EFFECTIVENESS OF TECHNOLOGY GENERATION AND DISSEMINATION PROCESS IN DAIRY PRODUCTION IN WEST SHEWA ZONE OF OROMIA, ETHIOPIA

THESIS SUBMITTED TO THE

ICAR-NATIONAL DAIRY RESEARCH INSTITUTE (DEEMED UNIVERSITY), KARNAL
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF DOCTOR OF PHILOSOPHY

IN

AGRICULTURAL EXTENSION EDUCATION

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This is to certify that the thesis entitled, **" EFFECTIVENESS OF TECHNOLOGY GENERATION AND DISSEMINATION PROCESS IN DAIRY PRODUCTION IN WEST SHEWA ZONE OF OROMIA, ETHIOPIA"** submitted by **Workneh Abebe Wodajo** towards the partial fulfilment of the award of the degree of **Doctor of Philosophy IN AGRICULTURAL EXTENSION EDUCATION** of the **ICAR-National Dairy Research Institute (Deemed University)**, Karnal (Haryana), India, is a bonafide research work carried out by him under my supervision and no part of the thesis has been submitted for any other degree or diploma.

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Date: 08-12-2016

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DEDICATION

THIS THESIS IS DEDICATED TO MY WIFE, WOSENE TILAYE AND OUR CHILDREN GALATOM, KENA AND BARNABAS

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"GLORY TO GOD, HE HAS DONE MARVELOUS DEEDS"

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"THE WORD OF GOD IS AUTHORITATIVE"

Place: Karnal (Haryana), India
Date: _____

Workneh Abebe Wodajo

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LIST OF ABBREVIATIONS

ADPLAC	Agricultural Development Partners Linkage Advisory Council
AI	Artificial Insemination
AKIS	Agricultural Knowledge Information System
ALM	Actor Linkage Matrix
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (International Maize and Wheat Improvement Center)
CSA	Central Statistical Authority
DA	Development Agent
DADIS	Domestic Animal Diversity Information System
DADPLAC	District Agricultural Development Partners Linkage Advisory Council
DAGRIS	Domestic Animal Genetic Resource Information System
EARO	Ethiopian Agricultural Research Organization
EIAR	Ethiopian Institute of Agricultural Research
EIBC	Ethiopian Institute of Biodiversity Conservation
FAC	Future Agricultures Consortium
FADPLAC	Federal Agricultural Development Partners Linkage Advisory Council
FAO	Food and Agricultural Organization
FARA	Forum for Agricultural Research in Africa
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
FRG	Farmers Research Group
FTC	Farmer Training Center
GDP	Gross Domestic Product
HARC	Holetta Agricultural Research Center
ILRI	International Livestock Research Institute
ISNAR	International Service for National Agricultural Research

KADPLAC	Kebele Agricultural Development Partners Linkage Advisory Council
KAM	Knowledge Assessment Methodology
KDB	Kenya Dairy Board
KI	Knowledge Index
MoA	Ministry of Agriculture
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NGOs	Non Governmental Organizations
PADETES	Participatory Demonstration and Training Extension Systems
RADPLAC	Regional Agricultural Development Partners Linkage Advisory Council
REFAC	Research Extension and Farmers Advisory Council
RELC	Research-Extension Liaison Council
TLU	Tropical Livestock Unit
ZADPLAC	Zonal Agricultural Development Partners Linkage Advisory Council

ABSTRACT

Research and extension agencies undertook strenuous efforts to generate and popularize various improved dairy practices during the past five decades in Ethiopia. However, the majority of the farmers still continue to adopt traditional dairy practices. Thus, this study was carried out to study the effectiveness of research and extension process in generating and disseminating improved dairy practices; to find out the factors influencing technology adoption in dairy production; and to measure the extent of convergence of different agencies promoting dairy production. Cross sectional survey design was employed for carrying out this study. Simple random sampling technique was employed to identify 250 respondents (Researcher, extension worker and farmers). Holistically, to capture all the relevant information, mixed methods such as focus group discussion, key informant interview, survey and observation were used for data collection. The data were analyzed developing dairy research and extension effectiveness index, descriptive statistics, ANOVA, ordered logistic regression, multinomial logistic regression, partial budgeting and ranking. The dairy research effectiveness index revealed that about 52, 42 and 6 per cent of the respondents were in the ranges of low, medium and high levels of the index respectively. On the other hand, the dairy extension effectiveness index indicated that about 74, 24 and 2 per cent of the respondents were in the ranges of low, medium and high levels of the index respectively. Ordered logistic regression model revealed that personal characteristics, research/extension participation, infrastructure, responsiveness of improved dairy practices, research/extension management, policy environment and social participation were found to be positively and significantly influencing the effectiveness of dairy technology generation and dissemination process. Weak linkage among the actors was prevailing in the study area mainly due to budget constraints, absence of commitment from the actors, coordination problem, frequent restructuring without in depth study, frequent shift of job (staff turnover), poor representations of actors, absence of external pressure from policy makers and absence of independent organization for taking responsibility of linkage activities. Ranking of research problems indicated that the research effectiveness sub indicators such as research management, infrastructure, research policy, responsiveness of improved dairy practices and research management rank 1st, 2nd, 3rd , 4th and 5th respectively, in terms of their importance for improving the effectiveness of dairy research process, whereas, ranking of extension problems indicated that infrastructure, extension policy, responsiveness of improved dairy practices and extension management rank 1st, 2nd, 3rd and 4th respectively. Multinomial logistic regression revealed that age, education level of household head, farm experience, livestock holding, frequency of extension contact, availability of improved dairy practices and training were found to be positively and significantly influencing the adoption of improved dairy practices. The main reasons for non adoption of improved dairy practices were that poor delivery of AI service, absence of market for milk production, attention of extension services only to model farmers living at accessible areas, absence of integration between agricultural production and marketing and less risk bearing capacity of the farmers. Generally, the dairy development of the study area was held back by the absence of shared vision between the key actors which necessitates the integrated action of multi-actors. The study suggests revisiting of the current dairy research, extension and actors linkage policies and strategies; capacitating dairy researchers, extension professionals and farmers; creating ready market; and promoting farmer-to-farmer extension in order to promote sustainable development of the livestock sector with focus on dairy development in Ethiopia. Immediate attention should be on organizing independent linkage coordination unit at zone and district levels and initiating collaboration program with experienced countries in dairy research through experience sharing and staff exchange program.

सारांश

इथोपीया में पिछले पांच दशकों से विभिन्न डेयरी सुधार प्रथाओं को लोकप्रिय बनाने के लिए अनुसंधान और विस्तार एजेंसियों द्वारा काफी ज़ोरदार प्रयास किया जा रहा है। हालांकि, किसानों का बहुमत अभी भी पारंपरिक डेयरी के तरीकों को अपनाने के लिए जारी है। इस प्रकार, पैदावार बढ़ाने व बेहतर डेयरी तकनीक अपनाने के लिए अनुसंधान और विस्तार की प्रक्रिया पर प्रभाव का अध्ययन करने के लिए; डेयरी उत्पादन में प्रौद्योगिकी अपनाने मे प्रभावित करने वाले कारक का पता लगाने के लिए; और डेयरी उत्पादन को बढ़ावा देने के लिए विभिन्न एजेंसियों के अभिसरण की सीमा को मापने के लिए, इस अध्ययन में क्रॉस अनुभागीय सर्वेक्षण डिजाइन नियुक्त किया गया था। उत्तरदाताओं) शोधकर्ता, विस्तार कार्यकर्ता और किसान (की पहचान करने के लिए सरल यादृच्छिक नमूना तकनीक 250 नियुक्त किया गया था। समग्र रूप से, सभी प्रासंगिक जानकारी, जैसे फोकस समूह चर्चा, कुंजी मुखबिर साक्षात्कार, सर्वेक्षण और प्रेक्षण के रूप में मिश्रित तरीकों के लिए डेटा संग्रह इस्तेमाल किया गया। डेटा डेयरी अनुसंधान और विस्तार प्रभावशीलता सूचकांक, वर्णनात्मक आँकड़े के विकास का एनोवा, रसद प्रतिगमन, अन्य रसद प्रतिगमन और रैंकिंग द्वारा विश्लेषण किया गया। उत्तरदाताओं का डेयरी अनुसंधान प्रभावशीलता सूचकांक से पता चला है कि 52 फीसदी कम, 42 फीसदी मध्यम व 6 फीसदी उच्च स्तर की सीमाओं में थे। दूसरी ओर, डेयरी विस्तार प्रभावशीलता सूचकांक के बारे में संकेत दिया है कि उत्तरदाताओं का 74 फीसदी कम, 24 फीसदी मध्यम व 2 फीसदी उच्च स्तर की सीमाओं में थे। रसद प्रतिगमन मॉडल से पता चला है कि व्यक्तिगत विशेषताओं, अनुसंधान/विस्तार भागीदारी, बुनियादी सुविधाओं, डेयरी प्रथाओं में सुधार की जवाबदेही, अनुसंधान/विस्तार प्रबंधन, नीति पर्यावरण और सामाजिक भागीदारी सकारात्मक और काफी डेयरी प्रौद्योगिकी पीढ़ी और प्रसार की प्रभावशीलता को प्रभावित करने का आदेश दिया। अध्ययन से पता चला की बजट की कमी, अभिनेता से प्रतिबद्धता का अभाव, समन्वय समस्या, लगातार पुनर्गठन के कारण अध्ययन के क्षेत्र में मुख्य रूप से प्रचलित, काम में लगातार बदलाव, अभिनेताओं में गरीब अभ्यावेदन, नीति निर्माताओं से बाहरी दबाव व लिंकेज का अभाव गतिविधियों की जिम्मेदारी लेने के लिए स्वतंत्र संगठन का अभाव ही अभिनेताओं के बीच कमजोर कड़ी है। अनुसंधान समस्याओं की रैंकिंग ने यह संकेत दिया है कि इस तरह के अनुसंधान प्रबंधन, बुनियादी सुविधाओं, अनुसंधान नीति, डेयरी सुधार प्रथाओं और अनुसंधान प्रबंधन रैंक 1, 2, 3, 4 और 5 क्रमशः की जवाबदेही, प्रभावशीलता में सुधार लाने के लिए उनके महत्व के मामले के रूप में अनुसंधान प्रभावशीलता उप संकेतक डेयरी अनुसंधान की प्रक्रिया है, जबकि, विस्तार समस्याओं की रैंकिंग कि बुनियादी ढांचे, विस्तार नीति, सुधार डेयरी प्रथाओं और विस्तार प्रबंधन रैंक क्रमशः 1, 2, 3 और 4 की जवाबदेही का संकेत दिया है। रसद प्रतिगमन में अनेक नामों कि उम्र, घरेलू अध्यक्ष, खेत अनुभव, पशुजोत का आकार, विस्तार संपर्क की आवर्ती की शिक्षा के स्तर का पता चला, डेयरी सुधार प्रथाओं और प्रशिक्षण की उपलब्धता सकारात्मक और डेयरी प्रथाओं में काफी सुधार को प्रभावी किया जाए। डेयरी प्रथाओं में सुधार में कमी करने के लिए मुख्य कारण थे जैसे, सेवाए, दूध उत्पादन व बिक्री के लिए बाजार का अभाव, केवल सुलभ क्षेत्र, कृषि उत्पादन, विपणन और जोखिम के असर के बीच एकीकरण के अभाव में रहने वाले मॉडल किसानों को विस्तार सेवाओं के ध्यान में रखकर गरीब वितरण किसानों की क्षमता। आमतौर पर, अध्ययन में क्षेत्र के डेयरी विकास के मुख्य अभिनेता जो बहु-अभिनेताओं की एकीकृत कार्रवाई के बीच जरूरी एवॅ साझा दृष्टिकोण के अभाव को वापस आयोजित किया गया। वर्तमान अध्ययन डेयरी अनुसंधान, विस्तार की पुर्नलोकन और अभिनेताओं की नीतियों और रणनीतियों के संबंध में, डेयरी शोधकर्ताओं, विस्तार पेशेवरों और किसानों की क्षमता; बिक्री के लिए तैयार बनाने के लिए किसान विस्तार को बढ़ावा देने इथोपीया में डेयरी विकास पर ध्यान देने के साथ पशुधन क्षेत्र में सतत विकास को बढ़ावा देने के लिए किया गया। तत्काल ध्यान देने, स्वतंत्र संबंध संगठन और अनुभव बांटने और कर्मचारियों के आदान-प्रदान कार्यक्रम के माध्यम से डेयरी अनुसंधान के क्षेत्र में अनुभवी देशों के साथ सहयोग कार्यक्रम की शुरुआत होना चाहिए।

CHAPTER 1

INTRODUCTION

INTRODUCTION

Ethiopia is a large and most populous Sub-Saharan African country with a total land area of 1,104,300 sq.km. As per the projection of (CSA, 2013), the total population of Ethiopia in 2015 is 90 Million with annual growth rate of 2.6 per cent of which the majority of the population (80.6 %) is engaged in farming. Agriculture contributes 46 per cent of GDP and also a major source of foreign exchange. The main agricultural exports are coffee, hides and skins, pulses, oilseeds, bee wax, tea and floriculture. Domestically, cereal, vegetable, fruit, meat and dairy production sustain the livelihood of people. Agriculture is characterized by low productivity despite its high economic importance (Amdissa, 2006).

Role of dairy production in Ethiopia

Dairy production is the major subsector of agriculture to improve the livelihoods of the community. Cattle, camel and goats are the major sources of milk and milk products in Ethiopia of which cattle constitute 83 per cent of the total milk and 97 per cent of cow milk comes from indigenous breeds (SNV, 2008). In addition, the country is endowed with diverse topographic and climatic conditions which support use of improved, high milk yielding breeds, and offer relatively suitable environment for dairy production. To exploit the dairy subsector of the country, it needs homemade policy and strategy on dairy technology generation, development and dissemination. In the other way, it needs the commitment of policy makers, planners, executors and all citizens to actualize the development efforts of the country; including exploitation of the natural resources in sustainable manner. It is in such a way that the country can successfully overcome a long struggle of poverty and join the middle income level countries within the timeframe of the plan. Significant growth in farm sector would promote sustainable development and reduce poverty (Amdissa, 2006). In this process, increasing dairy production and productivity are vital to improve the livelihoods, food security and poverty eradication efforts of the rural communities. This warrants huge investment in agriculture which is 2.5 to 3.0 times more effective in increasing the income of the poor than non agricultural investment (Johannes, 2012). In addition, farmers need to get access to improved agricultural technologies and extension services. The Ethiopia government has also made various efforts to maximize the productivity of the sector, of which establishing research organization is one to mention.

Agricultural research in Ethiopia

The inception of research organization in Ethiopia coincides with the establishment of Haramaya University the then Imperial College of Agriculture and Mechanical Arts in 1953. However, the organized research institute was established in 1966 with the name Institute of Agricultural Research (IAR), which was later renamed as Ethiopia Agricultural Research Organization (EARO); and currently is known as Ethiopian Institute of Agricultural Research (EIAR).

The federal, regional research centers, higher learning institutions of the country and NGOs have generated, verified, demonstrated and popularized various agricultural technologies. Scaling up of agricultural technologies and best practices program are also launched. Yet, agricultural production of the country is still characterized by low productivity and low level use of agricultural technologies. Hence, there is a felt need for the processes of communicating, sharing and scaling up agricultural knowledge beyond the range of research, extension services and farmers to other stakeholders (Aldernburg, 2007).

Agricultural extension in Ethiopia

Modern agricultural extension system had been introduced in the country since 1950s. Although different extension systems were used previously, the country has formulated Participatory Demonstration and Training Extension System (PADETES) in 1995. The main objectives of PADETES are: increasing production and productivity of small-scale farmers through research-generated information and technologies; empowering farmers to participate actively in the development process; increasing the level of food self-sufficiency; increasing the supply of industrial and export crops and ensuring the rehabilitation and conservation of the natural resource base of the country. Currently, PADETES promote packages on cereals, livestock, high economic value crops, improved post-harvest technologies, agro-forestry, soil and water conservation and beekeeping developed for different agro-ecological zones (Anandajayasekeram *et al.,* 2008). The Ethiopia government has also made effort to improve the accessibility of agricultural technologies of research centers to the farmers. The first effort is establishing agricultural extension wing in the research organization which is mandated to undertake extension research, technology demonstration and popularization. Agricultural Development Partners Linkage Advisory Council the then Research-Extension Advisory Councils at different stages (Federal, Regional, Zonal, District and 'Kebele' levels) were also established. Though such efforts are made, farmers' utilization of improved farm technologies is minimal and dormant. As a result, the gap between resource rich and resource poor farmers is escalating. On the other hand, the field-level extension service has a strong

foundation of Farmers Training Centers (FTCs) and trained development agents (DAs) already in place in the field. Roughly 8,489 FTCs have been established throughout Ethiopia, and about 62,764 Development Agents (DAs) have been trained in total, with a reported 45,812 staff on location (IFPRI, 2010). In Ethiopia, there are about 12.9 million rural households. As a result, the current development agent/farmer ratio is about 1:300 at the household level which is probably makes the country to have the highest development agent-farmers ratio.

Focus of dairy research and extension

The main areas of dairy research and extension in Ethiopia are breeding, improved feed and feeding, improved management and animal health. Though dairy is a familiar farming enterprise and income-generating activity in Ethiopia, no systematic study has been so far undertaken to identify dairy development constraints from research, extension and clientele perspective. Thus, there is a need for detailed probing of aspects such as artificial insemination, improved feed and feeding, and improved housing with respect to extent of their research and extension. Hence, to contribute to the development of the dairy subsector, a comprehensive study is required to have in-depth understanding of the existing dairy technology generation processes and its dissemination. At the same time, it is equally important to generate policy inputs on key problematic area of the dairy subsector accompanied by appropriate solution for making it more productive.

1.1. STATEMENT OF THE PROBLEM

Ethiopia ranks first in cattle population in Africa and it is also among the top 10 countries who own highest cattle population in the world. As a result, dairy production is an integral part of agricultural activities in Ethiopia. Livestock contributes to the national economy about 15 per cent of the total GDP, 40 per cent of the agricultural GDP and 31 per cent of the total employment (Aklilu, 2002; Getachew, 2003) as cited in Yilma, *et al.* (2011). This estimate did not include the value of draught power, manure and rural transportation services which could increase the contribution of the livestock sector beyond the estimated figure.

The introduction of improved dairy practices in Ethiopia was marked by 300 Friesian and Brown Swiss dairy cattle which were donated by United Nations Relief and Rehabilitation Administration in 1947. Modern extension system and agricultural research had also been started in 1950s and 1960s respectively. Since then, research generated various improved dairy practices in the area of improved management practices, feed and feeding practices,

health care practices, and breeding practices. Similarly, extension has been working on the dissemination of improved dairy practices to the end users. Scaling up of agricultural technologies and best practices program are also initiated. Though dairy research and extension made effort for more than five decades, the coverage of Artificial Insemination technology is one per cent. About 0.15 per cent of rural livestock holders use improved forages (alfalfa, *Medicago sativa* and Napier grass, *Pennisetum purpureum)* (CSA, 2008). Similarly, the use of industrial by-products like oil cake, bran and brewery residue is negligible (0.8%). EARO (2006) also states that "despite decades of research and development efforts, with the aim to provide farmers new technologies to improve their farming practices, agricultural productivity for both crop and livestock production is still very low." FAO Statistical Database (2011) also evidently points out that globally, Ethiopia has the lowest average milk productivity (380 kg/ cow/ year) and only it precedes Nigerian (245 kg/ cow/ year/) and Tanzania (239 kg/ cow/ year).

Generally, low productivity, low level use of agricultural technologies and low adoption of improved dairy farming technologies were the major concerns. Thus, for realizing the desired dairy subsector development, it was high time to evaluate the effectiveness of the existing dairy technology generation and dissemination process. This, in turn, would help to come up with the alternatives that enhance the livelihood improvement of the dairy farmers. In order to achieve the envisaged research objectives, the study considered dairy technology generation and dissemination process of Welmera, Ambo and Toke Kutaye districts in Ethiopia as the area of research focus. In the study area, research center and university have been working on various agricultural technology generation and dissemination. Additionally, Holetta Agricultural Research Centre serves as a centre of excellence for dairy research in the country. It also plays a role of dairy technology generation; demonstration of promising technologies on farms with the participation of smallholder farmers, capacity building and coordination of dairy improvement research activities at federal and regional levels.

In the light of these facts, this research project intended to look into the study from system perspective (research, extension and clientele). In fact, it is likely to contribute to the development of system approach in the country. This research also contributed to the methodological improvement in combining the conventional econometric model with index value. Leeuwis (2004) also notes that econometric models fail to conceptualize the social dimensions of knowledge, information, communication and rationality. In addition, policy makers, researchers and other stakeholders in the dairy development get adequate information on the current status of dairy technology generation and dissemination process which, in turn,

would help them to suitably modify the strategies. Consequently, the dairy subsector contributes towards poverty reduction and improvement of the livelihood of the rural people significantly.

1.2. OBJECTIVES OF THE STUDY

The major objective of this study was to examine effectiveness of dairy technology generation and dissemination from the system perspective. This study was designed with the following specific objectives;

a. To study the effectiveness of research and extension process in generating and disseminating improved dairy practices
b. To find out the factors influencing technology adoption in dairy production
c. To measure the extent of convergence of different agencies promoting dairy production

Research questions

The study made attempts to answer the following research questions.

a. What is the extent of the effectiveness of the existing technology generation process in dairy production?
b. What is the extent of the effectiveness of the existing technology dissemination process in dairy production?
c. What are the determinants of technology adoption in dairying?
d. How dairy farming innovations are perceived from farmers' perspective?
e. What is the extent of convergence among the actors that promote dairy production?

1.3. SIGNIFICANCE OF THE STUDY

Research, extension and other actors are engine to drive the dairy development of the country. Thus, realizing the factors that affect the effectiveness of dairy research and extension are very crucial for searching solution which, in turn, contributes to exploit the existing untapped dairy potential of the country. There are various factors that positively or negatively contribute towards the effectiveness of dairy technology generation and dissemination. Identification of the factors are important for policy makers, researchers and other actors involved in dairy development programs to get enough information on dairy technology generation and dissemination status, which, in turn, would help them to suitably modify the

strategies. Hence, the study would contribute much in generating appropriate information on dairy technology generation and dissemination; and extent of convergence of different agencies promoting dairy production.

1.4. SCOPE AND LIMITATIONS OF THE STUDY

The study dealt with assessing the effectiveness of dairy technology generation and dissemination by taking the sample from three districts only. It could not represent the whole population of dairy researchers and extension workers in Ethiopia. This hindered generalization about dairy research and extension situation in the country. However, the research center that serves for coordinating national and regional dairy research is included in sample of the study. Thus, the research finding that emanated from the study may reflect the effectiveness of dairy research and extension situation of the country. The sample size for using ordered logistic regression was small. It was mainly due to smaller size of the whole population of the study (Researchers and extension workers) in the study area. Though the sample size may influence the value of the model output, it can serve as indicative. The attempt of using model was made to indicate the possibility of further analysis of index value by using ordered logistic regression for indentifying the influencing variables. In the other way, sub indicators of index that influence the dependent variable can be identified using ordered logistic regression.

1.5. ORGANIZATION OF THE THESIS

The thesis is organized into five chapters. It starts with the introduction, which includes statement of the problem, research questions, objectives, significance of the study and scope and limitation of the study. The second chapter reviews literature that deals with past studies and information pertinent to the study. The third chapter explains research methodology including description of the study area, sampling techniques, methods of data collection and tools for data analysis. In the fourth chapter the main findings of the study are discussed. Finally, conclusions and recommendations are provided in chapter five. At the end, bibliography and appendices are given.

CHAPTER 2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The relevant literature relating to the objectives framed for the study have been collected and presented under the following sub-heads:

2.1. DAIRY DEVELOPMENT OF EAST AFRICA

Dairy development of Kenya and Sudan are considered among the neighboring countries of Ethiopia. Comparatively, the dairy productivity of both countries is high in east Africa.

In Kenya, livestock contributes 10 per cent of total and 30 per cent of agricultural GDP. Dairy products (excluding live animals) contribute 30 per cent of livestock GDP and more than 22 per cent of livestock gross marketed products.

Milk production system of Kenya is divided into large-scale and small-scale of which the later dominates. Size of holding, management and inputs are the main factors for differentiating large and small scale milk production of the country. However, some small holder dairy farmers use high quality of management and commercialized.

In Sudan, the rural communities own 80 per cent of the livestock and the nomadic tribes own 90 per cent of the rural holdings with livestock playing a central role in their livelihoods (Lutfi *et al.,* 2005). Kenana and Butana cattle breeds of Sudan are the most productive indigenous African cow milk breeds. The production systems are characterized by pure nomadic to more settled systems. The lactation records of the breeds show about 1500 kg and 1662.57 respectively. In a study report by Lutfi *et al.* (2005) pointed out that in some major production traits the Sudanese Butana cattle compare favorably with some of the best breeds in tropical countries and their performance does not fall far behind that of 50 per cent crossbred cattle in the Sudan, particularly if it is afforded the same level of management that crossbred cattle usually get.

In Kenya average annual milk production is about 1600 kg per lactating cow. In Kenya cattle, camel and goats are the main sources of milk production. Grade cattle consist about 50 per cent. The remaining are Friesian, Ayrshire, Jersey, Guernsey, Sahiwal and their crosses.

According to Philipsson (1999) comparatively, Sahiwal cattle has high potential for milk production in harsh conditions. It also has a trait of few milk let-down problems and good beef characteristics. These traits have led to an international demand for semen of Sahiwal-

crosses in tropical and subtropical countries. Some indicators of the success of Sahiwal breed are the evolvement of other breed from their crosses such as Sahiwal crosses with Bos Taurus gave Jamaica Hope (Jamaica), Karan Swiss (India) and AMZ and AFS (both Australia).

Moreover, dairy co-operatives of Kenya contributed much for the dairy development by creating conducive market environment and providing services to farmers. Similarly, the Sahiwal breed was pointed out by FAO due to its high potential in harsh conditions. It is to be given high priority for conservation by management, in order to develop the breed for further global use.

The literature revealed that the dairy productivity of Kenya and Sudan are better compared to Ethiopian dairy cattle. These countries possess almost similar climatic conditions with Ethiopia. Moreover, Ethiopia also witnesses the introduction of European dairy breeds since the late 1940s. However, evidence from literature indicates that more than 99 per cent are indigenous zebu cattle. Hence, taking into consideration the dairy breeds of the neighboring countries probably serve as an option for the dairy development in Ethiopia. Thus, designing a mechanism to access such alternatives enhances the dairy development of the country.

2.2. DAIRY DEVELOPMENT PROGRESS IN ETHIOPIA

Historical background

Following the changes of the government regime in the country, three different policies and strategies have been introduced in the dairy subsector. These are:

i. Imperial regime (before 1974): It was an era when exotic dairy cows were introduced to the country. During this period the government supported the large indigenous commercial farmers in peri-urban areas.
ii. Socialist regime (1974-1991): It followed a centralized economic system and state farms. There was a support to smallholders and large scale state farm productions.
iii. Free market (1991 and onwards): It aimed at increasing milk production through the introduction of liberalized markets and private sector investment. Following a strategy of Agricultural Development Led Industrialization, the focus was shifted from urban to rural areas. However, in the dairy subsector, urban and per-urban areas are getting more benefit from improved dairy practices.

During the aforementioned regimes of the government, different development polices and strategies were followed due to ideological variations among the governments. In fact, the

development policies and strategies of the previous governments were terminated along with their regime. There was less opportunity on the utilization of the development efforts of other after a shift from one regime to another. Such inconsistency of development polices and strategies among the governments significantly affected the development of the dairy sub-sector of the country.

Current position of dairy development

Ethiopia is home to the largest population of cattle in Africa, numbering about 52,129,017 cattle (CSA, 2011) and 99 per cent of them are indigenous low yielding breeds and managed by smallholder, commercial and pastoral farmers. CSA (2010) estimate indicates that the indigenous breeds accounted for 99.19 per cent, while the hybrids and pure exotic breeds were represented by 0.72 and 0.09 per cent, respectively. From the total cattle population, 45.13 per cent are males and 54.87 per cent females. In relation to breed of cows in the country, variation in data are observed among the reports for instance Domestic Animal Genetic Resource Information System (DAGRIS) reported 32, whereas, the Ethiopian Institute of Biodiversity Conservation (EIBC) reported 27 cattle breeds; and Domestic Animal Diversity Information System (DADIS) managed by FAO reported 31. High population of cattle, favourable climatic conditions and high urbanization rate favour the dairy development, though the current performance of the dairy industry in Ethiopia is not promising when compared to dairy development in Eastern African countries. In view of such a large number of dairy cows and the important number of producers engaged in the dairy sector, the development efforts so far made have not brought a significant impact on the growth of the sector. According to Yilma *et al.* (2011) during the production year of 2010, the average daily milk production was only 1.69 liters with average lactation length of about 180 days and mean annual milk yield per cow of 305 liters. Similarly in the previous study by Alemu *et al*. (2000) the annual growth rate in cow milk production reported in 1990 in Ethiopia was nearly 1 per cent as opposed to 6.2 per cent in East Africa and 3.3 per cent in the whole of Africa. The per capita milk consumption in Ethiopia is 18.68 liters which is very low as compared to the global average of 100 liters and even far below the average for Africa, 26 liters. The dependence on import milk and milk products remain increasing, for example, in 2001 import of milk and milk product was about 3.1million USD and increased to about 9 million USD in 2008. However according to Yilma *et al*. (2011) milk production in the country has generally increased over the last 10 years from about 1.5 billion liters in 2001 to about 2.2 billion liters in 2005 and around 2.9 billion liters in 2010. This increasing trend is

mostly associated with an increase in the number of cows. However, the per capita milk consumption has declined from 26 kg per annum in 1980, to 22 kg in 1993, 19 kg in 2000 and 16 kg in 2009. This is likely attributed to the mismatch between the growth rate of milk production and human population.

Livestock feeding mainly depends on grazing and browsing. In the highlands, grazing on communal lands is the common practice. This feeding method is supplemented with natural grass hay, crop residues such as straws and chaffs of cereals and pulps, and agro- industrial by-products mostly from the flour/oil industries and brewery residues. Dairy producers who keep improved dairy cows also cultivate improved forage crops such as elephant grass, oats, vetch and alfalfa to supplement grazing (CSA, 2010). According to CSA (2010), in Ethiopia the total agricultural land is reported to be about 16 million hectares occupying 12.9 million households accounting for an average of 1.23 ha per household.

Milk production systems in Ethiopia

There are four major milk production systems in Ethiopia, namely, highland smallholders, pastoralist, urban and peri-urban and intensive dairy farming.

The highland smallholder milk production: It is a central part and covers about 40 per cent of the land size of the country. The suitable climate of the area makes it potential for dairy development. The area is characterized by subsistence mixed farming of crop and livestock production system

Pastoralist: It is in the low land area (below 1500 m.a.s.l) of the country probably covers about 30 per cent of the livestock population of the country and characterized by low milk production due to feed and water constraints.

Urban and peri-urban: This milk production system consists small and medium dairy farms in towns and cities including their surroundings. It is mainly produced due to the presence of demand for milk in the area and produced for earning additional income from the milk sale. Feed sources are oil seed cakes, bran, roughage etc. It is also mainly located in the highlands area of the country.

Intensive Dairy Farming: It is specialized milk production system undertaken by private sectors and mostly concentrated in the capital and regional cities of the country. Exotic pure bred and crossbred are the main sources of milk. However, of all milk production system, it produces a very minimal amount of milk.

2.3. EFFECTIVENESS OF DAIRY TECHNOLOGY GENERATION AND DISSEMINATION PROCESSES

Future Agricultures Consortium (FAC) in 2011 emphasizes the importance of incorporation farmers needs for the effectiveness of agricultural technology generation and dissemination institutions based on the lessons across Africa. In many parts of Africa, realizing the potential of agricultural research to reduce poverty has been elusive as reported in 2006 by Forum for Agricultural Research in Africa (FARA), taking into account the existing prevalence of poverty, hunger and malnutrition among farm families, in many parts of Africa.

Sumberg (2004) also notes that agricultural research in Africa had generally yielded limited benefits for poor people because it was elitist and out-of-touch with rural realities. Similarly, Rolling (2006) argues that the production of agricultural technologies by research, even if they 'work' in the experiment station, is absolutely no guarantee for diffusion.

The main factors that affect agricultural research and extension work in developing countries are: lack of qualified research personnel, inadequate resources, inappropriate resource allocation, weak research-extension linkages, low extension worker farmer ratio, lack of practical skills on the part of extension workers, poor in-service training facilities, multiple work role of extension workers, lack of incentive for extension work, inefficient program planning, illiteracy and small land holdings of extension clientele (Tanvir *et al.,* 1994). The authors further state that lack of qualified personnel in the research organizations affects the technology development which ultimately affects agricultural extension work as the poorly developed technology is hard to be accepted or adopted by the farming community.

Similar study by Knowledge Assessment Methodology, KAM (2012) using Knowledge Index (KI) ranks Ethiopia 140th out of 145 countries in ability to generate, disseminate and use knowledge. EARO (2006) also states that despite decades of research and development efforts, with the aim to provide farmers new technologies to improve their farming practices, agricultural productivity for both crop and livestock production is still very low.

Additionally, a report by Azage *et al*., (2006) states that Knowledge generated by the national research institutes of Ethiopia was not communicated in a useful and accessible manner to livestock keepers. Tesfaye *et al*., (2008) also identified that the focus of dairy research has been on the generation of technical knowledge/technology with limited activities on technology transfer, marketing, service delivery and organization.

In Ethiopia, the responsiveness of research systems and researchers to farmer constraints and priorities remains unsatisfactory in too many cases. One of the main reasons for this is lack of

downward accountability by researchers (and others) to their customers. Research is accountable to those who provide the funds, usually government or contracted clients. Until it becomes more accountable to their real customers for at least a part of their funds, cementing close cooperation between research and extension and increasing their customer responsiveness, will remain an issue (Vince, 2005).

