ASSESSMENT OF REPRODUCTIVE MANAGEMENT AND EVALUATION OF BOVIPREG FOR PREGNANCY DIAGNOSIS OF DAIRY CATTLE IN SIDAMA ZONE OF SOUTHERN ETHIOPIA

MSc THESIS

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HAWASSA, ETHIOPIA
SEPTEMBER, 2019

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A thesis Submitted to the School of Animal and Range Sciences, College of Agriculture, School of Graduate Studies

HAWASSA UNIVERSITY

In Partial Fulfilment of the Requirements for the Degree of Master of Science in Animal and Range Sciences (Specialization: Animal Production)

Hawassa, Ethiopia
September, 2019

APPROVAL SHEET - I

DEPARTMENT of GRADUATION COMMITTE

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This is to certify that the thesis entitled **"ASSESSMENT OF REPRODUCTIVE MANAGEMENT AND EVALUATION OF BOVIPREG FOR PREGNANCY DIAGNOSIS OF DAIRY CATTLE IN SIDAMA ZONE OF SOUTHERN ETHIOPIA"** submitted in partial fulfillment of the requirements for the degree of Master of Science with the specialization in **ANIMAL PRODUCTION** to the graduate program of the School of Animal and Range Science, Collage of Agriculture, Hawassa University, is a record of original research carried out by **Mulugeta Tesfaye ,** under my supervision, and no part of the thesis has been submitted for any other degree or diploma.

The assistance and help received the course of this investigation have been dully acknowledge. Therefore, I recommended that it be accepted as fulfillment of the thesis requirements.

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As members of the Examining Board of the Final M.Sc. Open Defense, we certify that we have read and evaluated the thesis prepared by **MULUGETA TESFAYE** entitled ***ASSESSMENT OF REPRODUCTIVE MANAGEMENT AND EVALUATION OF BOVIPREG FOR PREGNANCY DIAGNOSIS OF DAIRY CATTLE IN SIDAMA ZONE OF SOUTHERN ETHIOPIA*** and recommend that it be accepted as fulfilling the thesis requirement for the degree of Master's.

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DEDICATION

I dedicated this thesis manuscript to my beloved wife Etifwork Shimels, my daughters Mihret , Elbetel and Amen Mulugeta and my best friend Tesfaye Kerga and also my Sisters for their unreserved appreciation, nursing me with affection and love in the success of my life.

STATEMENT OF THE AUTHOR

First, I declare that this thesis is my own work and all sources of materials used for this thesis have been duly acknowledged. This thesis strongly declared that this thesis is not submitted to any other institution for the award of any academic degree, diploma or certificate. This thesis has submitted in partial fulfillment of the requirements for MSc degree at Hawassa University.

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ACKNOWLEDGEMENT

First of all, I would like to express my gratitude to Almighty God in the name of Jesus Christ for enabling me to complete this thesis and for what He has done in my life and thanks to my family for their love and support.

I am deeply grateful and indebted to Dr. Sintayehu, Yigrem and Dr. Yoseph Mekasha my major and co-advisors respectively for their encouragement, precious comments and comprehensive advice until this work came to existence. I would like to take this opportunity to thanks all the people who have helped in the completion of this paper.

I would like to thank Livestock and Irrigation Value Chain of Ethiopian Smallholders (LIVES), fort the financial and provision of Bovipreg early pregnancy Diagnosis kit to my research. My special thanks go to Bensa, Bona and Arbegona district Livestock and Fishery Office staffs and Development agents who supported me during data collection.

ABBREVIATIONS AND ACRONYMS

AFC	Age at First Calving
AI	Artificial Insemination
AIT	Artificial Insemination Technicians
CFSI	Calving to First Service Insemination
CL	Corpus Leutum
DMY	Daily Milk Yield
CI	Calving Interval
CR	Conception Rate
CSA	Central Statistics Agency
GDP	Gross Domestic Product
GLM	General Linear Model
HF	Holstein Frisian
ID	Identification Card
LIVES	Livestock and Irrigation Value Chain for Ethiopia Smallholders
LL	Lactation Length
OSMAI	Oestrus Synchronization and Mass Insemination
PA	Peasant Association
PD	Pregnancy Diagnosis
PHS	Progeny History Survey
SNNPR	Southern Nations Nationalities and People Region

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Assessment of Reproductive Management and Evaluation of Bovipreg for Pregnancy Diagnosis of Dairy Cattle in Sidama Zone of Southern Ethiopia

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ABSTRACT

The assessment of breeding practice and reproductive management and evaluation of Bovipreg kit for early pregnancy diagnosis of crossbred dairy cattle was conducted in three districts of Sidama zone namely Arbegona, Bona and Bensa. The districts were categorized under high altitude and mid altitude to assess the existing breeding practice and reproductive management of dairy cattle. A total of 90 respondents were randomly selected from 6 kebeles for the survey. The data acquired from the respondents were analysed using the GLM of SPSS. The survey result revealed that the average age at first calving for crossbred was 3.3 years for the high altitude and 3.5 for the mid altitude and had no significantly difference ($p>0.05$) among the two altitudes, the result also indicate that the mean calving interval of 458.23 days and 439.9 days for the high altitude and mid altitude respectively and had no significantly difference ($p>0.05$); also *daily milk yield of the dairy cattle in the current study area had no significant difference ($p> 0.05$) between the two altitudes of the study area. As opposed to this there was significant difference ($p<0.05$) between the two altitudes with regard to lactation length and calving to first service insemination. The breeding practice in the current study areas shown 71.1% of the respondents were using natural mating of bull irrespective to the altitudes, but the pedigree of most of breeding bulls in the study area was not known clearly. The study further revealed that few of the respondents were aware the importance of heat detection to decide time of insemination. Thus in most cases the AM/PM rule for insemination was not followed properly and this is one of the cases to have low efficiency of the AI service in the study area. Due to this and related factors most of the farmers gradually shift their breeding system from AI service to bull mating in both study area. With regard to feed the main source of feed for dairy cattle was natural pasture followed by crop residue in both altitudes of the study area. Most of the respondent irrespective of the altitudes agreed that they kept their all livestock species including dairy cattle together with the family dwelling. In addition to survey part of the study action research was conducted to evaluate Bovipreg kit for early pregnancy diagnosis of crossbred dairy cattle in two PAs of Bensa district. A total of 44 crossbred cows were selected and randomly grouped to 2 groups (22 cows per a group) for early pregnancy diagnosis by using Bovipreg at 18 - 22 days post insemination. The groups were test for PD by using blood serum (group 1) and milk (group 2). The accuracy of Bovipreg kit for positive pregnancy was 81.18% for blood sample and it was 72.73% for milk sample and had significant difference ($p<0.01$) among the two samples. Use of Bovipreg kit can be an effective tool to identify the pregnancy status of dairy cattle much ahead than most of the current existing methods and has a fundamental important to improve the reproductive management of dairy cattle.*

Key Words: Productive and Reproductive performance, Bovipreg Kit, Pregnancy Diagnosis

1. INTRODUCTION

The livestock sector accounts for around one third of global agriculture gross domestic product (GDP) and growing faster than most other agricultural sector (FAO, 2018). Livestock is an integral part of the Ethiopian agriculture and the contribution accounts about 35 – 49% of agricultural GDP, and 37 – 87% of the household incomes (Ayele et al,. 2003); also it accounts about 19% of the total GDP, and 16 -19% of the foreign exchange earning of the country (MoA, 2012).

Ethiopia is one of the developing countries in the sub-Saharan Africa`s, with a large inventory of livestock population, particularly in terms of cattle population. The country has the largest cattle population among the African countries (Hunduma, 2013) and fifth in the world. Cattle population in Ethiopia is estimated to be 59.5 million heads which comprises 98.2% indigenous (Zebu), 1.6% and 0.18% crossbreeds and exotic breeds respectively which are mainly kept under smallholder subsistence farming system. Out of total population, the female cattle constitute about 55.49 percent while the remaining 44.51 percent are male (CSA, 2016/17).

The large and diverse livestock genetic resources, presence of wide range of agro-ecology which is suitable for dairy production could increase support for milk and milk products, better market opportunity, proximity to international market, trend of population growth, urbanization and economic development are opportunities for the development of dairy sector in Ethiopia (Azage, *et al.*, 2013). Furthermore, dairy production has multipurpose benefit for the livelihood of millions of people and economic development of the country. This includes employment opportunity, reliable income generation and asset accumulation, provision of safe dairy products, improved natural resource management and sustained farming systems through dairy cattlemediated nutrient cycling and improved child nutrition and cognitive development in resource-poor households.

In Ethiopia, although the major source of milk are cattle, camel, goat & sheep, the former accounts for about 81.2 % of the total volume of milk (CSA, 2009). However, the dominant cattle used for dairying is indigenous zebu, which has been well adapted to the tropical agro-climate, producing and reproducing under different biotic and abiotic stress (Assefa *et al.,* 2015). However, the reproduction and production performance of indigenous cattle is very low as compared to improved temperate breeds (Niraj *et al.*, 2014). It has been reported that the average daily milk yield of indigenous cows was only 1.44 liter with lactation length of 6 month and extended calving interval of 401.5 days (Addis *et al.,* 2015) and age at fist calving of 40.7 months (Asefa *et al.,* 2005). Consequently, the annual per capita milk consumption of the country is only 19 kg compared to African and world average of 40 and 100 kg/year, respectively (SNV, 2008). Thus, to bridge the gap between supply and demand the country has continued importing dairy products from abroad. Import is increased from about 3.1 million USD in the year 2001 to the level of 9.3 million in the year 2008.

Low genetic potential of the indigenous cows for functional traits such as low milk yield may be attributed to inadequate year round feed supply and poor nutrition, poor reproductive management, prevalence of disease and parasites, underdeveloped marketing are among the major constraints hindering dairy development in the country. Moreover, poor capacity by dairy value chain actors and service providers, traditional and lack of market oriented production system have also significant contribution (Woldemichael, 2008).

Thus, genetic improvement of indigenous cattle through crossbreeding with high producing exotic cattle breeds has been considered as a practical solution to address these challenges during the last five decades (Hunduma, 2013). To improve the genetic potential of the cattle, Artificial Insemination (AI) play greater role. However, despite its importance to improve milk yield, the production and reproduction performance of crossbreds has not been satisfactory due to poor reproductive management such as poor efficiency of AI technicians, poor heat detection and time of insemination, problem associated with poor semen quality (Solomon *et al.,* 2016) poor knowledge and skill on pregnancy diagnosis, poor input supply and wide use of inappropriate bull service, poor animal management and feeding.

