WOLLEGA UNIVERSITY

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DEPARTMENT OF ECONOMICS

ADOPTION OF CROSSBRED DAIRY COWS IN GENDJI AND LALO ASABI DISTRICTS, WEST WOLLEGA ZONE.

BY

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Nekemte, Ethiopia

WOLLEGA UNVERSITY

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A final thesis submitted to Department of Economics in partial Fulfillment of the Requirements for The Degree of Master of Science in Agricultural Economics

By

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As a thesis Research advisor, I hereby certify that I have read and evaluated this thesis under my guidance by Tariku Hordofa Babo entitled "Adoption of crossbred dairy cows in Oromia regional state, West Wollega zone in case of Gendji and Lalo Asabi districts" I recommend that it to be submitted as fulfilling the thesis requirements.

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I hereby certify that all the correction and recommendation suggested by the board of examiners are incorporated into the final thesis entitled “Adoption of crossbred dairy cows in West Wollega zone in case of Gendji and Lalo Asabi district by Mr. Tariku Hordofa,

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Adoption of Crossbred Dairy Cows in West Wollega Zone the Case of Gendji and Lalo Asabi District

The School of Graduate Studies Thesis Presented to Wollega University

In Partial Fulfillment of the Requirements
for the Degree of Master of Science in
Agricultural Economics

BY Tariku Hordofa

October, 2019
Nekemte; Ethiopia

DEDICATION

I dedicated thesis manuscript to the late my mother Kemina Aga and my grower the late Ayane Aga and also my father the late Hordofa Babo (may Lord put their soul in peace)

BIOGRAPHY

Mr. Tariku Hordofa was born on April 20, 1966 E.C in Gendji woreda, West wollega zone. He learn his primary education (1974-1981) at Gendji Elementary School and completed his junior secondary education (1982-1986) from Gimbi compressive high school and joined College of Agricultural TVET in 1990 and graduated in July 1992 with diploma in Natural resource and serve on different disciplines in agricultural office in Yubdo and Gendji woreda for 8 years and continue his education from 1999 to 2003 at yardstick international college of open learning in Addis Ababa and got B.S C. degree in Agricultural Economics. Soon after his graduation, he continues his work in his previous place in Ministry of Agriculture. And now the author works in west Wollega on zonal town Gimbi in the office of Coffee and tea authority as an expert.

STATEMENT OF AUTHOR

First, I declare that this thesis is my bona fide work and that all source of materials used for this thesis have been duly acknowledged. This thesis is submitted in partial fulfillment of the M.Sc. degree at Wollega university and to be made available at the university's Library under the rule of the library. I solemnly declare that this thesis has not been submitted to any other institutions anywhere for the award of any academic degree, diploma, or certificate. Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgement of source is made. Request for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by Dean of the School of graduates Studies when in his or her judgment the proposed use of the material is in the interest of scholarship. In all other instances, however, permission must be obtained from the author.

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Acronyms

AFL	**:**	Age at first lactation
AGP	**:**	Agriculture growth program
AI	**:**	Artificial insemination
BOA	**:**	Bureau of agriculture
CBDs	**:**	Crossbred dairy cows
CSA	**:**	Central statically authority
DA	**:**	Development agent
FAO	**:**	Food and agricultural organization
HH	**:**	Household
IFPRI	**:**	International food policy research institute
ILU	**:**	International livestock unit
MASL	**:**	Meter above sea level
MOA	**:**	Ministry of agriculture
PA	**:**	Peasant association
PADET	**:**	Participatory agricultural demonstration and training
SDDP	**:**	Simple device discovery protocol
T&V	**:**	Training and visit
USD	**:**	United states dollar

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

Ethiopia is the number one in terms of livestock population in Africa. Contrarily, the production of the country's livestock sub-sector is much below the productivity level realized in most countries in Sub-Saharan Africa. Poor genetic performance, feed shortage, and poor veterinary services have characterized the sector. These in turn have resulted in low productivity of the sub-sector. According to various theoretical and empirical studies, a wide range of economic, social and institutional factors influence adoption of agricultural technologies among farmers. A better understanding of the role irrelevant affecting farmers' decision on technology adoption would then help to design relevant policies and procedures that could fasten the development and diffusion of more appropriate technologies. With the purpose of contributing towards this end and lack of such study in the area, this investigation was undertaken in two selected woredas of West Wollega zone of Oromia National Regional State in Gendji and Lalo Asabi district. Secondary data were obtained from various relevant documents, while primary data were collected from farm households. A multi-stage random sampling procedure was used to draw sample farm households. The selection of kebeles using a simple random sampling method was followed by the selection of 138 farm households employing proportion to size random sampling procedure. The required data were collected through personal interviews, based on a structured questionnaire. Descriptive analysis was used to examine and understand the socioeconomic situation of sample farmers. The survey result has revealed that 28.98% of the sample farmers adopted crossbred dairy cows during study year. T-test and Chi-square test were used to examine statistical differences between adopters and non-adopters for different continuous and dummy variables, respectively. Logit model was used to identify factors affecting farm households' adoption decision of crossbred dairy cows. Among twelve explanatory variables included in the estimated logit model, nine of them were found to be significantly related to farm households' adoption decision of the technology. Formal education, family size, access to credit, access to bull, access to AI, heifer supply, household position in institutional organization and distance from market service were found to be significant variables in the adoption decision of crossbred dairy cows. Therefore, attention should be given to major factors that affect crossbred dairy technology adoption by livestock and fishery development office and NGOs to increase production and productivity of the sector.

key words: **-Adoption, Adoption rate, Dairy**

CHAPTER ONE
GENERAL INTRODUCTION

1.1 Back ground of the study

Ethiopia is the largest livestock producer, depending on recent data, in world tenth and in Africa continents Ethiopia is known with more than 59.5million cattle 30.70 million, sheep,30.20million goats, 2.16 million horses, 8.44 million donkeys, 0.41million mules, about 1.21 million camels and 56.53million poultry CSA (2017). In spite of the large livestock population, the contribution of the Ethiopian livestock sector in general and the dairy sector in particular is below its potential at both the national and household level (Behnkle, 2010). This low production level of the sector is attributed to inefficient of the livestock as a result of the traditional method of production, poor breeds, poor feeding, inferior health care and services, and low capital investment in human and fixed assets,

According to CSA (2017), estimation the total cow milk production (excluding milk suckled) for the rural inactive areas of the country during the reference period, is about 3.1 billion liters, average lactation period per cow, at country level was estimated to be about six months and average milk yield per cow per day was about 1.37 liters. In Ethiopia, dairy production is mainly of subsistent type largely based on indigenous breeds of cattle. This shows that intensification and commercialization of smallholder farm households used to improve the dairy production and the living standard of smallholder farmers. Intensification of smallholder dairy production typically involves the adoption of a combination of cattle breeds with increased genetic potential for milk production and other complementary inputs.

The country has set-up the second five-year growth and transformation plan (GTP) with a vision of building an economy which has a modern and productive agricultural sector with enhanced technology. One of the strategic pillars of the plan is maintaining agriculture as a major source of economic growth. The key strategy designed to achieve this is scaling-up of the best technologies and practices of the model farmers for use by all other farmers. Governmental, non-governmental, private and international organizations have been engaged in promoting and disseminating dairy production technologies to smallholder farmers through various channels of extension such as technology verification and demonstrations,

knowledge and skill enhancing, training, experience, sharing visits, farmer-to-farmer information exchange mechanisms and others. Improved dairy breed technologies, improved feeds and feeding practices, dairy processing technologies and improved health management practices are technologies diffused (Samuel *et.al*., 2016).

Even though large efforts have been made to disseminate dairy technologies through the support of governmental and non-governmental organizations in different parts of the country, the adoption of dairy technologies by farm households varies widely across different agro-ecologies and within the same agro-ecology based on various technical and non-technical determinant factors (Dehinenet *et.al*., 2014). Moreover, the impacts of the technologies on the farmers' livelihoods which can be used as an instrument for policy formulation in the dairy sector (breeding, marketing, health and other segments of the sector) have not been reviewed earlier and well- documented. Therefore, it is an effort to review the aspect thoroughly and bring minor details into focus to have better understanding of the rate and extent of adoption, impacts and determinant factors of dairy technologies.

Dairy development in developing countries has played a major role in increasing milk production, improving income level in rural areas, generating employment opportunities and improving the nutritional standards of the people, especially for small and marginal farmers. Low and unreliable income from cash crops suggest that alternative farming activities should be developed. This is in spites of indications that there is a potential for dairy development, and dairy can reduce the level of poverty. CSA (2017)

However, smallholder dairy production is becoming increasingly important and it contributes magnificently to the improvement of the livelihoods of rural people. Higher level of technology adoption is associated with better milk yield and improved dairying has direct impact on income generation, poverty alleviation and availability of animal protein. Thus, to increase the milk production existing dairy technology should be adopted in the small household dairy farms IGAD (2011)

Ethiopia's small ruminant population is among the largest in sub-Saharan Africa and the largest in East Africa FAO (2012)) we are homespun to the major population of cattle in

Africa, as it is discussed above the total cattle population for the country is valued to be about 59.5 million). Out of this total cattle population, the female cattle constitute about 55.5 percent and the remaining 44.5 percent are male cattle, mostly preserved by smallholder, commercial and pastoral farmers; and more than 99% are local low yielders that leaves a high gap between demand and supply of milk and milk products.

Concerning age groups, the majority of the cattle population (that is about 62.95 percent) is in the 3 years and less than 10 years' age category, with about 27. 48 percent male and about 34.47 percent female. On the other hand, the results obtained indicated that 98.20percent of the total cattle in the country are local breeds CSA (2017). The remaining are hybrid and exotic breeds that accounted for about 1.62 percent and 0.18 percent, respectively. Ethiopia holds large potential for dairy development due to its large livestock population, emerging market opportunity, improved policy environment for involvement of private sectors, and the relatively disease-free environment for livestock. Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of the dairy sector in Ethiopia can contribute significantly to poverty alleviation and nutrition in the country. Similar to the most dairy systems found in the tropics, dairy production system in Ethiopia ranges from small to large-sized and subsistence to market-oriented farms. Although there are different ways of classifications, (Azage et al., 2010/11) categorized dairy production systems as pastoral, agro pastoral, inactive dairy production system which includes rural highland dairy production system, urban and pier-urban dairy production systems. In spite of the existing high potential for dairy development due to huge livestock. The demand for milk is even expected to grow more as Ethiopia's population of World Fact Book (2016) resources, favorable climatic conditions and urbanizations, the performance of the dairy industry in Ethiopia has not been encouraging when evaluated against even the dairy performance of Eastern African countries.

A current report by CSA (2016/17) indicated that the total production of cow milk is about 3.07 billion liters, and this translates to an average daily milk production/cow of 1.35 liters/day. As a result, the per capita milk consumption of the country is only 19.2 liters MOA, 2017) which is much lower than Africa and world per capita average of 27 liters/year

and 100 liters/year, respectively. The requirement on import milk and milk products remain increasing, for example, in import of milk & milk product was about 3.1million USD and increased to about 9 million USD in 2018.

This will be falling with the high population growth rate (3.1%). Ethiopia's human population is projected to reach 140 million by the year 2025, World Fact Book (2016) This justifies the need for increasing the production of milk and milk products both horizontally and vertically in the country, where as relating Ethiopia and other African countries, less in consumption of dairy cow milk products.

In Ethiopia the per capita milk consumption has declined from 26liters/annum in 1980, to 22 liters in 1993, 19 liters in 2008 and 15 liters in 2018. This is likely to be attributed to the mismatch between the growth rate of milk production and human population (Zelalem et al. (2018) and Bingi & Tondel (2017)

However, productivity of dairy animals in general is limited in the region that results in shortage of supply of fluid milk and other dairy products both urban and peril-urban areas of the region. So, this study will help to identify the constraints of adoption of crossbred dairy cows in order to solve the need of milk and its product by increasing mobilization and consulting smallholder farmers (Rarer) on opportunity of technology of crossbreeding that comes for farmers that leads them in gaining milk and its product for their family, and also producing milk for market so as improving their livelihood income in the study area Gendji and Lalo Asabi district. Crossbred cow technology is a potent innovation in the dairy industry in the developing world where a vast majority of producers is smallholders. Having animals with high yielding abilities has a marked impact on smallholder's income and thus their standards of living. In this thesis an attempt will be made to study the variables that effect on time taken for adoption of this technology by the data obtained from selected region of Oromia in western wollega zone in Gendji and Lalo Asabi district that helps in identifying factors that affect adoption of crossbred dairy cows.

1.2 Statement of the problem

Different crop and livestock production technologies have been released from research centers to improve agricultural production and productivity in all over the country. In particular, tremendous efforts have been made to produce and disseminate crossbred dairy cows in the country over the last three decades. Despite these efforts, there have been no or very few studies that addressed the adoption of crossbred dairy cows among farm households in West Wollega zone. Consequently, information on factors affecting adoption of crossbred dairy cows is very scarce as a whole, Different authors conducted their studies on adoption of CBDCs on technology adoption that they are affected by institutional factors, personal and demographic factors as (Tamirat,2015; Melaku,2016)..But as this study from all social variables position of household, and from institutional variables heifer supply and access to animal health is not included. So problems associated with those factors are not sufficient and very small to decide adoption of the technology. Then the researcher tries to fulfill this gap to identify the critical constraints of adoption of CBDCs in the area. Other motivation of researcher for this study also still the population of crossbred and exotic dairy number found in Ethiopia is not more than 1.8% from the total dairy found in Ethiopia (Zelalem et al. (2018) and Bingi et al.(2017) and also from proposed study areas, as record data gained from both woreda agricultural bureau, it shows that number of improved dairies from total dairy is still less than 1% that initiate the researcher to plan standing in those districts. So, in the study area, dairy farming is important and highly valued due to the reason for small land holding size, that diversifies farmers to engage in crop-livestock integrated mixed farming system. Although efforts have been made, the supply of dairy product including milk is not still satisfactory as compared to the prevailing demand, CSA (2016/17). Because there is no sufficient current information in the study area on factors influencing the overall adoption of dairy technologies, the characterization of dairy technology supply and level use by small holder farmers; and the influences of dairy technology adoption on household is not correctly known in the area. The adoption of dairy technologies by farm households varies widely across different agro-ecologies and within the same agro-ecology based on various technical and non-technical determinant factors (Dehinenet et.al., 2014). Due to its multi dimensional importance, it is essential to assess these to full fill the information gap, and that lesson can

be learnt for future improvement of intervention in the sector. So this study will therefore, inmate to examine factors influencing the adoption of crossbred dairy cows by smallholder farmers in west wollega zone in both Gendji and Lalo Asabi districts by identifying the constraints that hinders them in adopting crossbred dairy cows by searching the studied area's problems on not adopting this technology were identified by researcher's full study. This will support policy makers, extension and farmers to make informed decisions and use this breeding strategy as sustainable development tool. In general, this area of interest has been widely neglected with the exception of a very small number of studies

1.3 General objectives

To study the adoption of crossbred dairy cows in Oromia regional state west Wollega zone Gendji and Lalo Asabi districts.