The author also identified the weaknesses of Ethiopian farm advisory services as follows; an institutional management culture that tends to inhibit innovation and risk-taking; continuance of top-down transfer of technology paradigm; insufficient qualified front line extension agents; lack of appropriate technologies for resource poor farmers; lack of proper' attitude' extension staff in listening and learning from farmers ; inadequate in-service training and field backstopping for all technical and extension staff; inadequate knowledge of the socio-economic situation of the target group including an understanding by extensionists of the family dynamics of poverty and food insecurity; absence of capacity empowerment programs for rural communities; too few female extensionists; technologies not being economically viable and socially acceptable to farmers individual situation; insufficient adaptation of technology recommendations to local agro-environments; weak information and communication system; and despite some recent strengthening, linkages with research remain tentative

For making research and extension effective frequent monitoring and evaluation needs to be a main regular activities of research and extension organizations. In this regard, CIMMYT Economics Program, (1993) summarizes as follows, "Organizations responsible for developing new technology need to know if the transfer process is functioning. Organizations responsible for promoting technology transfer need to know if their message is being heard by their clients. Community or regional development efforts need to judge to what extent technological change is contributing to their goals."

2.4. DETERMINANTS OF DAIRY TECHNOLOGY ADOPTION

Adoption is a decision-making process, in which an individual goes through a number of mental stages before making a final decision to adopt an innovation. Decision-making is the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward an innovation, to a decision to adopt or reject, to implementation of new idea, and to confirmation of the decision (Ray, 2001). The author further states that adoption is viewed as a variable representing behavioral changes that farmers undergo in accepting

new ideas and innovations in agriculture. The term behavioral change refers to desirable change in knowledge, understanding and ability to apply technological information, changes in feeling behaviour such as changes in interest, attitudes, aspirations, values and the like; and changes in overt abilities and skills

The result of adoption study is the direct reflection of research and extension effectiveness. For instance, more adoption of a technology implies the fitness of the research results and the extension system to the requirements of the users. CIMMYT Economics Program (1993) also states that one of the reasons for doing an adoption study is to provide evidence of the returns to a research or extension effort. The author also summarized the use of information obtained from adoption study as follows;

1) Provide feedback from a farmer that is helpful in refining the technology generation effort
2) Assess the effectiveness of a technology transfer strategy
3) Improve the flow of information between research and extension, on the one hand and policymakers, on the other
4) Document the impact of a technology generation or extension effort

As also noted by Langyintuo and Mulugeta (2005), the importance of adoption study are: to quantify the number of technology users over time to assess impacts or determine extension requirements; to provide information for police reform and to provide a basis for measuring impact.

Adoption studies have been undertaken on various agricultural technologies for more than five decades. The variables that affect farmers' decision to adopt technology have been clearly identified and reviewed as follows;

The study of Doss *et al*. (2003) on adoption of maize and wheat technology in Eastern Africa states that farmers cited several reasons for not adopting improved technologies. The first was simply being unaware of the technologies or that they could provide benefits; this may include misconceptions about the related costs and benefits. The second reason was that the technologies were not profitable, given the complex sets of decisions that farmers make about how to allocate land and labor across agricultural and non-agricultural activities. This may be due to the fact that appropriate varieties for farmers' agro ecological conditions were not available or that farmers preferred characteristics found only in local varieties. It may also be due to institutional factors, such as the policy environment, which affect the availability of inputs (land, labor, seeds, and fertilizer) and markets for credit and outputs. These institutional factors also affect input prices. It may also be that use of improved technologies

may increase production risks: if crops fail, the financial losses would be higher. Finally, technologies were not adopted because they were simply not available.

Ehui *et al*. (2004) explain that a new technology is introduced to small holders farmer by itself alone does not guarantee for a wide spread adoption and efficient use. For efficient utilization of the technology the fulfillment of specific economic, technical and institutional conditions are required. From the farmers' perspective, the new technology should be economically more profitable than the existing alternatives. The new technology should also be technically easily manageable by small holders and adaptable to the surrounding socio-cultural situations. Similarly, the availability of the new technology and all other necessary inputs to small holders at the right time and place and in the right quantity and quality should be ensured. As also noted by Yapa and Mayfeld (1978) adoption of an entrepreneurial innovation by an individual requires at least four conditions. These are: the availability of sufficient information, the existence of a favorable attitude towards the innovation, the possession of the economic means to acquire the innovation and the physical availability of the innovation. Research in the diffusion of agricultural innovations has demonstrated that knowledge/awareness of a new technology is a necessary first step in the adoption decision-making process (Rogers, 1995).

The farmers' socio-psychological system and their degree of readiness and exposure to improved practices and ideas i.e. changes like the awareness and attitude of farmers towards improved agricultural technologies and the institutional factors which act as incentives/disincentives to agricultural practices and the farmers' resource endowment like the land holding size and labor are some of the factors of considerable importance in bringing about the technological change in agriculture (Salim, 1986).

The rate of adoption is influenced by the farmers` perception of the characteristics of the innovation, the changes this innovation requires in farm management and the roles of the farm family (Van den Ban and Hawkins, 1996). The authors further stated that innovations usually are adopted rapidly when they have a high relative advantage for the farmers; compatible with the farmers' values, experiences and needs; are not complex; can be tried first on small scale and easy to observe the results. Adoption of improved technologies is strongly affected by the policy environment like input supply, market, credit, price policies and improved supply system. Likewise, the effectiveness of extension service and other communication media as well as farmers educational level influence the use of improved technologies

According to Rogers (1981), agricultural technology has its own factors, which affect its adoption by a given society. These factors are technologies relative advantage, compatibility, complexity, triability and observability. As to Byerlee *et al*. (1986) the adoption patterns of a particular component is a function of five characteristics namely profitability, riskiness, divisibility, or initial capital requirements, complexity and availability.

A study by Makokha *et al.* (1999), confirms that farmers characteristics such as participation in field days and demonstration, attendance at workshops and seminars contact with extension and leadership position have significant influence on perception and hence adoption decision of farmers. They also found that technological attributes such as supply (availability), economic and yield benefit and convenience had significant influence on adoption decision.

Farmers with high number of livestock have an opportunity to bear the risk that may occur. As a result, it encourages adoption of new agricultural technologies. In line of this, studies of Getahun *et al*. (2000), Endrias (2003) and Tesfaye *et al.* (2001) show that the number of livestock owned, that is expressed by Tropical Livestock Units (TLUs) significantly influence the probability of adoption of a farm technologies in their respective studies. Simeon and Nega (1997) also explain high cost, low return, inappropriateness of technologies, lack of credit facilities, the prevalence of animal diseases, absence of transport and marketing infrastructure as some of problems affecting diffusion of technologies.

Berhanu (2002) observes that the availability off- farm incomes, extension contact, feed shortage, the total livestock owned, distance between residence and market, bull service are found to have a positive and significant influence the adoption decision of the farmers on crossbred dairy cows in the central highlands of Ethiopia. Farmers with high levels of education are better adopters of improved farm practices than those with lower levels of education

Studies of Hassen *et al.* (1998) and Habtemariam (2004) identify that farmers' education had positive and significant influence on adoption.

Cramb (2003) infers that a number of farm-household factors are typically associated with adoption, such as, age, education and personal characteristics of the household head ; size, location and tenure status of the farm; availability of cash or credit for farm investment; and access to markets for farm produce; and so on

Determinants of technology adoption encompass characteristics of the technology, features of the farming system, market and policy environments as well as socio-economic characteristics of the decision- making unit (household, farmer) (Ehui *et al*., 2003). The study

conducted by Million and Belay (2004) indicated that age had a weak and at the same time negative association with adoption. In contrary, Omiti *et al*. (1997) investigated positive relationship between age and adoption behaviour of farmers. Several factors, some of which relate to the characteristics of the technology and others to the context do influence the speed of dissemination and adoption of technologies. The stimulant among these factors is the demonstrated value of such technologies especially the marketability and profitability of their products. Other factors such as the ease of application, access to support services and how the technology fits in the knowledge base of the production system also do significantly influence adoption (National Agricultural Research Organization, 2004).

The probability of adoption of a new technology will depend on the difference in profitability between the new and old technologies, and the ability of the farmer to perceive the advantages and efficiently utilize the new technology (Schultz, 1995). As also noted by Gavaian and Gemechu (1996), high yields are not sufficient conditions to persuade farmers to adopt a technology. With technology application, farming must be basically profitable or at least more profitable than other alternatives.

Leggesse *et al.* (2004) in their study on duration analysis of technological adoption in Ethiopian agriculture reveals that economic incentives are the most important determinants of the time farmers wait before adopting new technology. The authors further stated that other agricultural inputs (area of farm land, labour, credit), extension services and farmers` personal characteristics (education, gender, age) appear to have had little, if any, effect on adoption behaviour.

According to Yilma *et al.* (2011) the main Ethiopian dairy sector challenges identified are : genetic limitation, inadequate animal feed resources, limited access and high cost of dairy heifers/cows, absence of an operational breeding strategy and policy, inadequate veterinary service provision, weak linkages between research, extension service providers and technology users, inadequate extension and training service, milk market related constraints, limited availability of credit to the dairy farmer, and unavailability of land.

The most important constraints associated with AI service in Ethiopia include less structural linkage between AI Center and service giving units, absence of collaborations and regular communications between NAIC and stakeholders, lack of breeding policy and herd recording system, inadequate resource in terms of inputs and facilities, and absence of incentives and rewards to motivate AI technicians (Desalegn *et al.*, 2009).

According to Anandajayasekeram *et al.* (2008) some major factors that affect clients' access to extension services are: gender, farming system, wealth status, land ownership and farm

size, other factors such as cultural constraints, education, age, access to credit and risk taking ability may affect farmers' access to and benefit from extension services.

Similarly, the study by Ulfina *et al.* (2013) identifies that unavailability of improved dairy stock and in adequate A.I. services; shortage of feeds and cost of concentrates, disease challenges and price fluctuation in milk and milk products are some of the bottlenecks that requires systematic planning and intervention from all development practitioners.

According to Center for Development Research (2012) access to agricultural technologies requires knowledge of the existence of the technology, the ability to assess its suitability for the farming system, ability to use the technology; and ability to profitably sell surplus produce. Several studies on agricultural technology adoption (Workneh, 2011; Million and Belay, 2004; Endrias, 2003; Tesfaye *et al.*, 2001; Getahun *et al*., 2000; Ponnusamy *et al.*, 2016) identify that factors such as technological, agricultural policies, institutional and demographic affect adoption of technologies by resource poor farmers. The adoption of dairy technologies has significant impacts on livelihood indicators such as household income, nutrition, food security, health care and access to education (Kassahun and Jeilu, 2012).

As noted by Berhanu (2012) a number of factors such as use of traditional technologies, limited supply of inputs (feed, breeding stock, artificial insemination and water), inadequate extension service, poor marketing infrastructure, lack of marketing support services and market information, limited credit services, absence of producers‟ organizations, and natural resources degradation have contributed to poor exploitation of dairy potential in Ethiopia.

The study by Belay (2003) points out that the shortage or lack of working capital, the shortage of arable land, the shortage of extension personnel, the inadequacy of relevant technologies (as far as their adaptation to the different ecological, economic and socio cultural conditions of the country) and the involvement of extension agents in non-extension were the most important barriers to the adoption of modem agricultural inputs in Ethiopia.

To address the needs of the resource poor farmers, the agricultural technology generation process should consider the social, economical, cultural and agro ecological situations of the clientele. Van den Ban and Hawkins (1996) also note that farmers often accept the experiences on the demonstration farm that are valid for their conditions.

2.5. RESEARCH-EXTENSION LINKAGE MECHANISM FOR AGRICULTURAL EXTENSION AND ADVISORY SERVICES

Though the existence of effective linkage mechanism is considered as panacea to agricultural development, various linkage studies confirm that the research-extension and other stakeholders' linkage mechanism of Ethiopia is found to be weak. The government has been striving for improving the linkage mechanisms, for instance, institutional changes from RELC to REFAC then to ADPLAC are among the efforts made to mention.

Enhancing technology dissemination and adoption is part of an innovation system that starts with the technology development process itself. Concepts of participatory technology development (PTD) and now integrated agricultural research for development (IAR4D) indicate a shift from supply driven to more collaborative ways of generating and disseminating relevant agricultural technologies. It means that the responsibility to promote technologies cannot be left to extension agencies alone but rather a collective responsibility of researchers, extension agents, farmers and other service provides. Engaging in such collective responsibility demands new skills for integration and working together in partnership with key stakeholders. Skill for doing so has to be clearly identified and deliberately built in the system (National Agricultural Research Organization, 2004).

The concept of linkage implies the communication and working relationship established between two or more organizations pursuing commonly shared objectives in order to have regular contact and improved productivity.

Havelock (1986) contends that linkage is a term used to indicate that two systems are connected by messages so as to form a greater system. He argues that if the barriers between two systems are permeable enough for messages and responses to flow out of each to the other, then a link has been created between the two

A linkage mechanism is the concrete procedure, regular events, arrangement, device or channel which bridges the gap between components of a system and allows communication between them (Rolling, 1989).

These linkage mechanisms are categorized into structural and organizational mechanisms that are used to strengthen research-extension linkage. The structural and organizational mechanisms are listed as follows: Combining research and extension functions into one unit; De-centralizing research and extension activities into regional institutions; Fielding subject-matter specialists in extension; Staffing extension liaison positions in research institutions; Establishing communication-cum-information departments'; Redefining roles and

responsibilities between research and extension units; Creating inter-agency committees or councils; Developing inter-agency agreements for collaboration; Physically locating research and extension units together; Providing for farmer participation in research activities; Liaising with private organizations and NGOs; Redefining job descriptions to strengthen relationships; Establishing joint reviews of research and extension activities; Improving individual incentives (personal, professional and financial) for collaboration; Changing evaluation procedures to emphasize collaboration; Exchanging personnel, e.g., posting extension staff in a research organization; Joint training for expanded roles in a technology system; Joint use of facilities and services, such as, soil testing laboratories; Joint participation in functions, such as, field testing and demonstrations; Promoting informal linkages; and exchanging information using jointly developed protocols.

Though the aforementioned linkage mechanisms are identified, National Agricultural Research System (NARS), International Service for National Agricultural Research, ISNAR has made the following observations: Combining research and extension in one institution at national, regional or experiment station level does not necessarily ensure adequate linkages. Irrespective of whether combined or not, accountability of one to the other is a critical issue; Creation of permanent liaison department within research and extension for carrying out linkage functions can be effective. However, this alone is not sufficient to build effective linkages; Research and technology transfer institutions should have joint responsibility for diagnostic activities, adaptive research, on-farm trials, reviewing results and impact evaluation; Research-extension-producer linkages have improved with de-centralization of both authority and resources. However, it is important to maintain a critical mass of researchers at any one location; In general, high levels of vertical integration of functions enhance the possibility of effective linkages and stimulate producer demand for technology. However, single commodity programmes, are not suitable for producers of regions where many commodities are raised and the resource base is highly variable; and research institutions should be adapted to the local environment and conditions.

Kaimowitz (1991) identifies five mechanisms that enhance linkages between extension and research. Such as; Making Extension and Research in the same organization or program; Create liaison units and positions; Establish coordinating committees or meetings between extension and research; Having joint activities between extension workers and researchers; Communication through publications and training activities

Extension plays a key role in linkage and Hagmann, *et al.* (2003) identifies the role of extension as follows;

1. Building the capacity of farmers and farmer organizations to pursue their development goals by articulating high quality demand for services. This can be effected by offering need-based practical training and close follow up which enable them to examine their farming environment comparing with other farming situation. This, in turn, develops farmers' aspiration for change through adopting different farm technologies that is suitable to their farming system.
2. Linking farmers and farmer organizations to other support agencies including markets and input supply systems, creating platforms for their interaction and facilitating negotiation between the different stakeholders.
3. Helping farmers search for new knowledge and technologies as well as creating partnerships that enhance application of the knowledge and technologies.
4. Facilitate farmers for collective and individual learning about innovations to enhance community's capacity to innovate. Collective action helps to find appropriate solution. Hence, participating different actors in learning and experimenting together and sharing experiences enhance them to understand more about the technology.

Existence of strong links among actors ensures:-Research tackles user needs and problems; Farmers and extension workers keep up with research development; Research results from experiment stations are applied to solve farmers problems; Available technologies are adopted to with local agro ecological and socio-economic conditions; Successful technologies are promoted and distributed widely to farmers; Users have access to the information, inputs and services required to support a technology; Researchers can capitalize on users knowledge and obtain feedback on the relevance and performance of technology.

According to Agbamu (2000) factors considered for linkage study are: the size of the national research system; size of the extension service; level of adult literacy; the organization of agricultural administration; and agricultural policy in terms of the importance attached to research and extension. The study also identified five indicators for measuring factors: (i) number of research institutes/experiment stations at national and state levels; (ii) ratio of extension workers to farm families; (iii) percentage of adults with basic education; (iv) the organizational nature of agricultural administration; (v) research and extension budgets as a percentage of the national agriculture budget, together with the existence of laws and regulations for agricultural policy. On the other study Oladele (2010) identifies 13 linkage activities such as, joint problem identification, joint priority setting and planning, collaborative professional activities , establishment of small plot adoption technology, joint on-farm adaptive research, dissemination of knowledge, joint publication, joint demonstration

trials, joint field days, joint seminar and workshop, evaluation survey, evaluation meeting , and evaluation reports.

According to Zuidema (1989) six principles of linkage are given which, in turn, assists for developing appropriate mechanisms to strengthen linkage among stakeholders.

1. A necessary condition for groups or institutions to participate effectively in linkage activities is that they should share a common purpose (i.e. domain consensus)
2. The groups or institutions should perceive that it is advantageous for them to participate in linkage activities
3. There should be common ground or proximity of location between each group or institution to facilitate collaboration
4. Linkage activities should be compatible with other activities of each group
5. There should be rewards for individuals participating in linkage activities
6. Communication between members of different groups should be effective and there should be free flow of information between groups

According to Axinn (1988), there are at least four types of linkages every extension system must develop and maintain. They must have "enabling linkages" with government cooperatives, or the private sector to give them the right to exist and to provide their financial support. They must have **"**Functional linkages**",** with universities and other research and development organizations, **"**Normative linkages**"** with colleagues in other related professions, as well as **"**Diffuse Linkages**"** with farmers and other clientele groups.

ASARECA (2010) identifies the key challenges to scaling up proven agricultural technologies in Eastern and Central Africa, such as; limited recognition of the role of the research system in scaling up; weak linkages among agricultural stakeholders; inadequate communication plans for promotion of uptake and scaling up; inadequate evaluation for uptake and use of agricultural knowledge; inadequate budgets for promotion of uptake and scaling up; capacity weaknesses; failure to link reward and incentive systems to impact; insufficient end-user involvement; and ineffectiveness in the extension systems and the technology dissemination processes. Similarly, weak extension works on scaling up is often cited as a major reason why many existing proven technologies are not widely available for uptake by farmers.

Similarly, Antholt (1992) points out that though formal structures exist for communication and collaboration in many circumstances, there is no close interaction between research and extension institutions. It is mainly due to their existence in separate organizations. According to Yilma (2011) weak linkages between research, extension, and technology users are one of

the critical factors that have hindered dairy development in Ethiopia. This weakness stems partially from the absence of sound linkage policies in the agricultural knowledge generation and transfer systems.

Similarly, Tesfaye *et al. (*2008) states that there are multitudes of heterogeneous actors engaging in dairy development of Ethiopia such as government universities, research centers, NGOs etc. However, service provision by these actors is not in the organized way due to lack of effective coordination and weak linkage among the institutions.

Jancy and Singh (2006) study confirms that dairy information flow among different actors of dairy production is mainly linear i.e. weak feedback. It further indicates the existence of weak linkage between extension scientist and other scientists working in the same institute; and weak linkage between extension, workers and dairy researchers.

The two major concerns have been raised concerning the relative failure of research-extension services in increasing agricultural production:

First, the research problems being investigated are, generally, not in accordance with the priority needs of agricultural producers and, hence, are of less relevance in addressing the prevailing problems; and secondly, the (relevant) knowledge generated at the research stations have not been effectively transferred to the producers. Both problems are the result of weak linkage between research, extension and other stakeholders.

The reasons for poor linkages between research, extension and other stakeholders have been grouped under political, technical and organizational categories (Kaimowitz, Snyder and Engel, 1989).

Political: There is absence of institutional pressure that makes the linkage activities more productive. Linkage activity also suffers from limited financial resources.

Organizational: It includes structural problems, motivational and incentive problems, resource problems and communication problems.

Technical: Participates on linkage activity have Limited knowledge on concept of linkage**.** Coordinators and actors of the linkage need to be well oriented with AKIS concept.

The existence of the indentified problems is also witnessed by frequent criticism of weak agricultural development linkage activities of developing countries including Ethiopia.

2.6. CONCEPTION OF RESEARCH, EXTENSION, FARMERS AND OTHER ACTOR LINKAGES IN ETHIOPIA

Empirical studies confirm the existence of poor linkage among the actors of agricultural technology generation, development and dissemination process of Ethiopia. With the realization of the fact, Research Extension Liaison Committees (RELCs) was established in 1986 at the national and zone levels with the main objective of creating an appropriate forum for the stakeholders of participants in agricultural development of the country. RELC mainly undertook studies on weaknesses of the national research and extension systems as well as on factors affecting the adoption of potentially useful technologies developed by researchers in view of formulating new research and extension strategies (FDRE, 1999). Similarly, RELC were reviewing and approving research proposals submitted by research centers; evaluating improved technologies recommended by zonal research centers before they were released to farmers; designing training programs for subject matter specialists and development agents on improved technologies to be disseminated to farmers. However, RELC was found to be ineffective in achieving the intended objectives of linkage. Hence, it was restructured to strengthen the loose linkage between research and extension, particularly to improve the participation of farmers in the linkage activities. As a result, Research-Extension and Farmers Advisory Council (REFAC) was established in 1999. It was more formalized and played a role of bringing together all stakeholders in the entire process of technology generation and dissemination.

The results of the historical review reveal that research-extension linkage was generally weak and that neither research nor extension was sufficiently conscious of the need to understand the constraints and potentials of different farming systems as a basis for determining relevant technology and technology-development requirements (Belay, 2008). As a fact, REFAC was restructured in 2008 and named as Agriculture Development Partners Linkage Advisory Council (ADPLAC). It is mainly to strengthen linkage activities among the stakeholders of agricultural technology generation, development and dissemination. ADPLAC is multi actors' linkage platform which includes, research, extension, farmers, private sectors, cooperatives, NGOs etc; and organized at federal, regional, zonal, district and "kebele" levels. During the study period, ARDPLAC was not adequately established at district and kebele levels.

2.7. SUMMARY OF REVIEW OF LITERATURE

To improve the effectiveness of dairy research and extension of Ethiopia, scholars have studied at various times on constraints and challenges; adoption and impact studies of dairy subsector. The central challenges of the dairy subsector of Ethiopia link to policy, research, extension, farmers, technology, infrastructure, market and actor linkage problems. In line with these aspects, the prevailing challenges of the dairy subsector are summarized as follows;

Policy: Some challenges of dairying in Ethiopia emanated from the inconsistency in policy approach among different regimes (imperial regime (before 1974); socialist regime (1974-1991); and free market (1991 and onwards). Different development polices and strategies were terminated along with their regime due to ideological variations among the governments. Each regime continued to introduce new development approach to the dairy subsector as there were complete variations among their development approaches. The inconsistency in development approach affected the development of the dairy subsector of the country. Though similar development approach has been adopting since 1991, with relation to livestock sector, there was no comprehensive policy direction that gives broad map to various subsectors of livestock. Particularly dairy research, extension and development policies were lacking despite their having great potential in translating the dairy development efforts into action. In line with this (Yilma *et a*l., 2011) point out that the dairy development of Ethiopia is affected due to the absence of an operational breeding strategy and policy.

Research: The research has been making effort to generate various improved dairy practices in the areas of improved dairy management practices; feeds and feeding practices; breeding practices and animal health practices for the last more than five decades.

However, the responsiveness of research system to farmer constraints and priorities remains unsatisfactory. It is also a witness that KAM (2012) using Knowledge Index (KI) ranks Ethiopia 140th out of 145 countries in ability to generate, disseminate and use knowledge. EARO (2006), now IARI (the apex organization of national agricultural research of Ethiopia) also states that “despite decades of research and development efforts, with the aim to provide farmers new technologies to improve their farming practices, agricultural productivity for both crop and livestock production is still very low.” .

The main factors that affect agricultural research in developing counties including Ethiopia are: lack of qualified research personnel, inadequate resources and inappropriate resource

allocation (Tanvir *et al.,* 1994; Ponnusamy and Kumaran, 2008). The authors further state that lack of qualified personnel in the research organizations affects the technology development which ultimately affects agricultural extension work as the poorly developed technology is difficult to be accepted or adopted by the farming community.

Extension: Modern agricultural extension system was introduced in Ethiopia in 1950s. Though different extension systems were used previously, the country has formulated Participatory Demonstration and Training Extension System (PADETES) in 1995. PADETES promotes packages on cereals, livestock, high economic value crops, improved postharvest technologies, agro-forestry, soil and water conservation and beekeeping developed for different agro-ecological zones (Anandajayasekeram *et al.*, 2008).

The main factors that affect agricultural extension work in developing countries, including Ethiopia are:, low extension worker farmer ratio, lack of practical skills on the part of extension workers, poor in-service training facilities, multiple work role of extension workers, lack of incentive for extension work, limited recognition of the role of the research system in scaling up; inadequate communication plans for promotion of uptake and scaling up; inadequate evaluation for uptake and use of agricultural knowledge; inadequate budgets for promotion of uptake and scaling up; failure to link reward and incentive systems to impact; and ineffectiveness in the extension systems and the technology dissemination processes. Similarly, weak extension works on scaling up is often cited as a major reason why many existing proven technologies are not widely available for uptake by farmers. (Tanvir *et al.,* 1994; Ponnusamy and Kumaran, 2008; ASARECA, 2010). In the extension efforts of decades, the dissemination status of improved dairy practices was insignificant. For instance, CSA (2010) estimate indicates that the indigenous breeds accounted for 99.19 per cent, while the hybrids and pure exotic breeds were represented by 0.72 and 0.09 per cent, respectively. Likewise about 0.15 per cent of rural livestock holders use improved forages (alfalfa and Napier grass); and the use of industrial by-products like oil cake, bran and brewery residue is negligible (0.8%) (CSA, 2008). A number of factors such as, limited supply of inputs (feed, breeding stock, artificial insemination and water), poor marketing infrastructure, lack of marketing support services and market information, absence of producers organizations, inadequate veterinary service provision, managerial and financial constraints, inefficient heat detection and improper timing of insemination, inappropriate infrastructure, limited availability of credit to the dairy farmer, unavailability of land, and natural resources degradation have contributed to un exploitation of dairy potential of Ethiopia (Yilma *et al.,* 2011; Berhanu 2012; Ulfina *et al.,* 2013).

Farmers: To address the needs of the resource poor farmers, the agricultural technology generation process should consider the social, economical, cultural and agro ecological situations of the clientele. Van den Ban and Hawkins, (1996) also notes that farmers often accept the experiences on the demonstration farm that are valid for their conditions.

Some major factors that affect clients' access to extension services are: low economic status of the majority of the farmers to afford improved dairy practices (wealth status), gender, farming system, land ownership and farm size, other factors such as cultural constraints, education, age, access to credit and risk taking ability which affect farmers' access to and benefit from extension services (Anandajayasekeram *et al.,* 2008). Illiteracy and small land holdings of extension clientele also affected the adoption of improved dairy practices (Tanvir *et al.,* 1994). Access to agricultural technologies requires knowledge of the existence of the technology, the ability to assess its suitability for the farming system, ability to use the technology; and ability to profitably sell surplus produce (Center for Development Research, 2012). Several studies on agricultural technology adoption (Getahun *et al*., 2000; Tesfaye *et al.,* 2001; Endrias, 2003; Million and Belay, 2004; Workneh, 2011) identify that factors such as technological, agricultural policies, institutional and demographic related variables affected adoption of technologies by resource poor farmers. Insufficient end-user involvement is also the main factor that affects the effectiveness of the improved dairy practices dissemination (Ponnusamy and Kumaran, 2008; ASARECA, 2010).

Market: The availability of ready market for dairy products triggers adoption decision of farmers. In the absence of well established market for dairy products, dissemination of improved dairy practices, particularly crossbred is difficult to meet its target. In the dairy extension intervention, market needs to be a precursor to the promotion of the practices. The absence of effective market for dairy products in Ethiopia affected the development of dairy. In line with this, several studies boldly indicated the persistent problem of market for dairy products (Yilma *et al*., 2011; Berhanu 2012; Ulfina *et al.,* 2013).

Actor linkage: In Ethiopia, the importance of linkage for increasing the agricultural productivity of stakeholders was recognized in 1980s. Since then, different efforts were done to strengthen the linkage among actors of agricultural production. For instance, Research-Extension Liaison Committees (RELCs) were established in 1986 with the main objective of creating an appropriate forum for the stakeholders of participants in agricultural development of the country. RELC was restructured to strengthen the loose linkage between research and extension, particularly to improve the participation of farmers in the linkage activities. As a result, Research-Extension and Farmers Advisory Council (REFAC) was established in 1999.

The results of the historical review reveal that research-extension linkage was generally weak and that neither research nor extension was sufficiently conscious of the need to understand the constraints and potentials of different farming systems as a basis for determining relevant technology and technology-development requirements (Belay, 2008). As a fact, REFAC was restructured in 2008 and named as Agriculture Development Partners Linkage Advisory Council (ADPLAC). It is mainly to strengthen linkage activities among the stakeholders of agricultural technology generation, development and dissemination. ADPLAC is multi actors' linkage platform which includes, research, extension, farmers, private sectors, cooperatives, NGOs etc; and organized at federal, regional, zonal, district and Peasant Association (PA) levels. Though immense efforts were done to improve the linkage among the key actors of agricultural development, weak linkage was prevailing in the agricultural system of the country. Budget constraints, absence of commitment from the actors, coordination problem, frequent restructuring without in depth study, frequent shift of job (staff turnover), poor representations of actors and absence of external pressure from policy makers are the main causes for weak linkage. The study by (ASARECA, 2010; Yilma *et al.*, 2011) also confirm the weak linkages among agricultural stakeholders in Ethiopia.

Infrastructure: It includes facilities that are required to undertake dairy research/extension activities such as work office, laboratory, transport, road, communication, demonstration site, farmer training school etc. In the process of making intervention in the dairy development, infrastructure needs to be a precursor to the whole efforts made for improving the dairy subsector. Dairy development of the country is imbedded due to poor infrastructure (Simeon and Nega, 1997; Berhanu, 2012)

Technology: In the adoption process of improved dairy practices**,** availability, affordability, compatibility and adaptability of the technology are the main factors for stimulating farmers to decide the adoption of the technology. Likewise, the marketability and profitability of the products of the practice are the main inspiring factors for adopting the farm technology. The main challenges for the development of dairy farming in Ethiopia are: genetic limitation, inadequate animal feed resources, high cost of dairy heifers/cows, unavailability of improved dairy stock, inadequate A.I. services, shortage of feeds and cost of concentrates, disease and use of traditional technologies (Yilma *et al.*, 2011; Berhanu (2012; Ulfina *et al.*, 2013)

2.8. CONCEPTUAL FRAMEWORK FOR THE STUDY

The effectiveness of dairy technology generation and dissemination is influenced by personal characteristics of researchers and extension workers; social participation; financial capacity; research/ extension infrastructure facilities; research/extension policy environment; research/extension management; responsiveness of improved dairy practices and research/extension participation in various activities of research and extension. The effectiveness of research and extension further influences the adoption of improved dairy practices. Evidently, the adoption decision of farmers is affected by personal and demographic factors, economical factors, institutional factors and technological factors.

Dairy development actors' linkage that constitutes research center, university, NGOs, dairy cooperative, farmers, private sectors, agricultural development office etc. also influences the effectiveness of dairy research and dissemination process and improved dairy practices adoption. Generally, both economic and non economic factors affect the effectiveness of dairy technology generation, dissemination and adoption decision of the farmers. The conceptual model of the study is depicted in Fig. 2.1 as follows;

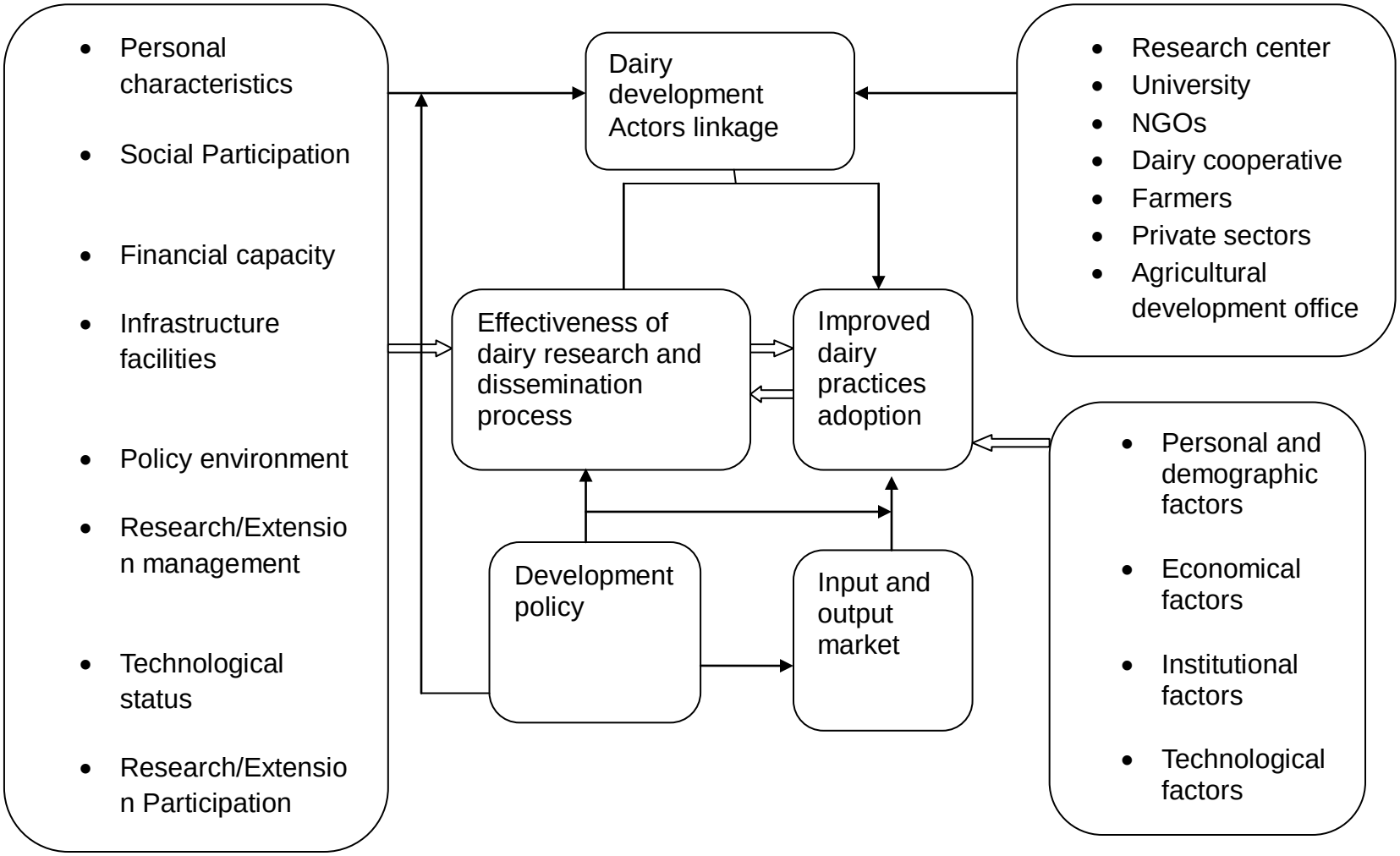

Fig 2.1: Conceptual framework on factors influencing dairy technology development and dissemination

CHAPTER 3

RESEARCH METHODOLOGY

RESEARCH METHODOLOGY

Research methodology is mainly aimed to describe the identification of study area, selection and operatinalisation of variables, procedure for measurement of chosen variables, methods of data collection and employment of different statistical tools for analysis of data. This section consists of following sub-headings:

3.1. Locale of research

3.2. Sampling design

3.3. Source of data

3.4. Data analysis

3.1. LOCALE OF RESEARCH

Ambo and Toke Kutaye districts are situated in West Shewa zone of Oromia Regional State, Ethiopia. The districts are located to the west of Addis Ababa, the capital, at about 114 and 126 km respectively. Welmera district which was previously part of West Shewa zone currently located in Oromia Special Zone Surrounding Finfinne is also the site of the study for including dairy researchers of Holetta Agricultural Research Center. It is located to West of Addis Ababa, the capital of Ethiopia at about 34 km. It receives an average annual rainfall of about 1100 mm. The altitude and average annual temperature of the area range from 2200 – 2600 meter above mean sea level (MSL) and 6 – 21 ^{0}c respectively.