Recently, oestrus synchronization and mass insemination (OSMAI) was included as a complement of conventional artificial insemination (AI) system (Solomon *et al.,* 2016) with the aim of increasing both number of crossbreed calves and milk production in Ethiopia. The total number of both exotic and crossbred hybrid female cattle produced for the last five decades in Ethiopia is about 370,981 (CSA, 2013), for example compared to Kenya with 3 million . It is therefore, important to assess the prevalent reproductive management and breeding practice, and challenges hindering efficiency of dairy cattle as an input for designing pertinent and sustainable breed improvement strategy in different altitudes of the study area.

Moreover, it is equally important to complement dairy breed improvement through introduction of appropriate technological intervention such as pregnancy diagnosis (Natnael *et al,*. 2016). There are various methods of pregnancy diagnosis techniques such as rectal palpation, with skilled technicians, progesterone assay using milk and ultrasonography. Most of the methods indicated ahead were well welcomed by the dairy producers in the rural area and the methods require skilled practitioners which are unfortunately very few in our context (Natnael *et al.*, 2016). Using accurate and effective technology, BOVIPREG enables dairy producers to determine pregnant and non-pregnant cow as early at 18 - 22 days after insemination, which can be tested by using blood serum or milk sample. It is a cow-side test and does not require any laboratory procedure for test result.

The production system and production constraints in different agro-ecological zones need to be studied adequately. Therefore, assessment of breeding practices and reproductive management, identification and prioritization of the constraints of production are important to design sustainable breed improvement and to develop effective intervention strategies which are compatible with the production system. Similarly, evaluation and introducing effective and accurate technology, BOVIPREG, to determine pregnant and non-pregnant cow early in the study area.

Therefore, the study was conducted with the following objectives;

General objective,

- To assess breeding practices and reproductive management, to identify and prioritize production constraints and to evaluate the efficiency of BOVIPREG for pregnancy diagnosis of dairy cattle in Sidama Zone, South Ethiopia.

Specific objectives

- ✓ To assess breeding practices and reproductive management, and constraints hindering reproductive efficiency of dairy cattle in Sidama zone of three districts

- ✓ To evaluate the efficiency of BOVIPREG for early pregnancy diagnosis of dairy cows and heifers.

2. LITRATURE REVIEW

2.1. The Role of Cattle in Ethiopia

The purposes of keeping cattle have a strong relation with production systems and agro ecology. In the mixed crop-livestock systems of the highlands and midland, livestock are secondary but economically integrated to crop production in providing traction power, threshing and transportation of farm products and inputs, which is a determinant to the overall farm labour requirement (Andualem, 2015). Cattle also provide meat, milk, cash income and manure, and serve as a capital asset against risk (Land o lakes, 2010). In the semi-arid low lands of the country, cattle are the most important livestock species supply milk for the subsistence pastoral families. In the arid areas, however, goats and camels are the dominant where cattle are secondary species because of harsh living environment. The former provide milk, meat and cash income, while camel are kept for the purpose of milk and transport (Andualem, 2016). Generally, Eighty-three percent of all milk produced in Ethiopia comes from cattle with the remainder coming from goats and camels. (MoARD, 2007)

2.2. Dairy production system in Ethiopia

Dairy production system is potentially a biological efficient system which enables to convert huge roughage the most abundant feed in the tropics, to milk the most nutritious food to human. Dairying is practiced all over Ethiopia involving vast number of small or medium or large-size, subsistence or market oriented farms (Sintayehu *et al.*, 2008).

Even though, there are different methods of classifying dairy production system in Ethiopia, based on location, agro-ecology, main objective of production, resource and resource use, scale of production and management, market orientation, type of breeds, access to input and services all are categorized under the following systems (Zewdie, 2010).

2.2.1. Pastoral and agro pastoralist dairy production

Pasture grazing for pastoralist and crop residue for agro-pastoralist is the main source of animal feed, extensive system, the production was subsistent, local zebu cattle breeds are dominant, milk is main objective of the production system in pastoralist but, animal traction ranked first, followed by milk and reproduction in agro-pastoralist system. Little or no input was required, the availability of feed and water is much more depend on season and based on this the level of production also vary (Tades and Mengist, 2016).

2.2.2. Highland smallholder dairy farming

The highland dairy cattle farming system is implemented in the central part of the country where dairy production is usually integral part of livelihood, smallholder mixed crop and livestock production. About 93% of total milk produced in the country is produced by the smallholder dairy farmers living in the village and engaging in most traditional dairying (Tades and Mengist, 2016). Crop residue is the main feed source of cattle and zebu breed are predominant cattle in the area. Dairy products such as butter, butter milk and cottage cheese are produced and used for home consumption and also as sources of income, while cattle are an asset securing the farmer at time of emergency (Asrat *et al.,* 2013).

2.2.3. Urban and Peri-urban Dairy production system

This production system is found in and around major cities and towns especially for the purpose of market access for milk, milk products and input for the dairy farm. Major feed sources are agro industrial by products, purchased roughage and to some extent purchased concentrate. The primary objective of the farm is generating additional income to the house hold (Asrat *et al*, 2

013). The system is based on cross breed dairy cow; mainly Friesian x Zebu and land was the major challenge for the system (Tadesse and Mengistie, 2016).

2.2.4. Specialized commercial dairy farms

Commercial dairy farms are located in urban and peri-urban areas mainly in and around the major cities and produce milk for sale. These farms are specialized dairy farms that own either crossbred and/or pure exotic breeds of dairy cattle. The commercial farms are small to large scale dairy farms, the large scale farms being concentrated in and around the capital (Fikre, 2007).

2.3. The opportunities of dairy cattle production

The large and diverse livestock genetic resources, presence of wide range of agro ecology suitable for dairy production, increase demand of milk and milk products, better market opportunity, proximity to international market, trend of population growth, urbanization and economic development are main opportunities for the development of dairy sector in Ethiopia (Azage *et al.,* 2013).

2.4. The role of dairy in Ethiopia

Ethiopia has the largest inventory of livestock population in Africa and ranks fifth from the world. The livestock sector currently comprise about 59,486,667 million of cattle, of which the female consist about 55.5 %, while 3,134,181,317 liter of milk produced from 11,833,179 million of milking cow per year (CSA, 2016/17). In Ethiopia, although the estimate gross value of ruminant livestock production was birr 32.64 billion this includes the values of livestock: off-take is birr 9.653 billion and milk and milk products were account about birr 19.471 billion (MOFED, 2009).

Regarding to consumption of milk, households consume approximately 85% of the total milk collected, 8% of the milk is processed in to products with longer shelf life, and 7% sold (MOARD, 2007).

Generally, dairy production has multipurpose benefit for the livelihood of millions of peoples and economic development of the country. This includes employment opportunity, reliable income generation and asset accumulation, provision of low cost and safe dairy products; improve natural resource management and sustainable market system through dairy cattle - medicated nutrient cycling.

2.5. Dairy Cattle breeding practices

To enhance the dairy sector having well-organized, systematic and functioning breeding strategy are determinant. The breeding strategy should also take into consideration the agro-climatic and production system as well as socio-economic conditions of the country and integrated with well-designed recording system (Zelalem *et al.*, 2011). The reproductive performance of breeding female, probably, single most important factor influencing herd productivity. This is because, all forms of output (milk, meat, traction, wool and hides) depend on it, and it is the determinant of output, which varies most likely between herds/flocks within a population (ILCA, 1990). Reproductive performance is influenced by both genetic and non-genetic factors and it affects total milk production and numbers of calves gain in the cow life time (Azage *et al.*, 2013). With this regard the main dairy cattle breeding practices involved in the country includes natural mating and AI service.

2.5.1. Natural mating

The use of bulls for natural service remains widespread even in areas where artificial insemination has proven to be very efficient. Many farmers believe that pregnancy rates are higher under natural mating (Malik et al. 2012). Generally, uncontrolled natural mating with bull is the dominant breeding practice under extensive husbandry in rural areas (Azage *et al.*, 2013).

2.5.2. Artificial insemination

Artificial insemination (AI) is the process in which sperm is collect from male animals and artificially introduced into the female reproductive organ intentionally for the purpose of fertilization. AI is an essential technique in breeding programs with progeny testing; provides the opportunity to choose sires that are proven to transmit desirable traits to the next generation; it increases the selection intensity since fewer bulls are needed and this is the basis for selection progress (Kelay, 2002). AI minimizes the risk of spreading sexually transmitted diseases and genetic defects.

Despite the wide application and success of AI throughout the developed world, the success rate in African and other developing countries were still low due to a number of technical, system related, financial and managerial problems (Azage *et al.*, 1995). Among the technical constraints poor heat detection skills, communication and transport problems that hamper timely insemination, poor semen collection and storage technology and handling procedures that affect semen quality, and inefficiency of AI technicians. Due to the poor financial capabilities of the countries means of communication and infrastructure are insufficient. It would also be difficult for the countries to bear costs for the production of liquid nitrogen and purchase of necessary equipment. The financial problem is further aggravated by the poor management of AI operations (FAO, 2000).

2.6. Advantages of AI Service

There are a number of reproductive technologies being applied to transfer desirable genetic materials, of these only AI is the most commonly used technique in developing countries including Ethiopia (Tegenu and Dima, 2016). AI is an essential technique in breeding programs with progeny testing, it provides the opportunity to choose sires that are proven to transmit desirable traits to the next generation, minimizes the risk of spreading sexually transmitted diseases and genetic defects and it increases the selection intensity since less bulls are needed and basis for selection progress **(**Kelay, 2002)

However, in order to benefit from the advantages of AI, farmers must detect the oestrus periods of their cows accurately, ensure that insemination is done at the correct time in relation to the onset of oestrus and detect any cows that later return to oestrus i.e. non conceiving cow as early as possible, so that they can be re-inseminated without delay. Even when these conditions are satisfied, optimum conception rates (CRs) will only be achieved if the quality of semen used is good and the AI technicians have adequate training and skills in the procedures for handling semen and performing inseminations (IAEA-TECDOC-1533, 2007).

2.7. Reproductive management of dairy cattle

2.7.1. Age at first service

Age at first service (AFS) is the age at which heifers attain body condition and sexual maturity for accepting service for the first time. It signals the beginning of the heifer’s reproduction and production and influences both the productivity and reproductive life of the female through its effect on life time calf crop (Tsadkan, 2012).

2.7.2. Age at first calving

Age at first calving marks the beginning of a cow`s productive life. Age at first calving closely related to generation interval and, therefore, influences response to selection. Under controlled breeding, heifers are usually mated when they are mature enough to withstand the stress of parturition and lactation. This increases the likelihood of early conception after parturition. In traditional production system, however, breeding is often uncontrolled and heifers are bred at first opportunity. This frequently results in longer subsequent calving interval (Nematollah *et al.*, 2013)

2.7.3. Calving interval

Calving Interval is a time elapse between two consecutive successive parturitions and is a function of day open and gestation length. Since gestation length is more or less constant the number of day open becomes the single variable for calving interval (Tsadkan, 2012). The calving interval of indigenous breeds are significantly longer than their cross with exotic breeds. This long calving interval was related with poor nutrition status, poor breeding management, inaccessible breed improvement services, longer day open, diseases and poor management practices (Addisu, 2013).