1.3.1 Specific Objectives.

1. To access factors influencing adoption of dairy production technologies in the area.
2.To analyze the rate of adoption of dairy production technologies in the study area.

1.4. Research Questions.

The study result can answer the following question; -

1. What factors influences adoption of crossbred dairy technologies in the study area?
2.. What is the rate of adoption of crossbred dairy cows in the study area?

1.5 Significance of the Study

This paper will generate information on adverse set of factors that influence the adoption of CBDCSs in the study area. It also generates information about how widely CBDCs are adopted in the area. So the information generated by this study would help in designing appropriate policy and extension services directed at fostering the adoption of the technology by farm households of Oromia regional state west Wollega zone in Gendji and Lalo Asabi district in three and two representative kebeles respectively.

1.6. Scope and Limitation of the Study

This study was limited to assess factor affecting adoption of dairy technology in west wollega zone in case of Gendji and Lalo Asabi district. From Gendji district (Busano Sicho, Busano Bolo,and Gandji Badiya kebeles) and from Lalo Asabi district (Warego Arsema and Nano Inango kebeles.) by surveying sample of 138 households from the total of 808 local and crossbred smallholder dairy farmers from five kebeles. The survey was based on questionnaires' that include socio economic, institutional and demographic factors that can be related variables of the households to get information patients to the research problem,

Furthermore, this collected survey data were a one-time data for the area, even also there is scarce on resource at this survey time, so this might not be enough to generate adequate information because there could be other variables which could be changed from one survey time to another within a given locality based on the type of survey used and other reasons. Even though there is presence of those factors in this study the researcher tries to tolerate the limitation and try to identify the gaps that hinders the local studied society for not adopting this technology depending on survey done from sample households which can be their best bench mark on adopting this technology in the future.

1.7. Organization of the Study

This research paper is organized in to five chapters. Chapter one deals with background, problem statement, objective and significance of the study. Chapter two contains the literature review part. Chapter three and four deal with the methodology, results and discussion of the research, respectively. Finally, chapter five presents conclusion, recommendation and policy implications for the study.

CHAPTER 2 LITRATURE REVIEW

2.1 Production of dairy in worldwide and Ethiopian context.

Worldwide FAO and IFCN (2018) estimate that globally there are about 112 million dairy farms keeping cattle and/or buffalo. Sixty-five percent of these, that is 73 million farms, are located in South Asia. Eastern Europe and Central Asia and Sub-Saharan Africa follow with an estimated 16 and 13 million dairy farms respectively. In each of the remaining world regions, which comprise high-income countries, the Middle East and North Africa, and East Asia and the Pacific, there are between 1 and 3 million dairy farms. Globally, the average dairy herd consists of three adult female cattle/buffalo with large regional differences. In South Asia, the average dairy herd size is less than two dairy animals. In sub Saharan Africa, North Africa and the Middle East, and Eastern Europe and Central Asia it is between 2 and 4 animals. In East Asia and the Pacific, a typical dairy farm raises about 9 dairy animals while in Latin America and the Caribbean this number rises to 15 and to over 42 in high-income countries. FAO and IFCN estimates on the number of dairy farms rely upon official statistics from 57 countries assembled by FAO's World Programmed for the Census of Agriculture and by IFCN. For these countries statistics were available both on the number of cattle/buffalo farms and the number of dairy farms. To generate an estimate of the number of dairy farms by region and for the world, FAO and IFCN calculated the regional shares of cattle and buffalo farms keeping dairy animals in the 57 sample countries, representing 28 and 72 percent of all world's countries and rural populations respectively, and applied these shares to the number of cattle/buffalo farms from Census data for countries lacking information on the number of dairy farms. The year of reference varied by country and is that of the most recent Census of Agriculture A large body of literature promotes dairy development as promising avenue for poverty reduction by adopting productive crossbred dairy cows FAO (2010).Thus, to strengthen the case for dairy development as a path for poverty reduction, the prime objective of this review of the literature was to compile and assess the evidence of factors that hinders adoption of productive and selected exotic dairy cows those helps in transforming production of milk in supporting the livelihood of smallholder farmers..

On milk consumption and nutrition three studies assessed the impacts of dairy cow ownership on household nutrition. Ownership of dairy cattle consistently resulted in an increase in household milk consumption (from a low base). All studies report a substantial increase in milk consumption (Jodlowski et al., 2016; Nicholson et al..,2005; Rawlins et al., 2013) lso assessed the impact of dairy cow ownership on total dietary composition. All studies found a statistically significant increase in the number of food groups consumed over the past week. Rawlins et al. (2013) also found increases in height-for-age z-scores of about 0.5 standard deviations among children in households that received dairy cows.

Similar findings are reported from Ethiopia by Hoddinott et al. (2014), where cow ownership raised children's milk consumption, increased linear growth and reduced child stunting by 7-9% points. These studies support the notion that livestock ownership in developing countries may significantly improve nutrition outcomes. As reported by Rao et al., (2015), the investment of dairy income into other activities is likely to be one of the underlying reasons why the difference in total income. As cited by in Ethiopia, because of the use of indigenous dairy cattle, production of milk and per capita share/person are not much each other. In Ethiopia currently the national average milk yield/cow/day is 1.35 liters for indigenous cows and the per-capita milk consumption in the country is about 19.24 kg/year respectively (CSA, 2014/2015; MOA, 2012). According to the report of the CSA (2010) the indigenous cattle breeds accounted for 99.1%, while the hybrids and pure exotic breeds accounted for about 0.72% and 0.09%, respectively. Despite its large livestock resources base and an ecological setting suitable for dairy production, it is not yet self-sufficient in milk production.

2.2 Concerts of crossbreds cows under different conditions

Multiple studies have investigated the differences in performance level between pure and crossbred animals, considering various environments, strategies, and, of course, breeds and species (Madalena *et al*., 2012; Galukande *et al*., 2013). The outcomes of those studies have generally underlined the following elements:

Crossbreeding between local and improved genetic resources allows, in a favorable environment, an improvement of performance of production traits such as growth or milk production. For instance, the meta-analysis performed by (Galukande *et al*.,2013) on 23 studies comparing local breed (*Bosindicus*) performance with *Bos Taurus* crossbred animals (under tropics) showed that individuals with 50% *Bos Taurus* showed on average 2.6, 2.4 and

2.2 times higher milk yield than local animals in highland, tropical wet and dry, and semi-arid climatic zones, respectively. In parallel, fitness traits of crossbred animals are usually deteriorated in comparison with local individuals. For example, a recent study on African Shorthorn Zebu in Kenya linked the level of introgression from European breeds (determined with genome-wide single-nucleotide polymorphism data) to increased vulnerability to infectious diseases (Murray *et al*., 2013) In general, studies have reported greater performance for F1 crosses in comparison with F2, underlining the importance of the global heterosis effect (Madalena *et al*., 2012; Galukande *et al*., 2013).

2.3 Fiscal influence of crossbreeding

The potential impacts of crossbreeding may also be considered on levels beyond the farm, such as for the local community or even on national basis. Increased production and commercialization of agricultural activities is likely to contribute to economic growth of developing countries, especially for milk and meat, given their increasing demand. The economic profitability differs between dairy systems, with their continuous flow of income, and meat systems, with irregular sales. In East Africa, national economic development goals have led the dairy industry (including smallholders) to rely more on crossbreds and improved dairy cattle to increase milk production (Makoni *et al*., 2013). In Ethiopia, a recent survey of Roschinsky *et al*.. (2015) showed that depending on the context, income improvement could be the main motivation for dairy cattle smallholders to adopt and maintain crossbreeding.

Although meat production at farm and national levels increased with crossbreeding, farmer income generation was negatively affected and environmental performance not improved (Widi, 2015).For proper consideration of economic issues, it appears important to differentiate resource-driven systems (i.e. subsidence production systems limited by global input) from demand-driven ones (systems in which production can be adapted to fulfill the demand through output increase and technological improvement). As an example, in Vietnam, Lemke *et al*. (2007) indicated that the use of improved crossed genotypes allowed for increased revenue, but demanded resources that could not be sustained in resource-driven pig systems.

Therefore, the general recommendation is the use of indigenous livestock in resource-driven systems and of improved animals (crossbred or exotic) in demand-driven systems (Lemke *et al*., 2007).

2.4 Definition of Dairy

Dairy products are mass produced and ingredients in any different foods. A simple definition of Dairy, is any foods made from the milk products of animals, or produced in the mammary glands. The most common of dairy products comes from Cows, they are often the prime producer of Dairy products, their milk also used in the production of creams, cheeses and desserts. Dairy products are not mutually exclusive to Cows though, we also take milk from Goats and Sheep, in other countries you will also find use from many other mammals. Even though we do class the sap from tree's as "milk", this is very high in proteins and is not counted under the same group.

2.5 Dairy Production Systems

Similar to most dairy systems found in the tropics, dairy production system in Ethiopia ranges from small to large-size farms. Four major systems of milk production can be distinguished in Ethiopia.

These are Pastoralist, rural highland Small Holder, Urban and peril urban (small and medium dairy farms backyards in and around towns and cities) and Intensive dairy farming. Dairy production is an important component of livestock farming in Ethiopia. The huge and diverse livestock population, diverse and favorable agro-ecology for dairying, increasing demand for dairy products in urban and peril-urban areas, long-standing culture of dairy products consumption, and favorable policy are indicators of the importance and potential of dairying in the country.

However, the level of production and productivity of dairy animals is limited mainly due to low genetic performance of local breeds. This resulted in shortage of dairy products supply, which necessitated the country to spend hard currency to import dairy products from abroad (Azage et al., 2013) Introduction of high yielding crossbred s dairy breeds (mainly Hole stain and Jersey) from abroad and crossbreeding with locally adapted indigenous cattle has been followed to boost milk production in the country (Emebet et al, 2010).

2.5.1. Rural Highland Dairy Production System.

The Ethiopian highlands possess a high potential for dairy development. In the highland areas agricultural production system is predominantly substance smallholder mixed farming, with crop and livestock husbandry typically practiced within the same management unit.

In this farming system all the feed requirement is derived from native pasture and a balance comes from crop residues and stub grazing. The majority of milking cows are indigenous animals which have low production performance with the average age at first calving is 53 months and average calving intervals is 25 months. Cows had three to four calves before leaving the herd at 11-13 years of age, the average caw lactation yield is 524 liters for 239 days of which 238 liters is off take for human use while 286 liters is suckled by the calf (Zegeye, 2009).

This system predominantly exists in the highland agro-ecological zone, where the climate favors both crop cultivation and livestock rearing as complementary enterprises. In this system, all major types of farm animals except camels are found and farmers usually prefer to keep mixtures of farm animal Species. Around 88% of the human population, 70% of cattle and sheep 30% of goats and 80% of equines are found in this agro-ecology (Alemayehu,2004). The principal objective why farmers engaged in mixed farming in highlands is, to gain complementary benefit from an optimum mixture of crop and livestock farming and spreading income and avoiding risks over both crop and livestock production.

2.5.2. Urban and Peril-Urban Dairy Production System

Such a system is considered as subsistent with little or no market direction. As a result, most of the milk produced retained for household consumption. Typically, the farmers put milk and milk products for sale after the household demand is being satisfied (Zegeye, 2009)

The highlands are more densely populated and subjected to more overgrazing and natural resource degradation than the lowlands. This system is characterized by land scarcity and the major livestock feed resources include grazing on marginal lands, crop outcome, and crop residues. Moreover, dung is an important source of fuel in this system.

The smallholder farmers in this system dominantly raise indigenous zebu cattle breeds. However, some farmers located near urban centers and that having access to milk markets for selling surplus milk those own crossbred cattle. Urban dairy systems in general are located in cities and/or towards focuses on production and sale of fluid milk, with little or no land resources, using the available human and capital resources mostly for specialized dairy production under stall feeding conditions. (Zegeye et al.,2013).

The main feed resources are agro-industrial byproducts and purchased roughages. As compared to other systems they have relatively better access to inputs (e.g. feeds) and services (e.g. artificial insemination) provided by the public and private sectors, and use intensive Management (Azage et e al., 2013).

Peril-urban milk production is developed in areas where the population density is high and agricultural land is shrinking due to urbanization around big cities and other regional towns. In this system crossbred animals ranging from F1 (50%) up to animals with a higher blood level of exotic breeds (mainly Holstein Friesian) are kept in small to medium-sized farms (Yitaye, 2015)

Peril-urban dairy system has relatively better access to urban centers in which dairy products are highly demanded. The main source of feed for the production system is both own farm produced and purchased concentrate and hay and the primary objective is to get additional cash income from sales of milk and milk product.

The per-urban milk system includes smallholder and commercial dairy farmers in the proximity of Addis Ababa and other regional towns. This sector owns most of the country's improved dairy stock (Tsehay. 2014)

This production system is now expanding in the highlands among mixed crop–livestock farmers, such as those found in Selale and Holeta, and serves as the major milk supplier to the urban market (GebreWold et al,2012). The system comprises small and medium size dairy farms located mainly in the highlands of Ethiopia. Farmers use all or part of their land for home grown feeds.

