda (2001). The Ethiopian Dairy Development Policy. In: A Draft Policy Document. Addis Ababa, Ethiopia: Ministry of Agriculture/ AFRDRD/AFRDT Food and Agriculture Organization/SSF.
20. Gizaw, S., Tesfaye, Y., Mekuriaw, Z., Tadesse, M., Hoekstra, D., Gebremedhin, B. and Tegegne, A. (2016). Oestrus Synchronization for Accelerated Delivery of Improved Dairy Genetics In Ethiopia: Results From Action Research And Development Interventions. LIVES Working Paper 12. Nairobi, Kenya: International Livestock Research Institute (ILRI).
21. Hailemariam Mekonnin (1994). Genetic Analysis of Boran, Friesian and Crossbred Cattle in Ethiopia. A PhD thesis submitted to the SwedishUniversity of Agricultural Sciences, Department of Animal Breeding and Genetics, Sweeden.
22. Hamid Jemal (2012). Study on Factors Affecting the Success of Artificial Insemination Program in Cattle, Siltie Zone. An M.Sc. Thesis, Addis Ababa University. Debre Zeit, Ethiopia
23. Himanen A and Azage Tegegn (1998). A Proposal for Establishment of a National Milk Recording and Herd Registration Scheme in Ethiopia. Ministry of Agriculture, Addis Ababa, Ethiopia.
24. Kiwuwa GH, Trail JCM, Kurtu MY, Getachew W, Anderson MF, Durkin J. (1983). Crossbred Dairy Productivity in Arsi Region, Ethiopia. ILCA Research Report No. 11, ILCA, Addis Ababa, Pp. 58.
25. Köhler-Rollefson I. (2004). Farm Animal Genetic Resources. Safeguarding National Assets for Food Security and Trade. A Summary of Workshops on Farm Animal Genetic Resources Held in the South African Development Community (SADC). GTZ, BMZ, FAO, CTA, SADC. Eschborn, Germany.
26. Leboeuf, B., Restall, B., Salomon, S. (2000). Production and Storage of Goat Semen for Artificial Insemination. *Animal Reproduction Science 62* 113–141.
27. López-Villalobos N. (1998). Effects of Crossbreeding and Selection on the Productivity and Profitability of the New Zealand Dairy Industry. PhD Thesis, Massey University, Palmerston North, New Zealand.
28. Negussie E. (1992). Reproductive Performance of Local and Crossbred Dairy Cattle at Assela Livestock Farm. Arsi, Ethiopia. MSc Thesis, Alemaya University of Agriculture, Ethiopia.
29. Ng Soon (2001). Somatic Cell Nuclear Transfer (Cloning) – Science. As this submission is to be part of the deliberations of the Bio-Ethics Advisory Committee on Human Stem Cell. Research Sub Committee, it will be relatively concise.
30. Nicholas, F.W. (1996). Genetic Improvements through Reproductive Technology. *Animal Reproduction Science 42*, 205–214.
31. Nordin Y, Zaini N, and Wan Zahari W.M. (2004). Factors Affecting Conception Rate in Dairy Cows Under Selected Smallholder Production System. *Journal of Tropical Agriculture and Food Science 32(2)*: 219– 227.

 DOI 10.5455/ijlr.20170521042914

32. Nuraddis Ibrahim, Reta Hailu and Abidu Mohammed (2014). Assessment of Problems Associated with Artificial Insemination Service in Selected Districts of Jimma Zone. *Journal of Reproduction and Infertility 5 (2)*: 37-44
33. Odde, K.G. (1990). A Review of Synchronization of Estrus in Postpartum Cattle. *Journal of Animal Science* 68: 817–830.
34. Rick R. and Gene D. (2013). Synchronizing Estrus in Beef Cattle. University of Nebraska–Lincoln Lincoln, NE 68588 | 402-472-7211.
35. Samuel Shiferaw (2015). Assessment of Breeding Practices and Evaluation of Estrus Synchronization and Mass Artificial Insemination Techniques in Dairy Cattle in West West Gojjam Zone. MSc thesis, Bahir Dar University College of agriculture and environmental sciences, graduate program, Ethiopia.
36. Sebsibe A. (2008). Sheep and Goat Meat Characteristics and Quality. In Yami A, Merkel RC(eds), Sheep and goat production handbook for Ethiopia. Ethiopian Sheep and Goat Productivity Improvement Program (ESGPIP), 297-324.
37. Shiferaw Y., Tenhagen B.A., Bekana M. and Kasa T. (2003): Reproductive Performance of Crossbred Dairy Cows in Different Production Systems in the Central Highlands of Ethiopia. Tropical *Animal Health* and *Production* 25, 551-561.
38. 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. 13-17.
39. Woldu, T. Giorgis Y. T. and Haile A. (2011). Factors Affecting Conception Rate in Artificially Inseminated Cattle under Farmer's Condition in Ethiopia. *Journal of Cell and Animal Biology Vol. 5 (16)*, pp. 334-338
40. Tadesse Gugssa (2015). Effects of Prostaglandin Administration Frequency, Artificial Insemination Timing and Breed on Fertility of Dairy Cows and Heifers in Eastern Zone, Of Tigray Region, Ethiopia. MSc thesis, Mekelle University.
41. Tadesse, B. (2008). Calf Sex Ratios in Artificially Inseminated and Natural Mated Female Crossbred Dairy Herd. In: Proceedings of the 13 annual Conference of the Ethiopian Society of Animal Production. Addis Ababa, Ethiopia, pp: 227.
42. Tegegne, A., Hoekstra, D., Gebremedhin, B. and Gizaw, S. (2016). History and Experiences of Hormonal Oestrus Synchronization and Mass Insemination of Cattle for Improved Genetics in Ethiopia: From science to developmental impact. LIVES Working Paper 16. Nairobi, Kenya: International Livestock Research Institute (ILRI).
43. Tegegne, A., Warnick, A.C., Mukasa Mugerwa, E. and Ketema, H. (1989). Fertility of *Bos Indicus* and *Bos Indicus X Bos Taurus* Crossbred Cattle after Oestrus Synchronization. *Theriogenology* 31,361-370.
44. Tessema Reta and Atnaf Alebie (2015). Assessment of Problems Associated with Artificial Insemination Services in and Around Gondar Town, North West Ethiopia. *Journal of Reproduction and Infertility 6 (2)*: 22-26
45. Tewodros Alemneh, Wondifraw Mogess, Guadie Marew and Zewdu Adera (2015). Study on the Conception Rate of Dairy Cows Artificially Inseminated During Natural Heat and By Synchronization in Fogera Woreda, North-West of Ethiopia. *African Journal of Basic & Applied Sciences 7 (5)*: 291-297
46. Vivanco-Mackie, H.W. (2001). Transferencia Embrionaria En Ovinos Y Caprinos. In: Palma, G. (Ed.), Biotechnology of Reproduction. Ediciones INTA, Buenos Aires.
47. Yemane B., Chernet T. and Shiferaw T. (1993). Improved Cattle Breeding. National Artificial Insemination Centre. Addis Ababa, Ethiopia. Pp. 15.

  DOI 10.5455/ijlr.20170521042914