Ambo and Toke Kutaye districts have a total population of 128,095 and 143,357 respectively of which 64,021 & 64,074; and 71,422 & 71,935 are male and female respectively (CSA, 2013). Ambo and Toke Kutaye districts have an altitude which ranges from 1400 - 3045 and 1600 - 3192 meter above mean sea level (MSL) respectively. The temperature of the areas ranges from 10 - 29 ^{0}c. The districts receive rainfall during the main rainy season of the country (June to September) which ranges from 800 -1000 mm. They are characterized by a crop-livestock mixed farming system in which livestock contributes much to the livelihoods of the community. The districts were selected purposively for the study mainly due to the existence of dairy extension intervention by Holetta Agricultural Research Center, zonal and district agricultural development offices, and Ambo University. Likewise, the office of Zonal Agriculture Development Partners Advisory Council (ADPLAC) which has a mandate of coordinating linkage among research, extension, clientele system is also available in the study area (Fig. 3.1).

Holetta Agricultural Research Centre (HARC)

HARC, under the Ethiopian Institute of Agricultural Research (EIAR), is the pioneer agricultural research center in the country. It is located in Holetta town, West of Addis Ababa (capital) at about 34 Km. It was established in 1966 with the main objectives of generating, adapting, testing and disseminating improved agricultural technologies that are suited to the highland agro ecological zone of the country. Currently, it is organized into four research processes, *viz*., Crop; Land and Water; Livestock and Agricultural Economics, Research Extension and Farmers Linkage.

Among the stakeholders that engaged in generating and disseminating improved dairy practices in the study area, HARC takes a lion share in undertaking research and extension activities of the livestock sector. Likewise, it serves as a centre of excellence for dairy research of the country. To attain its organizational goal, it has been vigorously participating in dairy technology generation, demonstration and popularization of promising improved dairy practices. Capacity building and coordination of dairy improvement research activities at national and regional research levels are also its key mandate.

Ambo University

Ambo University is located in Ambo town the capital of West Shewa Zone of Oromia Regional State, Ethiopia. It is situated in the west of Addis Ababa, at about 114 km. Ambo University the then Ambo agricultural school was established in 1946. It is one of the premier higher learning institutions in Ethiopia. It attained the status of university, passing through various restructuring processes. Accordingly, the school was renamed as Ambo Agriculture and Forestry Secondary School in 1958. Then, it was promoted to Institute of Agriculture and renamed as Ambo Agricultural Institute in 1967. Since then, it started offering a two-year post-secondary diploma course in General Agriculture. The institute was granted a Junior College status and named as Ambo Junior College of Agriculture in 1974. The college was promoted to full- fledged college in 1992 and renamed as Ambo College of Agriculture. Finally, it was promoted to University College in 2008 and then very soon to University in 2009. Currently the University has 26 graduate and 54 undergraduate programs. It also has four campuses including its main campus at Ambo and other campuses at, Awaro, Guder and Woliso.

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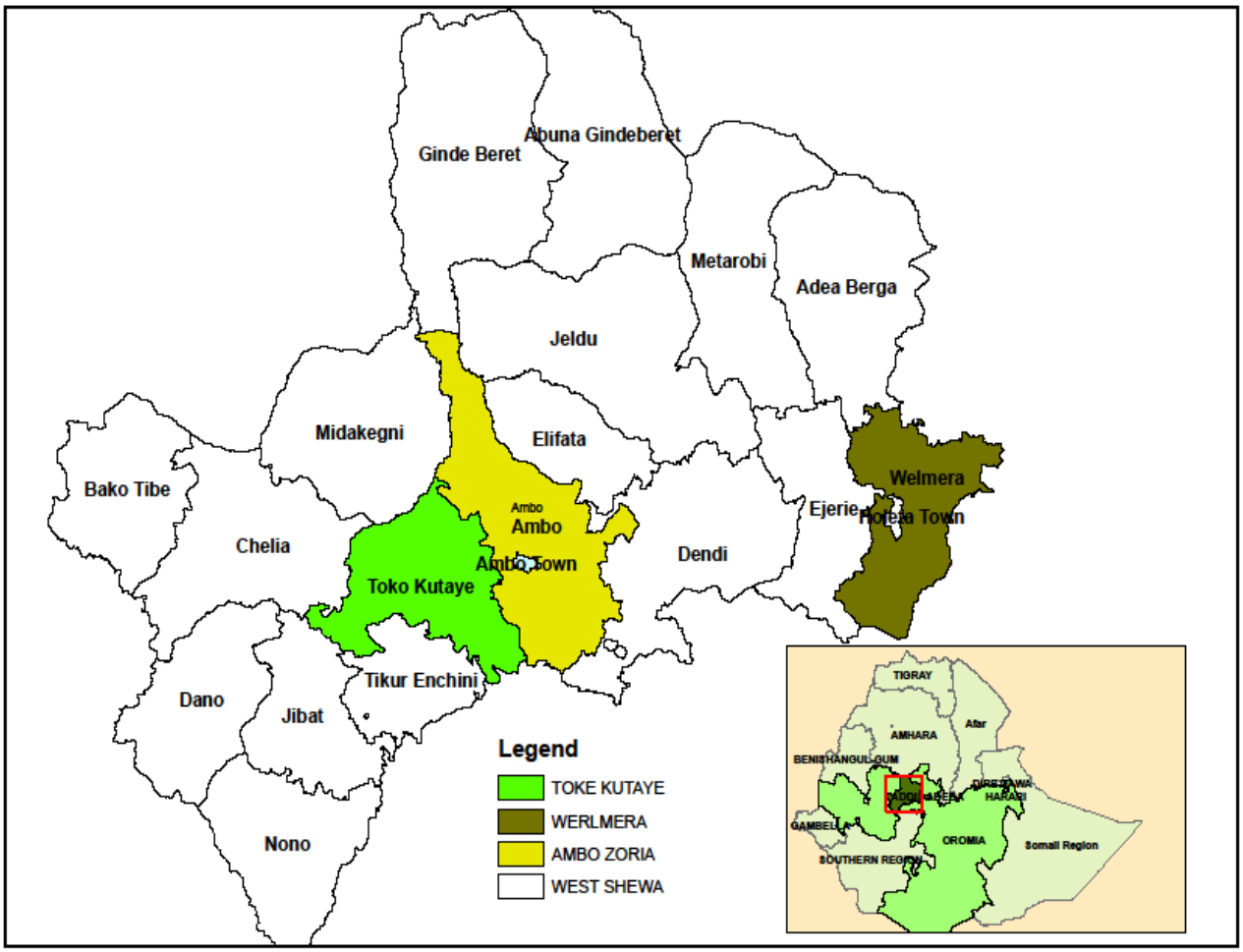

Fig 3.1. Map of study areas

3.2. RESEARCH DESIGN

The study employed cross-sectional survey design as it is appropriate for gathering information from the respondents without manipulating the population of the study. It is used to analysis the data that are collected from the whole population or sample of the population at a specific period of time. Cross sectional survey design also allows the researcher to compare many different variables at the same time. Thus, this study used it for comparing the influences of different variables that are selected for the study on the dairy research and extension effectiveness and adoption of dairy technologies. Cross sectional survey design also indicates the general characteristics of the population during the study period.

As depicted in Fig 3.2, sampling plan includes Oromia Special Zone Surrounding Finfinne and West Shewa zone that were selected purposively. Ambo, Welmera and Toke Kutaye districts were also selected purposively due to the existence of dairy research and extension intervention by HARC, zonal and district agricultural development offices, and Ambo University. The sample respondents were identified using simple random sampling technique from the respective population of the study (extension workers, researchers and farmers).

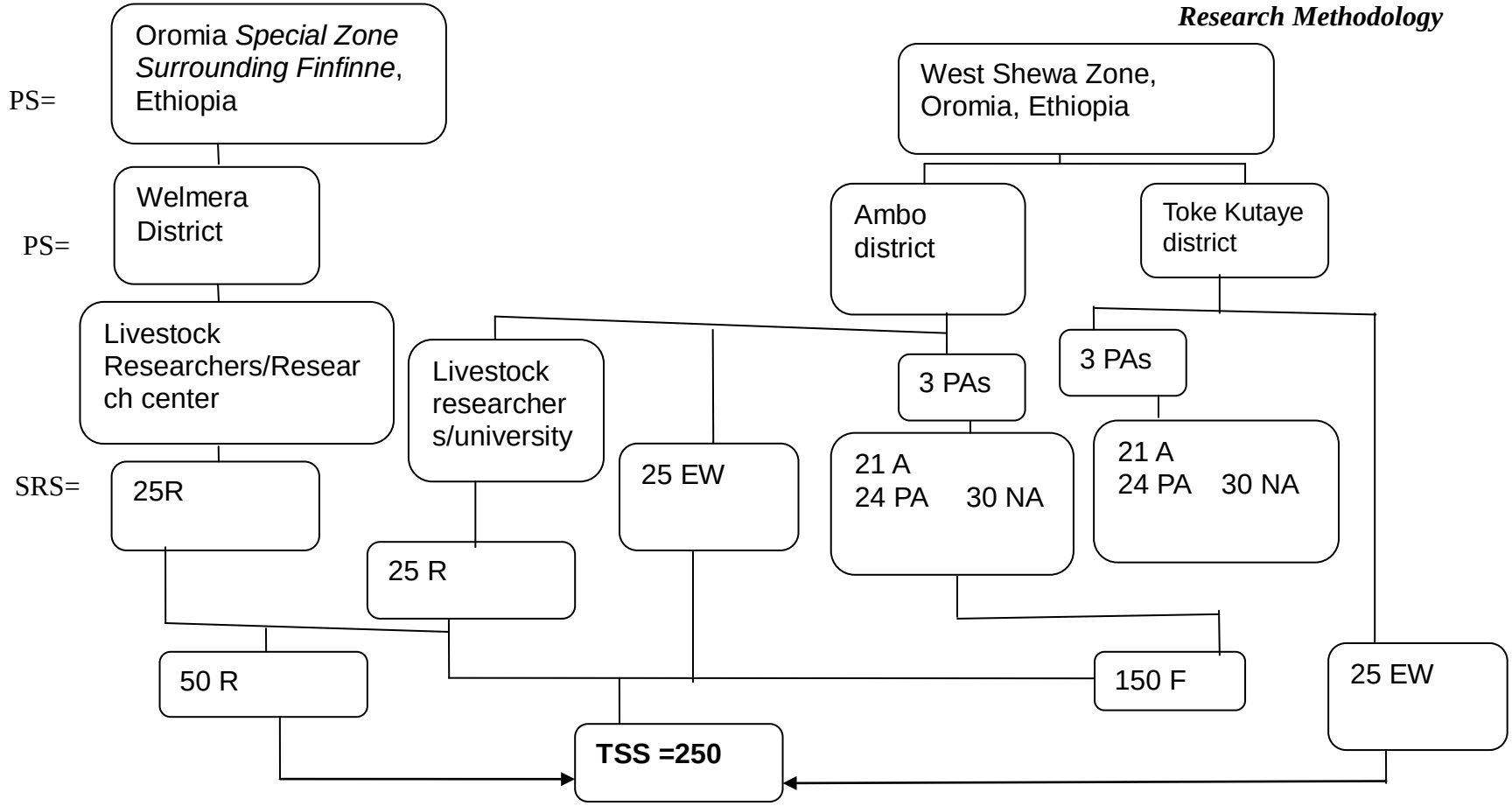

Fig 3.2. Sampling plan

PA=Peasant Association; A=Adopter; PA=Partial adopter; ND=Non Adopter; R=Researcher; F=Farmer, TSS=Total Sample Size; PS=Purposive Sampling; RS=Random Sampling; EW=Extension Worker

Selection of researchers

To achieve the objectives of the study, proper selection of the relevant respondents is indispensable. Accordingly, lecturers who are working in dairy and animal health research at Ambo University and researchers of livestock production at Holeta Agricultural Research Center were selected. Respondents who have more than two years of experiences in dairy research were included as the sample respondents. Researchers with two years experience are expected to participate in research activities, at least as co-investigator of a research project. These respondents are in a position to provide adequate information concerning to the study undertaken. Extension workers and Agricultural Development Partners Linkage Advisory Council (ADPLAC) members with two or more years of work experiences were included in the study population.

To maintain the representativeness of the sample respondents to the population of the study, adequate sample respondents were included in the study from the university and research centers. For the purpose of data collection, questionnaire, observation, Focus Group Discussion and checklists were prepared

Selection of extension workers

Dairy extension workers were selected for the study as they have adequate information on the current dairy extension status of the study area. Extension workers of Ambo and Toke Kutaye districts of West Shewa zone were included as the sample respondents based on probability proportional to size. The number of extension workers in both districts was almost equal. Accordingly, 50 respondents from both districts were selected and made to fill the questionnaire. Likewise, extension workers who were working at zonal and districts office level and development agents who were working at field level were included in the sample respondents. In such way, both extension managerial and coordination issues and field level activities could be investigated to address the research objectives.

Selection of farmers

The farmers who carry on dairy production were included as the sample respondents. To collect holistic information, the farmers were stratified into adopters, partial adopters and non adopters. Adopters are those farmers who received the whole recommended dairy packages from Research, Agricultural Office, NGOs and other stakeholders; and who used packages for two

years and decided to continue using of it. Partial adopters are those farmers who at least used one of the dairy technologies out of the whole recommended package. Non- adopters are those farmers who did not use any of the recommended dairy technologies. Adopters, partial adopters and non adopters are who have at least one crossbred cow with whole recommended practices, two local cows with some recommended practices and two local cows with no recommended practices respectively, were included in the study.

3.3. SOURCE AND TYPES OF DATA

The study used both primary and secondary data. Primary data were collected from researchers, extension workers, farmers and ADPLAC members. Secondary data were also sourced from research reports, extension reports, ADPLAC document, bi-annual reports, journal and proceedings. Both qualitative and quantitative data types were used to address the objectives of the study. The following tools of data collection were employed for gathering data.

Questionnaire

Questionnaire is the main tool of data collection in social sciences. For this particular study, three separate questionnaires for researchers, extension workers and farmers were formulated as per the objectives of the study. It was pre-tested for checking the clarity of the questions in view of the respondents. The comments were incorporated and the questionnaire was customized to the requirement of the respondents as well as nature and locality of study. The final questionnaire was distributed to the researchers and the extension workers. The farmers were interviewed through the researcher and enumerators/data collectors who were employed for assisting the researcher during the data collection.

Observation method

Observation method was mostly used in behavioural studies. Besides getting original information, it helped in cross checking/verifying information obtained through questionnaire or interview; for understanding the whole process of the activities which are difficult to grasp through interview or questionnaire; and recording natural behaviour of respondents. Accordingly, the researcher made observation on the dairy farm of the respondents to assess the level of using different improved dairy practices.

Key Informant Interview method

Personal interview was made with key informants such as researcher, head of zonal and district livestock agency, extension worker, zonal ADPLAC coordinator and farmers. For the purpose, check list was prepared to guide the interview and to generate all the required information for the study purpose. This method was mainly used for getting more information using flexible approach during the interview i.e. in the way that the respondents can easily understand.

Focus Group Discussion (FGD)

FGD is a good tool for collecting information from the respondents on the areas that are general and difficult to respondents to answer individually. Group discussion allows getting complete answers to the subject under the study. All questions cannot be included in the interview schedule. As a result, group discussion could use to supplement quantitative research methods.

Initially, the topic of discussion was identified by the researcher. Similarly, brief explanation about the objectives of the discussion was also made by the researcher. The participants made to reflect their idea around the selected topic for group discussion. Finally, the researcher presented the report to the group which, in turn, helped to reach on the consensus on the final summary of the discussion.

Case study

Case study is an in-depth study of a specific individual or phenomena in its existing context. In the other way, case study method is used to explore and provide holistic description about the study. Case study is useful for investigating information that does not adequately exist i.e. to get more in-depth information that is mostly difficult to find quantitatively. It can also be used to get new perspectives on an item that is already identified. Generally, it is useful when the area of the study is difficult to address through questionnaire to generalize about the population of the study. Initially, the researcher made intensive field observation for identifying the cases for study. During the intensive field observation, dairy extension intervention was addressing the dairy farmers of the study area. The researcher was inspired by the situation to identify the factors that create discrepancy between adopters and non adopters in deciding to use improved dairy practices. For this purpose, case study was selected to be an appropriate tool to capture the events.

3.4. METHOD OF DATA ANALYSIS

Descriptive statistics, research and extension effectiveness index, ordered logistic regression, ANOVA, multinomial logistic regression model, linkage matrix, convergence matrix, partial budgeting and ranking were used for data analysis. The details of the analysis are described under each objective of the study and briefly presented as follows;

Analysis of research effectiveness in dairy technologies generation and dissemination were carried out using primary and secondary sources of data. Accordingly, the main indicators of effectiveness for technology generation and dissemination process were identified. The total sample size for addressing this particular research objective was 50 extension workers and 50 researchers. The main improved dairy practices such as breeding practices, management practices, feeds and feeding practices and health care practices were identified for study purpose. Dairy researchers, other relevant stakeholders, extension and research documents were the main sources of the information. In order to address the objective of the study in a holistic manner, indicators for measuring effectiveness of research process such as existence of research policy/strategy, nature of research priority setting, research review process, qualification and number of researchers, research infrastructure, motivational factors, capacity building, research-extension and farmer linkage, dairy technologies generated, number of dairy technologies disseminated and adopted were considered. Similarly to measure the effectiveness of improved dairy practices dissemination, the identified indicators were participation in extension planning and research review process; relevance of best practices, responsiveness of research, number of dairy technology introduced and adopted; number of cross breeds per farmer, farmers` income and milk yield increment due to dairy technology adoption; number of extension personnel at district and village level; infrastructure; capacity building; research-extension and farmer linkage; motivational factors. Factors identified for indicating research and extension effectiveness were summarized into eight sub indicators such as personal characteristics, research/extension participation, infrastructure facilities, responsiveness of improved dairy practices, research/extension management, policy environment, social participation and financial capacity. In line with the identified indicators for both researchers and extension personnel, respective questionnaire were prepared. To measure whether the improved dairy practices generation and dissemination was effective or not, two indices namely effectiveness of improved dairy practices generation index and effectiveness of improved dairy practices dissemination

index were developed. Using cumulative square root frequency method, the result of the index was categorized into low, medium and high levels of research and extension effectiveness. To further identify the influencing sub indicators of research and extension effectiveness, ordered logistic regression model was employed. Additionally, data of Focus Group Discussion, Key Informant Interview and observation were analyzed qualitatively.

Ordered logistic regression model

Ordered logistic regression model is employed to predict an ordered dependent variable. The model is best fit to the dependent variable in ranking order. The advantage of ordered logistic is its ability to analyze a dependent variable that has more than two categories where the value between each category has meaningful unobserved sequential order (Greene, 2008). Following Greene (2003), the ordered logistic has a general form of;

$Y_i^* = \beta' Xi + \in i = 1,...N$ researcher/extension worker,

Where;

Y_i^* is the underlying unobserved (latent) variable that indexes the level of research/extension effectiveness

i represents observation i.e. researcher/ extension worker

Xi is a vector of explanatory variables.

β' are parameters to be estimated

$\in$ is the error term

To find out the factors influencing technology adoption in dairy production, the dairy farmers were stratified into adopters, partial adopters and non-adopters of improved dairy practices. The total sample size for addressing this research objective was 150 dairy farmers. Based on their probability proportional to size principle, sample size of adopters, partial adopters and non-adopters were determined. Thus, a sample size of 42, 48 and 60 adopters, partial adopters and non adopters were included in the sample respondents respectively. Finally, from each stratum sample respondents were identified using simple random sampling technique.

Based on literature and personal experience 13 variables were selected namely, age, education level of household head, family size, farm experience, land size, livestock holding size, extension contact, training, compatibility of technology, availability of technology, market for products, visit demonstration and access to credit. The influencing variables were identified using multinomial logistic regression. Additionally, financial increment due to adoption of dairy

technology was compared with farmers' practices using partial budgeting. Data were collected from dairy farmers, Agricultural Development Partners Linkage Advisory Council (ADPLAC) members and extension workers of the districts. Interview schedule was prepared to collect data pertaining to the proposed study. For obtaining the relevant information, observation, key informant interviews and Focus Group Discussion were conducted with dairy farmers, extension workers and dairy researchers. For the purpose of qualitative aspect of the study, check list was prepared for each category of the respondents.

The enumerators who have sufficient knowledge on dairy were employed to assist the researcher during data collection using the interview method. They were properly sensitized before deploying them for data collection. The researcher made a close supervision to each enumerator during the field work. Secondary data were collected from different sources such as books, research publications, journals, office reports, internet etc.

Multinomial regression model

The multinomial logistic regression model is selected to examine the adoption of improved dairy practices, categorizing the respondents into adopters, partial adopters and non adopters. It is a special form of ordered logistic regression model which is used when the dependent variable takes more than two categories without specified order. Following Greene (2003), multinomial logistic regression model can be specified as:

$$\text{Prob}\,(y_i = j) = \frac{e(\beta`_j \chi_i)}{\sum_{k=0}^{2} e(\beta`_j \chi_i)}\ , \text{as j is } = 0,1,2$$

Where,

P(yi=j) is the probability of farm household i's choice of adoption category of alternative j

β_j are the parameters to be estimated by maximum likelihood estimator

Xi is explanatory variable vector that contains the set of factors about household demographic and socioeconomic characteristics

j adoption category

Estimation procedure

Before using the model, multicollinearity was checked to exclude one of the highly correlated explanatory variables. With this particular study, there is no serious multicollinearity problem. There are various indicators of multicollinearity and no single diagnostic will give us a complete

handle over the collinearity problem (Gujarati, 1995). Accordingly, Variance Inflation Factor (VIF) and condition index (CI) were used for continues variables.

If there is larger value of VIF_i, there is more troublesome. As a rule of thumb, if the VIF of a variable exceeds 10 (this will happen if R_i^2 exceeds 0.95), that variable is said to be highly collinear (Gujarati, 1995). Following Gujarati (1995), the VIF_j is given as:

$$\text{VIF } (X_j) = \frac{1}{1 - R_j^2}$$

Where, R_j^2 is the coefficient of determination when the variable X_j is regressed on the other explanatory variables.

There may also be interaction between qualitative variables, which can lead to the problem of multi-collinearity. To detect this problem, coefficients of contingency were compounded. The contingency coefficient was compounded as follows:

$$C = \sqrt{\frac{\chi^2}{n + \chi^2}}$$

Where, C is coefficient of contingency

□2 is chi-square test and

n = total sample size.

The iterative maximum likelihood (ML) estimation procedure was used to estimate the parameters of the models. Maximum likelihood is the most efficient (and sometimes the only) way to estimate the parameters of specifications that involve limited dependent variables. In very general sense, the method of ML yields values for the unknown parameters, which maximize the probability of obtaining the observed set of data (Liao, 1994).

The extent of convergence of different agencies promoting dairy production was addressed by collecting data from the members of Agricultural Development Partners Linkage advisory Council (ADPLAC) through questionnaire as well as organizing group discussion. Key activities of research- extension and farmer linkage of the study area were identified. The existing linkage activities in the study area are: research problem identification, joint research review, joint planning, joint on farm trial, joint field day, workshop, field visit, joint monitoring

and evaluation. The study emphasized on capturing the extent of various stakeholder of dairy production participation on the identified linkage activities. The study also explored farmer- to-farmer extension status of the study area in promoting dairy farm technologies. In line with the identified linkage activities, Actor Linkage Matrix (ALM) was developed. According to Anandajayasekeram *et al*, (2008), ALM has the following advantages;

1. It can deal with more complex situations and more actors.

2. It has a cell for every possible linkage, and so encourages one to explore allpossibilities.

3. It plays a useful role in helping to pinpoint particularly significant links, e.g. strong links, coalition groups, weak links etc.

4. It enables users to quantify the strength of linkages using symbols in each cell, e.g. pluses and minuses, or codes such as s (strong), m (medium), w (weak), dn (do not know).

5. It enables users to condense and store a lot of information about linkage in the spreadsheet

Key informant interview and focus group discussion were made with respondents from ADPLAC which has members from farmers, university, researchers, extension workers, NGOs, dairy cooperatives, livestock agency, agricultural development office and private sectors.

Criteria for inclusion of respondents

Dairy researchers who had two and more years of research experience were included in the study with the notion that their two years experience allowed them to participate in research activities, at least as co-investigator of a research project. In fact, they could be able to provide adequate information for achieving the research objective of the proposed study. Extension workers and Agricultural Development Partners Linkage Advisory Council (ADPLAC) members with two or more years of work experiences were included in the study.

In relation to farmers' respondents, adopters are those farmers who received the whole recommended dairy packages by Research, Agricultural Office, NGOs and other stakeholders; and who used at least for two years and decided to continue using of it. Partial adopters are those farmers who at least used one recommended dairy technology out of whole recommended

package. Non-adopters are those farmers who did not use any of the recommended dairy technologies. Adopters, partial adopters and non adopters who have at least one crossbred cow with whole recommended practices; two local cows with some recommended practices and two local cows with no recommended practices respectively, were included in the study population.

Recommended packages of practices in dairy production of the study area

The packages of practices for dairy production in the study area are: Management practices (separate cow shed, rotational grazing, stall feeding, de-worming, record keeping, udder washing, Milk processing); feeds and feeding practices (Sesbania, Napier grass, vetch and oat mixed, straw urea treatment, hay making, silage making, supplementation with concentrate, supplementation with grain, supplementation with Noug (*Guizotia abyssinica*) cake); Breeding practices (Artificial Insemination), Castration of bulls, Bull mating, Use of crossbred cows) and animal health practices (Vaccination, Application of acaricides).

Index development

After intensive literature review, eight sub indicators were identified for developing research and extension effectiveness indices. Then, the statements/ items were separately prepared for measuring dairy research and extension effectiveness. For further improvement of the statements, it was sent to judges to get their comment on the relevance and appropriateness of the statements representing each sub indicators of dairy research and extension effectiveness. Finally, the comments of the judges (research and extension professionals) were included in the questionnaire.

To develop indices of dairy research and extension effectiveness, first the weightage of different indicators of research and extension effectiveness ranks were taken from the judges (researchers and extension professionals). For this purpose, the questionnaire was sent to 100 judges of whom 50 were researchers and the rest of them were extension professionals. Rank was converted to weightage following Alfares (2006). The mean values of sub indicators were calculated and taken as a weightage of that particular sub indicator. Weightage of each sub indicator was obtained in terms of 100 points out of sub indicators.

Composite or total score of research and extension effectiveness was calculated by multiplying the score of each sub indicators by their respective weightage. To combine the score of different sub indicators measured using different units of measurement; the score was normalized before combination. Standardized scores for each sub indicators were calculated using the formula,

$$Z \text{ ind } i = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

Where, X_i, X_{max} and X_{min} are the original values for indicator i, for the highest value, and for the lowest value respectively.

Z ind i = Value of standardized indicator i

Then, research and extension effectiveness value for each indicator of the researcher/extension worker was calculated by using the given formula:

$$REj = \frac{\sum_{j=1}^{n} Wi \, Z \text{ ind } ij}{\sum_{j=1}^{n} Wi}$$

REj = Research and extension effectiveness value of j respondent

Z ind ij = value of standardized indicator i for the j respondent

Σ Wi = Summated value of weightage of all i indicator

Finally using total score of research and extension effectiveness of each respondent, they were classified into low, medium and high categories using cumulative square root frequency method.

3.5. CONCEPTS, OPERATIONAL AND MEASUREMENT OF VARIABLES

Effectiveness: It is the degree to which the process of dairy research and extension is successful in generating and disseminating improved dairy practices/ dairy technology.

Improved dairy practice/dairy technology: Both are generated and disseminated by research and extension system, consequently the terms are interchangeably used in this particular study.

Independent variables that are identified for studying effectiveness of research and dissemination in dairy production

Personal characteristics: It refers to factors such as education level, work experience, level of exposure to collaborative research/extension works, level of positive perception towards research/extension works, research skills, communication skills and other factors that enhance researcher's/extension worker's capacity to generate/disseminate improved dairy practices.

Research/Extension Participation: It refers to the participation of researcher/ extension worker in activities of dairy research/extension works such as problem identification, extension program planning, research review meeting, on farm trial, Farmers' Research Group, field days, excursion, ADPLAC meeting, workshop and other experience sharing programs

Infrastructure facilities: It refers to facilities that are required to undertake dairy research/extension activities such as work office, laboratory, transport, communication, demonstration, farmer training school etc.

Responsiveness of improved dairy practices: It refers to the affordability, profitability, existing demand to the technology, adoption status of the technology, releasing process of the technology, relevancy of the technology and manageability of the technology in addressing the needs of the end users

Research/Extension management: It implies all research/extension managerial activities of the organization such as planning, staffing, directing, organizing, supervising, budgeting and level of decision making.

Policy environment: It refers to research/extension governing issues such as rules and regulation, strategies, linkage activities, collaboration works, research/extension monitoring and evaluation systems, presence of research/extension priority areas, presence of agreements with stakeholders.

Social Participation: It refers to researchers`/extension workers` participation in social activities of the organization and outside of the organization i.e. with farmers, researchers and other stakeholders which, in turn, increases knowledge/experience sharing, social capital formation and competition for generating / disseminating improved dairy practice.

Financial capacity: It implies researcher`s/extension workers` financial status in covering all his/her expenditure and includes presence of institutional support in capacitating the employees to exert his/her full energy to research and extension works.

Independent variables that are identified for studying factors that are influencing improved dairy practices adoption

Based on literatures and personal experience, the independent variables that influence the adoption of improved dairy practices is selected and operationalized as follows:

Age: It is a continuous variable and measured using completed years of life. According to Motamed and Singh (2003) young people are more flexible in deciding for change than aged

people. However, in dairying aged people opt to own few cows and decide to adopt improved dairy practices. Hence, it was hypothesized that old people better adopt the improved dairy practices than young people.

Family size: It is a continuous variable and was measured taking total number of household members. Farmers with large family size adopt the technology, to satisfy the need of their family and to use the human resources. Hence, it was hypothesized that household with large family would adopt the technology better.

Experience: It is a continuous variable and measured in years since the respondent engaged in dairying activities. Obviously, farmers who practise traditional dairy production develop more experience in dairying. Rahman (2007) also states that experience helps an individual to think in a better way and makes a person more mature to take right decision. Therefore, it was expected that farmers with more experience in dairying would adopt the technology more those who had less experience.

Education level of household head: Feder *et al.* (1985) noted that education improve the decision making process and thereby influence the level and/or composition of anther inputs. Hence education would increase the understanding of the technology and anticipated to increase adoption. This variable was measured based upon formal years of schooling attended by the respondents. It was also hypothesized that household with more education level would adopt the technology.

Livestock holding of household: Livestock holding is a good proxy indicator of wealth status of the farmers in the study area. Mostly, farmers with large livestock holding overcome a problem that may occur due to the technology failure. Therefore, it was hypothesized that farmers with large livestock adopt the technology than less number of livestock holders.

Land size: It is a proxy indicator of wealth status of the farmers in the study area. It is a continuous variable and measured in hectare. Land is a decisive factor for rural areas of the study area as they are allocating it for grazing of their dairy. It was assumed that the farmers who own large land size is likely to adopt the technology more.

Extension contact: Feder *et al.* (1985) notes that extension efforts increase the probable adoption of new technology by increasing the stock of information pertaining to modern production increment. It is a continuous variable and was measured by counting the frequency

of farmers contact with the extension agent in a month. It was hypothesized that farmers who have frequent contact with extension workers would adopt the technology better.

Availability of technology: The availability of the new technology and all other necessary inputs to small holders at the right time and place and in the right quantity and quality should be ensured (Ehui *et al.*, 2004). It is a dummy variable and was measured using 1 if the improved dairy practices were available whenever the farmers required and 0, otherwise. Therefore, it was hypothesized that regular availability of the technology is likely to stimulate interest for adoption.

Access to credit: As noted by Berhanu (2012) limited credit services have contributed to less exploitation of dairy potential in Ethiopia. Hence, lack of credit holdbacks the farmer from adopting the technology, especially, resource poor farmers. It is dummy variable and was measured using 1 if the respondent has access to credit and 0, otherwise. It was anticipated that regularly getting credit services enhances the adoption of the technology.