2.5.3. Intensive Dairy Farming

This is a more specialized dairy farming practiced by state sector and very few individuals on commercial basis. Most of the intensive dairy farms are concentrated in and around Addis Ababa and are basically based on exotic pure bred stock. The urban, peril-urban and intensive dairy farmers are produce 2% of the total milk production of the country. (Felleke & Geda, 2013) and most regional towns and districts (Nigussie, 2014)

2.6 Empirical studies on technology adoption

Several empirical studies have been carried out to investigate the factors that determine agricultural technology adoption (Katungi and Akankwasa,2010; Akuduguet al., 2012; Loevinsohnet al., 2012)The farmers' decisions about whether and how to adopt new technology are conditioned by the dynamic interaction between characteristics of the technology itself and the array of conditions and circumstances (Loevinsohnet al., 2012). Therefore, factors affecting adoption of innovative technologies were classified into different categories: Economic, social and institutional factors. The probability of dairy technology adoption and its intensity associated negatively and significantly with age of household heads This finding is in line with (Quddus,2013) report which stated that the probability of adoption decreased with the increase of age of household heads. It could be hypothesized that more educated and younger farmers are more ready to try the dairy technology but older farmers may be more conservative to participate in the new technology dissemination process and practices. But both family size and farming experience had positive and significant association with the probability of dairy technology adoption. This finding is also in line with the same author (Quddus,2013) which stated that adoption of dairy technology is positively associated with level of farmer's education and farming experience; household income and earning members. Household with large family size could have a high probability of dairy technology adoption which is similar with the finding of Howley, et al. (2012). As per the later, farmers with children were much more likely to use AI in a given period.

This justifies that dairy technology needs more labor, hence having more family size could alleviate labor scarcity that constitute one of the limitations for technology uptake. Mignouna et al., (2011) also considered household size as an adoption process in that, a larger household have the capacity to relax the labor constraints required during introduction of

modern technology The probability of dairy technology adoption and level of use increased with the increase of farmer`s farming experience. Practices and experiences lead the farmers to have a better knowhow to handle technologies and understand their benefits easily. Availability of dairy production extension services was positively associated with farmer`s probability of dairy technology adoption and use level. This result is in agreement with the finding of Amelaku, et al.. (2012). The later reported that the probability of adopting dairy technology increases by 43% for at least a onetime visit by the extension service per year. This implies that farmers that have access to extension services could get good information about the technologies that result in a high probability of adoption. Availability of cross breed cows and accessibility of saving institutions were also positively associated with farmer`s likelihood to adopt dairy technology and level of adoption. As the technology is available in the areas the probability of adopting the technology increases. This is because it reduces the transport cost and farmers may learn more about the technology by observing which initiate them to adopt. This is consistent with the report of Akudugu et al.. (2012). As per the later, the availability of modern agricultural production technologies to end users, and the capacities of end users to adopt and utilize these technologies are critical. Having access to formal (bank and microfinance) and informal (Iquib) saving institutions create a good opportunity for farmers to have an asset and to purchase different agricultural technologies including cross breed cows.

Muzari et al. (2012) stated that the major option for increased adoption of technology is to overcome the income/ capital constraint through increased credit provision. The availability of livestock training also increases the level of dairy technology adoption through creating awareness on the advantages of the technology and then improving the farm management skill. Therefore, farmers in the areas of training availability could adopt more and owned more dairy technology than non-training areas` farmers. Katungi & Akankwasa (2010) found that farmers who participated more in community-based organizations were likely to engage in social learning about the technology hence raising their likelihood to adopt the technologies.

This is in agreement with Quddus, (2013) report that indicated more knowledge on improved technologies through training, availability of reliable and continuous technical

assistance, availability and low price of concentrate feeds, increased and timely provision of medicine, increasing AI facilities, providing pure breed and strengthening extension services as the main suggestions from farmers.

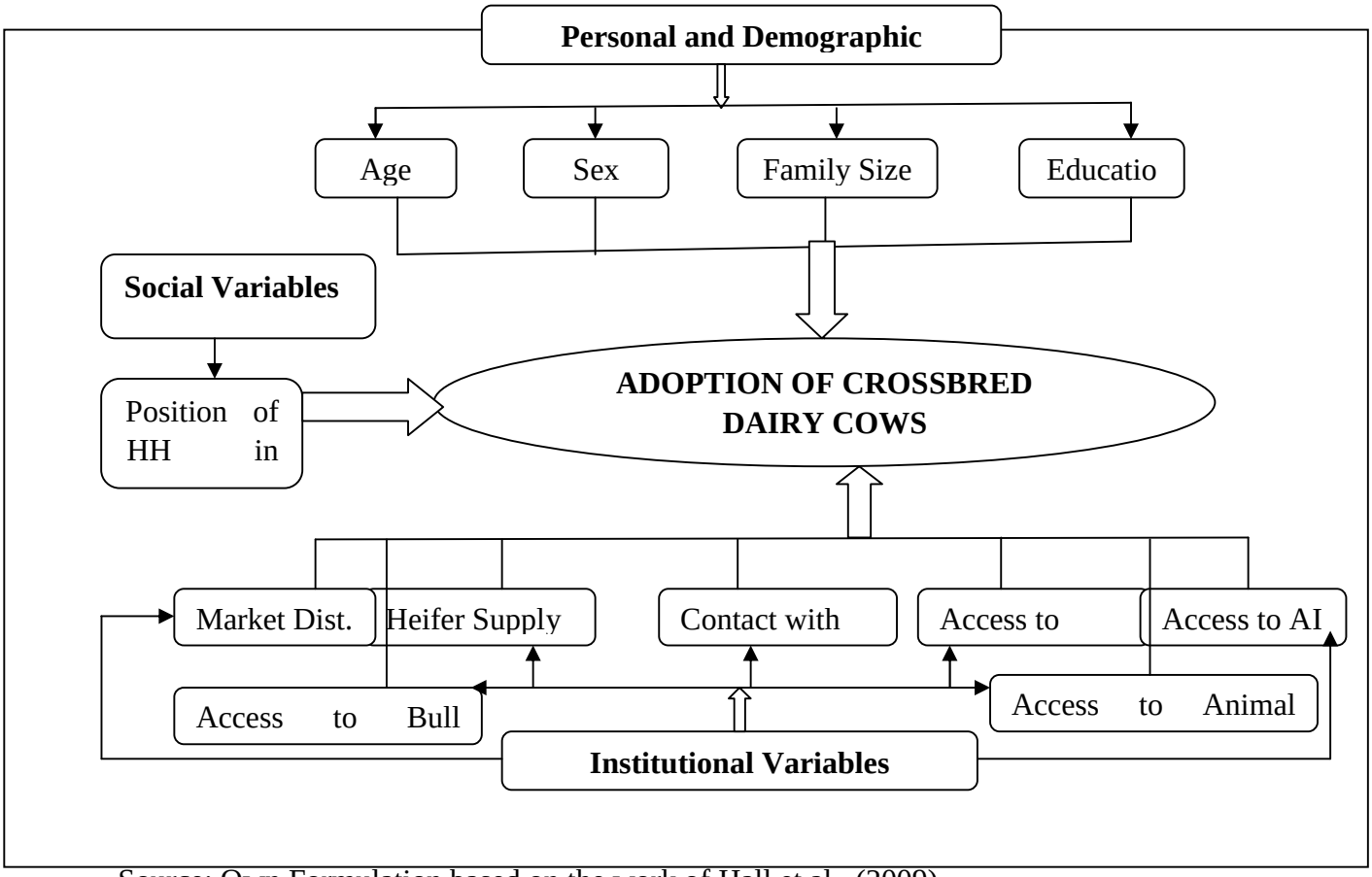
2.7 What is rate of adoption?

Identifying the rate of adoption is one of the objectives and research question which must be answered by this study. First it is better to know what the rate of adoption mean? The rate of adoption is the pace at which a new technology is acquired and used by the public. This can be represented by the number of a society who start using a new technology or innovation during a specific period of time. The rate of adoption is a relative measure, meaning that the rate of adoption of one group is compared to the another, often of the entire society.

Attributes of an innovation that affect the rate of adoption includes the advantage created by adopting the innovation can be adopted in to daily life, the ability of other members of society to see those who have already adopted the innovation and the expenses associated with trying the innovation. The adoption rate is part of the diffusion of innovation theory which seeks to explain how the use of new technologies, process and innovation spreads through a society, and why they are adopted over old methods. One measure factors that influence the rate of adoption is the type of society that is being introduced to an innovation, as closed societies and society without clear communication between adopters and non-adopters are less likely to take on a new technology. (https//wwwinvestopedia com,(searched on May 13/2019).

2.7. Conceptual Framework of the Study.

The conceptual framework of this study was discussed and as revealed below based on the assumption that dairy technology adoption and variables that determines adoption of crossbred dairy cows on farm household in west Wollega zone in Gendji and Lalo Asabi districts.



Source: Own Formulation based on the work of Hall et al., (2009)

CHAPTER THREE RESEARCH METHODOLOGY

3.1 The Study Area

This study focused in Oromia regional state west Wollega zone in case of **Gendji** and **Lalo Asabi** district. Two of the district is from among twenty districts those are found in west wollega zone. zonal town Gimbi is located at a distance of 446 km to the west direction from Addis Ababa (capital city of Ethiopia.)

Lalo Asabi: - is found at distance of 23 km to west of Gimbi through Dambi Dollo asphalt road. Have total land area of 43.35km^2, population of the district is 93380, of these male, 45,807 and Female 47,573. High, medium low temperature of the area ranges between $21^{0c}$to,$3o^{0c}$.

Rainy season starts at early March-September having average Rainfall that ranges between 1250-1700 mm. Total livestock of the area (cattle and shoot) is 57,974, Equine 5,490, totally 63,465 and poultry 88,842. A mixed farming system consisting of crop and livestock production was practiced. Crop production is mainly practiced under rain-fed conditions. According to information obtained from district agricultural office, account for 40% of the land covered by cereal crops. The major crops grown and average yields in the district are maize 40ku/hr sorghum 20ku/hr and teff 6ku/hr, and the rest 50% of their land is coffee and its yield is 7ku/hr, and the remaining land of the area is grass land and scattered agricultural crops. Farmers in the district are familiar with the use of agricultural inputs that helps them for improvement of productivity of their cereal crops mentioned above.

District has good ecology for honey production due to the presence of coffee production land that saves natural and man-made forests which is used for beekeeping activities (Data compiled in the woreda agricultural office 2017)

Gandji district is found at 70 km to south west of Gimbi. Have a total land area of 37.49$km^{2,\ total}$ population of 76,691. of which Male is 41,472 Female 35,219 in both urban and rural. Farmers households head Male 7,652 Female 984, total 8,636.

Temperature of the district ranges16oc to 25oc. Rainy season starts at half of march and ends at September last having Rainfall ranges between 1000-1500mm..total livestock population of the district is cattle 53,449 Sheep and Goats 23,301 Equine 9,700, poultry 110,700. In Gendji woreda there is also a mixed farming system consisting of crop and

livestock production. Crop production is mainly practiced under rain-fed condition and some irrigation lands for off season agricultural practices. According to information obtained from the district agricultural office, account for 30% of the land covered by cereal crops. Farmers in the district are familiar with the use of agricultural inputs, the major crops grown and average yields in the district are maize 45ku/hr sorghum 24ku/hr, and fingermilet 14ku/hr, and the rest 60% of their land is coffee and its yield's 8ku/hr, and the remaining land of the area is grass land and scattered diff types of different agricultural crops. This district also has good ecology for honey production due to the presence of coffee production land that saves natural and man-made forests which is used for beekeeping activities (Data compiled in the woreda agricultural office 2018)

3.2 Sampling Procedure and sample size

A sample is a representative portion of an entire population under study. The portion is also expected to fully represent the characteristics of the entire population and free of bias thus reducing sampling variability.

Sampling is a process of choosing the units of the target population which are included in the study. This is normally done because a complete coverage of the population is not practically possible observed that due to limitations in time, resources and energy, a study can be carried out from carefully selected sample to represent the entire population. The study applied the formula to come up with a sample size. According to (Cochrn1963). This formula gives a derivation of a constant N which is adjusted depending on the target population due to limited number of adopted crossbred dairy cows in the study area selected by researchers.

The study then applied simple random sampling to come up with the right interval on which the respondents were randomly picked. The researcher used random sampling to select one from Livestock Production and one member from CBDCS adopters were informants of the Key stakeholders. Random sampling allows a researcher to use cases that have the required information with respect to the objectives of the study.

The study used Cochran formula to calculate the sample size based on the sample for proportions due to limited numbers of CBDCs from all dairy farmers

$$n = \frac{Z^2 PQ}{E^2}$$

Where: n = the desired sample size

Z = the value corresponding to the level of confidence required (in this case 1.96corresponding to 95% level of confidence)

P = estimated level of an attribute that is present in the population (0.1 variability) Q=estimated level of the attribute that is not present in the population (0.9) E=desired level of precision (in this case 5%).

The adjusted minimum sample size was collaborated by use of the formula for correlation for finite populations. This was computed as:

$$\frac{1.96^2 * 0.9 * 0.1}{0.05^2} = 138$$

Table 3. 1.Sample Size identification**.**

No	Name of Woreda	Name of PA	Total dairy farmers	Crossbred farmers.		Local breed farmers (non participant)		Total sample size
				Total farmers of CBCs	Sample taken			
1	Gendji	Sichoo	184	56	9	128	22	31
		Bollo	112	32	6	80	14	20
		G/Badiya	146	44	7	102	17	24
2	L/Asabi	W/Arsema	148	29	5	119	20	25
		N/Inango	218	79	13	139	25	38
	Total		808	240	40	568	98	138

(Source Gendji and Lalo Asabi agricultural office & own sampling methods)

In this study the researcher uses multistage stratified random sampling procedure. At first, two woredas are randomly selected from twenty woredas of Western Wollega zone. In second stage three kebeles are randomly selected from eighteen kebeles of Gendji woreda and two kebeles also randomly selected from twenty-three kebeles of Lalo Asabi woreda due to their relatively similar potential in starting this technology in both district. After this, data of users and non-users are taken from five kebeles of DA's office and households are randomly selected by using simple random sampling and they are stratified in to users and non-users**.**

3.3. Data Collection Procedure

The data upon which this study was based were collected through structured farm HH survey conducted in the five PAs, namely Sicho, Bolo and Gendji Badiya from **Gendji** district and W/Arsema and Nano Inango from **Lalo Asabi.** Conducted from March to April 2019.Prior to the household survey, five enumerators were selected through the two woredas' agricultural office. All of the enumerators were selected from both district (five DAs) from those five selected kebeles', those DAs have previous experience in conducting farm household surveys within the kebeles in the study woredas. In addition, after the selection done, for all enumerators given intensive three-day training on data collection procedures.