Table1. Reproduction and production performance of indigenous Zebu cattle breeds

Parameters	Mean ± S.E	Reference
Age at service (month)	40.7 ±0.33	Asefa et al,2015
Age at first calving (moth)	47. 112 ±1.08	Zeru and Lijalem (2016)
Calving interval (days)	401.5 ± 73	Addis et al (2015)
Day open (dry) days	185±51.23	Niraj et al (2014)
Lactation length (days)	180	(CSA2014/15)

Table2. Reproduction and production performance of HF cross breed dairy cows

Parameters	Mea ± S.E	Reference
Age at service (month)	24.9±3.8	Hunduma 2013
Age at first calving (moth)	36.7 ±6	Belay et al, 2012
Calving interval (days)	297.4±24.96	Zeru and Lijalem (2016)
Day open (dry) (month)	8.6±5.4	Hunduma 2013
Lactation length (days)	284.25	Adissu Hailul, (2013)

2.7.4. Calving to First Service Insemination

The CFSI is the average number of days from calving to the day first insemination served. CFSI is although influenced by management rather than genetic factor.

2.8. Pregnancy Diagnosis in Cattle

Although pregnancy diagnosis is a common procedure on most dairy farms, it should be well organized, accurate and the detection performed early as possible. Even though, there are wider methods of pregnancy diagnosis when selecting the appropriate procedure we must look its accuracy, early identification, to provides the economic advantages of pregnancy testing (Richard 2016). Pregnancy diagnosis is essential for profitable animal husbandry particularly in the reproductive animal species. Although, early pregnancy diagnosis would help to evaluate the therapies at an early date and device alternative manipulations in planned breeding system (Natnael *et al.,* 2016). Accurate diagnosis of pregnancy is although, important to maintain better reproductive management of cattle and high profitability of dairy/beef farms. Early detection of pregnancy is always desirable for the farmer, so that the cow can be rebred without any delay. It is most beneficial if non-pregnancy can be detected before the first heat after insemination.

2.9. Factors affecting improved dairy development in Ethiopia

Challenge and constraints of dairy production in Ethiopia vary from one production system to another and/or form one agro ecology to another, therefore, knowledge of the specific characteristics of dairy production system is significant to be able to target recommendation to specific production system (Sitayehu *et al.,* 2008). The major constraints are described below.

2.9.1 Feed and water

Regardless of the dairy production system and agro ecology feed quality and quantity remains a cross cutting constraint in the dairy sector. It was considered in multi direction in terms of quality and quantity and seasonal supply to satisfy the requirement of dairy animals. Both roughage and concentrates feeds are either too expensive or unavailable in required amount and quality to enhance dairy production (Azage *et al.,* 2013). Generally, feed is among the main factors that determined the productivity of dairy animal second to genetic makeup. To reverse this situation introduction of improved grazing land management techniques combined with improved feeding system are appropriate for the improvement of grazing land, and simultaneously improve livestock production and environmental conservation. In addition to this an alternative method to improve feed production and system that enhance the supply feed especially in dry season should be in placed with the involvement of concerned development actors (Yoseph *et al.*, 2015).

2.9.2. Animal health

The prevalence of various animal diseases that has multi factor influence including reduce production, reproduction and also milk quality and even loss of the dairy animals and high calf mortality extremely hinder the development of the dairy sector in general. A number of parasites, bacteria, fungal and viral diseases and nutritional deficiency affect the reproductively and productivity of dairy cattle and limit the involvement of private sector especially cows used exotic blood. In addition to this the existence of weak animal health delivery system makes the situation more difficult (Tades and Mengistie, 2016).

2.9.3. Genotype related constraints

The dominant indigenous cattle breeds have been naturally selected for adaptive but not for functional traits are recognized by having low production and reproduction potential (Andualem, 2016). There is also unavailability of crossbred dairy animals both in type and amount shows the existence of weak AI delivery system as general. Crossbred cows are mainly concentrated around major urban and peri-urban areas. (Mohamed *et al.*, 2006)

2.9.4. Lack of specific Dairy policy

The country has promising agricultural development policy in general, but there is lack of specific feasible policy direction and support for dairy development (Azage *et al.*, 2013).

2.9.5. Lack of appropriate AI service

Most AI technicians receive only short initial training and mostly not getting refreshment training at regular interval to improve their capacity and it was lack of follow-up system to check their filled performance once they have started to work. Those factors affecting the efficiency of AIT includes accurate and timely pregnancy diagnosis skill which can be contributing to the commonly extended calving interval observed in the dairy sector in Ethiopia. Heat detection and identifying the appropriate time of insemination and lack of proper insemination technique skill are among the main factors that leads to low efficiency of AI service and should be considered during refreshment training (Fikre, 2007).

Poor access to input and service, lack of strong cooperatives and limited involvement of private sector are among the core factors that hinder the development of the dairy sector in general.

2.10. Breeding for dairy through cross breeding

Developing of any genetic improvement strategy requires description of production environment, identifying the availability of infrastructure, setting appropriate breeding objective, selecting traits to be improved based on their influence on returns and costs to the producer of stakeholders (Zewdu, 2004).

Most likely, 50% cross breeds were more productive in low input production system than higher level of inheritance. This could be either due to complementary or heterosis effect. The idea also support the level of management under most smallholder condition in Ethiopia which has been rather unfavourable to higher exotic inheritance level than 50% inheritance Aynalem *e al.*, (2009).

2.11. Bovipreg kit as pregnancy diagnosis technology for dairy cattle

Bovipreg is a technology which enables dairy farmers to diagnose pregnancy of their dairy cattle within 18-22 days after insemination through blood serum and milk samples. The method involves adding 3 - 5 drops of milk or blood serum in the cassette and getting the result in 5 minutes for blood serum and 10-15 minutes for milk.

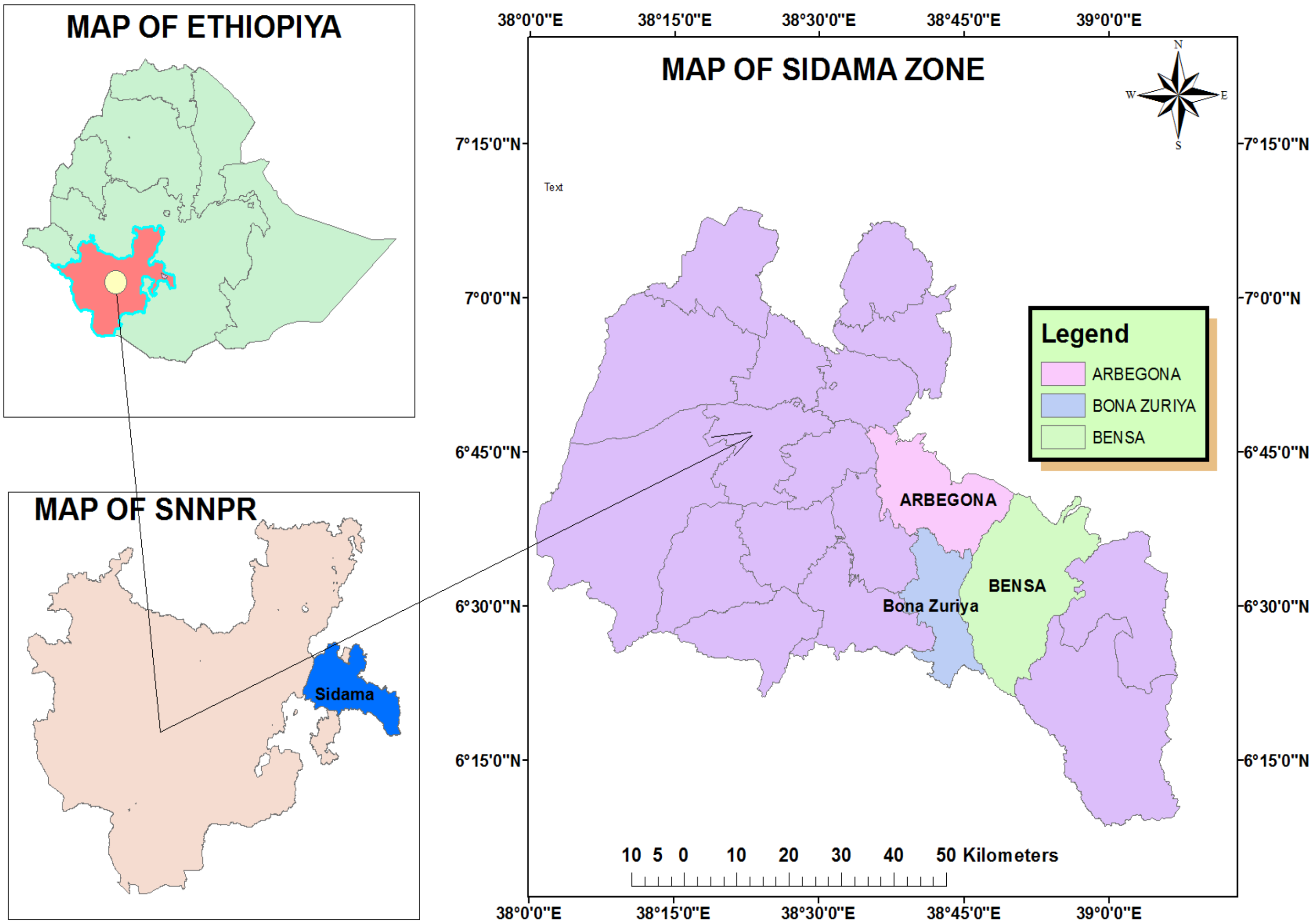
Early identification of non-pregnant cow and heifer post breeding can improve reproductive efficiency and pregnancy rate by decreasing the interval between AI services. Although, it is a Cow-side test, and we will get the result right in farmer barn, does not require to dispatch the samples to a laboratory for test result and does not require refrigeration. The accuracy of Bovipreg is 96% in positive pregnancy and 97.8% in negative pregnancy reference. Generally, this kind of technology which to identify non-pregnant cow and heifer early after AI play a key role in management strategy to improve reproductive efficiency and profitability of dairy sector.