Demonstration: A study by Makokha *et al.* (1999) confirms that farmers' characteristics such as participation in field days and demonstration enhance adoption of farm technology. Accordingly, participation in visiting demonstration site improves the awareness level of the farmers. It is a dummy variable and was measured using 1 if the respondent has visited demonstration site and 0, otherwise. It was hypothesized that farmers those who visit demonstration site would better adopt improved dairy practices.

Training: It is a dummy variable and was measured using 1 if the respondent has got training on improved dairy practices and 0, otherwise. Rahman, (2007) states that training might have inculcated technical competency, more exposure to the subject matter and convinced to adopt the improved technologies in the farms. As also noted by Rogers (1983) Knowledge is the function in which an individual is exposed to the innovation's existence and gains some understanding of how it performs. It was hypothesized that obtaining training on the technology has positive influence in the adoption of the improved dairy practices.

Market for the products: Van den Ban and Hawkins (1996) states that adoption of improved technologies is strongly affected by the policy environment like input supply, market, credit, price policies and improved supply system. It is a dummy variable and was measured using 1 if the respondent has market for their dairy products and 0, otherwise. Availability of the market for the dairy products determines the decision of adopting the technology. Thus, it was

anticipated that availability of market for the dairy products enhances the adoption of the technology.

Compatibility of the technology: It related to the suitability of the improved agricultural practices with the culture of the community, values of the community and traditional management practices. Ban and Hawkins (1996) also states that innovations usually are adopted rapidly when they are highly compatible with the farmers' values, experiences and needs;

It is a dummy variable and was measured using 1 if the improved dairy practices are compatible with the existing farmers' culture and practices and 0, otherwise. It is expected that a technology with a high level of compatibility would be adopted more.

Dependent variables

Research effectiveness: Developing need-based and sustainable improved dairy practices that contribute to the improvement of the livelihoods of the users and national economic development.

Extension effectiveness: Disseminating need-based improved dairy practices to the target group using appropriate extension methods which, in turn, improves the adoption of the technologies.

Adopters: are those farmers who received the whole recommended improved dairy practices by Research, Agricultural Office, NGOs and other stakeholders; and who used for two years and decided to continue using of it.

Partial adopters: are those farmers who at least used one improved dairy practice out of whole recommended package.

Non-adopters: are those farmers who did not use any of the recommended improved dairy practices.

CHAPTER 4

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Results and discussion is a central part of a research report writing under which the findings are presented to describe the achievements of study objectives. This chapter starts with description of the socio economic characteristics of the respondents followed by findings and discussion corresponding to the specific objectives of the study.

4.1. SOCIO ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

The mean age of dairy researchers, dairy extension workers and farmers (Adopters, partial adopter and non adopters) was 37.5, 32 and 47.2 years respectively (Table 4.1). With respect to farmer respondents, the mean age of adopters, partial adopters and non adopters was 47.8, 48 and 45.7 years respectively.

Mean years of work experience of dairy researchers, dairy extension workers and farmers were 13.7, 9 and 16 years respectively. On the other hand, the mean work experience of adopters, partial adopters and non adopters was 13.6, 14 and 20 years respectively. The work experience almost corresponds with age of the respondents. The younger age of researchers and extension workers should be properly harnessed to motivate the slightly elderly nature of farmer respondents through appropriate extension tools. The extension techniques should be in such a way that they create an interest and enthusiasm among the farmers by incorporating all adult education principles.

Mean family size of researchers and extension workers was nearly equal. It also holds true for the mean family size of adopters, partial adopters and non adopters. In addition to descriptive statistics, inferential statistics was used to identify influencing variables of improved dairy practices adoption. The details of results and discussion are presented under respective specific objectives of the study.

Table 4. 1: Mean distribution of sample respondents by socio-economic variables (n=250)

Variables	Researcher (n=50)	Extension worker(n=50)	Adopter (n=42)	Partial adopters (n=48)	Non-adopter (n=60)
Age	M= 37.5 SD=9	M=32 SD=7.7	M=47.8 SD=11.8	M=48 SD=11	M=45.7 SD=12.4
Family size	M= 3 SD=1	M=3 SD=1	M=7 SD=2	M=6 SD=2	M=6 SD=2
Work experience	M= 13.7 SD=9	M=9.4 SD=6.3	M=13.6 SD=5.9	M=14 SD=7.7	M=20 SD=12.9
Farm land size (ha)	-	-	M=1.6 SD=1.8	M=1.6 SD=1.8	M=2.4 SD=1.9
Livestock (No.)	-	-	M=4 SD=2.4	M=3 M=1.3	M=2 SD=2
Grazing land (ha)	-	-	M=0.41 SD=0.6	M=0.36 SD=0.6	M=0.65 SD=0.6

M=Mean, SD= Standard Deviation, n=sample size Source: Field survey, 2015

4.2. EDUCATION STATUS OF RESPONDENTS

Education is a powerful tool for developing social, economic and political activities in any society. It highly improves critical, logical and analytical thinking of the individuals which, in turn, contributes to solve the issues related to the development of the society. Thus, human capacity building needs to be a precursor to all the development endeavors. As depicted in Table 4.2, researchers constitute 28, 50 and 22 per cent of Ph.D, M.Sc./MA and B.Sc./BA level of education respectively. The majority (72%) of extension workers were with the education level of undergraduate. On the other hand, the mean class year for adopters, partial adopters and non adopters was 9, 7 and 5 respectively. Majority of the researchers and some extension workers acquired M.Sc. qualification which is a welcome trend and further motivate by self to learn more and more and develop capacity in their respective domain of specialization. Nevertheless, the level of formal education among farmer respondents was found to be relatively less which may inhibit the acquiring of scientific knowledge.

Table 4. 2: Education level of respondents

Education level	Researchers (n=50)	Extension workers (n=50)
PhD	14 (28)	-
M.Sc/MA	25 (50)	8 (16)
B.Sc/BA	11 (22)	36 (72)
Diploma	-	6 (12)
Total	50 (100)	50 (100)
Mean class year of farmer respondents		
Adopters (n=42)	**Partial adopters (n=48)**	**Non-adopters (n=60)**
9	7	5

() Figures in the parenthesis indicate percentage; Source: Field survey, 2015

4.3. DAIRY RESEARCH EFFECTIVENESS INDEX

Effective research process is a precursor for generating improved dairy practices that have a wide impact on the target groups. Different research centers and universities follow different approaches in their research process. An index was developed with the intention of bringing out a clear picture of the current dairy research process in Ethiopia.

Dairy research effectiveness index was developed using sub indicators that were selected through intensive expert reviews. Initially, as the sub indicators were new for measuring the effectiveness of dairy research process, its appropriateness and relevance were tested and validated by the dairy research professionals. The selected sub indicators are: Personal characteristics, research participation, infrastructure, responsiveness of improved dairy practices, research management, research policy, social participation and financial capacity. The index was developed for each sub indicator and finally the overall index of the sub indicators was worked out to determine the effectiveness level of the dairy research process in the study area. Using cumulative square root frequency (CSRF) method, the output of the index was categorized into low, medium and high levels of dairy research effectiveness. Furthermore, ordered logistic regression model was also used to identify the influencing sub indicators of dairy research effectiveness.

4.4. PERSONAL CHARACTERISTICS DAIRY RESEARCH EFFECTIVENESS INDEX

Personal characteristics dairy research effectiveness index was developed to investigate the capacity of the researchers to undertake dairy research activities. The experienced researchers were solicited to develop a responsive improved dairy practices provided that other factors are fulfilled. Table 4.3 revealed that about 30, 44 and 26 per cent of the respondents were categorized as low, medium and high level of dairy research effectiveness index respectively. The large proportion of the respondents (44%) was found in the range of medium level. Likewise, the overall level of personal characteristics dairy research effectiveness index was 64 per cent, which was in the range of middle level. Aggregate of medium and low levels constituted 74 per cent of the total respondents. It implies that the majority of the dairy researchers were not fully capacitated to undertake a comprehensive dairy research programme that could significantly contribute to the development of dairy subsector in the study area. Therefore, capacity building is required in the area of personal characteristics to strengthen the capacity of dairy researchers.

Table 4. 3: Distribution of respondents on the basis of personal characteristics dairy research effectiveness sub indicator

(**n=50**)

Personal characteristics research effectiveness index	**Frequency**	**Percentage**	**Mean**
Low (Upto 0.55)	15	30	
Medium (0.56-0.70)	22	44	0.64
High (0.71 and above)	13	26	
Total	50	100	

Source: Field Survey, 2015

4.5. RESEARCH PARTICIPATION EFFECTIVENESS INDEX

Participation of researchers in the activities of research review meetings, workshops, field visit, experience sharing, collaboration research works etc build their capacity to undertake research programmes which, in turn, contributes to the generation of improved dairy practices

that can solve the problems of clientele. About 42, 30 and 28 per cent of the respondents were in the category of low, medium and high levels of research participation index (Table 4.4). The data revealed that the majority of the respondents were in low range of research participation index. Correspondingly, the overall research participation index of the respondents was 43 per cent which was in range of low margin of medium levels. In combination, medium and low levels of the respondents constituted high proportion (72%). It indicates that the majority of the researchers lack exposure to activities that could develop their research expertise. This warrants better exposure of researchers to gain substantial experience in order to execute fruitful research programmes.

Table 4. 4: Distribution of respondents on the basis of research participation effectiveness sub indicator

(n=50)

Research participation effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.37)	21	42	
Medium (0.38-0.59)	15	30	0.43
High (0.60 and above)	14	28	
Total	50	100	

Source: Field survey, 2015

4.6. INFRASTRUCTURE EFFECTIVENESS INDEX

Infrastructure includes facilities that are required to perform dairy research activities such as transport, working office, laboratory equipments, communication etc. These play a crucial role for generating improved dairy practices. However, it is evident from Table 4.5 that 36, 56 and 8 per cent of respondents are grouped in low, medium and high levels of infrastructure effectiveness index respectively. The overall level of infrastructure effectiveness index of respondents was 40 per cent. Likewise, the highest proportions of the respondents were in low and medium levels that account 92 per cent. It indicates that the infrastructure level of the dairy research institution is at the lowest level. In the absence of adequate enabling infrastructure, generating utility oriented improved dairy practices will only be pipedream. Consequently, the inadequacy of infrastructure may not motivate and facilitate the researchers

to use their maximum capacity. It also, in turn, highly affects the generation of effective improved dairy practices. Therefore, substantial investment is required to be infused in creating enabling infrastructure to bring good research outputs.

Table 4. 5: Distribution of respondents on the basis of infrastructure effectiveness sub indicator

(**n=50**)

Infrastructure effectiveness index	**Frequency**	**Percentage**	**Mean**
Low (Upto 0.36)	18	36	
Medium (0.37-0.50)	28	56	0.40
High (0.51 and above)	4	8	
Total	50	100	

Source: Field survey, 2015

4.7. RESPONSIVENESS OF IMPROVED DAIRY PRACTICES EFFECTIVENESS INDEX

Responsiveness of improved dairy practices effectiveness index refers to the current status of improved dairy practices in addressing the needs of clientele. The improved dairy practice which is in line with the farmers` criteria can be easily disseminated to the clientele. About 36, 50 and 14 per cent of the respondents were classified in low, medium and high levels of responsiveness of improved dairy practices effectiveness index respectively (Table 4.6). The overall responsiveness of improved dairy practices effectiveness index was also 42 per cent, which was at low level of medium range of the index. The majority of the respondents were in low and medium ranges of the index (86%). It implies that the use of improved dairy practice by the clientele is at lowest level. Similar report by CSA (2010) indicated that the indigenous breeds accounted for 99.19 per cent, while the hybrids and pure exotic breeds were represented by 0.72 and 0.09 per cent, respectively. (CSA, 2008) also states low level of improved dairy practices for instance, about 0.15 per cent improved forages (alfalfa and Napier grass) used by livestock holders. Additional use of industrial by-products like oil cake, bran and brewery residue is negligible (0.8%). Similarly, EARO (2006) highlighted that despite decades of research and development efforts, with the aim to provide farmers new

technologies to improve their farming practices, agricultural productivity for both crop and livestock production is still very low.

Table 4. 6: Distribution of respondents on the basis of responsiveness of improved dairy practices effectiveness sub indicator

(n=50)

Responsiveness of improved dairy practices effectiveness index	**Frequency**	**Percentage**	**Mean**
Low (Upto 0.39)	18	36	
Medium (0.40-0.52)	25	50	0.42
High (0.53 and above)	7	14	
Total	50	100	

Source: Field survey, 2015

4.8. RESEARCH MANAGEMENT EFFECTIVENESS INDEX

Research management includes all research managerial activities of the organization such as planning, directing, staffing, decision making, monitoring and evaluation. Table 4.7 revealed that 46, 34 and 20 per cent of the respondents were in the range of low, medium and high levels of research management effectiveness index respectively. The highest proportion (80%) of the respondents was in low and medium ranges of the index. The overall research management effectiveness index was also 44 per cent. It shows that the majority of the respondents were nearly at low range of the research management effectiveness index. It has implication on the effectiveness of the dairy research works. As a result, it necessitates improving the management of the research programmes to achieve the intended targets set aside for even development of dairy subsector.

Table 4. 7: Distribution of respondents on the basis of research management effectiveness sub indicator

(**n=50**)

Research management effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.42)	23	46	
Medium (0.43-0.56)	17	34	0.44
High (0.57 and above)	10	20	
Total	50	100	

Source: Field survey, 2015

4.9. RESEARCH POLICY EFFECTIVENESS INDEX

Research policy includes research governing issues such as rule and regulation and research strategy that promote the generation of improved dairy practices. The presence of vivid research strategy sets a clear direction for generating problem solving technology. It also has great contribution for attaining the objectives of the dairy research. However, the research policy has less attention in dairy subsector in the study area. The respondents were categorized into low, medium, and high levels under research policy effectiveness index with 48, 36 and16 per cent respectively (Table 4.8). The majority of the respondents was in low level of the index. Aggregate of low and medium levels of the index constituted 84 per cent. Additionally, the overall research policy effectiveness index was 36 per cent. It implies that the research policy/strategy of the dairy subsector was not well cascaded to the researchers. In line with this, Yilma *et al*. (2011) pointed out that the dairy development of Ethiopia is affected due to the absence of an operational breeding strategy and policy. Well formulated research policy gives direction and guidance that lead to destination. In the absence of clear research policy, expecting effective dairy research work is unfeasible. The draft Ethiopian livestock breeding policy that focuses on local breed improvement through both within-breed selections of indigenous breeds and cross-breeding of local with exotic breeds also needs to be cascaded for effective implementation. For realizing effective dairy research work, it requires a strong and vibrant research policy in order to orient all the researchers with

effective research performance. In such way, every researcher knows what the organization expects from them and reacts accordingly.

Table 4. 8: Distribution of respondents on the basis of research policy effectiveness sub indicator

(n=50)

Research policy effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.33)	24	48	
Medium (0.34-0.46)	18	36	0.36
High (0.47and above)	8	16	
Total	50	100	

Source: Field survey, 2015

4.10. SOCIAL PARTICIPATION EFFECTIVENESS INDEX

Social participation refers to researchers` participation in social activities of the organization and outside of the organization. Social participation improves the interaction of the researchers with the community which further contributes to identify the real problems of the community. About 64, 24, and 12 per cent of the respondents were categorized in low, medium and high levels social participation effectiveness index (Table 4.9). The majority of the respondents (64%) were in low levels of the index. The overall social participation effectiveness index was also 52 per cent which was in the range of low level of the index. Low and medium levels of the index constitute 88 per cent which indicates that the social participation of the researchers were minimal. It further implies that the researchers' participation in community service is not to level of expectation. Though the participation of researcher in the social activities of their area enhances the community development, it was not observed in the study area owing to less social participation of the researchers.

Table 4.9: Distribution of respondents on the basis of social participation effectiveness sub indicator

(**n=50**)

Social participation effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.53)	32	64	
Medium (0.54-0.72)	12	24	0.52
High (0.73 and above)	6	12	
Total	50	100	

Source: Field survey, 2015

4.11. FINANCIAL CAPACITY EFFECTIVENESS INDEX

Financial capacity indicates researcher`s income in covering all family expenditures. Obviously, a researcher who has no adequate source of income cannot exert all his/her time and energy to research works. In the other way, more time is expended out of the organization for part time works for covering his/her family expenditure. Table 4.10 revealed that 92 per cent of the respondents were grouped in low level of the index; and each medium and high levels of financial capacity effectiveness index constituted 4 per cent. The overall financial capacity effectiveness index was 27 per cent. Likewise, the majority of the respondents (96%) were in low and medium levels of the index. Of all sub indicators, this sub indicator has the lowest mean value. Apparently, it points out that the financial capacity of the respondents was very poor to cover their family expenditure. The less financially capacity triggers staff turnover (job shifting) and it also makes difficult to sustain experienced researchers. Though the government is making efforts to financially capacitate the researchers, the beginners and the middle level researchers were found to perceive the absence of uniformity in improving the financial capacity of the researchers. Incentive mechanisms were perceived to favour few of the senior researchers and higher officials. Further, the feedback from the respondents also revealed that the financial problem of the researchers was not addressed to the extent of their satisfaction. Therefore, the financial package for the beginners and mid career professionals should be substantially stepped up and make the chosen profession as more attractive.

Table 4.10: Distribution of respondents on the basis of financial capacity effectiveness sub indicator

(**n=50**)

Financial capacity effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.33)	46	92	
Medium (0.34-0.46)	2	4	**0.27**
High (0.47 and above)	2	4	
Total	50	100	

Source: Field survey, 2015

Dairy research effectiveness index

The dairy research effectiveness index was developed by aggregating the score of research effectiveness sub indicators such as personal characteristics, research participation, research infrastructure, research management, responsiveness of improved dairy practices, research policy, social participation and financial capacity. As depicted in Table 4.11, about 52, 42 and 6 per cent of the respondents were in the range of low, medium and high levels of the dairy research effectiveness index respectively. The overall research effectiveness index was 44 per cent which came nearly in the range of low level of the index. Correspondingly, the majority of the respondents (94%) were in the range of low and medium levels of the index. It apparently indicates that the dairy research process effectiveness of the study area is almost low. The finding is supported by KAM (2012) that used Knowledge Index (KI) and ranked Ethiopia 140th out of 145 countries in ability to generate, disseminate and use knowledge. It is also in line with (FARA, 2006) that states realizing the potential of agricultural research to reduce poverty have been elusive in many parts of Africa. The researcher also came to such a conclusion while taking into account the prevalence of poverty, hunger and malnutrition among farm families, in many part of Africa. The ineffectiveness of agricultural research in Africa was also pointed out by Sumberg (2004) that notes agricultural research in Africa had generally yielded few benefits for poor people because it was elitist and out-of-touch with rural realities. Similarly, the apex organization of the national research system of Ethiopia the then EARO (2006) now EIAR also confirms that though research and development efforts have been made for decades to provide farmers the new technologies to improve their farming practices, agricultural productivity for both crop and livestock enterprises is very

low. Hence, fine-tuning of research programmes along with various sub-indicators as outlined above would pave the way for enhanced research effectiveness in terms of output and returns for the farmers.

Table 4.11: Distribution of respondents on the basis of aggregate of dairy research effectiveness sub indicators

(**n=50**)

Dairy research effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.43)	26	52	
Medium (0.44-0.56)	21	42	**0.44**
High (0.57-0.69)	3	6	
Total	50	100	

Source: Field survey, 2015

4.12. CONTRIBUTION OF DAIRY RESEARCH EFFECTIVENESS SUB INDICATORS

Though the level of contribution varies among the sub indicators of dairy research effectiveness, all sub indicators tend to contribute to improve the effectiveness of the dairy research of the study area. The sub indicators are interconnected and the ineffectiveness of any of the sub indicator affects the effectiveness of other sub indicators. Perusal of Fig 4.1 indicated that the mean scores of all sub indicators were low except for personal characteristics and slightly for social participation which rank 7th and 8th respectively. Among all dairy research effectiveness sub indicators, financial capacity had the lowest mean score (0.27). It is also evident from the observation that staff turnover (job shifting) especially for experienced researchers was high for the dairy research. The sub indicators (research management, infrastructure and research policy) were ranked first, second and third respectively (Table 4.12). It clearly points out that these sub indicators had high contribution to the improvement of dairy research effectiveness. However, they had low mean score. It implies that the sub indicators that contribute much to the effectiveness of dairy research were ineffective. It further indicates that the dairy research process of the study area is less

effective which also has implication in the overall effectiveness of the dairy subsector development in the study area.

Table 4.12: Rank summary of dairy research sub indicators

(n=50)

Sub indicators	Weightage	Rank
Research management	88.29	1
Infrastructure	85.76	2
Research policy	84.64	3
Responsiveness of improved dairy practices	79.58	4
Research participation	70.71	5
Financial capacity	60.90	6
Personal characteristics	58.21	7
Social participation	50.29	8

Source: Field survey, 2015

Therefore, the areas requiring greater attention for improving research effectiveness especially strengthening research infrastructure, streamlining research strategies and framing of appropriate policy guidelines accompanied by adequate financial support should be given more thrust.

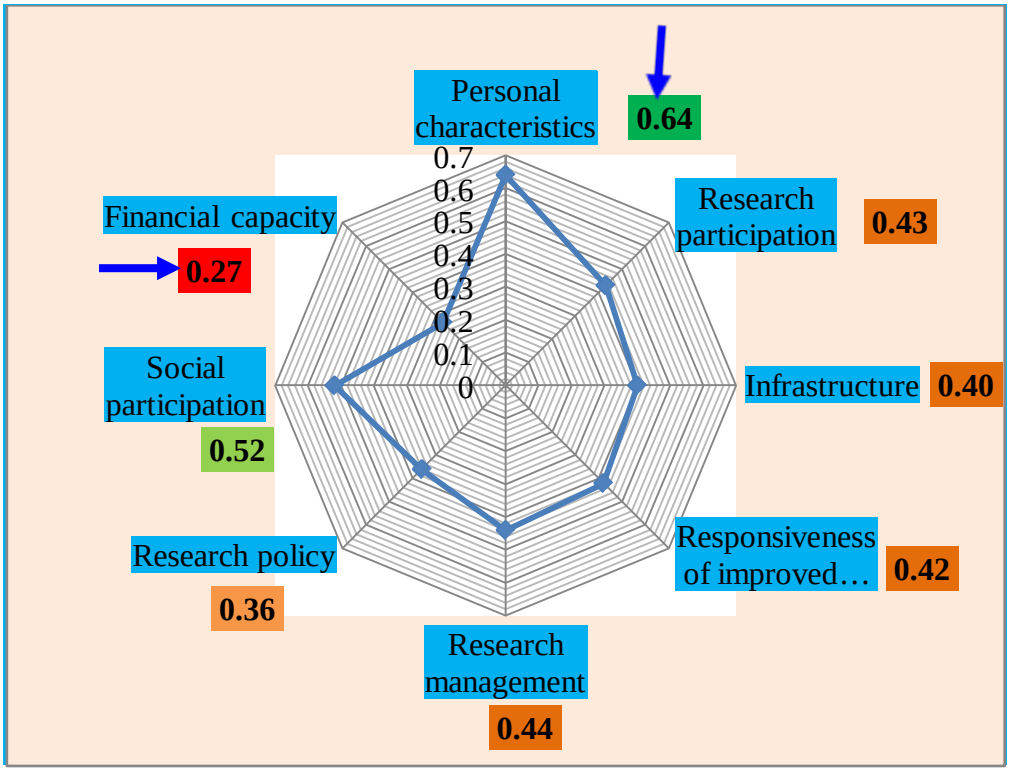

Fig 4.1: Summary of research effectiveness sub indicators

Source: Field survey, 2015

4.13. FACTORS INFLUENCING EFFECTIVENESS OF TECHNOLOGY GENERATION PROCESS OF DAIRY PRODUCTION

The result of ordered logistic regression on effectiveness of dairy technology generation process is summarized in Table 4.13. The ordered logistic regression model is estimated using maximum likelihood method. The χ^2 result shows that the parameters were significantly different from zero at $P<0.01$ for the effectiveness of dairy technology generation process. The McFadden's R-square or Pseudo R^2 is 0.825, indicating that 82.5 per cent of the variations in probabilities of getting in high level of effectiveness dairy technology generation process was explained by the selected explanatory variables.

Explanatory variables that were taken to the model are; personal characteristics, extension participation, infrastructure, responsiveness of improved dairy practices, extension management, policy environment, social participation and financial capacity. Among the variables taken to the model research participation and responsiveness of improved dairy

practices were found to be significant. Explanatory variables that are selected for econometric model and statistically significant at P<0.05 were further explained as under:

Table 4.13: Ordered logistic regression for factors influencing dairy technology generation process

		Estimate	Std. Error	Wald	df	Sig.
	[category = 1.00]	49.717	22.691	4.801	1	0.028
	[category = 2.00]	67.692	29.013	5.443	1	0.020
Location	Personal characteristics	8.628	12.605	0.469	1	0.494
	Research participation	20.022	9.404	4.534	1	0.033**
	Infrastructure	15.861	10.819	2.149	1	0.143
	Responsiveness of improved dairy practices	45.925	23.540	3.806	1	0.050**
	Research management	3.674	10.582	0.121	1	0.728
	Research policy	12.614	11.099	1.292	1	0.256
	Social participation	14.945	9.537	2.456	1	0.117
	Financial capacity	18.187	21.504	0.715	1	0.398

-2 Log Likelihood	96.115	Cox and Snell	0.795
Chi-Square	79.255	Nagelkerke	0.931
df	8	McFadden	0.825
p-value	0.000		

** significant at P<0.05 Source: Field survey, 2015

Research participation: It refers to the participation of researcher in activities of dairy research such as problem identification, research review meeting, on farm trial, Farmers' Research Group, field days, excursion, ADPLAC meeting, workshop and other experience sharing programs. The ordered log-odds estimate that improving research participation would result in 20.022 units increase in the ordered log-odds of being in a high range of research effectiveness index while the other variables in the model were held constant. It is statistically positively significant at P<0.05. It indicates that research participation plays a key role in improving the effectiveness of research activities. Effective participation of researchers in their respective activities would improve the effectiveness of research activities in any region.

Responsiveness of improved dairy practices: It refers to the affordability, profitability, existing demand to the technology, adoption status of the technology, releasing process of the

technology, relevancy of the technology and manageability of the technology in addressing the needs of the end users. Making improved dairy practices responsive would result in 45.925 units increase in the ordered log-odds of being in a high range of research effectiveness index while the other variables in the model were held constant. It is statistically significant at $P<0.05$. It indicates that responsiveness of improved dairy practices has high contribution in enhancing the effectiveness of improved dairy practices generation.

4.14. STATUS OF DAIRY RESEARCH REVIEW PROCESS

A research review maintains the quality of the research works and it equally avoids effort duplication. In the study area, a research review of the university is completed in the university. However, the research review of the research center took place at different stages and finally reaches the national research review meeting where the final approval of the research proposal is made. Table 4.14 revealed that 82 per cent of the respondents replied that the research review helps in improving the research work. The remaining 8 and 10 per cent of the respondents stated that the research review process of the study area was lengthy and full of professional bias respectively. On the other hand, researchers were made to evaluate their level of research skills. The majority (60%) of the respondents replied as they have sufficient research skills and the balance 40 per cent of the respondents replied as they have insufficient research skills.

In relation to research review process, observation and key informant interview were made with senior researchers. Thus, the research proposal review process at Holetta Agricultural Research Center took place at five different stages, namely, process, commodity, center, case team and national levels. At each stage, professionals of the discipline critically review following the presentation of the initiator/s of the research proposal. Technical soundness, relevancy and financial viability of each proposal is evaluated for consideration. Similarly, the anticipated contribution of the research output to the national development; dairy subsector development; technology needs of clientele are duly considered. At each stage of the research proposal review, the expectation is that the research proposals are getting more technically sound and problem solving. Finally, the research proposals that met the aforementioned requirements reach for national research proposal review level on which fund is granted.

The discussion with the key informants disclosed that there was no well established research proposal review system. As a result, the research proposal review process lacks stability and

subjected to frequent alteration. Lack of stable and strong research review process emanate from the absence of in-depth study during the change of the review process. As a result, the contribution of the review to the enrichment of the research proposal is minimal. The current research proposal review process is too long as reviewing at five stages is monotonous and time consuming. Though the review process was made at various stages, there were no well designed criteria at each stage to serve as guidance for reviewing the proposal.

Dairy research took place by national research centers, regional research centers, universities, NGOs etc. There was no common forum for all the organizations though they undertook similar activities in relation to research activities. There was an effort to create common forum for national and regional research centers though it was not strong enough to reduce redundancy of research works. Roles and responsibilities of each institution were not well demarcated and observing redundancies of research activities were common during reporting at different research review forum. On the other hand, it leads to unnecessary resource competition for the same research activity that took place at different organization. For instance, Research centers and University which are located in the study area have no collaborative research work. Unexpectedly, they also do not have a common forum for reviewing research proposals. The finding is in agreement with Belay (2003) who stated that the participation of different organizations in research and extension activities of Ethiopia is without proper co-ordination which, in turn, led to redundancy of effort and wastage of resources. Hence, proper guidelines should be framed for undertaking systematic research review process.

Table 4.14: Perception of researchers on research review and level of their research skills

Status of research review			Research skills	
Helps in improving the research work	Lengthy	Full of professional bias	Sufficient	Insufficient
41 (82)	4 (8)	5 (10)	30 (60)	20 (40)

() Figures in the parenthesis indicate percentage

Source: Field survey, 2015

Table 4.15: Effectiveness of improved dairy practices generation process as rated by researchers and extension workers

Particulars	Researchers (n=50)		Extension workers (n=50)		Researchers and Extension workers(n=100)	
	F	%	F	%	F	%
Ineffective	6	12	5	10	11	11
Rarely effective	15	30	25	50	40	40
Moderately Effective	24	48	14	28	38	38
Highly effective	5	10	6	12	11	11
Total	50	100	50	100	100	100

Source: Field survey, 2015

Researchers and extension workers were requested to rate the effectiveness of improved dairy practices generation process. It is a self evaluation for researchers whereas, extension workers are principally testing the improved dairy practices at field level and distinguish the performance of the practices. As depicted in Table 4.15 about 12, 30, 48, and 10 per cent of researchers rated as ineffective, rarely effective, moderately effective and highly effective

respectively. On the other hand, 10, 50, 28 and 12 per cent of the extension workers rated as ineffective, rarely effective, moderately effective and highly effective respectively. The majority of extension workers (60%) and 42 per cent of the researchers rated the effectiveness of improved dairy practices process below the average. In combination 51 per cent of the researchers and extension workers rated below the average. The data evidently confirms that the improved dairy practices generation process of the study area is below the average. As seen from the extension workers rating, the improved dairy practices are less addressing the problem of the farming community of the study area. The researchers and extension workers are the key actors in technology generation and dissemination process. If they themselves rate the ongoing process as below the satisfactory level, it is a serious concern and bottleneck in achieving the food security of poor farmers. Thus, it needs revisiting of the dairy research process to meet the needs of the clientele and for more contribution to the dairy development of the country.

Table 4.16: Status of improved dairy practices generation and dissemination

(n=50)

Particulars	Minimum	Maximum	Mean	Std. Deviation
Number of improved dairy practices generated	0.00	5.00	0.98	1.38
Number of improved dairy practices disseminated to the end users	0.00	3.00	0.78	1.06
Number of improved dairy practices adopted by the farmers	0.00	3.00	0.78	1.06
Number of improved dairy practices rejected by the farmers	0.00	0.00	0.00	0.00
Number of publications since employment	0.00	31.00	5.16	6.94
Number of ongoing research projects	0.00	5.00	1.60	1.67

Source: Field survey, 2015

An assessment was made to identify the performance of researchers in generating and disseminating improved dairy practices. In the previous discussion (under the sub topic "socio economics characteristics of the respondents" the mean years of work experience for researcher was 13.7. As summarized in Table 4.16 mean of improved dairy practices generated by the researchers was 0.98. In the other way the researcher was generating on average (0.98/13.7) 0.072 improved dairy practices per annum during his/her employment period. The figure points out that the majority of the researchers did not develop a single improved dairy practices during their stay in the organization. Based on the field observation, the disseminated and adopted improved dairy practices were minimal. The mean number of publications was 5.16 i.e. on average a researcher had (5.16/13.7) 0.38/annum during his/her employment period. Publication is useful tool for sharing scientific information among the scholars. However, the figure suggests that an effort of researchers in publications was not worth mentioning.

4.15. DAIRY RESEARCH STRATEGY

Well formulated research strategy provides a clear direction for undertaking a responsive research works. It has a considerable contribution for developing effective improved dairy practices. Majority (88%) of the respondents indicated the absence of clear dairy research strategy and the balance 10 and 2 per cent reported as lengthy and the presence of clear strategy respectively (Fig 4.2). The key informant interview also concluded the absence of clear strategy in overall guiding of dairy research. Initially, Ethiopia adopted cross breeding as strategy for improving the dairy subsector. Selection of indigenous cows and developing synthetic breed were not considered as option for improving the dairy subsector of the country. Cross breeding was implemented without thorough identification of genetic materials of the entire local dairy breeds. For the purpose, Boran, Horro and Barka indigenous breeds were selected for crossing with Holstein Friesian and Jersey. The average milk yield/day for boran and crossbred is 1.6 liters and 8 liters at farmer's level respectively. However, there are indigenous cows that produce more than 6 liters/day in the country. This would help to find the potential dairy cows that can ensure more milk production in the country. Thus, it needs exhaustive scanning and selection of the genetic resources of the cattle for improving the dairy subsector of the country. It is also evident from the literature that the Artificial Insemination (AI) coverage of the country is less than one per cent, in the long journey of cross breeding.