The research questionnaire was pre-tested using a pilot sample of 5 farmers who were not part of the study sample. During the interview process, the household members were volunteer to discuss among themselves on critical value estimates, such as yield, incomes, and expenditures. The presence of family members helped not only in making the heads comfortable during the interview, but also in enhancing their recall capacity and making them reach consensuses on answering questions related to land holding, area cultivated, income and other economic related questions. It is believed that this process plays a role in minimizing biases that could have been caused by either overestimation or underestimation of values of sensitive economic variables

3.5 Methods of Data Analysis

The farm survey data were analyzed using both descriptive and econometric procedures of data processing. Descriptive statistics, like mean, standard deviation (S.D), frequencies, ratios, percentages, and tabular analysis were used to examine and understand the socioeconomic situations of sample respondents. The core aim of this investigation is to understand the adoption stage of crossbred dairy cows and constraints to adopt this technology by farm households in the study area. The variable representing adoption of the technology is a dummy variable that takes a value of one for adopter or zero for non-adopter depending on whether or not a sample farmer has owned crossbred dairy cow during the survey period. This binary variable is related to several sets of factors (continuous and/or dummies) that are believed to influence adoption decision of the technology. Literature on

technology adoption indicates that for such type of dependent variable, the most commonly used response models are the logit and probit models. The logit model, a logistic distribution function, and the probit model, a normal distribution function, are used in estimating the probability of technology adoption. Whether or not a farmer adopted a new technology assumes a yes or no answers, a typical case of dichotomous variable. For such type of response, a discrete model is a popular tool of analysis. In this model, the dependent variable is a binary assuming two values, 0 and 1.

Hence, for a farmer who uses the crossbred dairy the value (y=1) and for a farmer who does not adopt, a value (y=0) will be assign. Several models such as simple correlation, linear probability function, etc., can use to analyze adoption behavior of farmers, but these models have limitations in that the t-ratios are incorrect, exhibit hetero scedasticity, non-normality, their estimated probabilities (Pi) may be greater than one or below zero, and assume Pi increases linearly with (Gujarati et al., 1995). The logit and probit models overcome these problems since both are based on a cumulative distribution function. For the study, however, the researcher select the logit model for the following reasons:

1) Probit and logit models are nonlinear (in the parameters) statistical models that achieve the objective of relating the choice probability Pi, to explanatory factors in such a way that the probability remains in the (0,1) interval (Griffiths, 1993).

2)The logistic function represents a close approximation to the cumulative normal and is simpler to work with. The close similarity between the logit and probit models is confined to dichotomous dependent variables and;

3) In many cases logistic regression is preferred to the probit due to its link to other models such as linear probability model, and its simpler interpretability as the logarithm of the odds ratio.

Following (Gujarati, D.N.1995)) the logistic distribution for the adoption of crossbred dairy cows can be specified as:

$$P_i = \frac{1}{(1+e^{-z_i})} \quad (1)$$

where `P_i is the probability of adoption of crossbred technology for the i^{th} farmer, e represents the base of natural logarithms and z_i is the function of a vector of n explanatory variables (X's) which is an underlying and unobservable index for thei^{th}armer (when z_i exceeds some threshold level the farmer is observed to be an adopter; otherwise he is a no adopter when z_i falls below the dawn value), and expressed as

$Z_i = \alpha + \sum \beta_i X 2)$

α is intercept, βi is a vector of mysterious slope coefficients and $x_1, x_2, --x_n$ represent the n explanatory variables.

The logit model assumes that the underlying stimulus index (z_i) is a random variable which predicts the probability of adoption of crossbred dairy cows. The slope tells how the log-odds in favor of adopting crossbred dairy practices change as independent variables change.

One way of approaching the (0, 1) constraint problem that is imposed on the probability is to transform P to eliminate one or both constraints ((Aldrich and Nelson, 1984)) in a ratio form.

If P_i is the probability of adopting the crossbred dairy cows, then 1-P_i represents the probability of not adopting and can be written as: -

$$P_i = \frac{1}{(1+e^{-z_i})} \quad (4)$$

whereP_i is the probability of adoption of CBDCs technology for the ith farmer, e represents the base of natural logarithms and Zi is the function of a vector of n explanatory variables (X's) which is an underlying and unobservable index for the ith farmer (when Zi exceeds some threshold level (Z*), the farmer is observed to be an adopter; otherwise he is a non-adopter when Zi falls below the threshold value), and expressed as

$$Z_i = \alpha + \sum \beta_i X_i \quad (5)$$

α is intercept, β_i is a vector of unknown slope coefficients and X1, X2,--Xn represent the n explanatory variables.

The logit model assumes that the underlying stimulus index (Zi) was a random variable which predicts the probability of adoption of CBDCs. The slope tells how the log-odds in favor of adopting CBDCs practices change as independent variables change. One way of

approaching the (0, 1) constraint problem that is imposed on the probability is to transform P to eliminate one or both constraints (Aldric & Nelson, 1984) in a ratio form.

If P_i is the probability of adopting the CBDCs, then 1- $P_i$represents the probability of not adopting and can be written as

$$1-P_i = 1 - \frac{1}{(1+e^{-Z_i})} = \frac{e^{-Z_i}}{(1+e^{-Z_i})} = \frac{1}{1+e^{Z_i}} \quad (6)$$

Dividing equation (1) by equation (4) and simplifying gives

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{(1+e^{-Z_i})} = e^{Z_i} \quad (7)$$

Equation (5) shows the odds ratio, which defines the probability of adoption relative to non-adoption. Finally, the logit model is obtained by taking the logarithm of equation (5) as follows

$$L_t = L_n\left(\frac{P_i}{1-P_i}\right) = \text{Ln}(e^{\beta_o+\sum_{j-i}^{n}\beta_o X_j}) = Z_i = \beta_o + \sum_{j-i}^{n}\beta_j x_{ji} \quad (8)$$

Where, L_i is log of the odds ratio in favor of CBDCs adoption, which is not only linear inX_j, but also linear in the parameters. Thus, if the stochastic disturbance term, (U_i), is introduced, the logit model becomes:

$$Z_i = \beta_o + \beta_1 X_{1i}\beta_2 X_{2i} + \ldots\ldots + \beta_n + U_i \quad (9)$$

Marginal effect was the partial derivative, also referred to as the marginal or instantaneous effect, equals; ∂p/∂xk =bk*p*(1-p)

After having the significant factors influencing the adoption decision of farmers, it was appropriate to understand the relative importance of these factors. This can be measure by examining elasticity of variable, as the percentage change in probabilities that result from a percentage change in the value of these variables. One way to do this is to select interesting values of the exogenous variables and compute the associate with P_i, vary the X_j of interest by some small amount and re-compute theP_i, and then measure the rate of change as dP_i/dX_j, where d$X_j$and d$P_i$stand for percentage changes in the continuous explanatory variable (X_j) and in the associated probability levels (P_i), respectively . When d$X_j$is very small, this rate of change is simply the derivative of $P_i$with respect to $X_j$and is expressed as follows (Aldrich and Nelson, 1985)

$$\frac{dP_i}{dX_j} = \frac{e^{Z_i}}{(1+e^{Z_i})^2}\hat{\beta}_j = P_i(1 - P_i)\hat{\beta}_j \quad (10)$$

3.4. Definition of Variable Measurement and Formulation of Hypothesis

Gender of the household

This variable is dummy variable taking value of 1 if the sex of the house hold head is female or 0 if sex of the house hold head is male. This variable is found that as the probability of participating in adoption of CBDCs' practice can be higher for male headed house hold as compared to female headed households as sources from different studies indicate that since CBD cows' management and also its running cost may be hard on having expenditure cost due to the pressure of male on administrating income of family.(Muhammad et al.,2013).Therefore, this hypothesis expect that house hold head female will be low probability of participating on CBDCS'.

Age of Household Head:

-Age is a continuous variable measured in years. It is one of the factors that determine participation of new technology. Thus, younger farmers are advances and be more willing to adopt a new technology and other related studies stated that young head of households is stronger and is expected to adopt CBCS' than old heads. Hence, the expected effect of age on young household adoption could be positive. Qudus (2013) and Dehinenet et.al.,(2014) stated that the probability of adoption decreased with the increase of age of household.

Educational Level of Household Head:

It is a continuous variable measured in formal schooling years completed by the household head. Education is expected to have a positive effect on participation of CBCS' status. Households with good educational level is believed to have a chance to apply scientific knowledge and better manage their technology adoption activities in good manner, in other way due to the knowledge on the technologies they can get from education or by reading or utilizing the social medias (Afework & Lemay, 2015), so It was expected that education has positive contribution on CBCS' user.

Family size:

Family size is a quantitative variable measured in numbers of persons included in the household. Evidences show that the farmers with higher family size is found positive on participating in adopting of CBCS' practice more than those with lower family size (Hadush,2014) This may be the case when the family members have enough labor force in managing CBCS'. This will reduce the cost incurred in hiring external labor. This means that the higher the family size of the household, the higher the probability of participation in adoption of CBCS'.

Access to Credit: -

was a dummy variable that takes the value 1 when the household takes loan and 0 otherwise. Access to credit (use) by different researchers was found affecting the adoption of CBCS' practice decision of the farmers positively (Muhammad et al., & Sit hole et al., 2013,2014) The farmers having access to credit are able to buy crossbreeding heifer and necessary inputs than those who do not have credit access. Therefore, this variable was hypothesized to affect participation decision and intensity of participation on adopting on CBCS's positively.

Market distance:

This variable is continuous variable measured in terms of walking hours on foot. It is found by different scholars as it hinders participation on adopting (Kinfe et.al.,2012). This factor leads to the higher cost for the farmers to buy and sell (input and output). Therefore, this variable is hypothesized to influence participation on crossbred dairy cows' negatively.

Access to artificial insemination service.

It is a dummy variable, which shows farm HHs accessibility to this service. It takes the value of 1 if the farmer has access to the service or 0 otherwise. Crossbred cows are expensive to buy for smallholder farmers. Provision of AI service is considered to be the best way of extending CBDCs and expected to determine the success of the technology. Access to AI service is, thus, hypothesized to be positively related with the farmers' adoption decision of CBDCs. Muhammad et al., (2013) &Sit hole et al.,(2014)

Access to bull services (ATBUSR):

Availability of bull service is the best way of extending CBDCs in the rural area where there is no accessibility of road for AI service provision. The availability of this service determines

the success of technology under discussion. Thus, in this study, bull service is hypothesized to influence adoption of CBDCs positively. (Hadush, 2014)

Heifer access

Heifer availability and potential to use is among the factors influencing adoption. Availability of selected dairy heifer is very important in dairy cows rearing Timeliness and availability of heifer in the market facilitate the adoption rates and intensive use of dairy technologies and hence intensity of adoption decision would be significantly and positively related with selected heifer access. It is measured as a dummy variable as if heifer is available for a farmer a value of one and zero otherwise. Consequently, availability of exotic heifer**s** assumed to influence adoption positively. Access to heifer was, thus, hypothesized to be positively related to adoption of dairy technologies. (Afework & Lemay, 2015),

Access to animal health service: -

Animal health service is the base and necessary for controlling of disease and to reduce animal death to control the risk of the farmer, so the presence of the service positively affect the adoption of CBCS'. Qudus (2013)

Position of HH in Organization

This is a farm HH's leadership position in the community-based organizations. It is a dummy variable and assumed that those farmers who have some position in PA and service cooperatives are more likely to be aware of new practices as they are easily exposed to information. It is, therefore, hypothesized that those farmers who participated in some social organizational leadership are more likely expected to adopt. Muhammad et al.,(2013).

Extension Contact

This is also continuous variable indicating HHs contact with development agent (DA) within a month. It takes the value 1,2,3 or more days a farmer has contact with DAs within a month. In most adoption literature, agricultural extension has positive correlation with adoption decision. It is believed to be the main source of information, knowledge, and advice to smallholder farmers in the country. Contact with extension agent, thus, gives the farmer access to information and it is hypothesized to increase the probability of farmers' adoption of CBDCs. Dehinenet et.al.,(2014

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter is subdivided into three sub-sections. The first part presents the descriptive statistics on the demographic and socio-economic characteristics of the sampled households, the second part result of econometric model analysis, the third section presents the results and discussion on the adoption of crossbred dairy cows on sampled households of the study area.

4.1 Descriptive Analysis

In this section the researcher discussed descriptive analysis of data to present the adoption of crossbred cows and % of rate of adoption condition in different demographic structures in rural households by using percentages, tables, mean, standard deviation, t-statistics, p-values and Pearson chi2 values. A total of 138 households were surveyed in West wollega zone in Gendji and Lalao Asabi woreda in five PAs and the results of the study revealed as follows.

Table 4. Demographic and Socio-economic characteristics of Households.

Table4. 1: Summary Statistics of continuous explanatory variables by Adoption

Explanatory variables	Adopters HH		Non Adopters HH		Total mean	Mean diff.	**t-value**	**p-value**
	Mean	Std. dev.	Mean	Std. dev.				
Age of HH head	44.575	12.1484	46.1633	12.73415	90.73	-1.5882	0.673	0.2509
Years of education	6.95	2.960	2.19388	1.75662	9.14	-4.7561	-11.674	0.0000***
Family size	6.85	2.370	6.82653	2.27503	13.67	-.023469	-0.05	0.4784
Distance from market	3.336	1.473	5.68674	1.89280	9.01	2.3504	7.02	0.0000***
Extension contact	0.775	0.422	0.32653	.471354	1.09	-.44846	-5.21	0.0000***

Source: Own computation from survey data (2019)

As we can observe from the above table, the mean of educational year for Adopters was higher than the mean of non-Adopters. The result found significant mean difference of 4.756 between crossbred dairy cow's adopters and no adopters at t-value of -11.674 indicating that adoption probability consistently increases as the year of education increase suggesting households whose head has achieved higher level of education have higher chance of acquiring information, thus affecting levels of adoption. Moreover, the t-value confirms that there is a significant mean difference between the adopters and non-adopters' education level of the household head with p-value of 0.000 at 1% level of significance.