3. MATERIALS AND METHODS

3.1. Study Area

The study was conducted in three districts of Sidama zone, namely Arbegona, Bensa and Bona of Southern Nation, Nations and Peoples Regional States (SNNPRS). Sidama zone is one of the zone from 14 zone of SNNPR located at central part of the region and it comprises 19 districts with a total land coverage of 10,000 km^2. Hawassa is the capital town of both Sidama zone and SNNPRS which is found at a distance of 275 km to the south of Addis Ababa (capital of Ethiopia). The districts located an altitude range of 2298-2606 m a.s.l., 1910 – 1921 m a.s.l. and 1992 – 2461 m a.s.l. for Arbegona, Bensa and Bona respectively. Arbegona district situated between $6^0$36’421” and $6^0$41’135”N latitude and $38^0$44’737” and $38^0$43’355”E longitude. Bensa district is located between $6^0$30’152” and $6^0$31’540”N latitude and $38^0$44’791” and $38^0$49’298”E longitude, while Bona district found between $6^0$31’177 and $6^0$32’310”N latitude and $38^0$39’677” and $38^0$42’410”E longitude. Major Altitude of these districts considered as, Arbegona dominated by high altitude (dega), while Bensa is more dominated by mid altitude (woyna dega) and Bona has both high (dega) and mid altitude (woyna dega). The districts have a distance of 75 km, 105 km and 120 km from Hawassa for Arbegona, Bona and Bensa respectively.

According to the Sidama zone report, the livestock population and type in each district is estimated, Cattle (217,884), small ruminants (132,876) Poultry (171,232) and equine (12,728) for Bensa, Arbegona cattle (167,806), small ruminants (83,170), Poultry (45,430) and equine (2543), whereas Bona cattle (96,842), small ruminants (23,975), poultry (87,732) and equine (4,724).



Geographical location of the study area

3.2. Sampling procedures

3.2.1. Survey

This part of the study was undertaken in three districts (Arbegon, Bensa and Bona) of Sidama zone. The districts were selected purposively based on the potential for high value livestock and irrigation commodities by the Livestock and Irrigation Value Chain for Ethiopia Smallholders (LIVES) project through the participation of stakeholders. Based on the dominant altitude the districts were broadly stratified in to two as high altitude > 2000 m.a.s.l. and mid altitude 1500 – 2000 m.a.s.l. The proportion area with low altitude (< 1500 m.a.s.l.) was very small and therefore it was not included in the study. Thus most parts of Arbegon fall in to high altitude, while most part of Bensa falls in to mid altitude. Bona district cover both high and mid altitude. A total of 6 PA`s 3 from each altitude was selected purposively based on the potential of cattle population, experience in conventional use of artificial insemination (AI) and Oestrus Synchronization and mass artificial insemination (OSMAI), and accessibility. Thus, 3 PAs (2 from Arbegona and 1 from Bona) were selected from high altitude and the other three (2 from Bensa and 1 from Bona) were selected from mid altitude. The list of dairy producers from each of the six PAs was collected from respective office of livestock and fishery resource and PA admirations; followed by selection of target households (dairy producers) randomly. Fifteen households were selected from each PA randomly, and the total numbers of households interviewed across the three districts were 90. Household survey was conducted using pretested semi-structured questionnaires. The Progeny History Survey (PHS) was held on individual dairy cattle managed in 90 households.

Data related to herd size and composition, role of livestock, reproduction and production performance, breeding practice of dairy cattle, management system, farmer’s awareness on breeding dairy animas and major challenges opportunities of breeding programs of dairy cattle were acquired from the respondents.

3.2.2. Part II: Evaluating the efficiency of BOVIPREG (Action research)

This part of the study was carried in Bensa district of Sidama zone with only 2 PAs. The PAs were selected from the ones involved in the first part of the study (survey part) based on the potential of dairy production, existence of high crossbred dairy cattle population, experience in OSMAI and conventional AI.

3.2.2.1. Animal selection

The participant dairy producers were selected from peri-urban areas based on willingness to participate in the study, availability of open crossbreed dairy cows and had experience on use of AI/OSMAI at least for the past 3 years. A total of 44 non-pregnant crossbred cows/heifers (HF x indigenous and Jersey x indigenous) with better body condition between 4 to 8 with no history of reproductive problem and completed the first stage of lactation (in case of lactating cows) and cow with first and second parity were selected for the study.

The animals were checked for pregnancy and presence of corpus leutum (CL) using experienced AI technicians before commencement of actual experiment.

Then each selected animals were synchronized with a synchromate hormone at a level of 2ml. The animals also inseminated with HF semen upon the manifestation of oestrus.

3.2.2.2. Sample collection

Blood Serum: Blood was collected through jugular vein by animal health professionals with in vacutainer tube and allowed to clot for a limited time; the clear straw coloured fluid (serum) which was found at the top of the clot was used for the purpose of pregnancy diagnosis.

Milk: Fresh milk sample was also used to evaluate Bovipreg kit. The first squirt of milk was discarded and then 5 - 10 ml of milk collected in the cup. The samples were well mixed before using for the test and also the sample milk kept at rest for half minutes. Then the milk samples were drawn from the bottom layer using the dropper in the kit and the use that milk on the test kit. Please note that the milk cream usually floats on the surface and avoid the disbursement of the milk sample over the test kit.

3.2.2.3. Treatment and experimental layout

A total of 44 cows, which were screened for the action research, were synchronized with 2 ml synchromate hormone and inseminated upon detected oestrus. Maximum care was taken to select non-pregnant animals since the hormone leads to abortion in case of pregnancy. After insemination the animals were stratified into two treatments (22 animals per treatment) completely at random as described below.

Treatment 1 - Early pregnancy diagnosis with BOVIPREG at 18-22 days post insemination by using BLOOD SERUM sample (n=22 animals)

Treatment 2 - Early pregnancy diagnosis with BOVIPREG at 18-22 days post insemination by using MILK sample (n=22 animals)

As mentioned above early pregnancy diagnosis was performed for oestrus synchronized cows using blood serum (T1) sample and milk sample (T2), at 18-22 days post insemination.

Interpretation of the result if both T and C bands are visible after adding the samples, the result is positive, which means the cow is pregnant. On the other hand if only C line is visible, the test result is negative, which means the cow is not pregnant. When control line does not appear on the membrane, the test is invalid due to improper test procedure or deterioration of reagents so the test will be repeated.

Based on this early pregnancy diagnosis was performed for oestrus synchronized cows using Blood serum (T1) and Milk (T2). Blood and Milk samples were collected from a total of 44 cows within the interval of 18 -22 days after inseminated with AI technician. Then all the sampled animals had diagnosed for pregnancy with Bovipreg kit. The method involves adding 3 - 5 drops of milk or blood serum in the cassette and getting the result in 5 minutes for blood serum and 10-15 minutes for milk.

The sensitivity and specificity of Bovipreg pregnancy diagnosis detection was estimated according to Broaddus and De Vries, (2005) as follows:

$$\textbf{Sensitivity} = \frac{\text{No. of cows correctly diagnosed as pregnant}}{\text{No. of cows correctly diagnosed as pregnant + Non-pregnant declared wrongly as pregnant}}$$

$$\textbf{Specificity} = \frac{\text{No. of cows correctly diagnosed as Non. pregnant}}{\text{No. of cows correctly diagnosed as Non. Pregnant + pregnant declared wrongly as non-pregnant}}$$

$$\textbf{Accuracy} = \frac{\text{No. of cows correctly diagnosed as pregnant both in kit test and palpation + non-pregnant both in kit test and palpation}}{\text{No. of cows inseminated}}$$

3.3. Data collection

Data were collected from secondary data sources, semi-structured questionnaire, organizing group discussions, and employing field experiments and observations.

3.3.1. Focus group discussion

Data were collected from focus group discussion and key informant interview. For key informants interview stakeholders who were interviewed and discussed with dairy farmers, AI technicians, livestock Experts at regional, Zonal, districts and PA level and also from Federal and Regional Semen processing and Distribution Centre and sub centre.

3.3.2. Questionnaire data collection

Before the survey was conducted, enumerators were trained on production and reproduction variables of dairy cattle and the questionnaire was pretested to determine all questionnaires were relevant and the duration of the interview. The following list of data were collected: (ID, breed, body weight, body condition, parity, stage of lactation, previous history of abortion and any reproduction cases, date and time of hormone administration, behavioural administration, behavioural oestrus, and insemination, date and outcome of PD using both methods).

3.4. Data management and statistical analysis

3.4.1. Questionnaire data

Before conducting the main data analysis, homogeneity test, normality test and screening of outliers was employed. The survey data were analysed and presented in the form of descriptive summaries (mean, standard deviation, frequency and percentage). Indices for all ranking data were conducted according to a formula: Index = sum of (3 for rank 1 + 2 for rank 2 + 1 for rank 3) given for an individual attribute divided by the sum of (3 for rank 1 + 2 for rank 2 + 1for rank 3) for overall attributes. SPSS was used to analyse qualitative and quantitative data and quantitative data were analysed using general linear model procedure. The magnitudes of quantitative variables were expressed as Least Square Means (±SE). The variation between groups was considered significant when $p<0.05$.

3.4.2. Analysis for evaluating the efficiency of BOVIPREG

The Chi-square test procedure of SPSS was used to analyse frequency data and quantitative data were analysed using general linear model procedure. The magnitudes of quantitative variables were expressed as Least Square Means (±SE). The variation between groups was considered significant when $p<0.05$.

The data generated from the study were analysed using following model.

$y_{ij} = u + t_i + e_{ijk}$, where;

y_{ij} = observations;

u = overall mean;

ti = treatment

e_{ijk} = random error.

4. Results and Discussion

4.1. General Household Characteristics

The family size, age group, sex and educational status of the respondents in the study area are shown in Table 3. The mean family sizes of the respondents were 6.89 ± 0.31 and 6.73±0.38 for high altitude and mid altitude respectively. The overall mean family size in both altitude of the study areas was 6.8 persons was higher than the average value reported for the national and regional level (CSA,2013). From the total of 90 household heads that participated in the study area 93.33% were male headed in both altitude of the study areas. The number of female household heads in all study sites was significantly ($p<0.05$) smaller as compared to male household heads. The small proportion of female household heads may be due to men play a dominant role in decision making over livestock production management and the use of benefits from live animal sale.

The mean (±SE) age of the respondents was 42.51 ±1.48 and 44.73±1.43 years for high altitude and mid altitude study areas, respectively. It can be assumed that most of the farmers were at productive age.

Only 4.44% of the high altitude and 8.89% of the mid altitude respondents were illiterate, the majority of the respondents were literate for both the study sites and that would be a good opportunity to implement a dairy improvement program as it might be easier for them to record basic performance and pedigree information.