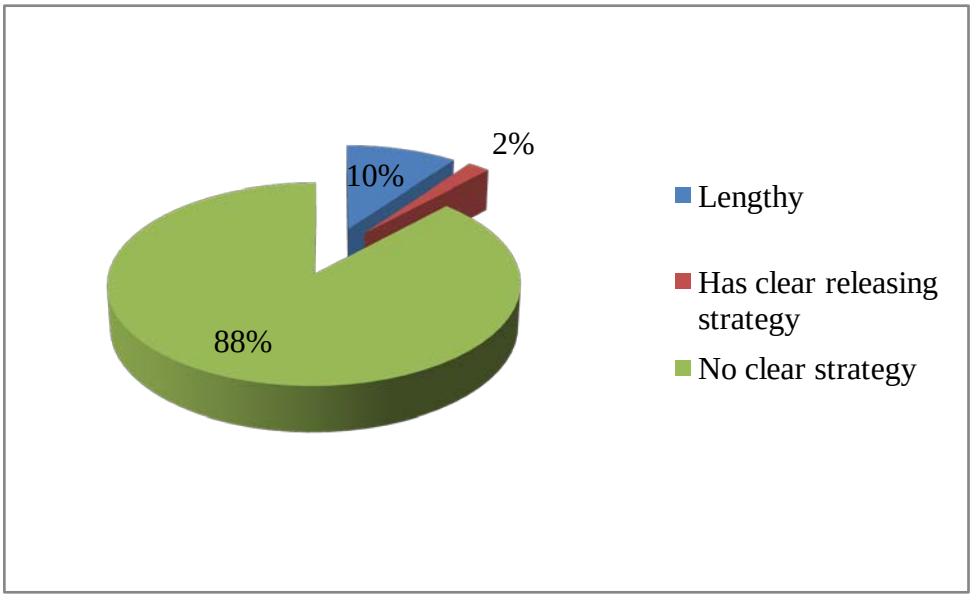

Fig 4.2: Researchers' perception on dairy research strategy

Source: Field survey, 2015

4.16. DAIRY RESEARCH AND DISSEMINATION STATUS

Farmers are keen observers of the development interventions that are made in their locality. The farmers evaluate the interventions from their perspective and circumstances. Considering the real situations of the dairy research and extension activities of their area, the farmers were requested to rate the items in relation to dairy research and extension. The rating of the items affects the effectiveness of improved dairy practices generation and dissemination positively or negatively. The higher rating (regularly) of the items contributes positively to the strengthening the effectiveness of the improved dairy practices generation and dissemination and; the lower rating (rarely and never) is vice versa. Table 4.17 revealed that the majority of respondents in all items rated `never`. The respondents gave relatively proportional rating for relevance of improved dairy practices and the level of improved dairy practices in problem solving. With respect to relevance of improved dairy practices, 8 and 40 per cent of the respondents rated as `regularly` and `occasionally` respectively and the balance 24.7 and 27.3 per cent rated `rarely` and `never` respectively. In aggregate rarely and never response for the level of improved dairy practices in problem solving constituted 70.7 per cent. Predominantly, the respondents rated "never" for the remaining items such as participation in dairy research activities; affordability of improved dairy practices; linkage among farmers,

research and extension; availability of improved dairy practices; contribution of ADPLAC; participation of farmers for setting research agenda; farmers visit to extension agent office and contribution of dissemination program to adoption of the practices. The data suggest that it needs to revisit the existing dairy research and extension program of the study area which, in turn, assists to improve the effectiveness of the improved dairy practices generation and dissemination. The contribution of dairy to the improvement of the livelihood of the community would be strongly observed when dairy research and extension interventions are positively influencing the clientele. It can also further attract the farmers to adopt the improved dairy practices and significant number of private sectors can invest in the dairy business. Compared to the dairy potential of the study area and available opportunity, the adoption rate of improved dairy practices was low. Correspondingly, the participation of private sectors in the dairy business was insignificant.

Table 4.17: Farmers' perception to dairy research and extension in the study area (n=150)

Particulars	Regularly		Occasionally		Rarely		Never	
	F	%	F	%	F	%	F	%
Are improved dairy practices relevant to your needs?	12	8.0	60	40.0	37	24.7	41	27.3
Are improved dairy practices problem solving?	10	6.7	31	20.7	61	40.7	48	32.0
Is dairy research participatory?	3	2.0	5	3.3	17	11.3	125	**83.3**
Is improved dairy practice affordable?	5	3.3	25	16.7	48	32.0	72	**48.0**
Is the linkage among farmer, extension, research and other actors strong?	3	2.0	10	6.7	31	20.7	106	**70.7**
Do you obtain improved dairy practices as per your demand?	7	4.7	24	16.0	39	26.0	80	**53.3**
Does ADPLAC forum contribute for the improvement of dairy subsector?	3	2.0	3	2.0	15	10.0	129	**86.0**
Do you have role in setting research agenda?	3	2.0	3	2.0	9	6.0	135	**90.0**
Do you visit the extension office for demanding improved dairy practices?	4	2.7	37	24.7	41	27.3	68	**45.3**
Have the dissemination programme helped you to adopt improved dairy practices?	3	2.0	13	8.7	39	26.0	95	**63.3**

Source: Field survey, 2015

4.17. DAIRY RESEARCH MONITORING AND EVALUATION

Observation and key informant interview were carried out at Holetta Agricultural Research Centre. It aimed at identifying the status of the center on research monitoring and evaluation.

Thus, monitoring and evaluation is an important tool in rectifying the implementation of the research works as planned and also assists to make the necessary adjustments for achieving the set research objectives.

The center has monitoring and evaluation committee that makes follow up on the overall research works of the center. The researcher also prepares progress report (status of research) and annual report (details of the activity). Monitoring and evaluation could not solve all the bottlenecks that exist within the research center. For instance, once the research proposal is approved, the researcher starts the research work without making a signed agreement with organization. The importance of agreement is to properly handover the research works when a researcher needs to leave the center due to various reasons. There is a mechanism of handing over of the research works for those who leave the center officially. However, there is no enforcing mechanism to handover the research works for those who leave the center by their own. The research works of such individuals are made discontinued after consuming the resources. To overcome such problem, it needs a set agreement between researcher and organization which, in turn, makes the researcher to take full accountability. The monitoring and evaluation committee undertakes its activities by taking samples of research projects from each research units i.e. it cannot address all the research projects of the center. In such a big center, undertaking effective monitoring and evaluation is unlikely with centrally established committee and it needs to cascade the establishment of the committee to each research units. Likewise, strong linkage needs to exist between the center and the research units monitoring and evaluation committees

A monitoring and evaluation committee needs to have a set guideline which supports them to make their activities objectively. What to monitor and evaluate? How to monitor and evaluate? When to monitor and evaluate? How to report the result of monitoring and evaluation? How to communicate the monitoring and evaluation result to the researcher? etc. needs to be set adequately before monitoring and evaluation took place.

Monitoring and evaluation committee is a mirror for the organization and it needs developing their capacity through short term training and experience sharing to render their services efficiently.

Furthermore, the researchers need to undertake impact evaluation on the adopted improved dairy practices. Impact evaluation should aim at getting feedback about the performance of the improved dairy practices under farmers' circumstances. It is an important tool to pinpoint the status of the practices and to serve as a base for decision regarding possible changes and improvements on the technology and the whole research and dissemination process. In the

process of improved dairy practices dissemination, intensive follow up would facilitate the adoption of the practices sustainable. It also assists to know the status of adopted improved dairy practices; the possible reasons for their discontinuation and non-adoption of the practices; socio-economic changes observed on the farmers due to adopting the improved dairy practices.

In respect to documentation of research works, a key informant interview was done with senior researchers. Research work is made ready to use when it is well documented in the way that it is accessible to the users. In the research center, the completed research works are documented at center level. It comes to documentation after reviewing the research works at different research forums. However, there is no supervision on the final write up of the research work and full responsibility is given to the researcher. Logically, monitoring and evaluation committee of the center could assess the completed research works in line with its initial research plan. For the purpose, the documentation of research proposal is also equally important. When the research proposal is developed, it should include clear strategy on how the research finding reaches the end users and act accordingly when the research work is completed. Final write up of a research is not an end by itself. It has to be translated into action to solve the problem that the research was initially planned for.

Submission of the whole research works is not enough and the summary of the research findings needs to be prepared and documented separately. Though it is difficult to disseminate the full write up of a research works, the summary of the research findings needs to be disseminated to the users including the policy makers and planners.

4.18. MAJOR CONSTRAINTS OF DAIRY RESEARCH

Identification of the constraints that impede the effectiveness of generating improved dairy practices needs to be the priority activities of actors participating in dairy research. By the same token, searching pertinent solution to the constraints boosts the generation, adaptation, testing and dissemination of improved dairy practices that solve the problems of the end users. The core constraints of dairy research were identified through group discussion with researchers and finally incorporated into the questionnaire. The respondents ranked the constraints in order of their importance (highest to lowest). Table 4.18 disclosed the weightage of each constraint along with its rank. Lack of clear research strategy, inadequate laboratory equipments, inadequate laboratory buildings and inadequate budget support were the top constraints of the dairy research in order of their importance. Research mainly needs

effective research management, competent and committed staff, resource and infrastructure. In the absence of such requirements, expecting problem solving improved dairy practices will be unrealistic. Similar views were expressed by senior researchers of the study area during key informant interviews. The research center in which the key informants work, has been making strenuous effort to generate improved dairy practices for more than five decades. Some technologies were generated, verified and popularized to the target group. Some of them are: determining the blood level of crossbred as per the agro ecological zone of the country; recommendation of agronomic practices of improved varieties of oats, vetch, elephant grass; improved management practices, improved housing, feeding practices etc. However, more sophisticated research works were lacking in the center mainly due to frequent restructuring, inadequate number of well experienced researchers, shortage of laboratory equipment, shortage of research inputs, and lack of skilled and dedicated laboratory workers. At large, MoA and ILRI (2013) identified several challenges of livestock sector including lack awareness of policymakers on the importance of livestock; lack of integration and coordination; under-utilized extension system; poor usage of demonstration sites; lack of sustainability; extension institutes lack capacities; lack of effort to carry out impacts assessments, underutilization of extension staff and overlooking of market and regulation.

Table 4.18: Ranking of major constraints for generating improved dairy practices by researchers (n=50)

Problems	Weightage	Rank
Lack of clear research strategy	85.69	1
Inadequate laboratory equipments	77.07	2
Inadequate laboratory buildings	75.22	3
Inadequate budget support	71.12	4
High cost of generation of improved dairy practices	70.84	5
Limited research skills	69.78	6
Inadequate research staff	63.82	7
Inadequate research materials (inputs)	63.02	8
Frequent job shifting of researchers	60.12	9
Inadequate incentives	53.41	10
Lack of team spirit among staff	46.45	11

Source: Field survey, 2015

4.19. DAIRY EXTENSION EFFECTIVENESS INDEX

Dairy extension effectiveness was developed using sub indicators that were selected through intensive expert reviews. Similar to research effectiveness sub indicators, the extension sub indicators are new for measuring the effectiveness of dairy extension. Prior to the application of the sub indicators, its appropriateness and relevance were tested and proved. The sub indicators are similar with dairy research effectiveness sub indicators. However, the items that are included under each sub indicator are different from the items that are under each dairy research effectiveness sub indicator.

4.20. PERSONAL CHARACTERISTICS EXTENSION EFFECTIVENESS INDEX

Personal characteristics extension effectiveness index was developed to estimate the competence of the extension workers to undertake dissemination of improved dairy practices. Skilled and experienced extension workers positively influence the dissemination of improved dairy practices. Table 4.19 revealed that 42, 48 and 10 per cent of the respondents were in the low, medium and high levels of personal characteristics of extension effectiveness index. The majority of the respondents (90%) were in low and medium levels of the index. Likewise, the overall personal characteristic of dairy extension effectiveness index was 60 per cent. Though the extension workers of field level were criticized for their inadequate skills and knowledge in the prior studies, their mean score is relatively in good position compared to the score of other sub indicators. It indicates that the current extension capacity development program has positive contribution to the higher score of the personal characteristics dairy extension effectiveness index.

Table 4.19: Distribution of respondents on the basis of personal characteristics effectiveness sub indicator

(n=50)

Personal characteristics effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.57)	21	42	
Medium (0.58-0.74)	24	48	**0.60**
High (0.75 and above)	5	10	
Total	**50**	**100**	

Source: Field survey, 2015

4.21. EXTENSION PARTICIPATION EFFECTIVENESS INDEX

It includes participation of extension workers in extension planning, extension problem identification, research review meetings, Agricultural Development Partners Linkage Advisory Council (ADPLAC) meeting etc. These activities develop the skills and experiences of extension workers to provide responsive dairy extension services.

Table 4.20 depicted that 58, 34 and 8 per cent of the respondents were in the ranges of low, medium and high levels of the index respectively. The high proportions of the respondents (92 %) were in low and medium levels of extension participation effectiveness index. Correspondingly, the overall extension participation effectiveness index was 26 per cent. It pointed out that the participation level of the extension workers in the main extension activities was low. It implies that the extension activities of the study area were almost non participatory. It further leads to provide slow and dormant extension service.

Table 4.20: Distribution of respondents on the basis of extension participation effectiveness sub indicator

(**n=50**)

Extension participation effectiveness index	**Frequency**	**Percentage**	**Mean**
Low (Upto 0.29)	29	58	
Medium (0.30-0.56)	17	34	0.26
High (0.57 and above)	4	8	
Total	**50**	**100**	

Source: Field survey, 2015

4.22. INFRASTRUCTURE EXTENSION EFFECTIVENESS INDEX

Infrastructure includes facilities that are required to execute field level dairy extension activities such as transport facilities, working office, demonstration sites, communication facilities etc. These play a decisive role for disseminating improved dairy practices. As revealed in Table 4.21, about 38, 40 and 22 per cent of the respondents were in the ranges of low, medium and high levels of the index. The combined percentage of low and medium levels of the infrastructure effectiveness index was 78 per cent. The overall infrastructure effectiveness index was also 53 per cent. It implies that the infrastructure situation of the study area was in the medium level. Though market infrastructure of dairy products was lagging behind, the data vividly revealed that extension organization is making considerable effort for fulfilling the infrastructure that is needed for undertaking effective extension activities.

Table 4.21: Distribution of respondents on the basis of infrastructure effectiveness sub indicator

(**n=50**)

infrastructure effectiveness index	**Frequency**	**Percentage**	**Mean**
Low (Upto 0.48)	19	38	
Medium (0.49-0.65	20	40	0.53
High (0.66 and above)	11	22	
Total	**50**	**100**	

Source: Field survey, 2015

4.23. RESPONSIVENESS OF IMPROVED DAIRY PRACTICES EFFECTIVENESS INDEX

Responsiveness of improved dairy practices effectiveness refers to the current status of improved dairy practices in addressing the needs of clientele. It also includes the response of clientele towards the technology in respect to its availability and affordability. The effectiveness of the responsiveness of improved dairy practices is a decisive factor in the process of improved dairy practice dissemination and adoption decision of the users. The improved dairy practice which is in line with the farmers` criteria can easily be disseminated to the clientele.

Table 4.22 revealed that about 10, 66 and 24 per cent of the respondents were in the ranges of low, medium and high levels of the index respectively. Low and medium levels of responsiveness of improved dairy practices effectiveness index constituted 76 per cent. Likewise, the overall responsiveness of improved dairy practices effectiveness index was 52 per cent. It indicates that the responsiveness of improved dairy practices effectiveness of the study area was at medium level. It further implies that the responsiveness of improved dairy practices that were disseminating in the study area were not fully responsive to the needs of the clientele. It necessitates more collaborative works among dairy technology suppliers and users to make it more productive.

Table 4.22: Distribution of respondents on the basis of responsiveness of improved dairy practices effectiveness sub indicator

(**n=50**)

Responsiveness of improved dairy practices effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.41)	5	10	
Medium (0.42-0.56)	33	66	0.52
High (0.57and above)	12	24	
Total	**50**	**100**	

Source: Field survey, 2015

4.24. EXTENSION MANAGEMENT EFFECTIVENESS INDEX

Extension management includes all extension related managerial activities of the organization such as planning, directing, staffing, decision making, monitoring and evaluation. Effective management accelerates the achievement of the organizational objectives. Majorly, the extension management effectiveness index of the study area was in the low ranges (70%). The balance 22 and 8 per cent of the respondents were in medium and high ranges of the index respectively (Table 4.23). Low and medium constituted 92 per cent of the respondents. The overall extension management effectiveness was in the low range of the index (39%). It apparently specifies the poor extension management of the study area. It further affects the overall performance of the extension activities of the study area.

Table 4.23: Distribution of respondents on the basis of extension management effectiveness sub indicator

(**n=50**)

Extension management effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.42)	35	70	
Medium (0.43-0.60)	11	22	**0.39**
High (0.61and above)	4	8	
Total	**50**	**100**	

Source: Field survey, 2015

4.25. EXTENSION POLICY EFFECTIVENESS INDEX

Extension policy includes rule and regulations governing extension and extension strategy that enhance the dissemination of improved dairy practices. The presence of vivid extension strategy sets a clear direction for disseminating problem solving dairy technology (improved practices). It also has great contribution for attaining the objectives of the dairy extension program. Table 4.24 revealed that 32, 46 and 22 per cent of the respondents were in low, medium and high ranges of the index. Low and medium levels of the index constituted 78 per cent of the total respondents. The overall extension policy effectiveness index was in the medium range of the index (45%). It implies that the extension policy was not translated into action to the level of expectation. It further affects the overall performance of the extension activities of the study area. The result is in harmony with Van den Ban and Hawkins (1996) who stated that policy environment strongly affects the adoption of improved technologies as it would provide the direction and confidence among the various actors

Table 4.24: Distribution of respondents on the basis of extension policy effectiveness sub indicator

(**n=50**)

Extension policy effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.40)	16	32	
Medium (0.41-0.51)	23	46	
			0.45
High (0.52 and above)	11	22	
Total	**50**	**100**	

Source: Field survey, 2015

4.26. SOCIAL PARTICIPATION EFFECTIVENESS INDEX

Social participation refers to extension workers` participation in social activities inside and outside of the organization. Social participation improves the interaction of the extension workers with the community which further builds the trust with them. Table 4.25 indicated

that 36, 56 and 8 per cent of the respondents were in the ranges of low, medium and high levels of social participation. Low and medium levels of social participation represented 92 per cent of the respondents. The overall social participation of the respondents was in the low border of medium range (53%). It implies that the social participation of extension workers in the study area requires immediate attention. It has also implications on their communication skills where less interaction with other social units would reflect the less communication skills. Thus, the data farther indicate that the communication skill of the extension workers of the study area was low.

Table 4.25: Distribution of respondents on the basis of social participation effectiveness sub indicator

(n=50)

Social participation effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.49)	18	36	
Medium (0.50-0.66)	28	56	
			0.53
High (0.67 and above)	4	8	
Total	**50**	**100**	

Source: Field survey, 2015

4.27. FINANCIAL CAPACITY EFFECTIVENESS INDEX

Financial capacity indicates extension workers` income in covering all family expenditures. Obviously, an extension worker who has inadequate source of income cannot exert all his/her time and energy to extension works. In the other way, more time is expended out of the organization for part time works for covering his/her family expenditure. Table 4.26 revealed that 34, 60 and 6 per cent of the respondents were in the range of low, medium and high financial capacity index. The highest proportion of the respondents was in low and medium levels of financial capacity (94%). The cumulative financial capacity of the respondents was 32 per cent. The data indicated that the financial capacity of the respondents of the study area

was low. This forces the extension workers to look out for other avenues to cover their family living expenses. Hence, the low financial capacity of the extension workers affects the overall performance of the extension activities of the study area. This warrants the immediate attention of the planners and policy makers to adequately compensate the actual contribution of the extension workers in terms of pay and allowances so that they would be able to fully devote their time and energy to the development of sustainable livestock farming.

Table 4.26: Distribution of respondents on the basis of financial capacity effectiveness sub indicator

(n=50)

Financial capacity effectiveness index	Frequency	Percentage	Mean
Low (Up to 0.28)	17	34	
Medium (0.29-0.43)	30	60	
			0.32
High (0.44 and above)	3	6	
Total	**50**	**100**	

Source: Field survey, 2015

DAIRY EXTENSION EFFECTIVENESS INDEX

The dairy extension effectiveness index was developed combining the scores of extension effectiveness sub indicators such as personal characteristics, extension participation, extension infrastructure, extension management, responsiveness of improved dairy practices, extension policy, social participation and financial capacity. Table 4.27 revealed that 74, 24 and 2 per cent of the respondents were in the ranges of low, medium and high levels of extension effectiveness index respectively. In combination, low and medium extension effectiveness index constituted 98 per cent of the respondents. The data evidently revealed that the extension effectiveness of the respondents of the study area was low (45%). Unless the extension effectiveness is increased the adoption and subsequently impact on livelihoods of farm families will be severely hampered. Similar finding was given by (Azage *et al*., 2006)

who stated that knowledge generated by the national research institutes of Ethiopia was not communicated in a useful and accessible manner to livestock keepers. This reflects the weakness of Ethiopian agricultural extension services (Vince, 2005) which needs to be addressed in a coherent manner for bringing overall improvement in the livestock extension systems.

Table 4.27: Distribution of respondents on the basis of aggregate dairy extension effectiveness sub indicator

(n=50)

Dairy Extension effectiveness index	Frequency	Percentage	Mean
Low (Upto 0.46)	37	74	
Medium (0.47-0.58)	12	24	
			0.45
High (0.59 and above)	1	2	
Total	**50**	**100**	

Source: Field survey, 2015

4.28. CONTRIBUTION OF DAIRY EXTENSION EFFECTIVENESS SUB INDICATORS

All sub indicators of dairy extension effectiveness contributes to improve the effectiveness of the dairy extension in the study area. The sub indicators are interlinked and the ineffectiveness of one sub indicator affects the effectiveness of other sub indicator. As indicated in Table 4.28, infrastructure, extension policy and dairy responsiveness of improved dairy practices ranked 1st, 2nd, and 3rd respectively. However, personal characteristics, financial capacity and social participation were in the bottom of the rank.

Table 4.28: Rank of dairy extension sub indicators

(n=50)

Sub indicators	Weightage	Rank
Infrastructure	91.29	1
Extension policy	86.54	2
Responsiveness of improved dairy practices	77.36	3
Extension management	75.46	4
Extension participation	71.66	5
Personal characteristics	59.79	6
Financial capacity	59.48	7
Social participation	56.72	8

Source: Field survey, 2015

Extension participation, financial capacity, extension management had low index value (Fig 4.3). Overall four of the sub indicators have below the half of the index value i.e. less than 0.5 and the balance four are nearly more than the half value of the index. The mean of all the sub indicators is below the half of the index value. It implies that the contribution of the whole sub indicators in improving the effectiveness of the extension service in the study area was low. It further indicates that the extension service of the study area was not to the level of its expectation. It needs strengthening of the sub indicators to make it more productive. A greater level of dialogue at various level of management is required to capture the critical factors for bringing the desired level of progressiveness. Multi actors of dairy development need to well acknowledge the importance of each dairy extension effectiveness sub indicators and emphasize on their improvement. As a result, the accumulated result of sub indicators contribute for the improvement of the dairy development. This needs sensitization of key actors of dairy development on addressing the gaps identified in this study.

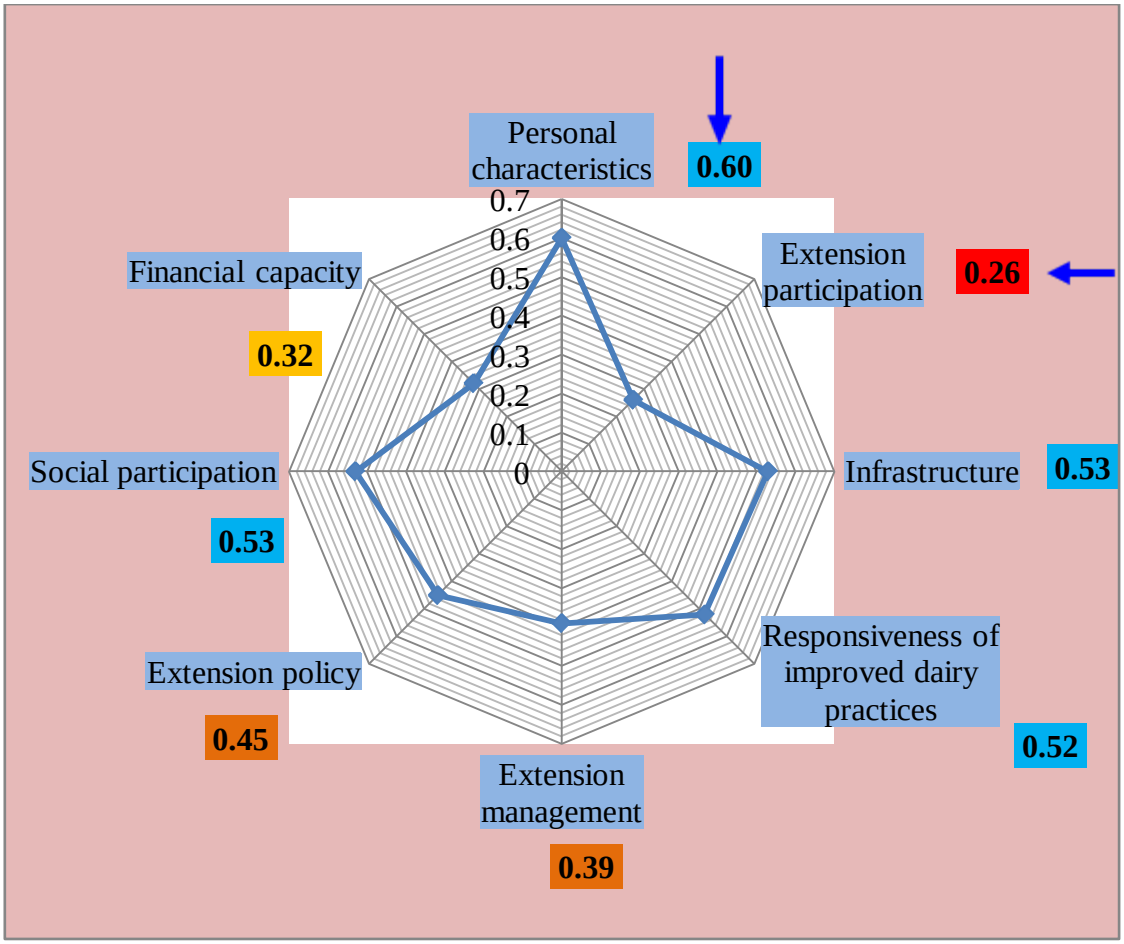

Fig 4.3: Mean score of extension effectiveness sub indicators

Source: Field survey, 2015

4.29. FACTORS INFLUENCING EFFECTIVENESS OF TECHNOLOGY DISSEMINATION PROCESS OF DAIRY PRODUCTION

The result of ordered logistic regression on effectiveness of dairy technology dissemination process is summarized in Table 4.29. The ordered logistic regression model is estimated using maximum likelihood method. The χ^2 result shows that the parameters are significantly different from zero at P<0.01 for the effectiveness of dairy technology dissemination process. The McFadden's R-square or Pseudo R^2 is 0.744, indicating that 74.4 per cent of the variations in probabilities of getting in high level of effectiveness dairy technology dissemination process was explained by the selected explanatory variables.

Explanatory variables that were taken to the model are; personal characteristics, extension participation, infrastructure, responsiveness of improved dairy practices, extension management, policy environment, social participation and financial capacity. Among the variables taken to the model personal characteristics, extension management, policy environment, responsiveness of improved dairy practices and social participation were found

to be significant. Explanatory variables that are selected for econometric model and statistically significant at P<0.05 are discussed as under:

Table 4.29: Ordered logistic regression for factors influencing dairy technology dissemination process

		Estimate	Std. Error	Wald	df	Sig.
Threshold	[category = 1.00]	96.086	42.231	5.177	1	0.023
	[category = 2.00]	107.944	47.127	5.246	1	0.022
Location	Personal characteristics	21.903	10.056	4.744	1	0.029**
	Extension participation	1.158	4.661	0.062	1	0.804
	Infrastructure	7.663	7.155	1.147	1	0.284
	Responsiveness of improved dairy practices	24.727	12.738	3.768	1	0.050**
	Extension management	49.969	25.679	3.787	1	0.050**
	Extension policy	65.718	33.012	3.963	1	0.047**
	Social participation	36.162	18.549	3.801	1	0.050**
	Financial capacity	6.309	16.383	0.148	1	0.700

-2 Log Likelihood	95.397	Cox and Snell	0.758
Chi-Square	70.945	Nagelkerke	0.890
df	8	McFadden	0.744
p-value	0.000		

**, significant at P<0.05; Source: Field survey, 2015

Personal characteristics: It refers to factors such as education level, work experience, communication skills and other factors that enhance extension worker`s capacity to disseminate improved dairy practices. The ordered log-odds estimate that improving personal characteristics related variables would result in 21.903 units increase in the ordered log-odds of being in a high range of extension effectiveness level while the other variables in the model are held constant. It is positively significant at P<0.05. It implies that personal characteristics are decisive factors in improving the effectiveness of extension activities.

Responsiveness of improved dairy practices: It refers to the affordability, profitability, existing demand to the technology, adoption status of the technology, releasing process of the technology, relevancy of the technology and manageability of the technology in addressing the needs of the end users. Improving responsiveness of improved dairy practices would result in 24.727 units increase in the ordered log-odds of being in a high range of extension

effectiveness index while the other variables in the model are held constant. It is statistically significant at P<0.05. When an improved dairy practice does not respond to the efforts of extension, then its feedback should be communicated to both research system and policy making bodies. It indicates that responsiveness of improved dairy practices had high contribution in enhancing the effectiveness of improved dairy practices dissemination.

Extension management: It includes all extension managerial activities of the organization. As depicted in Table 4.29, improvement of managerial activities of extension would result in 49.969 units increase in the ordered log-odds of being in a high range of extension effectiveness index while the other variables in the model are held constant. It is statistically significant at P<0.05. It implies that high managerial performance of extension organizations would improve the effectiveness of extension activities.

Policy environment: It includes extension governing issues. Enhancing policy environment of extension would result in 65.718 units increase in the ordered log-odds of being in a high range of extension effectiveness index while the other variables in the model are held constant. It is statistically significant at P<0.05. It indicates that formulating a homemade i.e. situation based policy is an essential strategy for the improvement of extension activities.

Social participation: Enhancing social participation of extension would result in 36.162 units increase in the ordered log-odds of being in a high range of extension effectiveness index while the other variables in the model are held constant. It is statistically significant at P<0.05. It shows that social participation is the source of experience, knowledge and skills which contributes much for the improvement of extension activities.

4.30. FACTORS INFLUENCING EFFECTIVENESS OF TECHNOLOGY GENERATION AND DISSEMINATION PROCESS OF DAIRY PRODUCTION

In addition to separately modeling the factors that influence the effectiveness of research and extension, it is also useful for modeling both for identifying factors that are influencing the effectiveness of research and extension effectiveness.

Accordingly, the result of ordered logistic regression on effectiveness of dairy technology generation and dissemination process is summarized in Table 4.30. The ordered logistic regression model is estimated using maximum likelihood method. The χ^2 result shows that the parameters are significantly different from zero at P<0.01 for the effectiveness of dairy technology generation and dissemination process. The McFadden's R-square or Pseudo R^2 is 0.685, indicating that 68.5 per cent of the variations in probabilities of getting in high level of

effectiveness dairy technology generation and dissemination process was explained by the selected explanatory variables.

Explanatory variables that were taken to the model are; personal characteristics, research/extension participation, infrastructure, responsiveness of improved dairy practices research/extension management, policy environment, social participation and financial capacity. Among the variables taken to the model personal characteristics, research/extension participation, infrastructure, responsiveness of improved dairy practices, research/extension management, policy environment and social participation were found to be significant. Financial capacity was insignificant. Explanatory variables that are selected for econometric model and statistically significant at P<0.01 and P<0.05 are discussed as under:

Table 4.30: Ordered Logistic regression for factors influencing dairy technology generation and dissemination process

		Estimate	Std. Error	Wald	df	Sig.
Threshold	[category = 1.00]	44.726	10.202	19.220	1	0.000
	[category = 2.00]	55.359	12.493	19.637	1	0.000
Location	Personal characteristics	18.494	6.056	9.327	1	0.002***
	Research/extension participation	11.450	3.178	12.984	1	0.000***
	infrastructure	5.843	3.001	3.790	1	0.052*
	Responsiveness of improved dairy practices	8.701	4.796	3.292	1	0.070*
	Research/extension management	10.794	4.600	5.506	1	0.019**
	Policy environment	18.479	5.715	10.454	1	0.001***
	Social participation	17.007	4.978	11.672	1	0.001***
	Financial capacity	5.833	5.493	1.127	1	0.288

-2 Log Likelihood	184.177	Cox and Snell	0.717
Chi-Square	126.099	Nagelkerke	0.852
df	8	McFadden	0.685
p-value	0.000		

***,** and * denotes significant at P<0.01, P<0.05 and P<01 respectively

Source: Field survey, 2015

Personal characteristics: It refers to factors such as education level, work experience, research skills, communication skills and other factors that enhance researcher`s/extension

worker`s capacity to generate/disseminate improved dairy practices. The ordered log-odds estimate that developing personal characteristics related variables would result in 18.494 units increase in the ordered log-odds of being in a high range of research and extension effectiveness level while the other variables in the model are held constant. It is positively significant at P<0.01. It implies that personal characteristics play decisive role in improving the effectiveness of research and extension activities. Adequate attention is required in capacity building of both researchers and extension workers to consider their personal characteristics and individual capabilities.

Research/Extension Participation: It refers to the participation of researcher/ extension worker in activities of dairy research/extension works. The ordered log-odds estimate that improving research/extension participation would result in 11.450 units increase in the ordered log-odds of being in a high range of research and extension effectiveness index while the other variables in the model are held constant. It is statistically positively significant at P<0.01. It indicates that research/extension participation plays a key role in improving the effectiveness of research and extension activities. Participating researchers and extension workers in different activities (workshops, seminars, experience sharing, linkage meeting, problem identification, research review meeting at different stages etc.) improves the effectiveness of research and extension activities of the study area.

Research/extension management: It includes all research/extension managerial activities of the organization. As depicted in Table 4.30, enhancing managerial activities of research and extension would result in 10.794 units increase in the ordered log-odds of being in a high range of research and extension effectiveness index while the other variables in the model are held constant. It is statistically significant at P<0.05. It implies that high managerial performance of research/extension organizations better improve the effectiveness of research and extension activities.

Policy environment: It includes research/extension governing issues. Enhancing policy environment of research and extension would result in 18.479 units increase in the ordered log-odds of being in a high range of research and extension effectiveness index while the other variables in the model are held constant. It is statistically significant at P<0.01. It indicates that formulating a homemade i.e. situation based policy is an essential for the improvement of research and extension activities.