As it is observed from the above survey result, there is significant mean difference among adoption status of households across the distance of household from the market. The study observed that the mean (average) market distance of the adopters was 3.33625and of that of non-adopters were 5.68674. The result of t-statistical value also reflected that there was significant mean difference in terms of market distance between adopters and non-adopter's households with t-value of 7.0272 (p = 0.000). This indicates that the higher the market distance the lower the probability of adopting crossbred dairy cow and it is significant at less than 1%.

One can also note that the adoption decision of households varies with the level of extension contact. On average, mean of extension contact for adopters is 0 .775 per household, whereas the mean extension contact of the non-adopter's category is 0.32653 per household in real terms. The result of t-statistical value also revealed that there was significant mean difference in terms of extension contact frequency between adopters and anon-adopter's households with t-value of -5.22 (p=0.000) This also indicates that the higher the frequency of extension contact, probability of adopting CBDC and it is significant at less than 1%.

Furthermore, it could also be seen from the analysis that there is an important variation among adopters and no adopter's households across age of household head and size of family members within household. However, the mean difference between adopters and non-adopters across household age and family size were statistical insignificant.

Table 4. 1: Proportion of categorical variables across Adoption status

Explanatory variables	Categories	Adopters		Not Adopters		χ^2	
		N	%	N	%	Z	P>|Z|
Gender of HH	Male	31	78%	84	86%	1.3800	0.240
	Female	9	22%	14	14%		
Access to Credit	Yes	30	75%	21	21%	34.9899	0.000***
	No	10	25%	77	79%		
Access to Bull	Yes	17	43%	1	1%	43.0904	0.000***
	No	23	57%	97	99%		
Access to Artificial insemination	Yes	30	75%	36	37%	16.6686	0.000***
	No	10	25%	62	63%		
Heifer Supply	Yes	30	75%	17	17%	42.0408	0.000***
	No	10	25%	81	83%		
Position	Yes	28	70%	30	31%	18.0871	0.000***
	No	12	30%	68	69%		
Animal Health Service	Yes	29	72%	36	37%	14.5832	0.000***
	No	11	28%	62	63%		

Source: Own computation from survey result (2019)

Concerning the adoption of CBDCs the surveyed data result shows**:** -Access to AI services of the household heads, from the total 138 sampled households about 66 households head were getting AI services and the remaining 72 households head were not. As indicated in the above table the result of the survey in the study area show that the proportion households getting access to AI service was higher in the adopters' household than non-adopter's households in the study area. On the other hand, the proportion of household that have not access to AI was higher in non-adopters than adopters' households. These results show that households having access to AI were more adopters of crossbred dairy cow than households those do not have access to AI. Additionally, the Pearson chi2 value supports this result.

Access to credit is an important constituent of the economic variables. Economic theory and most empirical literatures support the notion that the chance of adopting crossbred cow increases as one is get access to credit. This is due to when people get credit services, adoption probability will increase. Table 2 demonstrates that the percentage distribution respondents by access to credit shows that out of 51 adopters respondents 30 (75%) of them have access to credit services, whereas 87(79%) of head of households are excluded from the services of credit in non-adopters 'group at the time of survey. This indicates that the proportion of households who get access to credit is higher in adopters compared to non-adopters which probably show the influence of access to credit on technology adoption (adoption of crossbred dairy cow) of the households. This result of the study supported by z-value of Pearson chi2 ($z = 0.000$) in the above table.

Similar differences are also noticeable in the case of household access to bull. The first question posed in this research was whether any member of households gets service of access to bull and the alternatives provided to them were only two: yes, or no. Accordingly, from those who are adopters 17(43%) of them have access to bull services and the rest 23(57%) are excluded from this opportunity. On the other side, from those -adopters, only 29(72%) of adopters' household heads have access to animal health services, whereas the figure for the household those have not used the services in adopters is 11(28%). The survey data indicated that head of household that has access to animal health services in the non-adopters' category is 36(37%) whereas the household head do not have the services in this category are accounted 63%. This may be because of the increases the household's adoption probability by the virtue of the services (access to animal health services) and/or the service of animal health might be channeled to more probability of adoption activities, indicating the powerful role of animal health to maintain a sustainable increase in technology adoption.

There are also important variations across households according to the availability of heifer supply. A greater proportion of adopters' households have heifer supply compared to the non-adopters' respondents, though among some of the adopters headed households are likely do not have heifer supply. The analysis of variance indicates that there is an association between the adoption probability by a household and the accessibility of heifer supply used

at the time of the survey (P value= 0.000). Looking at the results from the above table, we can also understand that less than 30% of sampled households 40(28%) were in the category of adopters while the remaining 98(60%) of the respondents are found to be non-adopters. From the total households those are adopters, 28(72%) households have position while the remaining 12(28%) have no position. Of the total non-adopters headed households, only 36(37%) of them are positioned while the remaining 62(63%) are not positioned. With the p=0.000, there is confirmation that there is a significant association between the position status of the household head and the probability of households being adopter.

4.2 Rate of adoption of CBDCs in Gendji and Lalo Asabi district

To calculate the rate of adoption we have to take the total number of users. Then compare this number to itself over a given period of time for the rate of adoption. In other words:

Adoption rate=number of new users divided by total number of users, times hundred %. For this study in all peasant association, all the sample respondents were smallholder farmers participating on both crops and livestock production. In identifying the rate of adoption in study area, the following table3 shows the distribution of sample households by woreda and their rate of adoption of CBDCs, for Gendji and Lalo Asabi woreda was 28.92 % and 29.09% respectively and an average of 28.98% for both woredas.

Table 4. 2: Rate of adoption of CBDCs by woreda

Woreda	No. of interviewed		Whole sample	Adopters from
	Adopters	N/adopters	Number	% of total
Gendji	24	59	83	28.92
L/Asabi	16	39	55	29.09
Total	40	98	138	28.98

computed from survey (2019)

4.3. Result of Econometric Model

4.3.1. Logistic Regression Analysis

In Logistic regression analysis such as how to create interaction between variables and how to interpret the results of logistic model, the first setup for our analysis to be valid, our model has to satisfy the assumptions of Logistic regressions. When the assumptions of Logistic regression analysis are not met, we may have problems, such as biased coefficient estimates or very large standard errors for the Logistic regression coefficients, and these problems may lead to invalid statistical inferences. Therefore, before using our logit model to make any statistical inference, we need to check that whether the model fits sufficiently well and check for influential observations that have impact on the estimates of coefficients. Let's begin with a review of the assumptions of logistic regression. The conditional probabilities are a logistic function of the independent variables, no important variables are omitted, no extraneous variables are included, and the independent variables are measured without error. The observation is independent and not linear combinations of each other (Berry & Feldman, 1985).

4.3.1.1. Omitted Variable Test

The test for omitted variables can be made before logistic regression by Ramsey reset test or estat ovtest command and the null hypothesis which suggest model has no omitted variable accepted if the probability of F equals 0.000 and the alternative hypothesis of omitted variables should be rejected. Accordingly, the value of Prob >F = 0.000 so that the study free from the problem of omitted variables (appendix 1).

4.3.1.2. Model specification error.

When the researcher builds a logistic regression model, he assumes that the Logistic of the outcome variable is linear combination of the independent variables. The STATA 13 command **link test** can be used to detect a specification error, and it is issued after the logit or logistic command. The idea behind link test is that if the model is properly specified, one should not be able to find any additional predictors that are statistically significant except by chance. After the regression command, **link test** uses the linear predicted value (**-hat**) and linear predicted value squared (**-hatsq**) as the predictors to rebuild the model (Pregibon, 1981)

The variable (**-hat**) should be statistically significant predictor, since it is the predicted value from the model. This will be unless the model is completely mis specified. On the other hand, if our model is properly specified, variable (**-hatsq**) shouldn't have much predictive power except by chance. Therefore, if (**-hatsq**) is significant, then the **linktest** is significant. This usually means that either we have omitted variable or our link function is not correctly specified (Menard, 1985). Likewise, in this study, the model specification errors were checked by **linktest**, the test of **hat** *is* significant (with p- value 0.000) and **hatsq** insignificant (with p- value 0.261) were **linktest** is insignificant. Therefore, it shows that the **linktest** has failed to reject the hypothesis that the model is specified correctly. Accordingly, it seems to us that we don't have a specification error (Appendix-2).

4.3.1.3. Goodness –of- fit

In the logistic regression output of this study, the LINK test result in the appendices confirms the fact that the model is adequate. Evidence of a GOOD FIT is reflected in a non-significant _HATSQ here the p-value for _HATSQ is 0.261. This suggests good evidence of overall goodness-of-fit is reflected in a non-significant p-value. The other evidence of GOOD FIT is reflected in an ROC curve that lies above the 45-degree line reference area under the ROC curve = 0.9941 says that 99% of the observations are correctly classified (see appendices).

In addition, goodness of fit in logistic regression analysis is measured by count R^2 which indicates the number of sample observations correctly predicted by the model. The count R^2 is interpreted based on the principle that if the predicted probability of the event is less than 0.50, the event will not occur, and if it is greater than 0.50, the event will occur (Maddala, 1981). Hence, the model results showed that the logistic regression model correctly predicted 85 % of sample households. It is apparent from the results that the fitted model correctly predicted 85 % of the observed values.

4.3.1.4. Multicollinearity

Multicollinearity occurs when two or more independent variables in the model are approximately determined by a linear combination of the independent variables in the model. The degree of multicollinearity can vary and can have different effects on the model. When perfect multicollinearity occurs, that is, when one independent variable is a perfect linear combination of the others, it is impossible to obtain a unique estimate of regression coefficients with all the independent variables in the model. The variables included in the

model were tested for the existence of multi-collinearity, if any. Contingency coefficient and variance inflation factor were used for multi-collinearity test of discrete and continuous variables, respectively (see Appendix-4a and Appendix-4b). Contingency coefficient value ranges between 0 and 1, and as a rule of thumb variable with contingency coefficient below 0.75 shows weak association and value above it indicates strong association of variables. The contingency coefficient for the discrete variables included in the model was less than 0.75 that didn't suggest multi-collinearity to be a serious concern. As a common practice continuous variable having variance inflation factor of less than 10 are believed to have no multi-collinearity and those with VIF of above 10 are subjected to the problem and should be excluded from the model (Gujarati, 2009)

4.3.1.5. Estimation of Determinants of Adopting Crossbred Dairy cows in the study Areas.

The binary logit model was used to estimate the determinants of adopting crossbred cows in the study woredas. The estimation result of the model is presented in the following table

Table4. 4: Binary Logit Estimation of Determinants of Adoption of Crossbred in Cow

Adoption of crossbreds	Coefficients	Std. Err	Z	P>|Z|
Age of HHH	.0758193	.0541931	1.40	0.162
Gender of HHH	-7.455633	3.659668	-2.04	0.042**
Education level of HHH	.8417846	.3524763	2.39	0.017**
Family Size of HHH	.7887601	.3754658	2.10	0.036**
Access to Credit of HHH	7.519554	3.435526	2.19	0.029**
Access to Bull service of HHH	4.601748	2.765633	1.66	0.096*
Access to AI of HHH	2.536939	1.314877	1.93	0.054*
Heifer Supply of HHH	7.169383	3.097244	2.31	0.021**
Distance from market of HHH	-.0361025	.3976773	-0.09	0.928
Extension Contact	3.285138	1.690597	1.94	0.052*
Position	6.010248	2.951443	2.04	0.042**
Animal Health Services	1.048969	1.248697	0.84	0.401
_cons	-22.9952	9.007647	-2.55	0.011

Number of Observation = 138 Source: Own computation from survey data (2019)
LR chi2 (13) = 141.70
Prob > chi2 = 0.0000
Pseudo R2 = 0.8528
Log likelihood = -12.231206

Note: ** and * denotes level of significance at 5% and 10% respectively.

In the table 4 above out of 12 explanatory variables seven variables are dummy and 5 variables are continuous. From those 12 variables 9 of the variables are significant, of which 3 of them are continuous and the remaining 6 significant variables are dummies. Gender of the household head, educational level (years of education) of household head, family size of household head, access to credit, access to heifer supply and position of the household heads in an organizations are significant at 5% and access to bull service, access to AI supply, extension contacts have a 10% significant effect on the rural household's heads adoption of crossbred cows. The negative values of explanatory variables in the table above indicate that when the unit change in independent variable lead to decrease in probability of being adopter. The positive values of explanatory variables in the table above indicate that when the unit change in independent variable lead to increase in probability of being adopter. Among the significant explanatory variables, family size, years of education, access to credit, access to bull, access to AI, heifer supply, extension contact, and position of household in organization were affect the dependent variable (adoption of crossbred in cows) positively whereas the remaining one variable namely gender of household age affect the adoption decision negatively.

4.3.1.6. Marginal Effect after Logit regression.

In view of the fact that the logit model we are using for regression analysis is not linear, the marginal effect of each independent variable on the dependent variable is not constant but it depends on the value of the independent variables. Thus, marginal effects can be a means for summarizing how change in a response is related to change in a covariate. For categorical variables, the effects of discrete changes are computed, i.e., the marginal effects for discrete variables show how P (Y = 1) is predicted to change as Xk changes from 0 to 1 holding all other Xs equal. Whereas for continuous independent variables, the marginal effect measures the instantaneous rate of change, i.e. we compute them for a variable while all other variables are held variables constant. Marginal effect also tells us a dependent variable (out comes) changes when a specific independent variable (explanatory variables) changes. That means in this study change in the probability of being adopting crossbred dairy cows with a unit change in continuous independent variable (Greene, 1993). Thus, opposed to linear

regression case, it is not possible to interpret the estimated parameters as the effect of the independent variable up on being participant. However, it is possible to compute the marginal effects at some interesting values of the significant explanatory variables. We can see in table 5 below.