Table 3. Households gender (%), age (yr) and family size (mean ±SE)

Descriptor	High altitude		Mid altitude		Overall	
	N	%	N	%	N	%
Sex of respondent						
Male	42	93.33	42	93.33	84	93.33
Female	3	6.67	3	6.67	6	6.67
Marital status						
Single	1	2.22	1	2.22	2	2.22
Married	43	95.56	44	97.78	87	96.67
Divorced	1	2.22	0	0	1	1.11
Educational Status						
Illiterates	2	4.44	4	8.89	6	6.67
1 to 4	15	33.33	11	24.44	26	28.89
5 to 8	17	37.78	20	44.44	37	41.11
9 to 12	2	4.44	7	15.55	9	10.00
Above 12	9	2.00	3	6.67	12	13.33
Age of respondents (years)	42.51 ±1.48		44.73±1.43		43.62±1.3	
Family size(n)	6.89±0.31		6.73±0.38		6.81±0.25	

SE= standard error, N =number, Yr= Year

4.2. Land holding

The proportion of total land holding in the study areas including crop land, grazing land, land used for forage production and forest. The result obtained from the current study indicates that there were a significance difference ($p<0.05$) of average land holding among the two altitudes of the study area; which was 2.00*±0.18 and 1.62 ± 0.14 for the mid and high altitude respectively. The land allocated for crop production in the mid altitude was relatively higher than the high altitude, while the opposite was true for land allocated for grazing land. The higher farm size and relatively more share of land to crop production in the mid altitude area is mainly due to farmers in the mid altitude area practiced on crop production activity as compared to the high altitude of the study area. The average land holding in the current study area was almost similar with the national average (CSA, 2015).

Table 4. Land holding and land use pattern (*ha*) per household in the study area

Land holding pattern	Mid altitude	High altitude	Overall
	Mean (SE)	Mean (SE)	Mean (SE)
Total Land	2.00*±0.18	1.62 ± 0.14	1.81 ±0.11
Crop land	1.15 ±0.12	1.09±0.08	1.12 ± 0.07
Grazing	0.48 ±0.05	1.09*±0.08	0.36±0.03
Forage	0.22 ± 0.03	0.22±0.04	0.22 ±0.02
Forest	0.15* ± 0.03	0.08 ± 0.02	0.11 ±0.02

*SE = standard error, ha = hectare; *p<0.05 significant differences between means within rows,*

4.3. Livestock holding

The mean (±SE) ownership per household of cattle, sheep, goats, equines and poultry for high altitude livestock owners were indicated in Table 5. Cattle were found to be an important species owned by respondents in both study areas. Livestock species which constitute the largest share in the value of livestock assets of a household are defined as the principal animal (Fredu *et al.*, 2009). The mean (± SE) herd size of cattle in mid altitude was significantly ($P<0.05$) higher than the high altitude herd size. The number of cattle, goat and poultry were higher in the mid altitude where as the number of sheep and equine were higher in the high altitude of the study area. The result in Table 5 indicates there was a significance difference ($P<0.05$) among the two altitudes with regard to average cattle size: the average herd size in the mid altitude was higher than the high altitude of the study area. Cattle were the dominant livestock as compared to the rest livestock species in both altitudes of the study area.

Table 5. Livestock holdings per household in the study area

Livestock species	High altitude	Mid altitude	Total
	Mean (SE)	Mean (SE)	Mean (SE)
Cattle	5.84±0.48	6.47*±0.33	6.15±0.29
Sheep	1.00±0.27	0.91±0.24	1.72±0.18
Goat	0.02±0.02	0.18*±0.86	0.10±0.04
Equine	0.13±0.05	0.09±0.04	0.11±0.03
Poultry	3.40±0.46	8.15*±0.90	5.78±0.56

*SE = standard error, *p<0.05 significant differences between means within rows,*

4.4. Herd Composition

Regarding to the cattle herd composition at the two study areas were indicated in Table 6. Cows contribute the highest proportion of the herd followed by Heifers in both study areas.

Table 6 . Herd Composition per household in the study area

Livestock	High altitude	Mid altitude	Total
	%	%	%
Cow	37.73	44.80	41.50
Ox	6.86	1.08	3.76
Bull	3.43	3.72	3.59
Heifer	21.78	23.10	22.55
Female Calf	14.92	14.88	14.87
Male Calf	15.26	12.40	13.72

4.5. Purpose of keeping cattle

The purpose of keeping cattle in the study area are Presented in Table 7 (7.1 and 7.2). The study indicated that most of the farmers kept cattle for milk followed by income from sale of milk and milk products and the animal itself irrespective of altitude; the present study agreed with the study conducted by Debir (2016) for the same study area. When we came to the other function of cattle there was a difference between altitudes. Farmers on the highland rank manure as the fourth function of cattle whereas farmers at midland rank traction power as a third function of keeping cattle. The index value for traction power in midland is relatively higher due to farmers engaged more in agricultural activities in midland when compared to the highland

Table 7 . Ranks for the purpose of keeping Cattle in the study areas

Purpose	High altitude						Mid altitude					
	1st	2nd	3rd	4th	Index	Rank	1st	2nd	3rd	4th	Index	Rank
Milk	67.78	27.78	3.33	1.11	0.36	1	61.11	32.22	6.67	0	0.35	1
Income	24.44	61.11	11.11	3.33	0.31	2	31.11	56.67	8.89	22.22	0.31	2
Manure	5.55	7.78	50	36.67	0.17	3	0	0	27.78	72.22	0.13	4
Traction power	2.22	3.33	35.55	58.89	0.15	4	7.78	11.11	56.67	25.55	0.21	3

4.6. Major feed source of dairy cattle

The common feed source of dairy cattle in the study area is indicated in Table 8 (8.1 and 8.2). According to the finding obtained from the current study natural grazing pasture and crop residue were ranked the first and the second respectively irrespective of the altitude. The utilization of preserved feed and improved feed varied across the altitude. Preserved type of feed (hay and collected straw) source had more contribution in the mid altitude while improved forage had more contribution in the high altitude area as compared to the mid altitude.

Many researchers and development workers agreed that natural pasture comprises the largest feed resource in pastoralist production system, but estimates of the contribution of this feed resource vary significantly (Alemayehu, 1998). The availability of feed resources in the high altitude of Ethiopia depends on the mode and intensity of crop production as well as population pressure. The major basal feed resources are natural pasture, crop residues and stubble grazing, and their contribution varies from area to area based on cropping intensity (Seyoum and Zinash 1989; Seyoum *et al.,* 2001 and Adugna *et al.,* 2012). Studies in the Ethiopian highlands estimated that crop residues and post-harvest grazing contribute up to 50% of the annual feed demand (Daniel, 1988). Adugna, (2007) also indicated that in the mixed cereal livestock farming systems of Ethiopia, crop residues provide on average about 50% of the total feed source for ruminant livestock during the dry period. In another study, Solomon, (2004) noted that crop-residues and stubble grazing accounted for 74% of the total annual feed supply.

Table 8. Major types of feed sources

Parameter	High Altitude						Mid altitude					
	1st	2nd	3rd	4th	Index	Rank	1st	2nd	3rd	4th	Index	Rank
Feed type												
Pasture	65.3	19.3	10.3	5.1	0.34	1	68.3	18.3	8.3	5.09	0.35	1
crop residue	28.65	48.65	12.76	9.86	0.29	2	26.7	50.8	15.86	6.61	0.29	2
Improved forage	4.44	23.85	34.61	37.1	0.19	3	1.67	8.3	45.03	45	0.17	4
Preserved feed	1.53	8.2	42.33	47.94	0.18	4	3.3	22.53	30.8	43.33	0.19	3

4.7. Water source and watering frequency

In the study area farmers had mainly two water sources for their livestock. Most of the respondents agreed that river water was the main water source for their animal and stream water took the next irrespective of both altitude and season. Few of the respondents also use other source of water like pound and shallow well.

This also indicates there was no water shortage in the study area but the issue of providing clean and safe water to the cattle and advisable to focus on health pattern with relation to contaminated water is important. With regarding to watering frequency there was a variation across the season rather than the altitude. According to the current study 73% of the high altitude and 77.78% of the mid altitude were provide water for their animals once a day during wet season and twice a day during the dry season. This was attributed to most feed types during the wet season are succulent and the weather is also cooler as compared the dry season.

Table 9. sources of water and watering frequency

Parameter	Altitude		
	High (%)	Mid (%)	Total (%)
Main water source for dairy animals			
River	77.8	73.3	75.55
Stream	13.3	15.6	14.45
Other	8.9	11.1	10.0
Watering frequency in wet period			
once a day	73.3	77.78	75.54
twice a day	26.7	22.2	24.45
Watering frequency in dry period			
once a day	42.2	26.7	34.45
twice a day	57.8	73.3	65.55

4.8. Dairy cattle housing system

The housing system in the study area revealed that irrespective of the altitude 51.1% of respondents kept all livestock species including dairy cattle with the family dwelling. Keeping the livestock with the family dwelling was a treat on the health aspect of both the family and the livestock. Most of the respondents justified that predators and thieves were the main treat of the study area to hold the livestock in a separate shade. However, very little number (11.1%) of the respondents in the high altitude kept their dairy cattle in a separate shade.

Table 10. Dairy cattle housing system

Housing system	Altitude		
	High (%)	Mid (%)	Total (%)
Together with the family	51.1	51.1	51.1
Barn near homestead /all livestock together/	37.8	48.9	43.4
Corrals	11.1	0	5.6

4.9. Dairy cattle breeding system

Genetic improvement of cattle is a key element in the production of milk and milk products that determines the potential of dairy cattle. Crossbreeding has resulted in good improvement in production of milk especially when supplemented with adequate management level in terms of nutrition, disease control and other management aspects Addisu *et al.,* (2016).

Reproductive efficiency of the dairy herd is also another important trait to the economic success of the dairy production. One of the most widely used reproductive technologies implemented by most dairy farmers is artificial insemination (AI). Artificial insemination reduces the incidence of sexual transmitted diseases among cattle as well as increases the use of genetically superior sires to improve performance of the herd. However, as opposed to this the finding from the present study indicates uncontrolled natural mating is the dominant one which was followed by alternative use of natural mating and AI service in the study area. The finding was in line with (Godanaw *et al.,* 2014).

The main mating system in the study area is indicated in Table 11. The study indicated that 73.3% of high altitude and 68.9% of mid altitude respondent's benefited with bull mating followed by bull mating or AI service alternatively irrespective of the altitude. The study also justified on average about 6.85% of the respondents use AI service as a breeding tool for their dairy cattle. The low efficiency of AI service may be due to several reasons mainly the low efficiency of AI service when compared with the natural mating, limited awareness on heat detection, the AI service delivery system was also inconsistent because of input limitation and limited number of AIT at each district of the study areas.

The result also indicated most farmers in the study area used breeding bull from other farmers on payment bases irrespective of altitude. The trend of mating system was reversed from AI service to natural mating in the study area and this is treating for the breeding program in the near future. The pedigree of most of breeding bulls in the study area was not known clearly and there was no independent animal health service for the breeding bull rather than routine treatment when the bulls got sick. In addition vaccination service was given with other animals and this also increases the risk of spreading sexually transmitted diseases that harms both the cattle and human beings. The bulls are also serving for an extended period of time about 3 - 4 years without change this could be treat for inbreeding.