Social participation: The more involving in social participation for researchers and extension workers would result in 17.007 units increase in the ordered log-odds of being in a high range of research and extension effectiveness index while the other variables in the

model are held constant. It is statistically significant at P<0.01. It shows that social participation is the source of experience, knowledge and skills which contributes much for the improvement of extension and research activities.

4.31. MAJOR CONSTRAINTS FOR DISSEMINATING IMPROVED DAIRY PRACTICES

Identification of the constraints that impede the effectiveness of extension of improved dairy practices should be inbuilt in any organization that strives for high quality extension delivery. By the same token, searching pertinent solution to the constraints boosts the dissemination of improved dairy practices which, in turn, contributes much to the improvement of the livelihoods of the end users. Initially, the extension workers were made to identify the main constraints of extension effectiveness of the study area. The indentified constraints were included in the questionnaire and finally distributed to the respondents (extension workers) to rank constraints in terms of their importance. Table 4.31 revealed that cost of improved dairy practices, shortage of animal feed, lack of need-based improved dairy practices, and inadequate improved dairy practices were the main constraints of extension in order of their importance. The remaining constraints are also summarized sequentially from highest to lowest constraints. Death of cattle, farmers` unwillingness to change and inadequate budget were the least constraints in the study area. Farmers were well aware about the advantage of adopting improved dairy practices. Previously, the budget problem was frequently raised by the extension workers as justification for not undertaking effective extension activities. Though budget problem was solved to some extent, other constraints hampered them from disseminating improved dairy practices, for instance price of improved dairy practices is skyrocketing. The constraints of improved dairy practices dissemination are diversified and cannot be solved by a single actor. It necessitates the integrated action of multi-actors (research, input suppliers, animal health, marketing agency, livestock agency, cooperatives etc.). Such noble action can be translated into action by creating strong linkage.

Table 4.31: Main constraints of dairy subsector as ranked by extension workers

(n=50)

Problems	Weightage	Rank
Cost of improved dairy practices	83.65	1
Shortage of animal feed	81.09	2
Lack of need-based improved dairy practices	80.97	3
Inadequate improved dairy practices	78.89	4
Shortage of farm land	74.02	5
Inadequate input suppliers	66.70	6
Inadequate extension support	65.36	7
Inadequate AI service	58.28	8
Lack of well-organized market for dairy products	56.82	9
Inadequate budget	55.48	10
Prevalence of diseases	43.89	11
Farmers unwillingness to change	40.96	12
Death of cattle	38.16	13

Source: Field survey, 2015

Furthermore, focus group discussion was held with dairy extension workers in Ambo district. The discussion was focused on identifying the status of dairy extension activities in the district. In the course of discussion, it could be observed that the AI service was quota based. For instance in 2015, the AI quota of Ambo district was to inseminate 3143 cows. For this purpose, the cows were synchronized to forcefully bring them to heat. Estrus synchronization was started in 2012 in the district without testing the practice on pilot scale. Testing the feasibility of the oestrous synchronization practice would have been useful for developing the skills of the AI technicians of the district which, in turn, would have improved the effectiveness of oestrous synchronization activity. The conception rate of cows that came to heat through oestrous synchronization was about 20 per cent. It was mainly due to mass mobilization of all experts with only targeting the achievement of the quota. Though technical problems were mentioned for the low conception rate of cow, under close supervision of experts the conception rate was also too low. It necessitates further study for investigating the problems which, in turn, would help to take timely corrective action. Moreover, the number of AI technicians and population of cows were not commensurate with each other. In the district, there were two AI technicians; and the number of cows was estimated to be 40900. The AI technicians' office was in the town of the district which is far

from the farmers. Moreover, there was persistent problem of transport service to reach each farmer. The farmers were communicating the technician through the mobile phone to get the service. Obviously, all farmers were not the users of mobile phone and all areas were not accessed with mobile phone. As a fact, the AI service was confined to urban and peri-urban areas.

The discussion with senior AI technician revealed that the oestrous synchronization program was carried out despite encountering several limitations. Though oestrous synchronization brings the cows to heat, it needs to take place when there is enough feeds and forage for the effectiveness of the program. However, oestrous synchronization was made mostly during the dearth period (January and February). Forage is mostly available adequately from September to November in the study areas. The AI technician said "If oestrous synchronization and insemination is made during these months the likelihood of improving the conception rate of cows is high." Furthermore, it needs cows' collection center for synchronizing and inseminating. Naturally, the hormone used for oestrous synchronization attracts the bull as a result natural breeding can take place before AI service. Field observation also confirmed that artificially inseminated cows born local breeds. It created conflict between farmers and AI technician despite it would have been the farmers that keep their cows from local bulls. After oestrous synchronization some farmers do not bring their cows for insemination due to their distant location. As depicted in Table 4.32, among the large population of the cows, few cows got AI service. On the other hand, the trend of AI service is relatively increasing despite its efficiency is low (Fig 4.4).

Table 4.32: Status of AI service in Ambo district

Year	Number of cows inseminated	Number of calves born		
		Male	Female	Total
2011	356	25	31	56
2012	869	33	40	73
2013	993	60	44	104
2014	1253	113	116	229
Total	**3471**	**231**	**231**	**462**

Source: Ambo district livestock agency office report

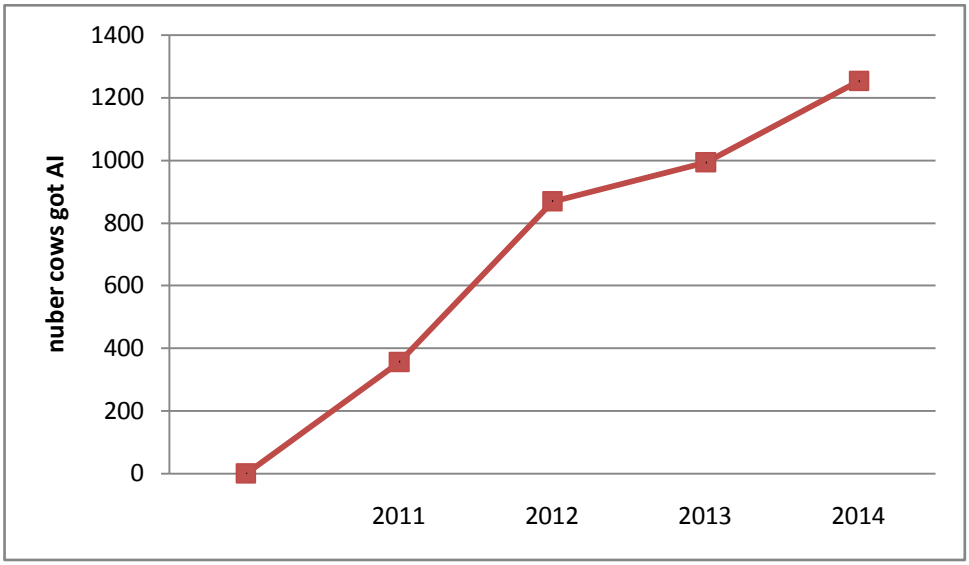

Fig 4.4: Trends of AI service in Ambo district

Besides AI services, feed, market and improved dairy management activities need to be the integral part of the intervention. The farmers were practising traditional management for both cross and local breeds. Realization of at least the minimum package was deemed necessary to bring significant change on the dairy development of the area. During the discussion with the dairy extension workers, the following key problems were identified;

- Less attention to AI technician
- Transport problem to reach farmers
- Inadequate equipment for AI service
- Inadequate skills of AI technician
- Unavailability of feeds and forage
- High cost of improved dairy practices
- Uniformly practicing traditional management for cross and local breeds
- Absence of linkage with dairy development actors (NGOs, research center, university, private sectors)
- Limited awareness of the majority of farmers about the benefit of AI
- Inadequate selection of local cows during AI service
- Quota system of AI service affected the quality of service delivery
- Technical problems during the application of oestrous synchronization
- Absence of harmonized delivery of dairy extension service
- Absence of milk collection centers
- Absence of linkage with dairy processing industry

- Absence of continuous training program for farmers
- Absence of cows collection center for Oestrous synchronization and insemination

Changing the outlook of farmers requires intensive promotional efforts on improved dairy practices. For the purpose, extension workers need to have training manual, production guidelines, leaflets, posters and extension folders on each improved dairy practices. These powerful tools that could bring the effort of extension on the ground were not observed in the study area. Farmer-to-farmer extension that can fill the gap of extension workers was not also practiced in the study area. Generally, dairy extension of the study area was not fully operated to bring the intended change on the farmers. As a fact, the dairy extension was not fully responsive. Low adoption (1.3%) of crossbred witnessed the low status of improved dairy practices adoption of the study area. The finding is in agreement with CSA (2008) that states the population of exotic and crossbred dairy cows in rural areas of the country accounted for less than one per cent of the total dairy cattle population; and the blood levels of the limited crossbred population were unknown, due to lack of appropriate breed registration system. It also further states that about 0.15 and 0.8% per cent of rural livestock holders use improved forages (alfalfa and Napier grass) and industrial by-products like oil cake, bran and brewery residue respectively. Similarly, MoA and ILRI (2013) indicates that adoption rates of crossbreds over the last 40 years have remained very low, comprising less than 2% of Ethiopia's cattle population today. Though efforts are made to develop the dairy subsector, various studies confirmed that the dairy potential of the country is not tapped at the level of expectation. Thus, it needs to launch strong dairy movement program in the country.

4.32. DEMOGRAPHIC AND SOCIO ECONOMIC VARIABLES OF FARMER RESPONDENTS

Demographic variables significantly influence the adoption of improved dairy practices. The importance of the variables is likely to vary depending upon the nature of agricultural technologies and demographic characteristics of the respondents. In this study, one way ANOVA was used to test the statistical mean difference among adopters, partial adopters and non adopters of farmers` respondents (Table 4.33). Education level and experience had significant mean difference among the category of the respondents at $P<0.01$. However, age and family size have no significant mean difference among the groups. The significant variables using ANOVA were further analyzed using post hoc multiple comparisons to

identify the significant variation among each category of the respondents (adopter, partial adopter and non adopter).

Table 4.33. Demographic related variables influencing adoption of improved dairy practices

Variables		Sum of Squares	df	Mean Square	F	Sig.
Education level	Between Groups	288.055	2	144.028	6.608	0.01***
	Within Groups	3203.838	147	21.795		
	Total	3491.893	149			
Age	Between Groups	192.145	2	96.073	0.688	0.50
	Within Groups	20521.748	147	139.604		
	Total	20713.893	149			
Experience	Between Groups	1441.812	2	720.906	7.542	0.01***
	Within Groups	14050.748	147	95.583		
	Total	15492.560	149			
Family size	Between Groups	1.023	2	0.511	0.080	0.92
	Within Groups	944.951	147	6.428		
	Total	945.973	149			

Post hoc

Variables	(I) category of respondent	(J) category of respondent	Mean Difference (I-J)	Std. Error	Sig.
Education level	Adopter	Partial adopter	2.05	0.99	0.04**
		Non adopter	3.41	0.94	0.01***
	Partial adopter	Adopter	-2.05	0.99	0.04**
		Non adopter	1.37	0.90	0.13
	Non adopter	Adopter	-3.41	0.94	0.01***
		Partial adopter	-1.37	0.90	0.13
Experience	Adopter	Partial adopter	-0.49	2.07	0.81
		Non adopter	-6.58	1.97	0.01***
	Partial adopter	Adopter	0.49	2.07	0.81
		Non adopter	-6.09	1.89	0.01***
	Non adopter	Adopter	6.58	1.97	0.01***
		Partial adopter	6.09	1.89	0.01***

***, ** significant at p<0.01 and P<0.05 respectively Source: Field survey, 2015

With respect to education level, there is significant mean difference between adopter and partial adopter at P<0.05; and between adopters and non adopters at P<0.01 (Table 4.33). It implies that education has a major role to positively influence the adoption of improved dairy practices as it attempts to influence the cognitive behavior of farmers.

Likewise, experience of respondents shows a significant mean difference between adopter and non adopter as well as partial adopter and non adopter at P<0.01. Less experienced farmers more adopted the improved dairy practices. However, this contradicts literatures of adoption study that came across farmers with more years of farm experience usually adopt improved agricultural practices than farmers with less years of farm experience. Though farm experience has its own contribution in the adoption process of improved farm practices, high cost of improved dairy practices impede the adoption of the practices in the study area. For more scrutinizing, focus group discussion was made with model farmers and development agents separately and they concluded that crossbred is unaffordable under the current financial capacity of most farmers. It was also coupled with inadequate and irregular Artificial Insemination (AI) service, shortage of forage, sensitivity of crossbred to diseases, less technical capacity of farmers and development agents in estrus detection of cows and reluctance of farmers in practising improved dairy management. The adopters of improved dairy practices of the study area were also residing in the periphery of the town. They adopted the practices with less farm experience for earning additional income. Though experience is needed for adopting a farm technology; it was not a precondition for adopting improved dairy practices. Relative advantage in terms of economic parameters could have significantly influenced the mindset of the farmers in the study area although own farm experience might have provided the comparisons of profitability of dairy farming over the years.

Livestock and land size are good proxy indicators for wealth status of the farmers in a sense those who own large number of livestock and large hectares of land have a capacity to bear risk in case of technology failure. It is also expected that they can afford the technology. There is statistically significant mean difference among the group at P<0.05 for grazing land and land size; and P<0.01 for livestock holding (Table 4.34). The adopters and partial adopters owned small farm land size and grazing land size compared to non adopters. Mean farm land size of adopters, partial adopters and non adopters are 1.6, 1.6 and 2.4 ha respectively. There is statistically significant mean difference among the group at p<0.05. As of the study by (Salim, 1986; Cramb, 2003 and Anandajayasekeram *et al.*, 2008), mostly farm size associates with adoption of a farm technology. However, in this study as land size increased adoption of the improved dairy practices decreased. To rectify the findings,

observation and key informant interview were made with non adopters which revealed that those farmers who have large farm size are located at marginal areas of the peasant association which is far from the town of the districts. The main reasons for their non adoption of improved dairy practices were found to be poor provision of AI service, absence of market for milk production, attention of extension services only to model farmers living at accessible areas, absence of integration between agricultural production and marketing and less risk bearing capacity of the farmers.

Largely, the adopters of improved dairy practices are residing in the adjacent of urban areas of the study area where there is a relatively high milk demand. The available milk demand by hotels, cafeteria and residents of the area stimulated them to adopt the practices. In the other way, they easily supply the milk to hotels, cafeteria and individuals on contract basis. However, the farmers who were living in remote area were deprived of these peri-urban dairying opportunities. Similar to the most rural areas of Ethiopia, farmers of the study area accustomed to traditional processing of milk into butter. Butter selling is a long practice in the dairy production system of the area. Comparatively, a culture of milk selling is a recent phenomenon which is hitherto confined to the town areas. In the adoption process of improved dairy practices, farmers opt easiest way of getting dairy products. Crossbred needs more feeds in quantity and quality and improved management. On the other hand, local breed survives on low quality and quantity feeds and roughages. Dairy products could be obtained from local breed using traditional management. However, it is hardly getting optimum dairy products from crossbred using traditional management practices. The availability of ready market for dairy products triggers adoption decision of farmers. In the absence of well established commercial milk market, dissemination of improved dairy practices, particularly crossbred will be a herculean task.

Table 4.34: Socio economic variables influencing adoption of improved dairy practices

Variables		Sum of Squares	df	Mean Square	F	Sig.
Grazing land	Between Groups	2.573	2	1.286	3.652	0.03**
	Within Groups	51.768	147	0.352		
	Total	54.340	149			
Land size	Between Groups	25.945	2	12.973	3.829	0.02**
	Within Groups	498.013	147	3.388		
	Total	523.958	149			
Livestock	Between Groups	39.642	2	19.821	4.976	0.01***
	Within Groups	585.532	147	3.983		
	Total	625.173	149			

Post hoc

Variable	(I) category of respondent	(J) category of respondent	Mean Difference (I-J)	Std. Error	Sig.
Grazing land	Adopter	Partial adopter	0.05	0.13	0.72
		Non adopter	-0.24	0.12	0.05**
	Partial adopter	Adopter	-0.05	0.13	0.72
		Non adopter	-0.29	0.11	0.02**
	Non adopter	Adopter	.0.24	0.12	0.05**
		Partial adopter	0.29	0.11	0.02**
Land size	Adopter	Partial adopter	0.07	0.39	0.86
		Non adopter	-0.81	0.37	0.03**
	Partial adopter	Adopter	-0.07	0.39	0.86
		Non adopter	-0.88	0.36	0.02**
	Non adopter	Adopter	0.81	0.37	0.03**
		Partial adopter	0.88	0.36	0.02**
Livestock	Adopter	Partial adopter	0.99	0.42	0.02**
		Non adopter	1.23	0.40	0.01***
	Partial adopter	Adopter	-0.99	0.42	0.02**
		Non adopter	0.24	0.37	0.54
	Non adopter	Adopter	-1.23	0.40	0.01***
		Partial adopter	-0.24	0.37	0.54

***, ** significant at P<0.01and P<0.05 respectively; Source: Field survey, 2015

Further analysis was made using post hoc multiple comparisons to identify the significant variation among each category of the respondents (Adopter, partial adopter and non adopter). Accordingly, there is significant mean difference in grazing land size between adopters and

non adopters; and between partial adopters and non adopters at P<0.05. The data revealed that the non adopters have more grazing land size than adopters and partial adopters. It implies that absence of large grazing land did not influence the adoption decision of the farmers. On the other hand, the opportunity of getting hay and crop residue from non adopters was high in the study area. Similar observation with land size, farmers with large grazing land were located at the margin of the peasant association where milk market was unavailable. There is also significant mean difference between adopters and non adopters; and between partial adopters and non adopters at P<0.05. The data indicated that the non adopters own large farm size than adopters and partial adopters. It implies that similar to grazing land size, the farm land size did not affect the adoption decision of the farmers with regard to improved dairying practices.

Livestock holding indicates a significant mean difference between adopters and non adopters (P<0.01); and between adopters and partial adopters at P<0.05. It implies that large livestock holding size increases adoption decision of farmers. In the other way, farmers have a capacity to afford the technology and bear a risk in case of technology failure. Moreover, the farmers tend to put more focus on care and maintenance of dairy animals when they increase the animal holding size.

4.33. VARIATION OF EXTENSION CONTACT AMONG ADOPTERS, PARTIAL ADOPTERS AND NON ADOPTERS

Frequency of extension contact per month among adopters, partial adopters and partial adopters were tested using one way ANOVA. Adopters and partial adopters had frequent contacts with development agents whereas; non adopters had less frequency of contact with development agents. Adopters contacted extension agent more than partial adopters and non adopters (Table 4.35). The mean contacts of extension agent of adopters, partial adopters and non adopters were 4, 3 and 2 days/month respectively. With the same trend, partial adopters contacted the extension agent more than non adopters.

There is significant mean difference among the category of the respondents at P<0.01. It indicates that frequent contact of extension with farmers and vice versa contributes to the adoption of improved dairy practices.

Table 4.35: Variation of extension contact among category of respondents

Descriptive **(n=150)**

Variable	Respondent category	n	Mean	Std. Deviation	Std. Error	Minimum	Maximum
Extension contact	Adopter	42	4.00	2.01	0.31	1.00	8.00
	Partial adopter	48	3.00	1.46	0.21	0.00	5.00
	Non adopter	60	2.00	1.27	0.16	0.00	5.00
	Total	150	3.00	1.76	0.14	0.00	8.00

ANOVA

Variable		Sum of Squares	df	Mean Square	F	Sig.
Extension contact	Between Groups	98.603	2	49.302	20.408	0.01***
	Within Groups	352.712	146	2.416		
	Total	451.315	148			

Post hoc

Variable	(I) category of respondent	(J) category of respondent	Mean Difference (I-J)	Std. Error	Sig.
Extension contact	Adopter	Partial adopter	1.26	0.33	0.01***
		Non adopter	1.99	0.31	0.01***
	Partial adopter	Adopter	-1.26	0.33	0.01***
		Non adopter	0.74	0.30	0.02**
	Non adopter	Adopter	-1.99	0.31	0.01***
		Partial adopter	-0.74	0.30	0.02**

***, ** Significant at P<0.01 and P<0.05 respectively; Source: Field survey, 2015

Further analysis was made using post hoc multiple comparisons to identify the significant mean differences among each category of the respondents (Adopter, partial adopter and non adopter). Table 4.35 revealed that there is significant mean difference between adopter and partial adopters; and adopters and non adopters in frequency of contacting extension agents at P<0.01. Partial adopters and non adopters also have significant mean difference at P<0.05. It indicates that having more frequent extension contact positively influences the adoption decision of farmers.

In the process of improved dairy practice dissemination, training plays a key role in developing skills, knowledge and attitude of the end users which, in turn, improves their productivity. Table 4.36 summarizes that 52.4, 35.4 and 16.7 per cent of adopters, partial

adopters and non adopters got training respectively. There is statistically significant difference among the group of the respondents at P<0.01. Among all the categories of the respondents, only 32.7 per cent of them got the training opportunity. It implies that the attention given to the training activity is minimal and it might have also contributed to less adoption of improved dairy practices. Therefore, more numbers of capacity building programmes especially training of farmers are crucial for enhancing the adoption of improved dairy practices due to the likely effect of better cognition and understanding.

Table 4.36: Response of sample respondents on the availability training in the study area

(**n=150**)

Category of respondent	Response			χ^2
	Yes	No	Total	
Adopter	22 (52.4)	20 (47.6)	42 (100)	
Partial adopter	17 (35.4)	31 (64.6)	48 (100)	14.570***
Non adopter	10 (16.7)	50 (83.3)	60 (100)	
Total	49 (32.7)	101 (67.3)	150 (100)	

*** Significant at P<0.01**; ()** Figures in the parenthesis indicate percentage

Source: Field survey, 2015

Organizing result or method demonstration on proven scientific dairy practices at farmers` field is a convenient way of educating farmers for stimulating the adoption of such practices. This method of teaching is highly relevant in the area where illiteracy is high, as it would develop the farmer's confidence about the intended practices. In fact, farmers show keen interest in learning and believing the fellow local farmers rather than the external agents. About 64.3, 41.7 and 20 per cent of adopters, partial adopters and non adopters participated in demonstration respectively (Table 4.37). The remaining respondents of same categories 35.7, 58.3 and 80 per cent respectively did not participate in the demonstration that was organized in the study area. Statistically, there is a significant difference among the group at P<0.01. It implies that timely, well planned and well-organized on farm demonstration tends to have positive impact in disseminating improved dairy practices. However, the majority

(60.7%) of the respondents did not participate in the demonstration which, in turn, contributed to the less adoption of improved dairy practices in the study area.

Table 4.37: Participation of farmers in visiting demonstration site (n=150)

Category of respondent	Response		Total	χ^2
	Yes	No		
Adopter	27 (64.3)	15 (35.7)	42 (100)	20.467***
Partial adopter	20 (41.7)	28 (58.3)	48 (100)	
Non adopter	12 (20)	48 (80)	60 (100)	
Total	59 (39.3)	91 (60.7)	150 (100)	

*** Significant at P<0.01**; ()** Figures in the parenthesis indicate percentage

Source: Field survey, 2015

In the process of disseminating improved dairy practices, availability of the technology alone will not ensure the full adoption of the practices. It needs to be accompanied with its associated packages, the required quantity, reliable supply and follow-up. As summarized in Table 4.38, about 61.9, 25 and 10 per cent expressed the availability of improved dairy practices from adopters, partial adopters and non adopters respectively. The large proportion of the respondents (70.7%) responded that the improved dairy practices were not available in the required time and quantity. There is statistically significant difference among the group at P<0.01. It indicates that making the improved dairy practices available through various extension interventions in the vicinity of the users is likely to improve the adoption by the farmers.

Table 4.38: Response of sample respondents on availability of Technology

(n=150)

category of respondent	Response		Total	χ^2
	Yes	No		
Adopter	26 (61.9)	16 (38.1)	42 (100)	
Partial adopter	12 (25)	36 (75)	48 (100)	
Non adopter	6 (10)	54 (90)	60 (100)	32.749***
Total	44 (29.3)	106 (70.7)	150 (100)	

*** Significant at P<0.01**; ()** Figures in the parenthesis indicate percentage

Source: Field survey, 2015

Compatibility of the technology to the culture, management practices and values of the community is also a crucial factor for adopting the improved dairy practices. The incompatibility of the technology was observed on improved dairy management practices among the respondents. In this connection, one of the respondent briefly stated that "The indigenous cow can easily survive in open housing system whereas it is difficult for crossbred animals during rainy season. In relation to feeds, the crossbred needs more feeds in quantity and quality. In addition, they are less resistant to disease." In the categories of adopters, partial adopters and non adopters 73.8, 60.4 and 50 per cent positively responded with the compatibility of the technology respectively. In the sequence of the category of the respondents 26.2, 39.6 and 50 per cent of them expressed the incompatibility of the technology respectively (Table 4.39). There is statistically significant difference among the categories of the respondents at P<0.05. It implies that the compatibility of the technology contributed to the adoption of improved dairy practices.

Table 4.39: Response of sample respondents on compatibility of the technology

(**n=150**)

Category of respondents	Response			χ^2
	Yes	No	Total	
Adopter	31 (73.8)	11 (26.2)	42 (100)	5.841**
Partial adopter	29 (60.4)	19 (39.6)	48 (100)	
Non adopter	30 (50)	30 (50)	60 (100)	
Total	90 (60)	60 (40)	150 (100)	

** Significant at P<0.05; **()** Figures in the parenthesis indicate percentage

Source: Field survey, 2015

4.34. STATUS OF CREDIT SERVICE AND MARKET FOR DAIRY PRODUCTS

In disseminating improved agricultural practices, availability of credit service plays a pivotal role for facilitating the adoption of the farm technologies. Particularly, it is greatly needed in the area where the farmers have less financial capacity to afford the high cost technologies. Unfortunately, from the adopters, partial adopters and non adopters of the study area; 26.2, 16.7 and 13.3 accessed the credit service respectively (Table 4.40). There is no significant difference among the group of farmers. In all categories of farmers, the majority of the respondents did not access the credit service mainly due to high interest rate, lack of collateral support and inadequacy of credit service. Similar finding was reported by (Ponnusamy and Pillai, 2014)

Table 4.40: Response of sample respondents on availability of credit service to dairy farming

(**n=150**)

Respondent category	Response				Total		χ^2
	Yes		No				
Adopter	11	(26.2)	31	(73.8)	42	(100)	2.852ns
Partial adopter	8	(16.7)	40	(83.3)	48	(100)	
Non adopter	8	(13.3)	52	(86.7)	60	(100)	
Total	27	(18.0)	123	(82.0)	150	(100)	

() Figures in the parenthesis indicate percentage and; ns, non significant;

Source: Field survey, 2015

Correspondingly, availability of market for dairy products has a vital role in the process of improved dairy practices adoption. Entirely the dairy market of the study area was unorganized. The dairy farmers supply the milk to the hotels, cafeteria and consumers directly. There was no milk collection center in the area though it is in the vicinity of Addis Ababa, the capital city of Ethiopia where dairy processing plants are available. However, in the categories of adopters, partial adopters and non adopters 88.1, 37.5 and 31.7 per cent were positively responded to the availability of market for their dairy product respectively which mainly represents butter marketing (Table 4.41). There is statistically significant difference among the groups at $P<0.05$. It indicates that the presence of market strengthen the adoption decision of farmers to use improved dairy practices. During the field observation and interview with adopters of improved dairy practices living at remote area from the market, one adopter responded that “Absence of ready market for milk production forced me to consume all the surplus milk.” Dairy development needs well established market that is accessed by all farmers. The dairy extension of the study area made enormous efforts to improve the productivity of cows using Oestrous synchronization. For the realization of extension organization goal, marketing needs to be part and parcel of dairy development.

Table 4.41: Response of sample respondents on market availability to dairy Products

(n=150)

Category of respondent	Response		Total	χ^2
	Yes	No		
Adopter	37 (88.1)	5 (11.9)	42 (100)	6.665**
Partial adopter	18 (37.5)	30 (62.5)	48 (100)	
Non adopter	19 (31.7)	41 (68.3)	60 (100)	
Total	74 (49.3)	76 (50.7)	150 (100)	

() Figures in the parenthesis indicate percentage, **, significant at P<0.05

Source: Field Survey, 2015

4.35. PERCEPTION OF FARMERS TOWARDS IMPROVED DAIRY PRACTICES

The rate of adoption is influenced by the farmers` perception of the characteristics of the innovation (Van den Ban and Hawkins, 1996). Perceived relative advantage of improved dairy practice and its relative disadvantage were measured using five points scale. Both relative advantage and disadvantage were identified through group discussion with farmers. Thus, high yield, increased income, enhanced social status and production of quality milk were identified as the major relative advantages of adopting improved dairy practices, while, high cost, requirement of high skills, need for close supervision and inadequacy of improved dairy practices were the main relative disadvantages of adopting improved dairy practices. The respondents rated both relative advantages and disadvantages on scale of five (very low, low, medium, high and very high).

Table 4.42 depicted that the mean value of perceived advantage for adopters, partial adopters and non adopters was 14.83, 14.33 and 13.45 respectively. On the other hand, the mean value of perceived disadvantage for adopters, partial adopters and non adopters was 12.40 12.48, and 13.23 respectively. The mean difference between total perceived advantage and total

perceived disadvantage was also with positive sign. It is a good indicator for realizing that farmers of the study area possess positive perception towards improved dairy practices. Statistically, there is a significant mean difference among the group at $P<0.05$. There is significant difference between adopters and non adopters and partial adopters and non adopters at $P<0.01$ and $P<0.1$ respectively. It implies that adopters and partial adopters have positive perception towards improved dairy practices and are likely to have a positive impact in disseminating improved dairy practices. It necessitates the extension organization to capitalize on the existing positive perception of the farmers towards improved dairy practices through need specific and client centric extension strategies.

Table 4.42: Status of farmers' perception towards improved dairy practices

(n=150)

Particulars	Respondents	N	Mean	Std. Deviation	Std. Error
Perceived advantage	Adopter	42	14.83	2.49	0.38
	Partial adopter	48	14.33	2.16	0.31
	Non adopter	60	13.45	2.75	0.36
	Total	150	14.12	2.55	0.21
Perceived disadvantage	Adopter	42	12.40	2.29	0.35
	Partial adopter	48	12.48	2.50	0.36
	Non adopter	60	13.23	3.78	0.49
	Total	150	12.76	3.04	0.25

		Sum of Squares	df	Mean Square	F	Sig.
Perceived advantage	Between Groups	50.49	2	25.24	4.03	0.02**
	Within Groups	919.35	147	6.25		
	Total	969.84	149			
Perceived disadvantage	Between Groups	22.52	2	11.26	1.22	0.29
	Within Groups	1352.83	147	9.20		
	Total	1375.36	149			

Dependent Variable	(I) category of respondent	(J) category of respondent	Mean Difference (I-J)	Std. Error	Sig.
Perceived advantage	Adopter	Partial adopter	0.50	0.53	0.35
		Non adopter	1.38	0.50	0.01***
	Partial adopter	Adopter	-0.50	0.53	0.346
		Non adopter	0.88	0.48	0.07*
	Non adopter	Adopter	-1.38	0.50	0.01***
		Partial adopter	-0.88	0.48	0.07*
Perceived disadvantage	Adopter	Partial adopter	-0.07	0.64	0.91
		Non adopter	-0.83	0.61	0.18
	Partial adopter	Adopter	0.07	0.64	0.91
		Non adopter	-0.75	0.59	0.20
	Non adopter	Adopter	0.83	0.61	0.18
		Partial adopter	0.75	0.59	0.20

******* and * significant at P<0.01 and P<0.1 respectively Source: Field survey, 2015

4.36. PATHWAYS AND STATUS OF USING IMPROVED DAIRY PRACTICES

Improved dairy practices were mainly transferred through livestock agency extension system. Each peasant associations have three development agents with an educational background of animal production, crop production and natural resource management. Additionally, some peasant associations have also middle level veterinary and cooperative organizer. The assumption of having development agents with different educational background is primarily to execute the extension activities in their area of expertise. Ironically, it was observed that development agents in the study area were carrying out all extension activities irrespective of their educational background. On the other hand, reporting was made to the respective district offices independently.

The improved dairy practices of the study area are categorized into five major parts, namely, crossbred, improved feeds, veterinary service, improved housing and improved management. Though efforts were made by extension organization for several decades to disseminate crossbred, the number of crossbred adopters were insignificant. It was yet confined to urban and peri-urban for accessing market, AI service, veterinary service and extension service.

Table 4.43 revealed that except for veterinary service, less percentage of respondents adopted crossbred, improved feeds, improved housing and improved management practices. To substantiate the quantitative findings with qualitative methods, under the theme “status of using improved dairy practices” observation and key informant interview were carried out during the period of data collection. In the due course of discussion, one of the respondents raised as a reason for non adoption of crossbred stating that “The cost of a crossbred is about the cost of four or five local cows. In the other way, to adopt a crossbred, it needs to sell the whole local cows. In the system there is no insurance, deciding and substituting four/five local cows with a crossbred is putting the livelihood of family in a question. It is a great devastation for the family in case of death happening to the crossbred as they are easily susceptible to disease.” Local cows are not only the source of milk but also the source of draught power and organic manure. Number of cows also serves to determine the social status of the individuals in the community.

In order to change this deep rooted stereotypic belief, it needs an elaborate and intensive work on changing the outlook of the farmers prior to the introduction of the improved dairy practices. Primarily, demand for agricultural technology among the farmers should be created before the introduction of the practices. The data evidently confirmed poor adoption of improved dairy practices in the study area. It was emanated from the application of wrong

implementation model in the process of improved dairy practices dissemination. The problem of technology dissemination model was well noticed from that the extension agents were disseminating new technologies to the farmers before testing on the demonstration site. Hence, the extension organization needs to revise the existing implementation of extension works to ultimately achieve the desired objectives of the organization. The extension organization needs to have its own demonstration site. Agricultural technologies need to be tested and verified in the demonstration site. The farmers need to verify the productivity of the improved technology. For the purpose, training and field day need to be organized on the demonstration site in the due course to enable the farmers to develop confidence on the agricultural technologies. Consequently, the demand to the agricultural technology is likely to arise from the farmers. The main role of the extension organization lies in creating demand for the technology. The existing experience of agricultural technology dissemination was that introducing the improved dairy practices to the model farmers directly with the assumption that the other farmers learn from the model farmers. Every new agricultural technology was introduced to same model farmers. As a result, the current agricultural technology dissemination program benefited the model farmers and such approach may lead to income inequality among the farmers. The result agrees with Belay and Abebaw (2004) that clearly criticizes the public agricultural extension services of Ethiopia for patronizing only resource rich farmers.