Table 4. 3. Marginal Effect of Logit Model

Variable	dy/dx	Std. Err	P>|Z|	X
Age of HHH	.000192	.0004	0.162	45.7029
Gender of HHH	-0.5590	.33626	0.042**	0.8333
Education of HHH	0.00213	.00447	0.017**	3.5724
Family Size of HHH	0.00199	.00395	0.036**	6.8333
Access to Credit of HHH	0.2256	.15206	0.029**	0.3695
Access to Bull of HHH	0.1208	.23001	0.096*	0.1304
Access to AI of HHH	0.00872	.01807	0.054*	0.4782
Heifer Supply of HHH	0.22336	.18832	0.021**	0.340
Distance from market HHH	-0.00009	.00104	0.928	5.0054
Extension Contact of HHH	0.01439	.02744	0.052*	0.4565
Position in COOP of HHH	0.07647	.07935	0.042**	0.4202
Animal Health Services of HHH	.00286	.00765	0.401	0.4710

Source: Stata output computation from survey data (2019)

4.3.1.7. Interpretation of Significant Explanatory Variables

The logistic regression model shows that from the total of twelve explanatory variables hypothesized to influence household's adoption of CBDCs some of them; namely gender of household, educational level of the household, family size, access to credit heifer supply, and position of the household in institutional organizations are significant at 5% significant level, whereas access to bull service, access to AI and frequency of extension contacts are significant at 10% level. The coefficients of three variables were not statistically significant at the conventional probability levels implying that they were less important in explaining the variability in household's participation decision in the district or even the independent variable for the adoption is the necessary one, the respondents may have access for those

variables. Those variables are age of the household, distance from market and animal health service. The coefficients of three variables were not statistically significant at the conventional probability levels implying that they were less important in explaining the variability in household's participation decision in the district. Thus, in what follows, the estimation result of the binary logit model and its interpretations of the significant explanatory variables will be discussed.

Gender of the HHH

Gender influence negatively and significantly rural household decision in adoption of CBDCs at less than 5% probability level. The model result shows that when number of male adopters increases by one, probability of adoption for female decreases by 56%. This variable is found that probability of participating in adoption of CBDCs' practice can be higher for male headed house hold as compared to female headed households. As sources from different studies indicate that since CBD cows' management and also its running cost may be hard on having expenditure cost due to the pressure of male on administrating income of family (Muhammad *et al.,* 2013). Therefore, this shows that female house hold head will be low probability of participating on CBDCS'

Education of the HHH

Education affects positively and significantly rural household decision in adoption of CBDCs at less than 5% probability level. The model result shows that when a years of education level increase by one-year result in 0.21% increase in the participation probability in adoption of CBDCs. The implication in that literate household more easily demand and protect his/her right and so education increases the knowledge and skill of the people in a society Hinzen (2014). Therefore, the more education to a society means the more intervention in different economic and social activities by that society. A household head is relatively better educated; he/she can have relatively better motivation to do income generating activities. The result of this finding is consistent with the results of Sharma & Zeller (2015).

Family Size of HHH

Family size affects positively and significantly decision in participation of CBDCs at less than 5% probability level. The model result shows that when the family size

increases in one person, the level of household chance of participation decision in adoption of CBDCs increase by 0.2%. while the other variables held constant. This implies as the number of family size increases, level of adoption for new technology increases due to their labor availability for managing CBDCS. Accordingly, household with more family members tended to have more labor and to adopt dairy technology than household with less family members which in turn increased milk production and then milk market participation of the households (Dehinenet et al.,2014). In addition, Workneh (2011) and Howley et al., (2012) also affirmed that farmers with large family size might significantly adopt the technology to satisfy the need of their family.

Access to Credit of HHH

The result of logistic regression indicated that access to credit had a positive effect on rural households' participation on adoption of CBDCs, and was significant at the 5% significance level. This means that those households getting access to credit service have a high probability to participate in adoption of CBDCs. The computed marginal effect results show that a unit increases in access to credit increases the probability of household's participation in adoption of CBDCs by 22.6 % keeping other variables constant, unlike their counter parts. Credit institutions were positively associated with farmer`s likelihood to adopt dairy technology and level of adoption. Having access to formal (bank and microfinance) and informal (Iquib) saving institutions create a good opportunity for farmers to have an asset and to purchase different agricultural technologies including cross breed cows (Sisay et al., 2013). The finding of Muzari et al., (2012) also stated that the major option for increased adoption of technology is to overcome the income/ capital constraint through increased credit provision. This is consistent with the report of Akudugu et al., (2012) & Obayelu (2017). Therefore, this variable affects participation decision and intensity of participation on adopting of CBCS's positively.

Access to artificial insemination service of HHH

The result of logistic regression indicated that access to AI had a positive effect on rural households' participation on adoption of CBDCs, and was significant at the 10% significance

level. This means that those households getting access to AI service have a high probability to participate in adoption of CBDCs. The computed marginal effect result shows that a unit increases in access to AI increases the probability of household's participation in adoption of CBDCs by 0.87% keeping other variables constant at their means. Crossbred cows are expensive to buy for smallholder farmers.AI service is considered to be the best way of extending CBDCs and it determines the success of the technology. **(**Belay et.al., 2012).

Access to bull services of HHH

Bull service affects CBDCs in the rural area where there is no accessibility of road for AI service, result of logistic regression also indicated that access to bull service had a positive effect on rural households' participation on adoption of CBDCs, and was significant at the 10% significance level. This means that those households getting access to bull service have a high probability to participate in adoption of CBDCs. The computed marginal effect result shows that a unit increases in access to bull service increases the probability of household's participation in adoption of CBDCs by 12% keeping other variables constant at their means. The availability of this service determines the success of technology under discussion. This result is consistent with the finding of Brehanu (2012), which found that bull service had a significant and positive influence on farmers' decision to adopt CBDCs in Selale zone. (Kaimba et al,2011)

Heifer access of HHH

The result of logistic regression indicated that heifer supply had a positive effect on rural households' participation on adoption of CBDCs, and was significant at 5% significance level. This means that those households getting supply of selected heifers have a high probability to participate in adoption of CBDCs. The computed marginal effect results show that a unit increases in supply of selected heifers increases the probability of household's participation in adoption of CBDCs by 22.3% keeping other variables constant at their means Heifer availability and potential to use is among the factors influencing adoption. Availability of selected dairy heifer is very important in dairy cows rearing. However, required inputs may not be available in accessible local markets. Timeliness and availability of heifer in the market facilitate the adoption rates and intensive use of dairy technologies

and hence intensity of adoption decision would be significantly and positively related with selected heifer access. (Quddus 2013)

Extension Contact of HHH

The result of the model shows that Extension contact had a positive effect on rural household participation on decision of adoption on CBDCs and was significant at 10% significance level. A unit increase in frequencies of extension agent to a farmer increases 14.3%, probability of adoption of CBDCs by the computed marginal effect above. In most adoption literature, agricultural extension has positive correlation with adoption decision. **(**Belay et.al., 2012).

It is believed to be the main source of information knowledge and advice to smallholder farmers in the country. So Contact with extension agent, thus, gives the farmer access to information and it increases the probability of farmers' adoption of CBDCs.

Position of HHH in Organization

The result of the model shows that the coefficient of leadership position is significant at less than 5% probability level. Farmers who have some leadership position in local organization are more likely to adopt CBDCs. The computed marginal effect results show that a unit increases in position of household in an organization increases the probability of household's participation in adoption of CBDCs by 7.6% keeping other variables constant at their means. The possible explanation for this is that those farmers who have leadership position are more likely to be aware of new practices as they are better exposed to information. The result, therefore, supports the hypothesis that leadership position in local organization positively influences the adoption of CBDCs. This finding is consistent with that of Lagasse (2008) & Samuel et al.,(2016)

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMONDATION

5.1 Summary

Ethiopia has the largest livestock population, which puts her first in Africa. However, the contribution of the livestock sub-sector to the Ethiopian economy has not been up to the expected level. Among main livestock production constraints are low genetic potentials of the indigenous stock, lack of efficient extension services, livestock diseases and lack of veterinary services, CSA (2017). Improvement in the performance of the sub-sector calls, among other things, for the use of better technologies. Accordingly, different livestock technologies have been released by research centers to improve livestock production and productivity in West Wollega zone and the country at large. More specifically, efforts have been made to produce and disseminate crossbred dairy cows in the zone over the last two decades. Despite these efforts, there have been very few studies that addressed the adoption of this technology among farm households.

Unlike theoretical and empirical studies conducted elsewhere on factors influencing adoption of agricultural technologies have underlined that factors, such as gender of HHH, educational level of HHH, family size of HHH, access to credit of HHH, access to bull, access to artificial insemination, access to heifer supply, frequencies of contact with extension workers (frequencies of contact) HHH, and leadership position in COOP of HHH are important determinants of adoption of new technologies. At the same time, the relevance and significance of each of these variables with respect of their impact on technology adoption vary from place to place. This necessitates location specific research on the issue. This study was, therefore, conducted to examine the influence of different factors on farmers' adoption decision of crossbred dairy cows in two purposively selected woredas, namely Gendji and Lalo Asabi woredas in West Wollega zone, Oromia National Regional State.

West Wollega zone is one of the twenty-two zones of Oromia National Regional State. It has 22 woredas and 515 kebeles. The zone is characterized by mixed food crops, cash crops and livestock farming system. A two-stage sampling procedure was employed to draw 5 peasant

association and then a total of 138 farm household heads (75 from Gendji and 63 from Lalo Asabi) using proportion to size random sampling method. The required data were collected through personal interviews of farm household heads based on structured questionnaire.

Descriptive statistics used to understand the socioeconomic situations of the sample respondents. T-test was conducted for a number of continuous variables to check for the mean differences between adopters and non-adopters of crossbred dairy cows. Chi-square test was also used for different dummy variables to examine the significant differences between adopters and non-adopters of crossbred dairy cows. The survey result has revealed that 28.98% of the sample farmers adopted crossbred dairy cows in the study year from both districts.

A logistic regression model was estimated using maximum likelihood estimation procedure to examine explanatory variables that have influence on farmers' adoption decision of crossbred dairy cows. Among twelve explanatory variables included in the model, Gender of the household, educational level, family size, access to credit, access to bull service, access to AI, heifer supply, extension contact and position of the household in an institutional organization have influence on farmers' adoption decision of crossbred dairy cows.

5.2 Conclusions and recommendation

In this study, there were gender differences in the participation/adoption of dairy technologies that shows significant and negatively, which decreases the probability of participation and use of improved dairy technological innovations for female. This indicated that male households relatively better in participation of dairy technologies due to many socio-cultural values and norms. This might be male households' freedom to mobility and access to extension services and access to information on innovation than female headed households. Therefore, attention should be given for gender equality for accessing and empowering female households by the women and children affair, and livestock development offices and (by other concerned body).

Education has positive and significant influence on farmers' adoption decision of crossbred dairy cows. The diffusion of the technology could, thus, be facilitated through educated farmers to be used as contact farmers, besides improving farmers' level of education.

Family size affects positively and significantly decision in participation of CBDCs when the family size increases the level of household chance of participation decision in adoption of CBDCs increase. This implies as the number of family size increases, level of adoption for new technology increases due to their labor availability for managing CBDCS. Accordingly, household with more family members tended to have more labor and to adopt dairy technology than household with less family members. So, farmers those have more family member can easily adopt this technology and those have no more family member can hire other human power and adopt CBDCs depending on their income or financial position

The empirical result of this study figures out that access to credit is positively and significantly related to the adoption of CBDCs. One way of extending CBDCs among farm households on increasing their purchasing power by facilitating credit access for farmers. Because crossbred heifers or cows are expensive in the study area much beyond the financial capacity of many farm households. On the other hand, the existing agricultural credit system focuses on short-term credit given mainly for fertilizer and seed. The provision of medium and long-term credit specially from formal sources directed to the promotion of dairy development would, therefore, is a vital step to foster the adoption of crossbred dairy cows.

The study revealed that extension contact significantly affects the adoption of crossbred dairy cows, although the spread of the technology is not up to the expected level. The extension service should, thus, be further strengthened to change the current livestock production practice in the area and to enhance the existing low adoption rate of crossbred dairy cows. Due attention should be given to the livestock sub-sector particularly to dairy by motivating the extension agents on increasing the frequencies of contact on farmers in order to initiate farmers on taking new technologies.

Accesses to artificial insemination, bull services and heifer supply have positive and significant influence on the adoption of crossbred dairy cows, they are found to be the most important factors in influencing the adoption of the technology. Furthermore, these methods minimize the cost of disseminating and adoption of the technology in comparison with the distribution of heifers. The government and other concerned bodies need to strengthen the services and expand area coverage by establishing additional bull service stations and increasing the number of inseminators and special attention should be given for supply of

heifers and also the price of crossbred heifers must, therefore, be considered in view of the purchasing power of small-scale farmers, so that they would get access to the technology. To reduce the problem on heifer supply, government and other concerned body should be done on reducing the costs of producing crossbred dairy cows or heifers by improving the management system of existing ranches and/or subsidizing poor farmers.

Farmer's position in local organizations has a positive influence on the adoption of crossbred dairy cows. This tends to reveal that farmers with positions are more likely to have easy access to information. It is necessary to correct such biased flow of information towards positioned farmers and ensure evenly dissemination of information on new agricultural technologies through farmers' local organizations and by increasing the frequency of contacts by extension agents.

REFERENCES

Akudugu MA.,Guo E., and Dadzie SK.(2012). Adoption of Modern Agricultural Production Technologies by Farm Households in Ghana: What Factors Influence their Decisions? J. Biol., Agric. Healthcare 2(3):1 - 13.

Amlaku A., Sölkner J., Puskur R and Wurzinger M (2012) The Impact of Social Networks on Dairy Technology Adoption: Evidence from Northwest Ethiopia. The World Fish Center, Batu Maung,11960 Bayan Lepas, Penang, Malaysia

Azage Tegegne, Gebremedhin, B., Hoekstra, D., Belay, B. and Mekasha, Y. 2013. S*mallholder dairy production and marketing and systems in Ethiopia*: IPMS experiences and opportunities for market oriented development. IPMS (Improving Productivity Market Success) of Ethiopian Farmers Project Working Paper 31. Nairobi: ILRI. Productivity Market Success) of Ethiopian Farmers Project Working Paper 31. Nairobi: ILRI.

