Technological options and approaches to improve smallholder access to desirable animal genetic material for dairy development: IPMS Experience with hormonal oestrus synchronization and mass insemination in Ethiopia

<u>Azage Tegegne</u>[*1], Awet Estifanos[2], Asrat Tera[3], Dirk Hoekstra[1]

[1]Improving productivity and Market Success (IPMS) Project, International Livestock Research Institute (ILRI), P.O. Box 5689, Addis Ababa, Ethiopia; [2]Tigray Agricultural Research Institute (TARI), Mekelle, Ethiopia; [3]Southern Agricultural Research Institute (SARI), Awassa, Ethiopia.

Introduction

Ethiopia has over 50 million indigenous cattle, and about 10 million are breeder cows, with annual calving rate of 45%. The number of improved dairy type animals is insignificant. Average milk production from local cows is 1.54 liters/cow/day (CSA, 2009/10) with total annual production of 2.94 billion liters. Per capita milk consumption is low and stands at 19 kg/year FAO (2011). Due to the high demand-supply variance, annual import of dairy products is over USD 10 million. The current human population of 80 million will double by 2030; increasing the demand for dairy products. However, there is huge potential for dairy development due to the large human and livestock population and suitable agro-ecologies. One of the major problems hindering smallholder farmers from participating in milk production and marketing is lack of access to and high price of improved dairy animals. Hormonal oestrus synchronization (AZAGE TEGEGNE ET AL., 1989) under smallholder context could be used, among others, to produce large number and dairy animals in a short period of time (kick start), to match calving with feed availability and market demand for dairy products and to improve the effectiveness and efficiency of AI service. The objectives of this study are to test a simple hormonal oestrus synchronization regime and mass insemination under on-farm condition; to improve access to improved dairy genetics by smallholder farmers and to kick-start market-oriented smallholder dairy development in selected sites. This paper documents the experiences of the IPMS project (www.ipms-ethiopia.org) and its partners in implementing and testing this innovative approach.

Materials and Methods

The study was conducted in Adigrat-Mekelle milkshed in Tigray Regional State, in the north and the Awassa-Dale milkshed, Southern Region in the south (Figure 1). These two milksheds were purposively selected due to a large market potential in the Regional capitals. Households with at least two cows/heifers, who have adequate feed resource, with experience in managing dairy animals and milk marketing were selected. Cows with body condition score of 4 and above (scale 1-9), in good reproductive health and with function corpus lutea on rectal palpation were selected and used. Oestrus was synchronized using single injection of prostaglandin $F_{2\alpha}$. Cows that showed oestrus within 24 hours were inseminated, while the remaining cows were brought to a central animal handling facility and checked for oestrus and inseminated. Data were analyzed using SPSS (SPSS, 2003).

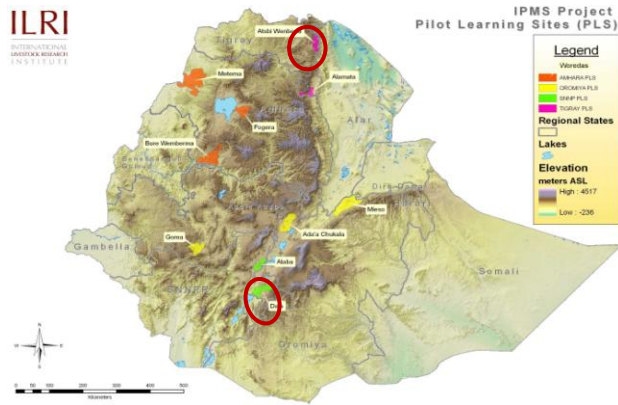*Corresponding author. Email: a.tegegne@cgiar.org

Figure 1. Locations of the Adigrat-Mekelle and Awassa-Dale milksheds in Ethiopia

Results and Discussion

Understanding the existing AI system
The existing AI system is provided exclusively by the public sector through mobile, stationary and on-call basis (urban areas). One AI technician is expected to inseminate on average about 300 cows per year, and in practice ranges from 50 to 1000. Pregnancy rate to 1st insemination is 27% in the existing AI system (DESALEGN ET AL., 2009). Considering that only half of the pregnant cows will deliver female calves, the annual output of an AI technician is about 41 female calves. Weak performance of the AI system has led to the country to having only about 350,000 improved dairy type animals. Problems associated with the existing AI system include technical limitation, lack of transport facility, poor quality of semen, poor heat detection, lack of incentive, and unavailability of the service off-working hours (weekends, holidays, etc.).

Capacity building
Multi-disciplinary regional teams composed of animal production experts, breeders, feeds and nutrition experts, veterinarians, and AI technicians were assembled and trained on hormonal synchronization techniques at the Ethiopian Meat and Dairy Technology Institute (EMDTI) at Debre Zeit. Participating men and women farmers were also trained on the subject, estrus detection and management of dairy cows.