In addition to these constraints, farmers and dairy research have different objectives on dairy production. The farmers need cattle for farming purpose, keeping them as emergency asset and indication of social status whereas; dairy research is highly focused on improving the genetic makeup of dairy animals for increasing milk production. Thus, the dairy development of the study area was hampered by the absence of shared vision between the key actors. The improved dairy practices releasing mechanism also lacks clear direction. After the technology is generated, the researchers verify it on the farmers' field and demonstrate to the farmers. It implies that the farmers in the vicinity of the research centre are benefiting from the improved dairy practices. Even, in the vicinity of the research center, model farmers are benefiting from the improved dairy practices. The assumption of using model farmers as approach is to trickle down the improved dairy practices through them to the follower farmers. The study revealed that there were no improved dairy practices that were trickled down to the farmers. The main reason was that the model farmers adopted the technology at subsidized price. On the other hand, the technology is supplied to other farmers at actual cost. However, the farmers expect the support that is made to the model farmers to adopt the

technology. As such deviation noticed among the farmers, they do exhibit no interest in adopting the technology. The farmers who are selected as model farmers are relatively resource rich farmers. Logically, resource poor farmers need support to adopt the technology as they are representing the majority of the farmers. Resource poor farmers who have interest to adopt the technology and have willingness to teach the others need to be considered as model farmers. There was also no well designed mechanism that gives direction on how the improved dairy practices that are generated at research center link to the extension system to reach the large community. Better methodologies including sociometry can be thought of in identifying the model farmers who could able to represent the majority of farmers in every village.

In relation to dairy development, there was no technology multiplication center. In this regard, the involvement of the private sector was less as the investment payback period takes considerably long time. Hence, the intervention of the government in fulfilling the infrastructure and attracting the private sector is vital to capitalize the strengths of dairy subsector in the country.

Table 4.43: Distribution of respondents on the basis of adopting improved dairy practices ***(*n=150*)***

Improved dairy practices	**Adopters**	**Non adopters**	**Total**
Crossbred	42 (28)	108 (72)	150 (100)
Improved feeds	53 (35.3)	97 (64.7)	150 (100)
Veterinary service	139 (92.7)	11 (7.3)	150 (100)
Improved housing	69 (46)	81 (54)	150 (100)
Improved management	42 (28)	108 (72)	150 (100)

() Figures in the parenthesis indicate percentage; Source: Field survey, 2015

For effective dissemination of improved agricultural /improved dairy practice, developing a model to be followed for reaching the farming community has paramount importance. Though a new improved agricultural technology is tested and verified before disseminating to the framers by researchers, it further needs to be well demonstrated at field level prior to disseminating to the farmers by extension workers. The farmers also develop confidence about the practice and then develop interest to adopt it. Creating strong linkage with sources

of improved agricultural technologies, finance, input suppliers and marketing agency make the dissemination program complete.

The demonstration site of the peasant association needs to play a central role in disseminating improved agricultural practices. Any modification that is required on the practices should be completed at demonstration site itself. For the purpose, it has to be equipped with the necessary infrastructure. The improved agricultural technologies that reach the farmers should bring significant impact on the livelihoods of the majority of farmers. In the other way, directly providing improved dairy practices to the model farmers affected the effectiveness of agricultural practices dissemination. As a consequence, the current fragile kind of dissemination of improved dairy practices needs due consideration for strengthening and making extension organization as responsive to needs and aspiration of majority of resource poor farmers.

During group discussion with district extension workers, appropriate model to disseminate improved dairy practices to the farming community was formulated. Every peasant associations of the district have Farmers Training Center (FTC) which was not fully functional. FTC was useful for undertaking demonstration of improved farming practices before disseminating for the large farming communities. Demonstration is a powerful tool to persuade farmers about the new farming practices. Model to be followed during the introduction of new practices is depicted in Fig 4.5 as follows:

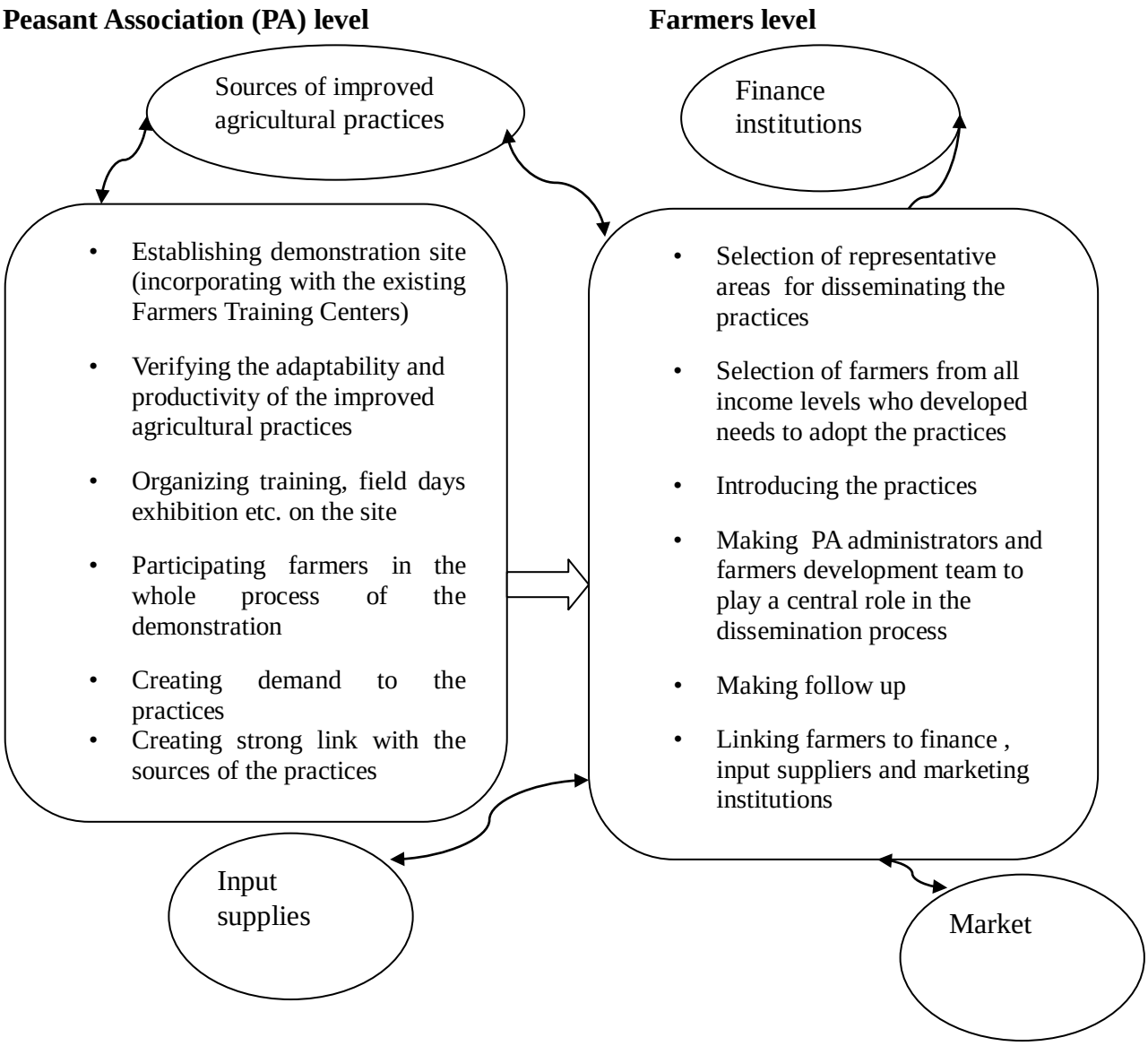

Fig 4.5: Model of improved agricultural practices dissemination process at field level

Source: Field survey, 2015

4.37. LEVEL OF FARMERS' PARTICIPATION IN RESEARCH ACTIVITIES

Experts and scholars have been advocating the benefit of participatory research in developing problem solving, affordable and tailor made improved farm technologies since 1970s. The research system of the study area is also participatory in approach. The key challenge in the research process is the identification of problem solving research problems. In the research process, this step needs a researcher thinking and rethinking and approaches the problems with creativity. It is the step where to envisage the likelihood of increasing the adoption of the intended technology by the end users.

Research problem is obtained from personal experience, field observation, review of literature and research funding agencies. In the process of discussion with the key informants, in the research center research problem is mainly obtained based on the personal experience. Agriculture Development Partners Linkage Advisory Council (ADPLAC) is also a source of research problem. However the members of ADPLAC from Agricultural development office and farmers do not come with in depth scanning of their real agricultural problem during the ADPLAC meeting. As a result, finding a research problem from ADPLAC that is representative of a majority was not worth mentioning. On the ADPLAC forum, few representative researchers participate and all researchers had no opportunity to use it for research problem identification. Additionally, there is no a practice of synthesizing the output of the discussion on the forum and sharing to non-participant researchers for the action. Observation also revealed that the researchers did not have a practice of organizing a discussion forum with farmers at field level for problem identification. These were some of the barriers for identifying the intended research problems which in turn, led to non-generation of adequate solution for the actual field problems being faced by farmers and extension agents.

As depicted in Table 4.44, the participation of farmers in all research activities was negligible. Farmers' Research Group (FRG) and on farm trial are mainly undertaken on farmers land plot. Unexpectedly, on FRG and on-farm trial 86.7 and 77.3 per cent of the respondents did not participate respectively. Correspondingly, research problem identification which is a key activity for identifying need based research problems was also neglected. The majority of the respondents (88%) did not participate in identifying the research problem of their farming activities. The data suggest that participatory research activities had less attention in the study area. It further has negative impact on adoption of improved dairy practices. It notifies that the organization that participated in dairy research needs to revisit

their approach to respond to the needs of the target group. The more participation of the farmers in research activities makes the adoption of improved dairy practices easier. In the other way, the technology that is generated based on the needs of the end users can be quickly disseminated at large scale with less promotional efforts. Therefore, obtaining regular feedback through appropriate mechanism will pave for sustainable development of dairy subsector.

Table 4.44: **Participation level of farmers in research activities of the study area**

(**n=150**)

Particulars	**Regularly**		**Occasionally**		**Rarely**		**Never**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Participation in research problem identification	-	-	6	(4)	12	(8)	132	(88)
Participation in research review meeting	-	-	3	(2)	12	(8)	135	(90)
Participation in Farmers Research Group (FRG) meeting	-	-	3	(2)	17	(11.3)	130	(86.7)
Participation in improved dairy practices training	-	-	12	(8)	31	(20.7)	107	(71.3)
Participation in field visit/demonstration	1	(0.7)	18	(12)	55	(36.7)	76	(50.7)
Participation in ADPLAC meetings	-	-	9	(6)	12	(8)	129	(86)
Participation in improved dairy practices evaluation	1	(0.7)	13	(8.7)	23	(15.3)	113	(75.3)
Participation in on-farm trial	1	(0.7)	10	(6.7)	23	(15.3)	116	(77.3)

() Figures in the parenthesis indicate percentage; Source: Field survey, 2015

4.38. DISSEMINATION OF IMPROVED DAIRY PRACTICES

Obviously, the generated improved dairy practices need to reach the ultimate end users especially the farmers. The improved dairy practices bring the widespread impact when it is multiplied and made available for the farmers. In this relation, except the forage varieties, other dairy improved practices did not have a set direction to enter into the existing extension system. As a result, the improved dairy practices were confined to the vicinity of the research center. Demonstration and dissemination of the improved dairy practices were mainly undertaken by the dairy researchers. The participation of researchers belonging to socio economics group of the research center in the demonstration and dissemination processes was less due to the complexity of the practices. However, generating the technologies and demonstrating to the end users consumes the considerable quantum of time of dairy researchers. As a fact, the socio economics researchers need to develop their capacity to perform the demonstration activities in a full-fledged manner. The improved dairy practices that initially envisaged reaching the farmers needs to get the participation of the socio economics researchers during its whole research works/ generation which, in turn, support them to develop their capacity for proper demonstration and dissemination.

4.39. CONSTRAINTS IN ADOPTION OF IMPROVED DAIRY PRACTICES

Identification of the constraints facilitates to take right decision and appropriate action which, in turn, improves the adoption of the improved dairy practices. Constrains for less adoption of improved dairy practices are multifarious. It varies from farmer to farmer and among categories of farmers (Adopters, partial adopters and non adopters). Initially, the constraints were identified through group discussion with respondents from all categories. During the discussion, 12 major constraints that impeded adoption of improved dairy practices were identified. Finally, it was incorporated into the data collection schedule to rank it in order of their importance. The respondents (Adopters, partial adopters and non adopters) ranked the constraints. The ranking of the constraints were categorized into adopters, partial adopters, non adopters and aggregate of the whole categories. Separate ranking was made with the intention of making easier for taking action.

Table 4.45 depicted that shortage of animal feeds, lack of problem solving improved dairy practice, cost of improved dairy practices and shortage of farm land were the main constraints for adopters. Likewise, lack of problem solving improved dairy practices, inadequate improved dairy practices, inadequate extension support and cost of improved dairy practices

were the core constraints for partial adopters. Non adopters also ranked shortage of animal feeds, lack of problem solving improved practices, cost of improved dairy practices and shortage of farm land as the main causes for non adoption of improved dairy practices. In aggregate, lack of problem solving improved dairy practices, shortage of animal feed, inadequate improved dairy practices and cost of improved dairy practices were in the highest rank that affected the adoption of improved dairy practices in the study area. The major constraints ranked by the category of the respondents were included in the aggregate ranking. Though there are variations among the category of the respondents in ranking, there were similarities among the respondents in ranking of major constraints. Consequently, the data suggest that searching a solution for aggregate ranking is part of a solution for main constraints ranked by the three different categories of the respondents.

Table 4.45: Major constraints of farmers in adoption of improved dairy practices

Constraints	Adopter (A) (**n=42**)		Partial adopter (PA) (**n=48**)		Non adopter (NA) (**n=60**)		Cumulative (**n=150**)	
	Weightage	Rank	Weightage	Rank	Weightage	Rank	Weight-age	Rank
Lack of problem solving IDP	76.142	2	81.635	1	80.128	2	79.536	1
Shortage of animal feed	84.9	1	70.272	5	83.194	1	79.283	2
Inadequate IDP	69.347	5	80.710	2	76.640	5	75.858	3
Cost of IDP	73.424	3	75.689	4	79.328	3	75.647	4
Shortage of farm land	70.555	4	68.874	6	78.437	4	72.560	5
Inadequate extension support	55.757	10	75.821	3	66.282	6	66.641	6
Prevalence of disease Farmers	64.364	7	54.549	10	59.517	7	59.199	7
unwillingness to change	53.643	11	66.440	7	54.760	10	58.016	8
Death of cattle	56.663	9	52.699	11	58.037	8	55.902	9
Lack of milk storage facility	64.213	8	54.945	9	45.670	11	53.407	10
Inadequate AI service	46.244	12	55.210	8	55.394	9	52.994	11
Lack of milk collection center	66.327	6	50.585	12	45.247	12	52.519	12

IDP indicates, Improved Dairy Practice Source: Field survey, 2015

4.40. DETERMINANTS OF TECHNOLOGY ADOPTION IN DAIRY PRODUCTION

The result of multinomial logistic regression on determinates of technology adoption in dairy production is presented in Table 4.46 using non adopter as reference category. The multinomial logistic regression model is estimated using maximum likelihood method. The χ^2 result shows that the parameters are significantly different from zero at $P<0.01$ for the adoption of improved dairy practices/dairy technology. The McFadden's R-square or Pseudo R^2 is 0.396, indicating that 39 per cent of the variations in probabilities of adopting improved dairy practices/dairy technology was explained by the selected explanatory variables.

Explanatory variables that were taken to the model are; age, education level of household head, experience, family size, land size, livestock holding, frequency of extension contact, availability improved dairy practices, compatibility of improved dairy practices, training, demonstration, credit and market. Among the variables taken to the model age, education level of household head, experience, livestock holding size, frequency of extension contact, availability of improved dairy practices and training were found to be significant. Family size, land size, market availability, compatibility of improved dairy practices, visit demonstration, credit and market availability were insignificant. Explanatory variables that are selected for econometric model and statistically significant are discussed as under:

Table 4.46: Multinomial logistic regression for factors influencing technology adoption in dairy production

Category of respondent	Variables	B	Std. Error	Wald	df	Sig.	Exp(B)
Adopter	Intercept	-11.278	2.426	21.611	1	0.000	
	Age	0.145	0.041	12.750	1	0.001***	1.156
	Education	0.227	0.082	7.722	1	0.005***	1.254
	Experience	-0.242	0.061	15.518	1	0.001***	0.785
	Family size	0.061	0.157	0.153	1	0.696	1.063
	Land size	-0.223	0.223	1.004	1	0.316	0.800
	Livestock	0.467	0.243	3.703	1	0.054*	1.596
	Extension	0.975	0.272	12.879	1	0.001***	2.650
	Availability	1.867	0.824	5.136	1	0.023**	6.470
	Compatibility	1.060	0.804	1.738	1	0.187	2.885
	Training	1.873	0.851	4.840	1	0.028**	6.506
	Demonstration	0.646	0.776	0.693	1	0.405	1.907
	Credit	0.639	0.937	0.465	1	0.495	1.894
	Market	0.326	1.100	0.088	1	0.767	1.386
Partial adopter	Intercept	-5.779	1.684	11.771	1	0.001	
	Age	0.126	0.035	13.046	1	0.001***	1.134
	Education	0.087	0.062	2.009	1	0.156	1.091
	Experience	-0.202	0.050	16.616	1	0.001***	0.817
	Family size	0.027	0.128	0.046	1	0.831	1.028
	Land size	-0.244	0.180	1.839	1	0.175	0.784
	Livestock	0.311	0.199	2.449	1	0.118	1.365
	Extension	0.525	0.228	5.313	1	0.021**	1.690
	Availability	0.656	0.743	0.779	1	0.377	1.927
	Compatibility	0.508	0.650	0.611	1	0.434	1.662
	Training	1.861	0.686	7.359	1	0.007***	6.429
	Demonstration	0.217	0.656	0.109	1	0.741	1.242
	Credit	0.002	0.792	0.000	1	0.998	0.998
	Market	0.102	0.827	0.015	1	0.902	0.903

-2 Log Likelihood	197.124	Cox and Snell	0.577
Chi-Square	129.145	Nagelkerke	0.651
df	26	McFadden	0.396
p-value	0.000		

*****,** ** and * significant at P<0.01, P<0.05 and P<0.1 respectively

Source: Field survey, 2015

Age: In this study, age is influencing the choice of adopting of improved dairy practices positively. As the age gets increased, the respondents tend to opt to maintain one or two crossbred instead of owning many indigenous cows. It was also observed that owning one or two crossbred was not demanding extra labour and managed by the owner. It is positively significant at P<0.01, The odds that a farmer will choose to adopt improved dairy practices/dairy technology increases by a factor of 1.156 for farmers who are older while keeping all other factors at constant. The finding is in agreement with the studies of Cramb (2003), Omiti *et al*. (1997) and Anandajayasekeram *et al*. (2008) that investigate positive relationship between age and adoption behaviour of farmers. On the other hand, the finding is in contrast to the conclusion of Motamed and Singh (2003) that young people are more flexible in deciding for change than aged people. It is also in contrary with the study conducted by Million and Belay (2004) that indicates age had a weak and at the same time negative association with adoption

Education: Feder *et al*. (1985) notes that education improves the decision making process and thereby influences the level and/or composition of other inputs. Hence, education would increase the knowledge and skills of farmers about the technology which would ultimately enhance adoption of improved dairy practices/dairy technology. As hypothesized, education was a significant determinant of the choice to adopt improved dairy practices/dairy technology positively and significant at P<0.01. The odds that a farmer will choose to adopt improved dairy practices/dairy technology increases by a factor of 1.254 for farmers who had more education level, while keeping all other factors constant. The finding coincides with earlier studies of Hassen *et al*. (1998), Feder *et al*. (1985), Cramb (2003) and Habtemariam (2004) that conclude farmers' education had positive and significant influence on adoption.

Farm experience: Farmers who practice traditional dairy production usually possess more experience in dairying. Rahman (2007) also states that experience helps an individual to think in a better way and makes a person more mature to take right decision. Though in most of the adoption study, experience influences adoption positively and significantly, in this particular study, it affected adoption of improved dairy practices/dairy technology negatively and significantly at P<0.01. The odds that a farmer will choose to adopt improved dairy practices decreases by a factor of 0.785, all other factors held constant. To substantiate the finding with the qualitative study, observation and key informant interview was made with community leaders and development agents. It was found that the majority of the adopters had less experience in dairying. The adopters were inhabitants of the vicinity of the town that engaged in dairying for additional income generation. The observation also brought out the fact that

the dissemination of improved dairy practices/dairy technology did not penetrate to the rural areas at large. It implies that the dairying would be managed even with less farm experience, but with right attitude and harnessing of available opportunities. It was also found that having more farm experience need not necessarily stimulate the adoption decision of farmers on improved dairy practices/dairy technology.

Livestock holding: It is a good proxy indicator of wealth status of the farmers in the study area. Mostly, farmers with high number of livestock have a financial capacity to bear a risk that may occur due to a technology failure. As expected, livestock holding influenced the choice to adopt improved dairy practices positively and significantly at $P<0.1$. The odds that a farmer will choose to adopt improved dairy practices/dairy technology increases by a factor of 1.596 for farmers who had large livestock holding, all other factors held constant. In line of this, studies of Getahun *et al*. (2000), Tesfaye *et al.* (2001) and Endrias (2003) show that the numbers of livestock owned positively and significantly influence the probability of adoption of farm technologies in their respective studies, which, in turn, encourages adoption of new agricultural technologies. In fact, keeping more livestock size increases the care and responsibility of owners and lead livestock farming as a professional farm enterprise.

Frequency of extension contact: Feder *et al.* (1985) notes that extension efforts increase the probability of adopting new technology by increasing the stock of information pertaining to modern production increment. Extension contact influenced the choice to adopt improved dairy practices/dairy technology positively and significantly at $P<0.01$. The odds that a farmer chooses to adopt improved dairy practices increased by a factor of 2.650 for farmers who frequently contact extension workers, all other factors held constant. The finding is in agreement with Feder *et al.* (1985), Berhanu (2002) and Makokha *et al.* (1999) that confirm contact with extension agencies has significant influence on the perception and adoption decision of farmers.

Availability of technology: The availability of the new technology and all other necessary inputs to small holders at the right time and place and in the right quantity and quality should be ensured (Ehui *et al.*, 2004). The availability of all the necessary packages with the affordable cost stimulates the adoption of improved dairy practices/dairy technology. It influences the adoption of the practices positively and significantly at $P< 0.05$. The odds in favour of adopting improved dairy practices/dairy technology increased by a factor of 6.470 for farmers who accessed improved dairy practices/dairy technology whenever they require, all other factors held constant. The finding is in line with a study by Makokha *et al.* (1999) that finds technological attributes such as supply (availability), economic and yield benefit

and convenience had significant influence on adoption decision. Yilma *et al.* (2011) also points out limited access to technology as the main Ethiopian dairy sector challenges. The finding is also supported by Yapa and Mayfeld (1978) which identifies that adoption of an entrepreneurial innovation by an individual requires at least four conditions. These are: the availability of sufficient information, the existence of a favorable attitude towards the innovation, the possession of the economic means to acquire the innovation and the physical availability of the innovation.

Training: Rahman, (2007) states that training might have inculcated technical competency, more exposure to the subject matter and convinced to adopt the improved technologies in the farms. As also noted by Rogers (1983) Knowledge is the function in which an individual is exposed to the innovation's existence and gains some understanding of how it performs. Training influences the adoption decision of farmers positively and significantly at $P<0.05$. Providing training to the farmers on improved dairy practices/dairy technology increases the adoption by odds of 6.506, holding other factors constant. Prior studies of Cramb (2003) and Anandajayasekeram *et al.* (2008) support the finding. Likewise, Rogers, (1995) supports the finding in stating that research in the diffusion of agricultural innovations has demonstrated that knowledge/awareness of a new technology is a necessary first step in the adoption decision-making process.

With respect to the category of partial adopters, age, frequency of extension contact, training influenced the choice of a farmer to adopt at least one of the improved practices/dairy technology positively and significantly at $P<0.01$, $P<0.05$ and $P<0.01$ respectively. The odds in favor of adopting at least one of the improved practices/dairy technology increase by a factor of 1.134, 1.690 and 6.429 respectively. However, with similar trend to adopter category "farm experience" influenced the adoption of at least one of the improved dairy practices negatively and significantly at $P<0.01$. It implies that improved dairy practices could be performed with having less farm experiences also as training would provide sufficient technical knowledge and motivate the farmers by sharing their experiences and case studies.

4.41. FINANCIAL BENEFIT OF ADOPTING IMPROVED DAIRY PRACTICES/DAIRY TECHNOLOGY

In the process of adopting improved agricultural practices, farmers are sensitive to the financial benefit of the practices. The higher the benefit obtained from the introduced improved agricultural practices easier it is to persuade the farmers to adopt the practices. Though there is no habit of calculating the financial benefit of the new practices by farmers in the study area, they estimated the benefit that they earned from the new practices comparing it with their own local cows. Thus, it needs to scrutinize the financial increment of the new practices before disseminating and making the farmers to be aware of the impending benefits. The average daily milk production for indigenous cow and crossbred was 2 and 8 liters/cow respectively. With the lactation period of 7 and 8 months, the total milk production was 420 and 1920 liters for indigenous cow and crossbred respectively. Table 4.47 revealed that incremental net benefit of adopting crossbred cow with improved management practices increased by **26947.38** Birr/cow/annum. Prior study by Ebrahim (2006) also concludes that adoption of crossbred dairy cows with recommended management practices changes the profit of dairy farmers by 2865.47 Birr per cow per year. Earlier study by Ketama (2000) also concludes that crossbred cow yield a gross margin of 937 EB/cow/year, or more than seven times the gross margin of a local cow. Correspondingly, Ojala 1998, cited in Ketama (2000) with his study in central highland of Ethiopia indicates that crossbred yield a gross margin of 865 EB/cow/year with milk production of 700 litters annually.

The finding of this study and empirical literatures confirmed the profitability of adopting crossbred cows vividly. Thus, crossbred dissemination along with the necessary package is paramount importance for the development of dairy subsector of Ethiopia.

Table 4.47: **Partial budgeting for crossbred adoption**

(**n=42**)

Column 1			**Column 2**		
Added cost (Birr)	Crossbred cow	Ingenuous dairy cow	Additional return (Birr)	Crossbred cow	Ingenuous dairy cow
Transport cost	150	--	Milk yield	34560	7560
Interest	790.72	324.10	Calf sale	8000	2000
Labour cost	1200	960	Cow dung sale	3240	2160
Service charge for AI	6 100	-- 70			
Veterinary cost	9840	3600	Total added return	45800	11720
Feed cost	12086.72	4954.10	Reduced cost	--	--
Total added cost	-	--	Total reduced cost	--	-
Reduced return	-	--	Total positive	45800	11720
Total reduced Total negative	12086.72	4954.10			

Net income from crossbred cow (45800-12086.72 =33713.28 Birr)

Net income from indigenous cow (11720-4954.10=6765.90 Birr)

Incremental net benefit of crossbred cow (33713.28 -6765.90=**26947.38** Birr)

Source: Field survey, 2015

4.42. DIVERGENCE ON ADOPTION DECISION AMONG ADOPTERS AND NON ADOPTERS OF IMPROVED DAIRY PRACTICES IN AMBO DISTRICT: A CASE STUDY

Ambo district is endowed with conducive climate for dairy production. The agricultural production system of the district is characterized by subsistence mixed farming of crop and livestock production. Both farming practices play a complementary role to each other. Draught animal and organic manure are the main sources of livestock for crop production. On the other hand, crop production provides diversified feeds and fodder to livestock. Dairy is the main farming avocation in the study area. Improved dairy farming was being practised in urban and peri urban areas. It is mainly due to the availability of market for the dairy products. By the same token, residents of the area adopt the improved dairy

practices for additional income generation to improve their livelihoods. Presence of awareness on the importance of milk consumption by the residents of urban; cafeterias and hotels created high demand for milk. Thus, dairy farming is the most remunerative farming practice in the area where it is integrated with the market.

There was an observation in the peripheries of the town where some farmers are adopters and the others are non adopters of improved dairy practices. Market, extension, credit and transport facilities were available for farmers in the study area. Though such adoption enhancing facilities were available, the non adoption of improved dairy practices/dairy technology was continuing persistently in the study area. It indicates that there is a variation within the dairy farmers in exploiting the dairy potential of the area. Hence, it was useful to find out factors that contribute for the divergence of adoption decision among adopters and non adopters of improved dairy practices/dairy technologies. It could create a learning environment for dairy extension intervention to design a strategy that improves the adoption of improved dairy practices/ dairy technologies.

The case study approach was employed for studying this phenomenon. Case study is an in-depth study of a specific individual or phenomena in its existing context. It is useful when the area of the study is difficult to address through questionnaire to generalize about the population of the study. Initially, the researcher made intensive field observation. Dairy extension intervention is being undertaken in the area for more than three decades. However, number of non adopters of improved dairy practices was predominating. The researcher was inspired by the situation to identify the factors that create discrepancy between adopters and non adopters in deciding to use improved dairy practices/dairy technologies. For the purpose, case study was considered as an appropriate tool to capture the events. The study was carried out using observation, in-depth interview and group discussion. Three groups were organized for Focus Group Discussion. Each group had ten respondents (five adopters and five non adopters). A total of 30 respondents were selected for the study and the data were collected during the months of March-August 2015.

Dairy farming experiences

Dairy farming practices have been passing from generation to generation since the time immemorial. As a result, the farmers have accumulated experiences in dairy farming. The majority of farmers learnt traditional dairy farming from their parents. The main aim of dairying is to get draught animal for land cultivation. Among dairy products, butter and local cheese are supplied to market in the study area. The number of dairy cow is an indicator of social status. In the other way, having large number of dairy cow is a symbol

of high saving as farmers save their money in kind. Presence of such mindset stimulates the farmers to own a significant number of livestock, though currently shortage of farm land is constraining them.

Adopters and non adopters of improved dairy practices/dairy technologies

Improved dairy practices/dairy technologies have been introduced to the study areas for more than three decades. According to Getachew (2003), the introduction of improved dairy practices/dairy technologies in Ethiopia was marked by 300 Friesian and Brown Swiss dairy cattle which were donated by United Nations Relief and Rehabilitation Administration in 1947. The duration of introducing improved dairy practice/dairy technology and its level of adoption was not commensurate. In the study area, different organizations are working on dairy development such as Agricultural development office, research center, university, private sector, cooperatives and NGOs. However, the efforts of those organizations did not bring significant change on the livelihoods of farmers. The organizations are operating independently and their pooled intervention efforts did not meet its target properly. Agriculture and Development Partners' Linkage Advisory Council (ADPLAC) plays a role of linkage for creating a common platform for the dairy actors. However due to its organizational problems, it could not bring observable impact on the adoption and livelihood. ADPLAC is organized by pooling the representatives of the different actors. It is a sideline activity for the members of the ADPLAC and they could not devote their full time and energy.

Members of ADPLAC have organized different extension intervention programs such as, field visit, demonstration, workshops, training etc. Both members of adopters and non adopters have also got opportunity to participate on the occasions at various times. A summary of points of divergence for adopters and non adopters on the decision of either using or not using of improved dairy practices/dairy technologies is presented as follows;

Adopters: Initially, the stimulating factors for adopting improved dairy practices/dairy technologies were collected from the members of adopters through interview. Finally, the group discussion was done with the members to point out their common response on the motivating factors that support them to come to decision for adopting the practices. The respondents evidently pointed out that searching additional income for improving their livelihoods was the central point to adopt improved dairy practices/dairy technologies. The participants have other sources of income such as ox fatting, poultry, crop production, petty trade, salary etc. Presence of additional income develops their confidence to reach on decision to adopt the practices. It enables them to bear a risk that may associate with the

technology failure. The long year's extension intervention on dairy development made the farmers to have a good outlook on the productivity of crossbred. The presence of ready market for dairy products is also another stimulating factor for adopting improved dairy practices /dairy technologies. The residents of town are well aware on the nutritional value of milk. Hotels, cafeteria, bars etc. are the main business areas that created market for dairy products. These business centers are expanding in the area. As a result, the adopters have diversified customers for supplying their dairy products.

Non adopters: Agricultural extension interventions of the area were targeting farmers. However, the majority of the respondents were not adopting the improved dairy practices/dairy technologies. It was mainly due to high cost of the practices, particularly crossbred cows. On an average, a crossbred and local cow cost 30,000 and 7000.00 birr respectively. Farmers who have additional sources of income can afford the cost of technology. For farmers who have no additional source of income, adopting a cross bred costs about 4-5 local cows. In most cases, it is hardly getting of 4-5 local cows per farmers. One respondent said that "Local cattle are used for threshing crop and compacting "teff" field. Alternative technologies that fit to the situation of farmers need to be available for adopting improved dairy practices/dairy technologies especially, crossbred. Similarly, developing financial capacity of the farmers needs to be a precursor to introducing the improved dairy practices/dairy technologies." Observation also confirmed that with the existing dairy extension interventions, those few farmers who have financial capacity are the beneficiaries of the practices. Similar observation from other respondents was that the crossbred can be adopted by availing credit support. However, crossbred are highly susceptible to disease. In the absence of insurance for the purpose, there is high risk of loss to adopt improved dairy practices/dairy technologies. The other respondent strengthened the fear of adopting improved dairy practices/dairy technologies in explaining that "If a farmer decides to adopt crossbred and substitute his/her 4-5 local cows with a crossbred, it is critical for the livelihoods of his/her family in case of technology failure?" Finally the respondents concluded that they need productive and disease resistant crossbred which can be managed as more or less similar to local breeds along with insurance scheme.

Non adopters identified the key perceived factors for not willing to adopt improved dairy practices/dairy technologies which are summarized as follows:

- Cost of Improved dairy practices/dairy technologies is high and it is unaffordable under the majority of farmers' circumstances. This is the main reason for less adoption of the practices.