Belay, D., K. Yisehak and G.P.J. Janssens, 2012. Productive and Reproductive Performance of Zebu X Holstein-Friesian Crossbred Dairy Cows in Jimma Town, Oromia, Ethiopia. Global Veterinarian 8 (1): 67-72.

Behnke, R., 2010. The Contribution of Livestock to the Economies of IGAD Member States: Study Findings, Application of the Methodology in Ethiopia and Recommendations for Further Work, IGAD LPI Working Paper 02-10. Odessa Centre,IGAD Livestock Policy Initiative, Great Wolford, UK

CAI World Fact Book. (2012). *The demand for milk is even expected to grow more as Ethiopia's population.*

CSA (Central Statistical Authority). (2014/15). Agricultural Sample Survey. *Report on Livestock and livestock characteristics, II*, 2(468):107.

CSA (2011), of the Federal Republic of Ethiopia. Agricultural Sample Survey 2010/2011, vol. II. *Report on Livestock and Livestock Characteristics. Statistical bultin. 2(468):107*

CSA (2016/17). Report on livestock and livestock. *Report on livestock and livestock characteristics. Statistical Bulletin 578. Addis Ababa, Ethiopia, II.*

CSA (2017), Agricultural sample survey 2016/2017 on livestock and livestock characteristics. Central Statistics Authority. Addis Ababa, Ethiopia

Dehinenet G., Mekonnen H., Kidoido M., Ashenafi M. and Guerne Bleich E. Factors influencing adoption of dairy technology on small holder dairy farmers in selected zones of Amhara and Oromia National Regional States, Ethiopia. *Discourse Journal of Agriculture and Food Scienceswww.resjournals.org/JAFS ISSN: 2346-7002* Vol. 2(5): 126-135, May, 2014

FAO (2012) Livestock sector development for poverty reduction: an economic and policy perspective – Livestock's many virtues. By Otte J, A. Costales A, Dijkman J, Pica-Ciamarra U, Robinson T, Ahuja V, Ly C and Roland-Holst D. Rome. 161pp.

FAO (2010) Status of and Prospects for Smallholder Milk Production – A Global Perspective. By Hemme T, Otte J (Eds), FAO, Rome. 181pp.

FAO. (2012). statics of ruminant population. Fekede F., Shiv P., Getnet A., Getu K., and Seyoum B.,(2013). *The status of production, conservation and utilization of natural pasture hay for feeding dairy cattle in the greater Addis milk shed, central highlands of Ethiopia. E3J. Agric. Res. Dev. 3(6):* (Griffiths, e. a. (1993). *econometric use of logit* (Vol. II).

Gujarati, D. (1995). *Basic econometrics. 3rd edition, McGraw Hill, Inc., New York.*

Gebrehiwot Woldegebrial Gebru, Kinfe Asayehegn and Deribe Kaske (2012). *Challenges of Development Agents (DAs) Performance in Technology Dissemination*: A Case from Southern, Nationalities and Peoples Regional State (SNNPRS)Ethiopia. Available (Online).

Hailemariam, F., Melesse, A. and Banerjee, S. (2013) Traditional Sheep Production and Breeding Practice in Gamogofa Zone, Southern Ethiopia. International: Journal *of Livestock Production Research, 1, 26-43. Italy, 2–4 July 2006*. Communication Técnica INTA Bariloche Nro PA 489 IGAD, 2010/011. *The contribution of Livestock in Ethiopian Economy.*

Hoddinott J, Headey D, Dereje M (2014) Cows, missing milk markets and nutrition in rural Ethiopia. Ethiopia Strategy Support Program Working Paper 63. 18pp.

Howley P., Donoghue Cathal O. and Heanue K(2012). Factors Affecting Farmers' Adoption of Agricultural Innovations: A Panel Data Analysis of the Use of Artificial Insemination among Dairy Farmers in Ireland. J. Agric. Sci. 4(6):171 – 179

Kenneth F. G. Masuki , Khamaldin D. Mutabazi, Siza D. Tumbo, Filbert B. Rwehumbiza Amon Z. Mattee & Nuhu Hatibu, 2005. Determinants of Farm-level Adoption of Water Systems Innovations in Dry land Areas: T*he Case of Makanya Watershed in Pangani River Basin, Tanzaniawww.swmrg.suanet.ac.tz retrieved on February 2007*

Kaba Merga, (2009). *Analysis of Gender Disparity in Agricultural Extension ServiceDelivery: The Case of Gedeb Woreda, West Arsi Zone, Oromia Regional State. MSc Thesis, Alemaya University, Ethiopia.*

Katungi, E., Akankwasa, K. (2010). Community-Based Organizations and Their Effect on the adoption of Agricultural Technologies in Uganda: A Study of Banana (Musa spp.) Pest Management Technology, AGRIS, Food and Agriculture Organization of the United Nation.

Lemke, U, Kaufmann, B, Thuy, LT, Emrich, K and Valle Zárate, A 2007. Evaluation of biological and economic efficiency of smallholder pig production systems in North Vietnam. Tropical Animal Health and Production 39, 237–254. CrossRef | Google Scholar | PubMed

Loevinsohn, M., Sumberg, J., Diagne, A. (2012). Under what circumstances and conditions does adoption of technology result in increased agricultural productivity? Protocol.

London: EPPI Centre, Social Science Research Unit, Institute of Education, University of London.

Madalena, FE, Peixoto, MGCD and Gibson, J 2012. Dairy cattle genetics and its applications in Brazil. Livestock Research for Rural Development 24, 97. Google Scholar

Makoni, N, Mwai, R, Redda, R, van der Zijpp, A and van der Lee, J 2013. White gold opportunities for Dairy Sector Development Collaboration in East Africa. Centre for Development Innovation, Wageningen, The Netherland. Google Scholar

Mignouna, B., Manyong., M., Rusike., J., Mutabazi, S., Senkondo, M. (2011). Determinants of adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya: AgBioforum, 14(3), 158-163. Hall, B.

MOA. 2012. Livestock strategy and action. Draft discussion paper. A. A MOA (Amharic v

Murray, GGR, Woolhouse, MEJ, Tapio, M,MboleKariuki, MN, Sonstegard, TS,Th umbi, SA, Jennings, AE, vanWyk, IC, ChasTopping, M, Kiara, H, Toye, P, Coetzer, K, Bronsvort, BMC and Hanotte,2013.

Muzari Washington, Gatsi Wirimayi and Muvhunzi Shepherd (2012): The Impacts of Technology Adoption on Smallholder Agricultural Productivity in Sub-Saharan Africa: A Review. Journal of Sustainable Development, 5: 69 – 77.

Quddus MA (2013). Adoption of Dairy Farming technologies by Small Farm Holders: Practices and Constraints. Department of Agricultural Statistics, Bangladesh Agricultural University, Bangladesh. Bang. J. Anim. Sci. 41(2):124-135

Rao EJO, Omondi I, Karimov AA, Baltenweck I (2015) Dairy farm households, processor linkages and household income: the case of dairy hub linkages in East Africa.

International Food and Agribusiness Management Review 19(4): 95–108. DOI: 10.22434/IFAMR2014.0177

Roschinsky, R, Kluszczynska, M, Sölkner, J, Puskur, R and Wurzinger, M 2015. S mallholder experiences with dairy cattle crossbreeding in the tropics: from introduction to impact. Animal 9, 150–157.CrossRef | Google Scholar

Samuel, D., Chelkeba, M.Anteneh, T., Efrem, A., Gutema, B.Erko, E., and Addisu, B(2016). Adoption and Impacts of Dairy Production Technologies in Southwest Ethiopia: The Cases of Jimma and Ilu- Ababora Zones. *Journal of Biology, Agriculture and Healthcare:* Vol.6, No.7, 2016

Rawlins R, Pimkina S, Barrett CB, Pedersen S, Wydick B (2013) Got milk? The impact of Heifer International's livestock donation programs in Rwanda on nutritional outcomes. Food Policy 44: 202–213.

Widi, TSM 2015. Mapping the impact of crossbreeding in smallholder cattle systems in Indonesia. PhD thesis, Wageningen University, Wageningen, 136pp. Google Scholar

Zelalm Yilma et al., and Bingi and Tondel. (2011 and 2015). mismatch between the growth rate of milk production and human population.2003), (. (2003). *milk division between human and calve*

Appendixes

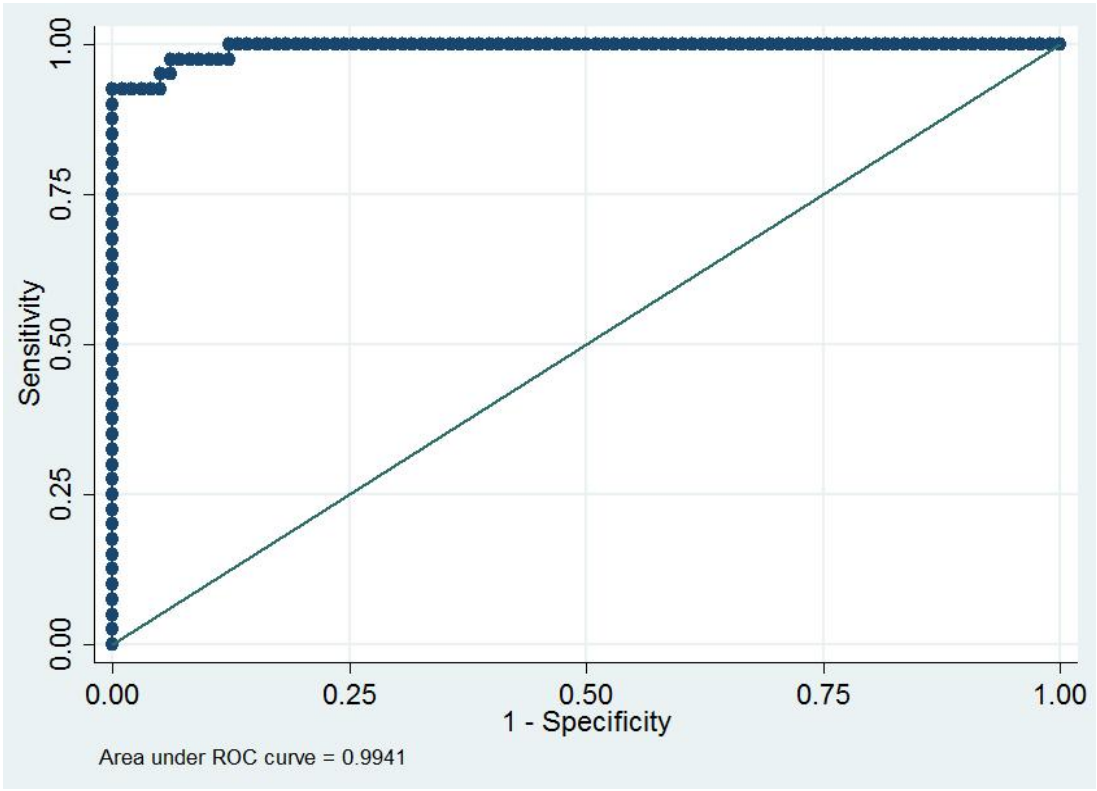
Appendix 1: Omitted Variable Test for Logit Model

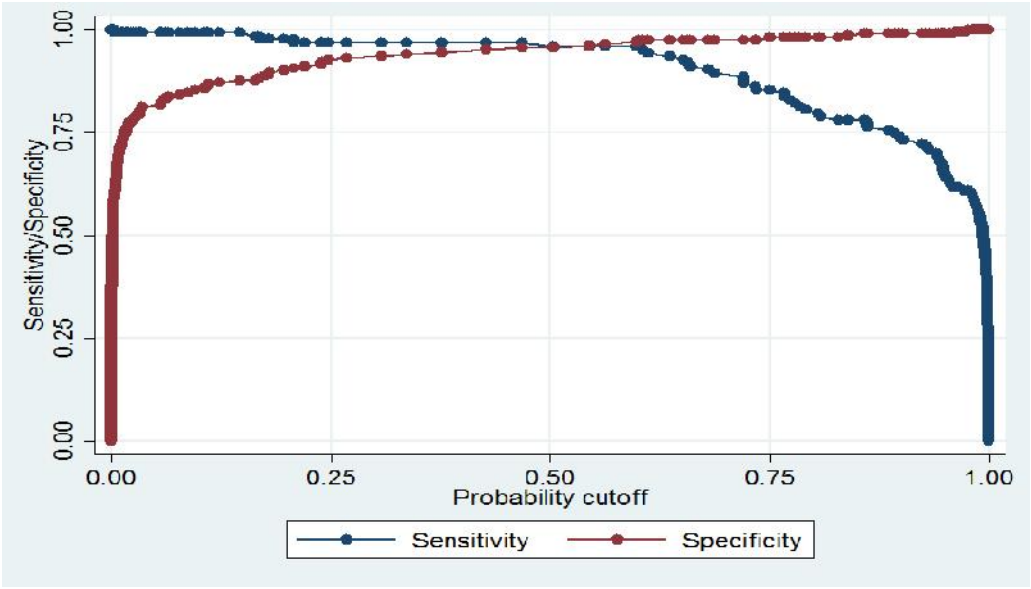
```
. estat ovtest

Ramsey RESET test using powers of the fitted values of Adoption
       Ho:  model has no omitted variables
                 F(3, 122) =     16.59
                  Prob > F =      0.0000
```

Appendix 2: Model Specification Test

```
. linktest

Iteration 0:   log likelihood = -83.079017
Iteration 1:   log likelihood = -19.525322
Iteration 2:   log likelihood = -12.862702
Iteration 3:   log likelihood = -12.078475
Iteration 4:   log likelihood =   -12.0458
Iteration 5:   log likelihood = -12.043727
Iteration 6:   log likelihood = -12.043706
Iteration 7:   log likelihood = -12.043706

Logistic regression                             Number of obs     =        138
                                                LR chi2(2)        =     142.07
                                                Prob > chi2       =     0.0000
Log likelihood = -12.043706                     Pseudo R2         =     0.8550

------------------------------------------------------------------------------
    Adoption |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        _hat |   1.056545   .3086325     3.42   0.001      .4516365    1.661454
      _hatsq |   .0327089   .0291271     1.12   0.261     -.0243792    .0897969
       _cons |  -.1023394   .5392087    -0.19   0.849     -1.159169    .9544903
------------------------------------------------------------------------------
Note: 0 failures and 12 successes completely determined.

.
```

Appendix 3: Graph of Sensitivity and Specificity Test for Logit Model





Appendix 4: Contingency Test of Multicollinearity Test for Discrete Variables

	Sex	CrAcces	AccBull	ACCAI	Hefersup	position	AHserv
Sex	1.0000						
CrAcces	0.0201	1.0000					
AccBull	-0.0577	0.2384	1.0000				
ACCAI	0.0778	0.2888	0.2322	1.0000			
Hefersup	-0.0068	0.2417	0.2665	0.3221	1.0000		
position	-0.0525	0.0780	0.1933	0.0664	0.1935	1.0000	
AHserv	-0.0454	0.1497	0.2380	0.1428	0.2408	0.2847	1.0000

Appendix 5: Variance Inflation Factor Test of Multicollinearity for Continuous variables.