Table 11. Common dairy cattle mating system in the study area

Mating system	Altitude		
	High	Mid	Average
	%	%	%
AI	6.7	7	6.85
Bull	73.3	68.9	71.1
Both	20	24	22

4.10. Source of breeding bull

The source of mating bull in the study area reported in the present study also shows bulls from neighbours in both altitude was the dominant one. Most of the breeding bulls were crossbred resulted from the AI or natural mating. Most of the farmers were not aware of the pedigree of the bull undoubtedly only judge with the information received from the bull owner or farmers who got the service before and also only by observing the colour of the bull.

Table 12. Source of breeding bull

	Altitude		
Source of breeding bull	Mid (n=45)	High (n=45)	Total (n=90)
Own (Number)	15	11	26
%	33.3	24.4	28.89
Neighbour (Number)	30	34	64
%	66.7	75.6	71.11

4.11. Animal health management and disease prevalence

A number of parasitic, bacterial, fungal and viral diseases and nutritional deficiencies which are prevalent in the area affect the productivity and reproductive efficiency of dairy cattle and make individuals insecure to be involved in and invest on dairy production specially using cows with exotic blood. According to respondents and the data collected from secondary source; mastitis and venereal diseases have a direct effect while and nutritional deficiencies and other infectious diseases play an indirect role in hampering the reproductive efficiency of dairy cows. Therefore, to adopt adequate health management strategies, it is fundamental to identify causes of morbidity and mortality, and prevalence of diseases which occurs frequently.

4.12. Constraints associated with Dairy production

Identification of major constraints for a given farm animal production in a given production system is a prerequisite to plan appropriate intervention strategies. Based on the current study result, feed shortage, weak AI service delivery system and unavailability of cross bred dairy cow and disease were the first, second and third major constraints of dairy production.

4.13. Farmers awareness on time of insemination

Few of the respondents in the study area were familiarized with the AM/PM principle of mating system with regard to the insemination time, whereas irrespective the altitude around 70% of the respondents were not aware on the effect of time of insemination on successful breeding.

Standing heat is the most reliable indication that a cow is going to ovulate and release an ovum or egg. Estrous behaviour is used to determine when a cow should be inseminated. A brief window of opportunity exists for fertilization of the egg and pregnancy of the cow occurs. However, in the current study most respondents were unaware of the AM/PM breeding procedure as a rule of thumb in relation to breeding/ mating time. This may attributed to low conception rate of AI service which also result prolonged calving interval. This might indicates weak and inefficient extension service was provided by the concerned institution.

Table 13. Farmer's awareness on heat detection and time of insemination

Time of insemination	Cow/heifer heat in the morning (n=90)		Cow/heifer showing heat in the afternoon (n=90)	
	number	%	number	%
Immediately	43	47.8	46	51.1
Afternoon of the same day	22	24.4	---	---
Next day morning	16	17.8	21	23.3
next day afternoon	7	7.8	21	23.3
After the 2nd day	2	2.2	2	2.2

4.14. Productive and Reproductive performance of Dairy Cattle

4.14.1. Age at First Calving

The study indicated in Table 14. The mean AFC in the present study was found to be 3.3 years for the high altitude and 3.5 year for the mid altitude and had no significantly difference ($p>0.05$) between the two altitudes of the study areas. The AFC in present finding was although, shorter than the result obtained by Selamawit *et al.*, (2017) for Holetta Agricultural Research. However, the AFC in the present study in both agro-ecology was longer than Deber, (2016) for SNNPR. Prolonged calving interval leads to reduced productivity and productivity of the cow due to less calf crop and milk production per life time of the cow.

4.14.2. Calving to first service interval

The mean CFSI had significantly difference ($p<0.05$) among the two altitudes of the study areas. The mean CFSI 161 day for the high altitude in the study area was longer than study conducted at Alage dairy farm 156 days by (Berihanu *et al.*, 2018). On the other hand, the mean CFSI 126 day for midland of the study area was shorter than the same study mentioned above. However, the present finding of CFSI in both altitudes was very longer as compared to the optimum recommended rage of 75 - 90 days for well managed dairy cattle. This longer CFSI was mainly due to management factor, farmers' awareness on heat detection and time of insemination and the availability of breeding service. On the other hand, some farmers prefer to get little milk rather than rebreed their cow on time that they think the lactation length shortened if they rebreed their cow on the recommended period.

4.14.3. Calving Interval

The gap elapse between two successive calving is called calving interval. The CI of the present study there had no significantly difference ($p>0.05$) among the two altitudes of the study areas. The study justifies that the mean calving interval of 458.23 and 439.9 days for the high altitude and mid altitude respectively. The present findings were shorter than the finding of Mulugeta and Belayeneh (2013) for Norh Shoa Zone and Amare *et al.*, (2018) for the central highland of Ethiopia. However the CI in both agro-ecology of the study area was longer than the study conducted by Debir, (2016). Calving interval is the best index of a cattle herds` reproductive efficiency (Meseret, 2014). Generally, CI is reducing the life time reproductively potential and productivity of the cow. Long calving interval could be attributed to low attention and farmers' skill on dairy cattle management and inefficient breeding service.

4.14.4. Lactation Length

The mean lactation length in the study assessed were 340.36±19.76 for the high and 277.52±7.08 for the mid altitude. The lactation length of crossbred dairy animals across the study area shows significantly difference ($P <0.05$) between the two altitudes. The mean value of lactation length of 308.59±10.87 days for crossbred in the present study was higher than the study conducted by Woldemichael, (2008) for dairy marketing chain analysis: the case of Shashemene, Hawassa and Dale district`s Milk Shed but, shorter than the study obtained by Niraj *et al.,* 2014 for crossbred dairy cow for Gondar. The variation of lactation length across the study area could be mainly due to both genetic and non-genetic aspects. Dairy farming with inefficient breeding system leads to poor conception rate, which finally result prolonged LL. However, some farmers in the study area desire prolong lactation length intentionally to have milk for extended time with the expense of reduced reproductive performance of the cow.

14.14.5. Daily milk yield (DMY)

The mean daily milk yield was 5.51± 0.23 for the high altitude and 5.16±0.16 for the mid altitude in the present study and had no significantly different (P> 0.05) between the altitudes. Mean milk yield in the study area was 5.33 litre per day was lower than the result obtained by Meseret *et al.,* (2014) for crossbred dairy cow in Hawassa city and although from Shashemane, Hwassa and Dale milk shed by Woldemichael, (2008). However, the milk yield was higher than the finding by Debir, (2016) for the same study area.

Table 14. Reproductive performance of crossbred cows in the study area

Parameters	High altitude	Mid altitude	Overall
Age at First Calving (Yr)	3.32± 0.65	3.46±0.05	3.39±0.43
Daily Milk Yield (Litter)	5.51± 0.23	5.16±0.16	5.33± 0.14
Lactation Length (Day)	340.36*±19.76	277.52±7.08	308.59±10.87
CFSI (Day)	161.25*±5.81	126±3.66	143.43±3.88
Calving Interval (Day)	441.5±9.59	456.23±11.23	448.96±7.4

SE=standard error

4.15. Evaluation of Bovipreg for early pregnancy diagnosis

Early identification of pregnant and non-pregnant cows post insemination improves reproductive efficiency and pregnancy rate in cattle by decreasing the interval between breeding services. Many new and old technologies are available to identify pregnant and non-pregnant animals early post service and can play a key role in an overall reproductive management strategy to rapid return these animals to the breeding program (Brent *et al.*, 2005).

In general, early pregnancy diagnosis has a significant importance to increase the profitability of the herd by enabling the producer to decide either to treat or to cull the non-pregnant cow earlier. In the present study the result of early pregnancy diagnosis with Bovipreg kit at 18-22 days post insemination revealed relatively higher positive pregnancy (45.45%) for sample from blood serum than for sample from milk of crossbred dairy cow. Accordingly, 13.64% positive pregnancy was detected in milk samples. After Pregnancy diagnosis was performed with Bovipreg for each sample of the selected experimental animals they were rectal palpated after 90 days of post insemination. The relation between Bovipreg and rectal palpation for pregnancy were used to estimate the accuracy of Bovipreg kit. That means when the result of both Bovipreg and rectal palpation were similar for a given cow the result was considered as accurate result. Otherwise the result of rectal palpation remains accurate. In this study, higher positive pregnancy was detected for cows in 1 (blood serum sample) at 90 days post insemination using rectal palpation with AI technicians.

The proportion of cows considered as pregnant at early pregnancy diagnosis with Bovipreg but confirmed negative through rectal palpation after 90 days (false positive) was 9.1% for 1 and 9.1% for 2. Although, the proportion of cows diagnosed negative at early pregnancy with Bovipreg but confirmed positive through rectal palpation after 90 days (false negative) was 9.1%

for 1 and 18.18% for 2 samples. The main reason for the difference between positive pregnancy diagnosis with Bovipreg at 18 - 22 post insemination and rectal palpation after 90 days of post insemination might be due to embryonic mortality and/or skill of AIT to diagnosis pregnancy. Generally, the accuracy of Bovipreg kit for positive pregnancy was 81.18% for blood sample and it was 72.3% for with milk sample. Pregnancy diagnosis by rectal palpation is the most widely implemented method, but the most challenging reason here was it was performed after 90 days of post insemination and it requires highly skilled professional that lack/limited in number today in most cases. The result obtained with the current study for Bovipreg was relatively higher for sample from blood serum than milk sample, and it was consistent with (Biruk 2016). The finding of the current study with blood serum sample was closer to the study conducted by Alemayehu et, al (2019) but lower for the milk sample of the same study. The result obtained from the present study by Bovipreg with blood sample was higher than milk sample due to the presence of considerable amount of lipids in the milk which restrict/limit the uniform distribution of the milk within the capillary of the Bovipreg kit.

Table 15 Evaluation of the accuracy of Bovipreg kit as early pregnancy diagnosis using blood serum and milk sample of dairy cows

Variables	1 Blood	2 Milk	Chi-square
No of cows selected for study	30	30	
No of cows injected for hormone	26	26	
No of cows response to hormone	22	22	
Response %	84.62	84.62	
No of cows inseminated up on detected oestrus	22	22	
No of cows early PD after 18-22 days of insemination	22	22	
Cow tested positive	10 (45.45%)	3 (13.64%)	*
Cow tested negative	12 (54.55%)	19 (86.36%)	
Rectal palpation after 90 days			
Cows tested positive	10 (45.45 %)	5 (22.72%)	*
Cows tested negative	12 (54.55%)	17(72.27%)	
PD positive as non-pregnant (false negative)	2 (9.1%)	4 (18.18%)	
Non PD as pregnant (false positive)	2 (9.1%)	2(9.1%)	
Sensitivity of Bovipreg test %	83.33%	71.43%	
Specificity of Bovipreg test %	85.71%	80.95%	
Accuracy of Bovipreg test %	81.81%	72.73%	

No = Number , PD pregnancy diagnosis, Pregnant negative = non pregnant cows, positive = pregnant cows, Negative = non pregnant cows

5. SUMMARY AND CONCLUSION

Reproductive management has immense effect on the productivity and production performance of dairy cattle. Most of reproductive performance of dairy cattle improved through appropriate and efficient breeding system.