Awareness creation and community mobilization and infrastructure development
Regional teams identified study locations and participating farmers in the project. Awareness creation meetings were held and community mobilization efforts undertaken. Both the government and the communities contributed resources for the construction of proper animal handling facilities at strategically selected sites. The IPMS project provided technical assistance in the form of capacity building and supplied hormones and other field consumables. Regional governments provided semen, AI consumables, local transport and other logistic support.

Technological, organizational and institutional innovations
Technologically, the use of hormones is introduced to regulate the heat cycle of a cow. The use of hormones to regulate the heat cycles of animals is well established (AZAGE TEGEGNE ET AL., 1989). Organizationally, the use of highly qualified mobile teams was introduced instead of the stationary AI technicians in one location. Each mobile team comprised of highly trained AI

technicians, extension specialist, livestock expert, veterinarian and livestock researcher. Institutionally, the major change was the insemination of several cows at the same time in one location instead of the traditional approach of inseminating individual cows in different locations. The technological intervention linked to this institutional change is the hormonal synchronization of the heat cycle of the cows to be inseminated.

Table 1. Performance of oestrus synchronized cows in two Regional States, Ethiopia

Variables	Awassa-Dale Milkshed		Adigrat-Mekelle Milkshed	
	No.	%	No.	%
Total animals presented for synchronization	210	-	212	-
No. animals treated with $PGF_{2\alpha}$	175	83.3	199	93.9
No. of cows that aborted after treatment	-	-	6	3.0
Final No. cows synchronized	175	100	193	97.0
No. of animals that responded to $PGF_{2\alpha}$ treatment	171	97.7	193	100.0
Animals that died (after insemination)	3	1.8	-	-
Animas that did show up for pregnancy diagnosis	5	2.9	-	-
Interval to oestrus, hours	NA	-	45.13	-
Pregnant animals	94	57.7	119	61.7

In the Adigrat-Mekelle milkshed, six cows aborted due to treatment with prostaglandin as they were in early pregnancy and the owners had no idea when they were bred. Estrus response to treatment was impressive as there was strict follow up of the animals and technicians also participated in detecting estrus through palpation per rectum after day two of treatment. Selection of cows in good body condition and with functional corpus lutea was also crucial factor for such a good estrus response. Some farmers, particularly in the Awassa-Dale milkshed were reluctant to bring their cows for pregnancy diagnosis per rectal palpation as they considered this intrusive and may damage the early fetus.

This mass AI intervention aimed at improving the effectiveness of the insemination (increasing pregnancy rate/first insemination) and the efficiency of the AI service delivery (more inseminations/AI technician). Results indicate that pregnancy rate after first insemination can be improved from 27 % to about 60 % (Table 1), mainly as a result of timely availability of well-trained AI technicians at the time of planned heat period. Efficiency results of mass insemination in the two milksheds indicate that respectively 200 and 175 animals were treated with hormones/inseminated over a two-week period by two AI technicians per milkshed. This resulted in about 45 inseminations/AI technician/week compared to 6 insemination/AI technician/week in the existing system. This 'campaign type' approach is designed to re-vamp and fast-track the dairy system and could be further improved when the regional field teams gain more experience.

Further improvement in the effectiveness and efficiency of the AI system could be tested including i) use of selected semen (local as well as exotic) of different breed for the butter, milk and meat system ii) use of sexed semen or sex fixer to increase the proportion of female calves

born in the dairy system, and iii) testing different organizational and institutional models for mass insemination including commercial mobile AI teams.

Conclusions and Outlook

Key factors that stimulate local innovative practices in market-oriented dairy development include economic incentives, availability of desirable genetic materials, functional input supply system and support service. Despite the existence of artificial insemination services over the last four or so decades in Ethiopia, smallholder farmers have not benefitted adequately from milk production and marketing primarily due to unavailability or high price of improved dairy animals. Weak AI services and poor pregnancy rates have hindered the expansion of dairying in Ethiopia. In order to increase access to improved dairy genetics to smallholder farmers, on-farm hormonal oestrus synchronization and mass insemination of farmer owned indigenous cows could serve as an alternative to kick-start the system. This will require an innovative approach through the use of multi-disciplinary technical team with new organizational and institutional arrangements. This study has demonstrated that hormonal oestrus synchronization could be implemented under smallholder farmers' condition. Awareness creation, proper training, careful animal selection (good body condition score, free from diseases and with functional ovaries), good animal handling facility at a convenient location, a well-trained, organized and motivated multi-disciplinary team (livestock science, feeds and nutrition experts, veterinarians, AI technicians, etc.) and proper leadership and coordination are key elements for success. Community participation involving local leaders, particularly women farmers, is essential. Adequate supply of consumables, equipment, transport, proper planning, implementation, and follow-up are critical. This approach has to be closely linked up with dairy value chain development through continuous engagement with the actors, input suppliers and service providers to ensure the production and supply of safe and quality milk to consumers. There is a great opportunity and possibility for scaling-up and out this approach in areas where there is potential for dairy development. The same approach could also be tested and used in improving beef cattle production and quick multiplication of some breeds of cattle with special traits in Ethiopia and elsewhere.

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