Vif

Variable	VIF	1/VIF
Markdis	1.35	0.74001
Edu	1.32	0.7574
Extcont	1.14	0.87389
Age	1.04	0.962543
Famsize	1.01	0.985266
Mean VIF	**1.17**	

Appendix B
Survey Questionnaire
General Instructions

Respondent's (farmer's) name_____ PA _____

Woreda _____ Name of the enumerators _____ Date _____

Section1**:** Respondent'spersonalCharacteristics

1.1Sex_____1____Males___2. Female_____

1.2 Age _____ Years old.

1.3 Marital status 1. Married_____2. Single____3. Divorced_____4. Widowed_____

1.4 Educational back ground. (Can you read and write)?

1. Yes_____ 2. No_____

1.4.1 If yes, level of education grade_____.

1.5. Labor availability and utilization (under personnel factor)

1.5.1. What is the size of your family member? Male____ Female____ Total _____

1.5.2.No. of Adults (>15 years) Male___ Female____ Total_____

1.5.3 No. of old person (>60 years) Male_____ Female___ Total____

1.5.4 No. of children 10 to 15 years? Male____ Female_____ Total_____

1.5.6.No. of children <10 years? Male____ Female_____ Total_____

1.5.7.No. of family members' permanently working full-time on farm?

Male____ Female_____ Total_____

1.5.58. Do you face labor shortage? Yes_____ No. _____

1.5.9. If yes do you think it is major problem? Yes____ No. _____

1.5.10. Time (month) of labor shortage occurs? From _____to _____

1.5.11. For which kind of farming activity labor shortage occur?

1.5.12 Weeding (Food crops) _____

1.5.13 Harvesting (Food crops) _____

1.5.14 Harvesting(Forage)_____

1.5.15 Herding_____

1.5.16 Soil conservation activities_____

1.5.17 Others (Specify) _____

1.5.18 If you face labor shortage how do you solve the problem of labor Shortage?

1.By Hiring_____ 2. Labor exchange _____

3. Others

(Specify)_____

2.Total Livestock holding by small house holders?

Type of lives stock Local(number)_____ Crossbred(number)

Cattle Cows _____ _____

Oxen _____ _____

Heifers _____ _____

Bulls _____ _____

Calves _____ _____

Heifer _____ _____

Small ruminant _____ _____

Sheep _____ _____

Goat _____ _____

Equine _____ _____

Horse _____ _____

Donkeys _____ _____

Mules _____ _____

Poultry _____ _____

2.1 Describe the reason why you keep livestock (Mark with X)

No	Purpose	Cattle		Sheep Goats	Equine	Poultry
		Local	CB			
1	Milk					
2	Meat					
3	Eggs					
4	Ploughing					
5	Transportation					
6	Trashing					
7	Cash					
8	Others					

3.Yield and income from total livestock and total land cultivated.

3.1. List your major source of income by order of importance.

3.2 Crop production_____

3.3. Livestock production_____

3.4. Both equally _____

3.5. Others (Specify) _____

4.Crop grown, production and utilization during 2017/2018 including cash crops

No	Types of crops	Area planted hr.	Total production	Amount consumed Qt	Amount sold	
					Qt	Value in Birr.
1	Coffee					
	Maize					
3	Sorghum					
4	Finger millet					
5	Barley					
6	Wheat					
7	Teff					
8	Lentin					
9	Pea					
10	Beans					
11	Suger beat					
12	Nug					
13	Others (specify)					
14	Total					

5.Livestock production status during 2017/2018 production year

N o	Types of live stock during the year 2017.	No of sold during the year 2017/2018				Died during the year 2017/2018				Alive now			
		Local		CB		Local		CB		Local		CB	
		N o	Value	N o	Value	N o	Value	N o	Value	N o	Value	N o	Value
1	Oxen												
2	Cows												
3	Bulls												
4	Heifer												
5	Calves												
6	Sheep												
7	Goats												
8	Horse												
9	Donkey												
10	Mules												
11	Poultry												

5.1 What is the daily output of a dairy cows?

1. Local _____ liters/cow/day
2. Crossbred_____ liters/cow/day

6. Credit Provision

6.1 Did you get credit during the last 3 production years?

1.Yes_____ 2. No_____ 6.2 If yes, who did provide you?

1.Development Bank_____ 2. Commercial Bank_____

3.Agricultural Bureau_____ _4.NGO_____

5.Local moneylender_____ 6. Service cooperatives_____ 7. Others (specify)_____

6.3 For what development activities did you get credit during the year?

1. To purchase fertilizer _____ birr.
2. To purchase crossbred cows (Heifers) _____ birr.
3. To purchase seed _____ birr.
4. Others (specify) _____ birr.

6.4 On what basis did you get credit?

1.Individual basis_____ 2. Group basis_____

6.5 If you got credit for crossbred cows, in what form did you receive?

1.In kind_____ 2. In cash_____

6.6 If you obtain credit for crossbred cow, how much was the down payment? _____ Birr

6.7 What was the duration for loan repayment? _____ Years.

6.8 What was the interest rate for the credit you received? _____ %.

6.9 If you have not used credit so far for livestock, what were the main reasons?

1. Due to high interest rate_____ 2. Shortage of down payment_____
3.Un availability_____
4. Others (specify)_____

7. Either bull service to use in your area during the last 2-3 years?

1.Yes_____ 2. No_____

7.1 if yes have you used Bull service for your cow?

1. yes_____2. No_____

7.2.If yes what was the benefit you get from it in 2017/2018? _____

8. supply of AI service.

8.1 Either AI service in your area?

1.Yes_____ 2, No_____.

8.2 If yes, what was the benefit you get from it in 2017/2018?

1. Calve_____ 2. Not used with AI _____

8.3 In your opinion is the price of AI service too expensive?

1. Yes _____ No. _____

9. Either supply of CB Selected Heifer in your area?

1, Yes_____ No _____

9.1 In your opinion is the price of crossbred heifers too expensive?

1.Yes_____ 2. No_____

10. Market distance

10.1 Did you sell your animal and animal products during the last cropping Season?

1.Yes_____ 2. No_____

10.2 If yes, where do you sell your animal products?

1. At farm gate_____ 2. Taking to local market_____

3.Others (specify)_____

10.3 For how far km do you walk from your home to sell your animal Products? _____ kms.

10.4 Who is responsible for selling the following animal and animal products?

1. Milk _____
2. Butter _____
3. Egg _____
4. Sheep/goat _____5. Cattle _____

10.5. Are you satisfied with the prices received for livestock and livestock products?

1.Yes_____ 2. No_____

10.6. If not, for which livestock and livestock products you were dissatisfied?

_____

10.7. What are the major Livestock and Livestock products marketing constraints you have observed? _____. _____ _ _____

11. Household's Extension services

11.1 Is a development agent assigned to your PA?

1.Yes_____ 2.No_____

11.2 Have you ever consulted a development agent?

1.Yes_____ 2.No_____

11.3 Have you received an extension advice on dairy technologies and crossbred cattle practices during the last 3 to 5 years?

1.Yes_____ 2.No_____

11.4 If yes, which of the following have you heard so far?

1.About Crossbred_____2. Improved feeding_____

3.Bull services____ 4.AI service_____ 5.Others (Specify)_____

11.5 On average how many days in a month has the development agent

Visited you during the last crop season? _____ Days/month_____ day/year.

11.6 Have you got the advice given to you very important in improving your Livestock management? 1.Yes_____2.No_____

11.7 Which kinds of technologies have you been adopted?

1.Buying of Crossbred heifers _____ 2.AI_____ 3.Bull service_____

11.8 Which kinds of technologies you found is better in minimizing costs?

1.AI_____ 2.Bull services_____ 3.Crossbred heifer distribution_____

11.9 How did you decide to use crossbred dairy cow, if you have local cows?

1 Observed the benefits that other farmers obtained from using it_____

2.Persuaded by other farmers_____

3.Persuaded by change agents_____

4.Others (specify) _____

11.10. If you have crossbred cows what are the problems that you have faced in Using crossbred dairy cows?

1.Land shortage_____ 2. Labor shortage_____

3.Feed shortage_____ 4. Lack of government assistance_____

5.Health problem_____ 6. Market problem_____

7.Lack of credit for expansion regarding crossbred dairy cows_____

8. Management cost is too high_____ 9.Others (specify)

_____ 11.11. If not used, have you heard/observed when other farmers use crossbred technologies?

1.Yes_____ 2.No_____

11.12. Do you have interest in using dairy technologies?

1.Yes_____ 2.No_____

11.13. If yes, why have you not used so far?

_____

11.14. If you are not interested in using the technologies what are your reasons?

_____

11.15 What is your opinion about the performance of crossbred cows in your area?

_____

11.16. If you used, what advantage do crossbred cows have over local breed cows?

1.To reduce over stocking_____

2. Increase milk yield_____

3. Others (specify) _____

11.17 Have you used others agricultural inputs (Fertilizer, Seed herbicides etc.)

1.Yes_____ 2.No_____

11. 18.How do you see the availability of crossbred cows?

1.Adequate_____ 2.Inadequate_____

11.19. Are agricultural inputs provided at required amount and time?

1.Yes_____ 2.No_____

11.20.What are the inputs not provided at the required time and amount? Specify?

_____.

12.Household leader ship position in the community?

1. Have position _____2. No. position_____

13. Either problem of animal diseases found in the area? Yes_____No_____

13.1. What are the major diseases of livestock in your area?

13.2. Which breed is more susceptible to disease?

1.Local cattle_____ 2. Crossbred_____

13.3. At what season does high death of cattle have been observed due to disease in your area?

_____

13.4. How frequently you get vaccination service in your area?

1.Very frequent_____ 2. Yearly____ 3. Only during outbreak_____ 4. Less frequent_____ 5.Never_____

14. Animal health service,(presence of animal health service in the area)?

1.Yes _____2. No_____

14.1. If yes, who has given health services for livestock in your area?

1.Agricultural Bureau those trained for animal health_____ 2. NGO_____

3.privatehealth service _____4. Others_____(Specify) _

14.2. what was the estimated total cost you incurred for veterinary service during 2017/2018? _____ birr.

14.3. Housing and watering condition.

14.3.1 where do you keep your cattle during the night?

A. Local cattle, in the house_____ 2.Traditional barn_____

3.Improved barn_____ 4. Others_____

B, Crossbred 1_____In the house____2. Traditional barn____

3.Improved barn_____ 4. Others_____

14.4. Is their water shortage problem during dry season?

1.Yes_____ 2. No_____

14.5.1. If yes, how do you solve the problem? _____

14.5.2. How far the watering place _____ km?

14.5.3. Animal feeding system.

14.5.4. What are the major livestock feeding systems you use?

1.Free grazing_____ 2. Zero grazing_____

3.Rotational grazing_____

14.6. Do you have feed shortage?

1. Yes_____ 2.No_____

14.6.1. If yes, what are the main causes for the problem?

1. Lack of rain_____ 2.Lack of grazing land_____

3.Increased livestock population_____

4. Poor pasture quality_____ 5.Others (Specify)_____

14.7. Do you grow tree Lucerne?

1. Yes_____ 2.No_____

14.8. What fodder and forage crop you have grown?

1. Fodder beat_____ 2. Elephant grass_____ 3. Tree legumes_____

4. Oat_____5.Others_____

14.9. Do you feed your livestock concentrate? 1. Yes_____ 2.No_____

14.9.2. If yes which livestock category you often feed concentrates?

1. Local cows_____ 2. Crossbred cows _____3. Oxen____

14.10. Describe concentrate type and amount purchased during 2017/2018

No	Types of concentrate	Amount bought	Unit price	Total price	Source of concentrate
1	Fagullo (Qt)				
2	Furushica (Qt)				
3	Salt (Kg)				
	Others				

14.11. Are concentrates available at required amount and time?

1. Yes_____ 2.No_____

14.12. Do you use hay (from traditional pasture) for livestock feeding?

1. Yes_____ 2.No_____

14.13. What are the main sources of livestock feed during dry season?

1. Crop residue_____ 2Hay_____ 3.Tree legumes (leaves)____

4. Others _____

14.14. Do you use crop residue (straw) for livestock feeding? 1.Yes_____ 2.No_____

14.14.1. If yes, where do you get it?

1. From own farm_____ 2.By purchasing_____

3.Others specify_____

14.14.2. If purchased specify the total cost you incurred to buy crop residue during 2018? _____ birr.

14.15. Specify type of pasture land and its availability found in your area.

1. Communal grazing_____ 2.Individual grazing_____

3. Others (Specify)_____

14.16. Is there a seasonal feed shortage problem?

1.Yes_____ 2. No_____

14.16.1. If yes in which season it is a serious problem? _____ Month.

14.17. Please mention problems associated with livestock production in your area? _____

14.18. Describe any social economic and environmental problems you have in PA?

_____

14.19.What change have you observed in your farm after adopting crossbred dairy technologies?_____

_____1

4.20.What intervention must be used for better implementation of dairy technologies in the future?_____
_____

14.21. Any idea with regard to the negative impact of crossbred dairy cows?
_____
_____

14.22. What are the constraints for the adoption of dairy technologies in general and crossbred cows in particular? _____.