The current study was carried with the objective of assessing the reproductive management and breeding practice, and evaluation of Bovipreg for early pregnancy diagnosis of improved dairy cattle in the three selected districts namely Bona, Bensa and Arbegona Sidama zone of SNNPR. The study has 2 parts where the first part of the study was survey aimed to assess to the reproductive management and breeding practices of dairy cattle while the second part of the study was devoted to evaluate Bovipreg for determination of early pregnancy. Data for the first part of the study were collected from households across the 3 districts through survey. The action research was carried out to evaluate early pregnancy diagnosis with Bovipreg at day 18 - 22 post insemination in Bensa district. With related to breeding practice even though farmers in the study area were aware about the advantage of crossbred dairy cow, most of them use breeding bulls than AI service given the fact the bulls used for natural mating do not have pedigree information and other records. The dominant feed resource of dairy cow in the study area was grazing natural pasture followed by crop residue irrespective of the altitude of the study areas. Most of dairy cattle were maintained within the family dwelling. According to the current study the major constraints of dairy production were feed shortage, lack of proper breeding management, unavailability of crossbred dairy animals and disease were the main challenges of dairy production in the study area.

The result obtained from the action research showed that the response to hormone for oestrus synchronization with the current hormone and protocol for both groups was high (84.6%). The sensitivity, specificity and accuracy of BOVIPREG test was relatively higher for samples taken from the blood compared to milk samples. Early pregnancy diagnosis with Bovipreg kit at 18 -22 days after insemination by using Blood serum and milk sample from crossbred dairy cow was about 81.81% and 72.73% for blood and milk sample respectively. On the other hand, the accuracy of Bovipreg for negative pregnancy was 85.71% for blood and 80.95% for milk sample.

In conclusion this study revealed that the reproductive performance of dairy cattle in the study area was low as indicated by extended calving interval, long calving to first service interval etc besides, the action research confirmed that it is suitable to use Bovipreg for early pregnancy diagnosis under small holder dairy farms in Ethiopia. Moreover, it was revealed that accuracy of early pregnancy diagnosis was relatively higher for samples taken from blood serum than milk.

6. RECOMMENDATIONS

- Reliable and efficient breeding practice and reproductive management is highly essential to improve the reproductive performance of dairy cattle.
- Sustainable breed improvement strategy that fit the existing circumstances should be put in place to improve the dairy sector and to use existing demand of the farmers as a best opportunity in southern region in general and the current study area in particular.
- Improving the awareness of farmers on improved reproductive management and breeding practices is critical to improve the performance of dairy cattle in the study area.
- Since Bovipreg kit is suitable for early pregnancy diagnosis of dairy cows it should be promoted and used by the extension system to improve reproductive efficiency through reducing extended calving interval and improving lifetime reproductive efficiency of dairy cows.
- A well designed breeding system should be established for proper utilization of improved breeding bulls for breed improvement in the study area. This includes, among others bull selection, pedigree, bull management and appropriate utilization.
- Establishment of recording system at smallholder farmer's level should be considered as an important tool for improved reproductive management in the study area.

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8. Appendixes

Appendix Table - 1 Households Age (yr) and Family size (mean ±SE)

Report

Agro ecology		age	family size
highland	Mean	42.5111	6.8889
	N	45	45
	Std. Deviation	9.91469	2.12370
	Std. Error of Mean	1.47799	.31658
midland	Mean	44.7333	6.7333
	N	45	45
	Std. Deviation	9.60445	2.58844
	Std. Error of Mean	1.43175	.38586
Total	Mean	43.6222	6.8111
	N	90	90
	Std. Deviation	9.76991	2.35546
	Std. Error of Mean	1.02984	.24829

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
age * Agro ecology	Between Groups	(Combined)	111.111	1	111.111	1.166	.283
	Within Groups		8384.044	88	95.273		
	Total		8495.156	89			
family size * Agro ecology	Between Groups	(Combined)	.544	1	.544	.097	.756
	Within Groups		493.244	88	5.605		
	Total		493.789	89			

Appendix Table - 2 Land holding

Report

agro ecology		total land	total crop land	grazing land	forage land	forest land
highland	Mean	2.0056	1.1480	.4813	.2213	.1467
	N	45	45	45	45	45
	Std. Deviation	1.22415	.80486	.33359	.19435	.19252
	Std. Error of Mean	.18249	.11998	.04973	.02897	.02870
midland	Mean	1.6251	1.0940	.2311	.2133	.0809
	N	45	45	45	45	45
	Std. Deviation	.93459	.56945	.16600	.25322	.13036
	Std. Error of Mean	.13932	.08489	.02475	.03775	.01943
Total	Mean	1.8153	1.1210	.3562	.2173	.1138
	N	90	90	90	90	90
	Std. Deviation	1.09967	.69377	.29063	.22448	.16679
	Std. Error of Mean	.11592	.07313	.03064	.02366	.01758

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
total land * agroecology	Between Groups	(Combined)	3.257	1	3.257	2.746	.101
	Within Groups		104.369	88	1.186		
	Total		107.625	89			
total crop land * agroecology	Between Groups	(Combined)	.066	1	.066	.135	.714
	Within Groups		42.771	88	.486		
	Total		42.837	89			
grazing land * agroecology	Between Groups	(Combined)	1.409	1	1.409	20.294	.000
	Within Groups		6.109	88	.069		
	Total		7.518	89			
forage land * agroecology	Between Groups	(Combined)	.001	1	.001	.028	.867
	Within Groups		4.483	88	.051		
	Total		4.485	89			
forest land * agroecology	Between Groups	(Combined)	.097	1	.097	3.602	.061
	Within Groups		2.379	88	.027		
	Total		2.476	89			

Appendix Table - 3 Livestock holdings per household in the study area

Report

Agro ecology		cow	ox	bull	heifer	female calf	male calf
highland	Mean	2.2000	.4000	.2000	1.2667	.8667	.8889
	N	45	45	45	45	45	45
	Std. Deviation	.91949	.65366	.45726	1.40454	.72614	.64745
	Std. Error of Mean	.13707	.09744	.06816	.20938	.10825	.09652
midland	Mean	2.8889	.0667	.2444	1.4889	.9556	.8000
	N	45	45	45	45	45	45
	Std. Deviation	1.17207	.25226	.43461	1.27247	.67270	.66058
	Std. Error of Mean	.17472	.03761	.06479	.18969	.10028	.09847
Total	Mean	2.5444	.2333	.2222	1.3778	.9111	.8444
	N	90	90	90	90	90	90
	Std. Deviation	1.10322	.52037	.44413	1.33726	.69742	.65190
	Std. Error of Mean	.11629	.05485	.04682	.14096	.07351	.06872

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
cow * agroecology	Between Groups	(Combined)	10.678	1	10.678	9.623	.003
	Within Groups		97.644	88	1.110		
	Total		108.322	89			
ox * agroecology	Between Groups	(Combined)	2.500	1	2.500	10.185	.002
	Within Groups		21.600	88	.245		
	Total		24.100	89			
bull * agroecology	Between Groups	(Combined)	.044	1	.044	.223	.638
	Within Groups		17.511	88	.199		
	Total		17.556	89			
heifer * agroecology	Between Groups	(Combined)	1.111	1	1.111	.619	.434
	Within Groups		158.044	88	1.796		
	Total		159.156	89			
female calf * agro ecology	Between Groups	(Combined)	.178	1	.178	.363	.548
	Within Groups		43.111	88	.490		
	Total		43.289	89			
male calf * agro ecology	Between Groups	(Combined)	.178	1	.178	.416	.521
	Within Groups		37.644	88	.428		
	Total		37.822	89			

Appendix Table - 4 Herd Composition per household in the study area

Report

Agroecology		Cattle	Sheep	Goat	Equine	poultry
highland	Mean	5.8444	1.0000	.0222	.1333	3.4000
	N	45	45	45	45	45
	Std. Deviation	3.21188	1.80907	.14907	.34378	3.12177
	Std. Error of Mean	.47880	.26968	.02222	.05125	.46537
midland	Mean	6.4667	.9111	.1778	.0889	8.1556
	N	45	45	45	45	45
	Std. Deviation	2.25227	1.64900	.57560	.28780	6.03383
	Std. Error of Mean	.33575	.24582	.08581	.04290	.89947
Total	Mean	6.1556	.9556	.1000	.1111	5.7778
	N	90	90	90	90	90
	Std. Deviation	2.77594	1.72171	.42532	.31603	5.34175
	Std. Error of Mean	.29261	.18148	.04483	.03331	.56307

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Cattle * Agroecology	Between Groups	(Combined)	8.711	1	8.711	1.132	.290
	Within Groups		677.111	88	7.694		
	Total		685.822	89			
Sheep * Agroecology	Between Groups	(Combined)	.178	1	.178	.059	.808
	Within Groups		263.644	88	2.996		
	Total		263.822	89			
Goat * Agroecology	Between Groups	(Combined)	.544	1	.544	3.080	.083
	Within Groups		15.556	88	.177		
	Total		16.100	89			
Equine * Agroecology	Between Groups	(Combined)	.044	1	.044	.442	.508
	Within Groups		8.844	88	.101		
	Total		8.889	89			
poultry * Agroecology	Between Groups	(Combined)	508.844	1	508.844	22.051	.000
	Within Groups		2030.711	88	23.076		
	Total		2539.556	89			

Appendix Table - 5 Productive and Reproductive performance of Dairy Cattle

Report

Agro-ecology		calving interval	post calving Insemination	Milk yield	Lactation length	Age at first calving
Highland	Mean	441.4886	161.2500	5.5057	340.3636	3.3159
	N	44	44	44	44	44
	Std. Deviation	63.60429	38.56624	1.52164	131.07234	.43292
	Std. Error of Mean	9.58871	5.81408	.22940	19.75990	.06526
midland	Mean	456.2667	126.0000	5.1576	277.5244	3.4618
	N	45	45	45	45	45
	Std. Deviation	75.33513	24.53198	1.05581	47.48200	.36692
	Std. Error of Mean	11.23030	3.65701	.15739	7.07820	.05470
Total	Mean	448.9607	143.4270	5.3297	308.5910	3.3897
	N	89	89	89	89	89
	Std. Deviation	69.78311	36.63080	1.31125	102.56854	.40530
	Std. Error of Mean	7.39700	3.88286	.13899	10.87224	.04296

ANOVA Table

		Sum of Squares	df	Mean Square	F	Sig.
calving interval * Agro-ecology	Between Groups (Combined)	4858.568	1	4858.568	.998	.321
	Within Groups	423673.544	87	4869.811		
	Total	428532.112	88			
post calving Insemination * Agro-ecology	Between Groups (Combined)	27643.525	1	27643.525	26.593	.000
	Within Groups	90436.250	87	1039.497		
	Total	118079.775	88			
Milk yield * Agro-ecology	Between Groups (Combined)	2.696	1	2.696	1.578	.212
	Within Groups	148.609	87	1.708		
	Total	151.305	88			
Lactation length * Agro-ecology	Between Groups (Combined)	87848.908	1	87848.908	9.121	.003
	Within Groups	837937.965	87	9631.471		
	Total	925786.873	88			
Age at first calving * Agro-ecology	Between Groups (Combined)	.473	1	.473	2.945	.090
	Within Groups	13.983	87	.161		
	Total	14.456	88			

9. Appendix Questionnaire Format

I/ Data Collection Format Survey Questionnaires

1. **General Information**

1.1. District ------------------------- PA ---------------------------------- Agro ecology ------

(1= low land, 2 = medium altitude or 3= high land)

1.2. **Dairy Farm Owner** Name ---------------------- sex -------------- District ------------------------

PA ----------------------------------- Sub PA--------------------

1.3. **Socio-economic variables here**

1.3.1.1. **characteristics of the respondent**

Characteristics	Answer	
Age group of respondent (1=18-25, 2=26-34, 3=35-43, 4=44-52 and 5=>52		
Sex (1= male and 2= Female)		
Responsibility in the house hold 2=Husband, 3= wife, 4= Grandparent, 5=Brother, 6= sister, 7=daughter, 8=son, 9=relative 10=sibling 12=other relative (other specify)		
Marital status (1=single, 2=married, 3= divorced, and 4=polygamy		
Family size male ------- female --------- total -------		
Educational Status 1= illiterate, 2=religious, 3=read & write, 4=grade1-3, 5=grade 4-6, 6=grade 7-9, 7=grade 10-12 8=diploma, 9= BSC/BA		

1.3.2 Major farming system in the area 1=crop production, 2=livestock production, 3=mixed with crop dominant and 4= mixed with livestock dominant

1.3.2. Land holding and land use system

Total area of land owned by the house hold in hectare --------- or ----- * ---- meters = ----- square meter

- ✓ Land use

Crop production ------%, grazing land ---% , fallow land --- %, forage production ---- % forest and wood land ----- %, rented/contracted --- % other specify ---- %

1.3.3. Livestock ownership of the respondents

Type	Composition	Number	Purpose of keeping	
Cattle	Cow			
	Oxen			
	Breeding bull			
	Heifer			
	Male calves			
	Female calves			
Sheep				
Goat				
Chicken				
Equine				
Bee colony				

*1=milk, 2=source of income, 3=traction power 4=manure 5=other /specify

1.3.4. What type of feeding system do you use for your cattle?

1= mainly grazing (free range/tethering) 2= mainly grazing with some stall feeding

3=mainly stall feeding with some grazing 4= Mainly grazing 5 = other specify

1.3.5. Do you give supplement feed for your cattle? 1=yes 2=no

If the answer is yes please mention kind of supplement feed do you give?

1=hay 2=Improved forage 3= concentrate 4=treated straw (EM, Urea, …) 5=mineral block 6=other specify

1.3.6. Feed source of the dairy cattle with ranking

Feed source	**Rank**
Natural pasture	
Crop residues	
Improved forage	
Preserved feed /hay/	
Other specify	

1.3.7. What are sources of water for your cattle?

Source of water	Dry season (1=yes, 2=no)	Wet season (1=yes, 2=no)	Rank	
			Dry season	Wet season
River				
Pond				
Stream				
Tap water				
Deep well				
Other specify				

1.3.8. How frequently do you provide water for your dairy cattle?

Watering frequency	Season (1=yes, 2=no)	
	Dry season	Wet season
Once a day		
Twice a day		
Every other day		
Other specify		

1.3.9. Housing

- ✓ How do you keep cattle? 1=together with the family house, 2=together with all type of livestock, 3=separately according to cattle type, 4=other specify
- ✓ If you keep cattle in separate house what was the type of housing? 1=permanent 2=semi-permanent
- ✓ Structures in the housing? 1=watering tank, 2=water trough, 3=milking stall, 4=feed trough, 5=other specify

2. **Breeding practice**

Main breeding practice & reason of preferring this breeding system

Breeding Practice	***Why you prefer this breeding system***						
	cheaper	Easily available	Ready when the cow is on heat	High successive rate	frequently provides female calves	helps to avoid inbreeding	other
Bull							
AI							
Both							

2.1. For Bull service

2.1.1. If you use bull service mention the source

Breed	**Source of bull**			
	Own	Other farmers	Bull scheme	unknown
Local				
HF				
Jersey				

2.1.2. How long did you use bull service ----------------- years ------- months

2.1.3. Is there any regular inspection & health control mechanism for the breeding bull?

a/ yes ☐ b/no ☐

2.1.4. If yes how is it t performed ---

2.1.5. Have you encountered any problem when using bull service?

a/ yes ☐ b/no ☐

2.1.6. What are the major constraints related to bull service ---

----

2.1.7. If it was a reproductive disease specify type of disease & its consequences -----------------------

----

2.1.8. Do you change the breeding method of dairy cattle for the last 3 years?

2.1.9. If you made change, from which method do you shift

a/ from bull to AI ☐ b/from AI to bull ☐

2.1.10. Why do you made the change? --

2.1.11. What is the average cost per service? Bull service ----------------birr

AI service ____ birr

2.1.12. Do you pay for repeated breeding? a/ yes ☐/ no ☐

2.1.13. What is the payment for repeat breeding (birr)---

2.2. For AI service

2.2.1. For how many years do you use the service? ---------------- Years ----- month.

2.2.2. What is the distance in Km from home to AI service provider's area? --------

2.2.3. How many hours/minutes does it takes to walk from your residence to AI service provider? -----

2.2.4. Why do you need to cross breed your cow? ---

2.2.5. What is your main source of information about new agricultural technologies like AI service? 0=no 1=yes

2.2.6. If your answer for question number 2.2.6 is yes, where did you know? 1=extension agent, 2=AI technician 3=my neighbors, 4=my parents, 5=other specify

2.2.7. Frequency of contact with extension service providers? 1=once a month 2= twice a month, 3=3times a month 4=4 times a month 5=other specify

2.2.8. Do you participate in dairy cattle breeding & management training? 0=no 1=yes

2.2.9. If yes mention the period in month bases for the last training you were participated? ------

2.2.10. Method of getting AI service

Means of getting AI service	Put a mark
✓ Stationed	
✓ Phone call	
✓ AIT visit at regular interval	
✓ All the three methods are implemented	

2.2.11. Have you any problem of accessing AI technician when your cow is ready to mating?

a/ Yes ☐ b/ no ☐

2.2.12. If you face any problem what is the cause?

Source of problems	Ranking
• Not available on time	
• AI station was located at a distant	
• Shortage of AI technician	
• High payment	
• Low Efficiency	
• Other (specify)	

2.2.13. Do you have the knowledge on how to detect estrus in dairy animals?

a/ yes ☐ b/no ☐

2.2.14. If the answer for number 2.2.13. is yes Please mention main signs recognized at the time of estrus/heat? --

----

2.2.15. How frequently do you inspect the herd for estrus signs?

a/ 2 times a day ☐ b/once a day ☐ c/ I don`t follow ☐

2.2.16. Estrus and time of insemination

If you're cow shows estrus in the morning, when you do you take to AI or bull service					If you're cow shows estrus in the afternoon, when you do you take to AI or bull service				
immediately as the cow shows estrus	afternoon of the same day	morning of the next day	afternoon of next day	when the service was available	immediately as the cow shows estrus	morning of the next day	afternoon of next day	when the servic e was availa	

2.2.17. If the answer for number 2.2.13 is no how do you know the right time of insemination 1=with the support of AI technician, 2=my family helps me,3=my neighbor, 4=other specify

2.2.18. When did you mate /inseminate your cow after calving? -------

1 = after 2 month , 2= after 3 month , 3= after 4 month 4= after 5 months and above

2.2.19. Do you bring your cow for repeat breeding? If so, when do you bring your cow for re-insemination?

a/ after a month ☐ b/ after 2 -3 months ☐ c/after 4 - 5 months ☐ d/after 6 – 8 months ☐ e/ after 8 & above months ☐

2.2.20. When did you bring your cow for PD test after insemination?

1= 1-2 months, 2= 2-3 months, 3 = 4-5 months, 4 = 5-6 months, 5 = after 6 and above months , 7= I don't bring for PD

2.2.21. Which PD procedure do you prefer?

a/ Palpation by AIT ☐/ on observation ☐oth by palpation & observation ☐

2.2.22. Why prefer the method?

a/accuracy ☐ b/ accessibility ☐ cheaper ☐ has no risk ☐

2.2.23. Which method you find an accurate -----------------------------?

2.2.24. What are the major treats to PD for inseminated cow?--

----

2.2.25 What is the average calving interval of your cattle (in month)? -------------

2.2.26. Are you satisfied with the current AI service provision systems in the district

a/ yes ☐ b/ no ☐

2.2.27. If you are not satisfied on AI service mention main causes --

----

3. Production & Reproduction

3.1. What was the average age of your cow when they gave birth to their 1st calve (year & month)?

3.2. What is the average daily milk yield in liter and milking Frequency of your cattle?

3.3 Lactation length (month)

Cow	Breed		LL (months)
	Zebu	cross	
Cow 1			
Cow 2			
Cow 3			
Cow 4			

BIOGRAPHICAL SKETCH

The author of the present thesis, MULUGETA TESFAYE was born in 1974 in Borena Zone of Oromiya Regional State, Ethiopia. He attended his primary and secondary school at Wadera primary and Negele Borena secondary school respectively from 1978 to 1989. He joined Hawassa Agricultural College in 1990 where, he studied Animal Science and graduated in 1991 with Diploma of Animal Science. He was employed in office of Agriculture and Rural Development between 1991 and 2000. He again joined at Hawassa college of Agriculture in 2001 he where studied Animal Production and Range Science. He graduated in July 2006 with a Bachelor Science in Agriculture (Animal Production and Range Science). He was then employed at Bureau Agriculture, SNNPR (Livestock and Fishery Agency), between 2007 and 2014. He worked as Cattle Breed improve expert. He was admitted to the School of Graduate Students for the degree of Master of Science in Animal Production, the graduate program of Animal and range Science University of Hawassa in 2015. Now the author is working as the coordinator of Livestock and Fishery Sector Development project at Bureau of Livestock and Fishery, SNNPR.