- The crossbred are susceptible to disease and there is no coverage of insurance from intervening organizations. Likewise, there is no arrangement of compensation mechanism.
- Among agricultural technologies, cost of dairy technologies is high. However, there is no incentive mechanism to stimulate the farmers to adopt improved dairy practices
- Milk collection center which could create market is not available. The presence of unorganized market system discouraged adoption of the practices. In the dissemination process of improved dairy practices, market needs to be a precursor to the dissemination of the practices (Workneh & Ponnusamy, 2015).
- Though Ambo district is in the vicinity of Addis Ababa where milk processing industries are available, the district has no linkage with the milk processing industries.
- The main objective of dairy intervening organization is to increase milk production whereas; the objective of farmers is to get draught animal for farm land cultivation (Picture 2) and threshing (Picture 1) which demands significant number of cattle. There is lack of common goal for farmers and intervening organizations. These made the improved dairy practices adoption more to be confined to farmers that engaged in non farming activities.
- High cost of improved feeds coupled with inconsistent supply hindered the adoption of improved dairy practices
- Uniformly delivering of AI service without proper selection of local cows affects the yield of milk production. Lack of focus and inconsistency of extension service created low adoption of improved dairy practices. Similar study also investigated that the availability of the new technology and all other necessary inputs to small holders at the right time and place and in the right quantity and quality should be ensured; and changes like the awareness and attitude of farmers towards improved agricultural technologies and the institutional factors enhance adoption (Salim, 1986; Ehui *et al*., 2004).
- The AI service is mainly confined to urban and peri urban areas of the study area which also hold true for the rest of the country. Workneh & Ponnusamy (2015) came with the same observation that the majority of farmers did not access the AI services as it is yet confined to urban and peri urban areas. The wide rural areas did

not get access to the AI service mainly due to infrastructure problem, inadequate number of AI technician and management problems of crossbred. Similar finding by Azage *et al*. (2006) state that problem with efficiency and effectiveness of AI technician and monopolized public delivery of the service are some of the major problems in the country AI system.

- Extension system is addressing more better off famers. Initially, the improved dairy practices are introduced to better off farmers. As a result, they get incentive and adopt the practices whereas, in the subsequent efforts made to reach large farmers, there is no incentive and close follow up by the extension workers. This highly slowed down the dissemination of improved dairy practices. The result agrees with Belay and Abebaw (2004) that clearly criticizes the public agricultural extension services of Ethiopia for patronizing only resource rich farmers. Similarly, the main challenges for the development of dairy farming in Ethiopia are: genetic limitation, inadequate animal feed resources, high cost of dairy heifers/cows, unavailability of improved dairy stock, inadequate A.I. services, shortage of feeds and cost of concentrates, disease and use of traditional technologies (Yilma *et al.*, 2011; Berhanu, 2012; Ulfina *et al.*, 2013).

Picture 1:Threshing

Picture 2:Ploughing

Correspondingly, both adopters and non adopters were facilitated to suggest ways that would enhance adoption of improved dairy practices/dairy technologies; and summarized as follows;

- A mechanism has to be worked out to address the aforementioned key constraints for finding the immediate solutions. For instance, constituting a committee of experts can

work our immediate and long term targets for realizing the full potential of dairying based on the challenges and availability of opportunities.

- It is absolutely necessary for dairy extension to diversity the target groups for providing tailor made extension services i.e. some farmers to engage in feeds production, others in milk production, milk collection, value addition, logistics, marketing etc.
- Instituting awards and recognitions for outstanding performance of dairy farmers would invariably, stimulate the adoption of improved dairy practices
- Adoption of improved dairy practices needs either subsidy/incentives or making the cost of dairy farming technologies lower.
- Searching alternative technologies for threshing crop and compacting teff field needs high priority for enhancing adoption of improved dairy practices/dairy technologies.
- Making selection among the local cows and identifying the breeds that are at least suitable for milk production.
- The selection of model farmers needs not to be necessarily from the better off farmers. It should be from the representatives of the majority of the farmers.

Benefits for farmers from dairying

Productivity of the dairy herd of Ethiopia is low with an average milk yield of 1.3 – 1.54 liter per day for an average lactation period of 180 – 210 days in indigenous cattle and 10 liter per day in crossbred cattle (Belete *et al.*, 2010). Though it is less productive, field observation showed that dairy farming is a remunerative activity. It provides economic and non economic benefits to the farmers. Economic benefits are earning of income from sale of dairy products, calf and cow dung. On the other hand, non-economic benefits of dairy are indication of social status and using milk products for religious ceremony. With a group, gross profit comparison was made between indigenous cow and crossbred taking into account milk yield/cow alone.

A non-adopter on average had two indigenous cows, whereas, adopter group had one cross breed and three indigenous cows. During focus group discussion, it was identified that Indigenous cow and crossbred on average yield 2 and 8 liters of milk/day respectively. The lactation period of indigenous cow and crossbred was 210 and 320 days respectively. Accordingly, indigenous cow and crossbred yield 420 and 2560 liters per lactation period respectively. Adopter and non adopter earn a gross profit of 35840.00 and 5880.00 Birr respectively with a price of 14.00 Birr/liter. It indicates that a farmer needs to own more than

five indigenous cows to earn a gross profit comparable to a crossbred. (**1US dollar =21.42 Birr)**

Synthesis of the case study

Adoption of a farm technology is subject to various factors of production and marketing. Favourable factors positively influence the decision making capacity of the farmers and subsequently the adoption of recommended farming practices. The present study also brought similar observations and findings. Dairy extension intervention in Ambo district was started in late 1970s. However, the majority of the respondents were found to be non adopters of the improved dairy practices/dairy technologies. Few adopters of the practices were observed in urban and peri urban area. Perceived factors that non adopters pointed out for not adopting dairy technologies were high cost of improved dairy technologies, susceptibility of crossbred to disease and absence of compensation mechanism, absence of ready market, lack of common goal for farmers and intervening organizations, diversified advantage of local cattle (threshing *by trampling* of cattle, soil compaction *of* Teff *field,* Ploughing with oxen etc), and inappropriate selection of model farmers. On the other hand, adopters of dairy technologies stated that presence of adequate income for overcoming risks associated with technology failure was the main reason for deciding adoption of dairy technologies. Thus, improving the income of farmers is vital for increasing their adoption decision of dairy technology. For the purpose, arranging accessible credit services and technical back-up on dairy technology are paramount importance for exploiting the existing dairy potential of the study area.

The study also brought out the need for converging the efforts of key actors for effectively targeting the clients and producing the output with lesser cost of effort. The strong emphasis should also be on framing a farmer friendly policy framework to give impetus to vibrant growth of dairy farming.

4.43. LINKAGE MECHANISM

Well designed organizational structure that is equipped with the required human resource and budget improves the performance of the organization. The current structure of agricultural linkage in Ethiopia is organized at different levels starting from federal to peasant association (PA). There are focal persons who are entirely working on the coordination of linkage activities at Ministry of Agriculture and Regional Agricultural Development Bureau, while focal persons who coordinate the linkage activities of zones and districts from agricultural development office have their own regular office works. This led to consider the linkage

works to be a sideline activity. As a result, they were not in a position to allocate their full time and energy for the purpose. Though efforts were made to strengthen linkage activities, weak linkage is yet prevailing among the actors of agricultural development. Similarly, MoA and ILRI (2013) strongly concluded that the theoretical linkage between farmers–extension–research, usually underlined by many speakers and writers, is not seen to be implemented in the Ethiopian case effectively

As depicted in Fig 4.6, Ministry of Agriculture, Regional Agricultural Development Bureau; Zonal Agricultural Development Offices; District Agricultural Development Office and Kebele administrator are responsible for FADPLAC, RADPLAC, ZADPLAC, DADPLAC and KADPLAC linkage activities respectively.

Budget for linkage is based on project fund and it does not have its own source of regular budget. Observation of documents, evidently pointed out that lack of its own budget and independent unit that is entirely responsible for linkage activities impede the effectiveness of the linkage. In the effort of several years for improving linkage activities, budget and organization problem are the central for its insignificant improvement.

At each level of the linkage, members of the ADPLAC are drawn from different participating organizations in agricultural development activities of their respective areas. The members have no binding rule and regulation.

With respect to planning, it was top down in approach. RADPLAC sends draft plan to ZADPLAC then to DADPLAC and KADPLAC. Though, the zone, district and 'kebele' have a mandate to modify and adapt the draft plan to their context, the approach made members of the ADPLAC not to well scan the field problem of their area. In the two districts of the study area, there were no significant functional linkage activities at district and 'Kebele' levels. However, the district agricultural development office and kebele administrator along with development agents carry out the activities. The final plan is presented to the members of ADPLAC of the respective levels and gets approval for implementation. Each member of the ADPLAC get the approved plan for implementing activities related to their organization. However, there is no way of obligating the organizations to accomplish the plan of ADPLAC. The plan is incorporated with the regular activities of the organizations due to absence of budget from ADPLAC. The implementation of the ADPLAC plan is based on the willingness of the organizations.

The monitoring and evaluation took place through attending report presentation of each actors during the regular meetings (twice/annual) of the ADPLAC. Unexpectedly, there is no formal reporting system to the ADPLAC; and no well developed guideline for monitoring

and evaluation of the activities. Field level evaluation of the activities of the actors is not common. The existence of such gaps evidently hindered the effectiveness of the ADPLAC, which was hoped for solving persistent problem of agricultural development partners' linkage.

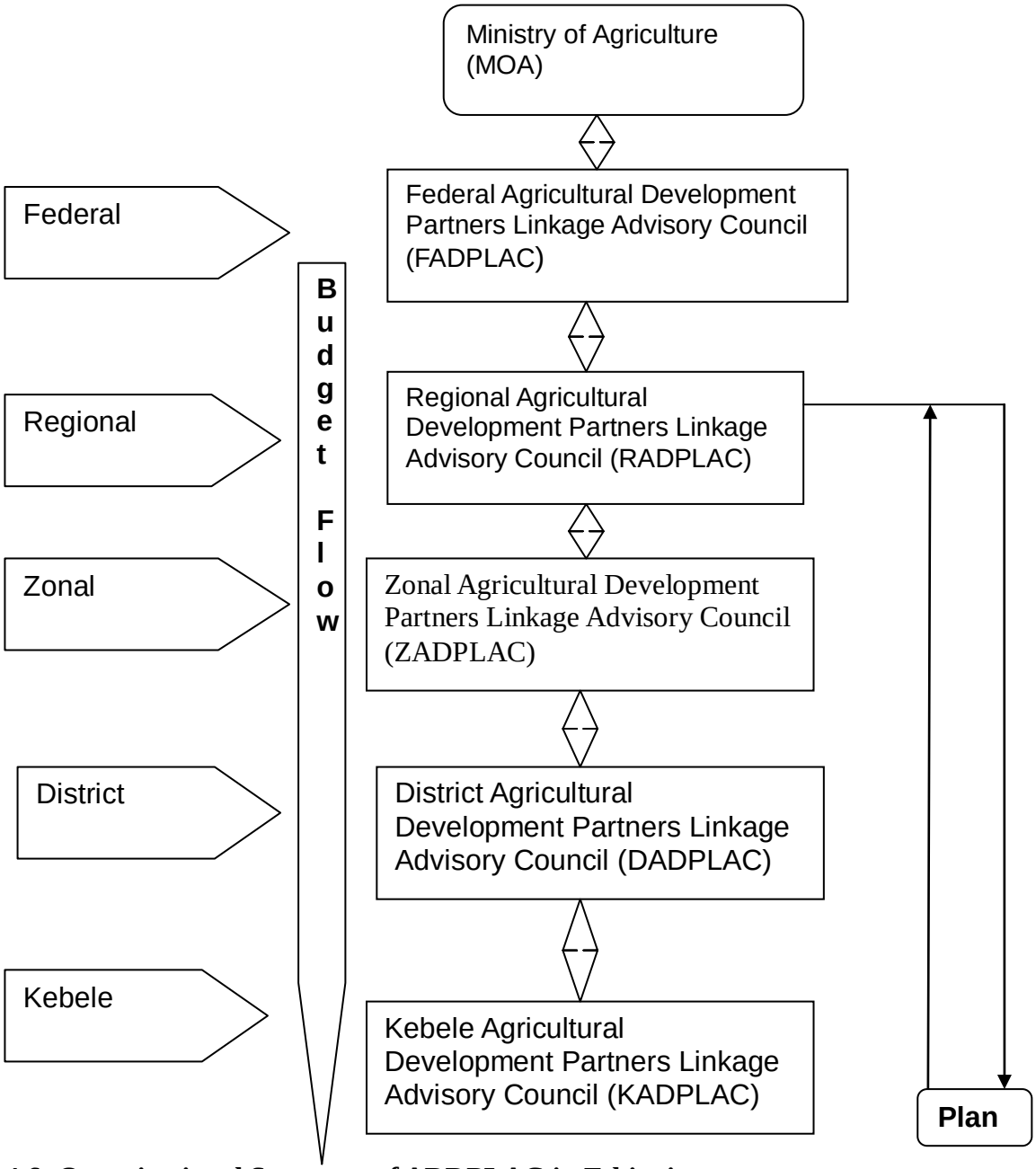

Fig 4.6: Organizational Structure of ARDPLAC in Ethiopia

Source: Field survey, 2015

4.44. KEY ACTOR PARTICIPATION LEVEL IN LINKAGE ACTIVITIES OF THE STUDY AREA

In Ethiopia, the importance of linkage for increasing the agricultural productivity of actors was recognized way back in 1980s. Since then, different efforts were undertaken to strengthen the linkage among actors of agricultural production. For instance, Research-Extension Liaison Committees (RELCs) were established in 1986 in order to create an appropriate forum for the actors in agricultural development of the country. RELC was restructured to strengthen the loose linkage between research and extension, particularly to improve the participation of farmers in the linkage activities. As a result, Research-Extension and Farmers Advisory Council (REFAC) was established in 1999.

The results of the historical review reveal that research-extension linkage was generally weak and that neither research nor extension was sufficiently conscious of the need to understand the constraints and potentials of different farming systems as a basis for determining relevant technology and technology-development requirements (Belay, 2008). As a fact, REFAC was restructured in 2008 with renaming it as Agriculture Development Partners Linkage Advisory Council (ADPLAC). It is mainly aimed at strengthening linkage activities among the actors of agricultural technology generation, development and dissemination. ADPLAC is multi actors' linkage platform which includes, research, extension, farmers, private sectors, cooperatives, NGOs etc; and organized at federal, regional, zonal, district and kebele levels. Budget constraints, absence of commitment from the actors, coordination problem, frequent restructuring without in depth study, frequent shift of job (staff turnover), poor representations of actors and absence of external pressure from policy makers were identified as the main causes for weak linkage. Taking into consideration, the main linkage activities, the participation level of researchers, extension workers and farmers were assessed. Table 4.48 evidently showed that the participation level of key actors in different activities of linkage was insignificant. Among the linkage activities, on research problem identification, the majority (88 %) of farmers did not participate. Commonly, farmers did not participate in all the linkage activities to the level of required. It also holds true for the extension workers. Though the data indicated relatively better participation for researchers, significant number of the researchers was not participating in all linkage activities regularly. The data suggest that linkage among the actors was facing enormous challenges that hindered its strength. In the other way, the three decades efforts made for improving the linkage among the actors did not bring significant change. As a result, the weak linkage among the actors was still persisting in the study area.

The status of the linkage among other actors of the study was addressed through key informant interview and Focus Group Discussion. Thus, the discussion was made with actors such as private sector, cooperative, NGO, and University. The main objective of the discussion was for assessing the linkage status among the actors of dairy development in the study area. The group discussion indicated the weak linkage status of the area. It is mainly due to poor participation of the members. The members of the council were pooled from different organizations; mostly heads of the organizations. There was frequent turnover (shifting of job) of the members and on every meeting participation of new members were common. It made difficult for improving and achieving the objectives of linkage activities with new members entering the council consistently.

Furthermore, the members have their own regular responsibility in their organization and linkage was considered as a sideline activity. The members were not directly accountable to the council of the linkage. Likewise, members of the linkage were not evaluated based on their contribution to the linkage activities. This was primarily affecting the linkage activity of the study area. Principally, lack of independent unit for coordinating linkage activities impeded the improvement of the linkage of the study area. Since the inception of RELCs, several attempts were made to improve the linkage activities. However, the significant improvement was not observed in strengthening the linkage activities. As a fact, it necessitates the need for having its own unit that mainly executes linkage activities.

Table 4.48: Participation level of key actors in linkage activities in the study area

(n=250)

Linkage activities	Farmers (n=150)				Extension workers (n=50)				Researcher (n=50)			
	Re	O	Ra	N	Re	O	Ra	N	Re	O	Ra	N
Regular meeting of actors	1 (0.7)	48 (32)	23 (15.3)	78 (52)	5 (10)	9 (18)	6 (12)	30 (60)	3 (6)	17 (34)	21 (42)	9 (18)
Research problem identification	-	6 (4)	12 (8)	132 (88)	2 (4)	2 (4)	13 (26)	33 (66)	3 (6)	17 (34)	21 (42)	9 (18)
Setting of research agenda	-	5 (3.3)	9 (6)	136 (90.7)	1 (2)	3 (6)	8 (16)	38 (76)	9 (18)	13 (26)	15 (30)	13 (26)
Joint research review	-	3 (2)	12 (8)	135 (90)	1 (2)	5 (10)	9 (18)	35 (70)	12 (24)	13 (26)	15 (30)	10 (20)
Joint planning	-	6 (4)	16 (10.7)	128 (85.3)	3 (6)	6 (12)	9 (18)	32 (64)	9 (18)	14 (28)	12 (24)	15 (30)
Joint on farm trial	1 (0.7)	10 (6.7)	23 (15.3)	116 (77.3)	3 (6)	6 (12)	10 (20)	31 (62)	8 (16)	17 (34)	10 (20)	15 (30)
Joint field day	1 (0.7)	18 (12)	55 (36.7)	76 (50.7)	5 (10)	10 (20)	16 (32)	19 (38)	3 (6)	16 (32)	18 (36)	13 (26)
Research result review meeting	-	7 (4.7)	16 (10.7)	127 (84.7)	4 (8)	5 (10)	11 (22)	30 (60)	15 (30)	18 (36)	15 (30)	2 (4)
Field visit	1 (0.7)	19(12.7)	57 (38)	73 (48.7)	6 (12)	6 (12)	19 (38)	19 (38)	8 (16)	14 (28)	14 (28)	14 (28)
Joint monitoring and evaluation	1 (0.7)	13 (8.7)	23 (15.3)	113 (75.3)	3 (6)	6 (12)	11 (22)	30 (60)	6 (12)	5 (10)	13 (26)	26 (52)

() Figures in the parenthesis indicate percentage; Re- Regularly O-Occasionally, Ra, Rarely, N- Never
Source: Field survey, 2015

Actor linkage status in the study area

The desired dairy development can be actualized when there is active involvement of multi actors in improved dairy practices` generation, demonstration, multiplication, input supply and readiness to adopt the practices. The contribution of each actor to the development of dairy subsectors needs to be well synchronized with an effective linkage mechanism.

Currently, Agricultural Development Partners Linkage Advisory Council (ADPLAC) is playing a role of coordinating linkage activities. Though restructuring and strengthening of

linkage mechanisms were made at various times, linkage status among the key actors of agricultural development was weak and summarized in Table 4.49.

Actor Linkage Matrix (ALM) is used to identify actors of dairy subsector and show their links clearly. In the matrix, actors are represented along the vertical and horizontal axes. The cells in the matrix represent areas of actors' linkage in the rows to actors in the columns.

The linkage between research and university was observed to be weak. Lack of collaborative research work and a common forum for research review meetings could convey the weak linkage between the organizations. These two key actors would have played an exemplary role to other actors in creating strong linkage. The two organizations could create collaboration in different activities beyond improved dairy practices generation and dissemination. Staff exchanges, short and long term training, hosting students for practical works and uses of reference materials were some of further areas where both organization could collaborate effectively.

Research center and private sector had also weak linkage. It is mainly due to less participation of private sectors to invest in multiplying improved dairy practices. Lack of improved dairy practices releasing mechanism also contributed to the weak linkage of both organizations. The weak linkage of both organizations further revealed in less adoption of improved dairy practices by farmers. Thus, the existence of strong linkage between both organizations would have highly contributed for the dissemination of improved dairy practices to bring wide impact on the large community.

It is evident from the matrix (Table 4.49) that there was weak linkage between agricultural development office and university; livestock agency and university; farmer and private sector and farmers and university. Strong linkage was also observed among agricultural office, livestock agency and farmers. In general, dairy development is not the sole mandate of a single organization. The development of dairy subsector is the shared effort of all actors that explicitly and implicitly participate in the different activities of dairy development. ADPLAC intervention in overtly clarifying the role and responsibilities of each key actor and then making them to play their role and responsibilities is a key function for solving the prevailing linkage problem among the key actors of dairy development. In the linkage activities, each role of the key actors was identified through group discussion and summarized as follows (Table 4.50):

The areas where farmers can contribute to the dairy development are providing feedback on improved dairy practices; technology dissemination, provide land for on farm trial (OFT), materials and labour support. Though the farmers delivered the service to all actors

participated in dairy development, in return, farmers did not adequately receive the required services from the actors.

NGO provides financial, material, training, inputs and technical support to actors of dairy development. Due to the existence of weak linkage with other actors, its support in this respect was minimal. Research provides improved dairy practices, training and laboratory service to actors of dairy development. High cost of improved dairy practices and absence of ready market impeded the effectiveness of the research efforts.

Agricultural development office renders demonstration site, feedback, facilitation role for on-farm trial, mobilizing farmers, coordination of actors of dairy development. Livestock agency plays more or less similar services with agricultural development office. The actors obtain services from university such as training, improved dairy practices, lab service and logistic support (transport). Cooperatives also contribute in organizing dairy cooperatives, improved forage seeds multiplication cooperatives and auditing services. Private sectors mainly contribute in scaling up the technology and input supply. However, the prevailing weak linkage hindered the actors to exploit the available opportunities. Belay (2003) also came with same finding that the research-extension linkage has been very poor and extension agents have been involved in different activities which are not related to their normal duties.

The absence of strong linkage between research, university and extension organization further leads to the competition for government resources. Research and extension organizations in developing nations generally compete over the same scarce government resources and frequently, leaders of these institutions do not see themselves as part of a broader system (Swanson *et al*., 1998).

Table 4.49: **Linkage status among dairy actors**

-	Re.	Agr	Uni	LS	Coop	F	NGO	PS
Re	-	xx	x	xx	xx	xx	x	x
Agr		-	x	**xxx**	**xxx**	**xxx**	x	xx
Uni			-	x	xx	x	x	x
LS				-	xx	**xxx**	x	xx
Coop					-	**xxx**	x	xx
F						-	x	x
NGO							-	x
PS								-

xxx, strong; xx, medium; and x, weak; Source: Field survey, 2015

Table 4.50: Actor linkage matrix

→	Re.	Agr.	Uni	LS	Coop	F	NGO	PS
Re	**X**	IDP,T	TL	IDP,T	IDP,T	IDP,T	IDP,T	IDP,T
Agr.	FR	**X**	FR	FR	F	IT	TF	TF
Uni.	T	TL	**X**	TL	T	IDP,T	T	T
LS	F	F	F	**X**	IDP,TI	IDP,TI	TF	TF
Coop	F	F	F	F	**X**	**TI**	T	T
F	FR	FR	FR	FR	FR	**X**	FR	FR
NGO	FS	FS,T	FS	FS,T,IDP	FS,T	IDT	**X**	FS,T
PS	I	I	I	I	I	I	I	**X**

Contact areas:-IDP-Improved dairy practices; F-Feedback and facilitation role; R-resources (land, labour); FS-financial support; I-inputs; L -laboratory service; T- Training

Actors:- Re. Research; Agr.-Agriculture development office; Uni.-University; LS-Livestock agency; NGO-Non Governmental Organization ;PS: Private Sector; Coop. Cooperative; F. farmer

Rows: - delivering information **Column**: - receiving information

Source: Field survey, 2015

4.45. CONVERGENCE OF ACTIVITIES FOR DAIRY DEVELOPMENT

Convergence can take place at institution, process and activity levels. At institution level, convergence takes place through formulating plan that encompasses similar activities of the actors.

Activities of actors participated in dairy development are interconnected. It needs identification of their convergence area and pooling resources to carry out a meaningful dairy development intervention. In such way, it brings a significant impact on the large community. As indicated in Fig 4.7, policy is the overall guiding instrument that encompasses research, extension, inputs and market. Apparent policy framework that is formulated considering the components was lacking though it is an engine for the development of dairy subsector. The well established linkage among the actor ultimately contributes to the development of dairy subsector (Fig 4.7).

Dairy research activities of actors such as research center, university and NGOs of the study area have similarities. As depicted in Table 4.51, though there were possibilities of creating convergence in the activities of problem identification, research review meetings, on-farm trial, demonstration and others; there were no collaborative efforts among the actors. Convergence is a tool for assuring efficient use of resources and actor with similar activities needs to mobilize all their efforts to bring significant impact on the dairy development of the study area. Extension organization organizes demonstration, field day and training. Correspondingly, research center, university, livestock agency, agricultural development office and NGOS are engaging in similar activities independently. Provided that the organizations created convergence, they could pool their resources and organize the activities in the way that it influences large community. Currently, the piece meal approach could not bring the expected dairy development in the study area.

The activity of convergence requires committed, far sighted and visionary leaders of the respective organization. Putting into consideration the efforts made for more than five decades, the question of less adoption of improved dairy practices and other agricultural technologies needs to get an urgent comprehensive response from the professionals of the respective actors. Closed system of each actor, less participation in shared vision, absence of ready market and less attention to coordinated efforts of actors could be among the causes for low dairy development of the study area.

Market has a driving force for enhancing improved dairy practices adoption. In the other way, unavailability of ready market negatively affects the efforts of improved dairy practices

dissemination. In the efforts of disseminating improved dairy practices, market issue needs to be a priority area. High cost of improved dairy practices was perceived by the farmers. On the other hand, they perceived absence of market for their dairy products. The improved dairy practices/dairy technologies adoption decision of farmers was highly affected by such circumstance.

Table 4.51 summarized similar activities that can be performed by different actors. Identifying and converging on similar activities widen the impact of the actors in developing the dairy subsector. On each activity, degree of the actor convergence was assessed. In all aspects, it was weak. However, the convergence matrix showed the area where the actors can create convergence to exploit their pooled efforts for bringing significant change on the dairy development of the area.

Generally, technology generation, training, technology dissemination, technical support, technology multiplication, technology testing and input supply are the main areas where convergence can be capitalized on by the actors.

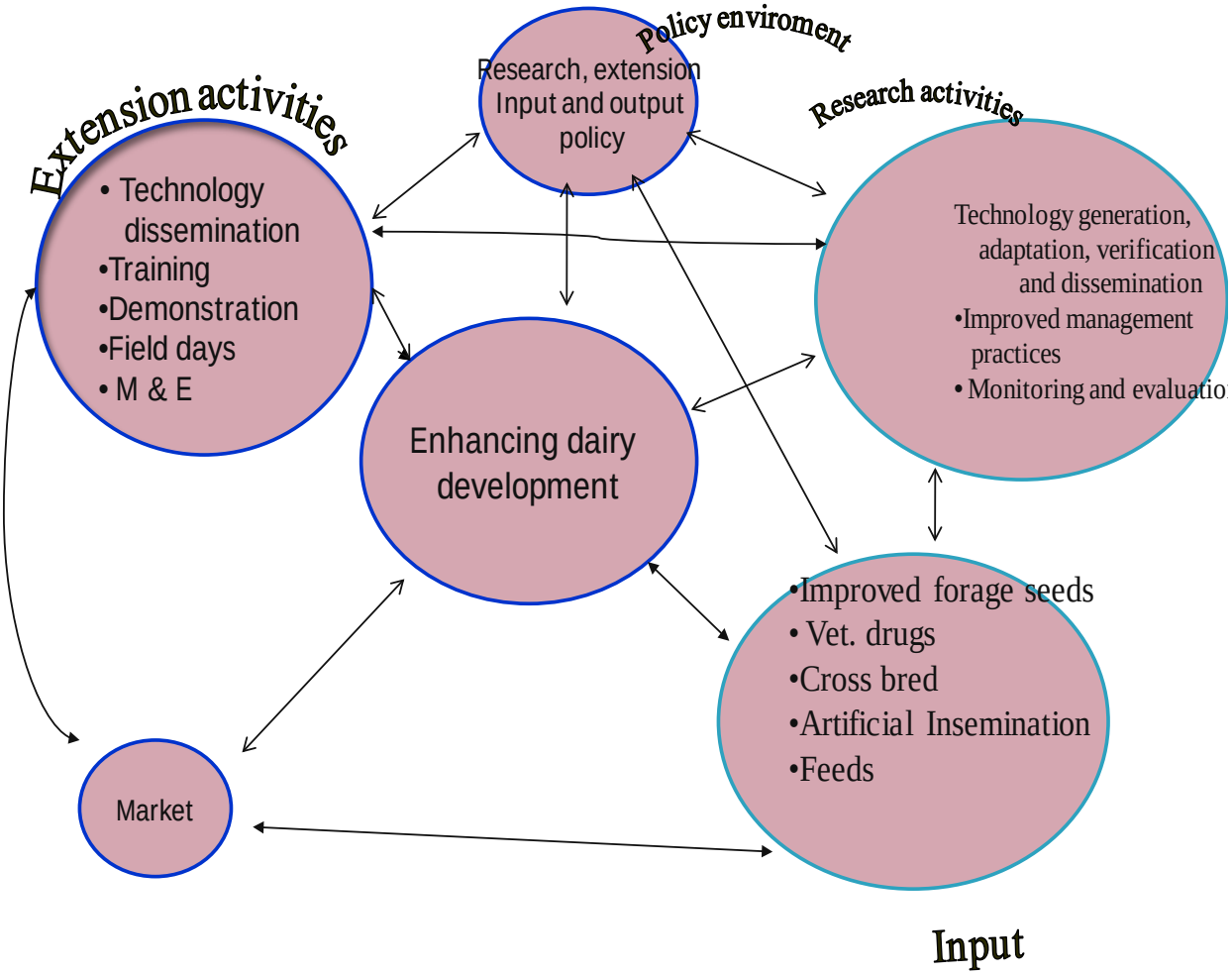

Fig. 4.7: Activity convergence matrix in dairy development process

Source: Field survey, 2015

Table 4.51: Convergence matrix in research and extension activities

S.No	Major activities	Rs	Agr.	Uni.	LS	Coop	F	NGO	PS
1	**Research**								
	I. Problem identification	x	x	x	x	x		x	x
	ii. Research review meeting	x		x				x	
	iii. On farm trial	x	x	x	**x**			x	
	iv. Technology verification	x		x					
2	**Extension**								
	i. Technology dissemination	x	x	x	x	x	**x**	x	x
	ii. Training	x	x	x	x	x		x	
	iii. Field day	x	x	x	x				
	iv. Demonstration	x	x	x	x			x	
	v. Veterinary service	x		x	x				x
3	**Inputs**								
	i. AI	x		x	x				
	ii. Improved forage seeds	x	x	x	x	x	x	x	x
	iii. Crossbred	x	x	x	x				x
	iv. Drugs				x				x

Re- Research; Agri- Agricultural development office, Uni.- University, LS- Livestock agency, Coop- Cooperatives, NGO- Non Governmental Organization, PS, Private sector,

X - Convergence area

Source: Field survey, 2015

CHAPTER 5

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

5.1. SUMMARY

Dairying is being practised as an integral part of agricultural activities in Ethiopia since time immemorial. Although the inception of dairy research and dissemination of improved dairy practices lasts for more than five decades, the majority of the farmers still continue to adopt traditional dairy practices. In order to capture the challenges and work out the plausible strategies, this study was carried out in Welmera, Ambo and Toke Kutaye districts of Oromia, Ethiopia. The objectives of the study were to assess the effectiveness of research and extension process in generating and disseminating improved dairy practices; to find out the factors influencing technology adoption in dairy production; and to measure the extent of convergence of different agencies promoting dairy production. Sample respondents were included from researchers, extension workers and farmers to carry out the research from system perspective. Accordingly, indicators for measuring effectiveness of research and extension process such as personal characteristics, research/extension participation, infrastructure facilities, responsiveness of improved dairy practices, research/extension management, policy environment, social participation and financial capacity were selected.

The major improved dairy practices which were selected for the study purpose include breeding practices, management practices, feeds and feeding practices and health care practices. Details of research and extension processes such as research priority setting; research review process, qualification and number of researchers; research infrastructure; motivational factors; capacity building, research-extension and farmer linkage; dairy technologies generated; number of dairy technologies disseminated and adopted; participation in extension planning and research review process; relevance of best practices, responsiveness of research, number of crossbreds per farmer, farmers` income and milk yield increment due to dairy technology adoption; number of extension personnel at district and village level were considered for carrying out the study.

Socio economic characteristics of the respondents

The mean age of dairy researchers, dairy extension workers and farmers (Adopters, partial adopter and non adopters) was 37.5, 32 and 47.2 years respectively. With respect to farmer respondents, the mean age of adopters, partial adopters and non adopters was 47.8, 48 and 45.7 years respectively. Mean years of work experience of dairy researchers, dairy extension workers and farmers were 13.7, 9 and 16 years respectively. On the other hand, the mean years of work experience of adopters, partial adopters and non adopters were 13.6,14 and 20 respectively. About 28, 50 and 22 per cent of researchers had PhD, M.Sc/MA and B.Sc/BA degree respectively. The majority (72%) of extension workers had the education level of BSc/BA. On the other hand, the mean class year for adopters, partial adopters and non adopters was 9, 7 and 5 respectively.

Research effectiveness in dairying

The dairy research effectiveness index was developed aggregating the score of research effectiveness sub indicators such as personal characteristics, research participation, research infrastructure, research management, responsiveness of improved dairy practices, research policy, social participation and financial capacity. About 52, 42 and 6 per cent of the respondents were in the range of low, medium and high levels of the dairy research effectiveness index respectively. The overall research effectiveness index was 44 per cent which was nearly in the range of low level of the index. Correspondingly, the majority of the respondents (94%) were in the range of low and medium levels of the index. Ranking also indicated that the research effectiveness sub indicators such as research management, infrastructure, research policy, responsiveness of improved dairy practices and research management rank first, second, third, fourth and fifth respectively, in terms of their importance for improving the effectiveness of dairy research process. On the other hand, lack of clear research strategy, inadequate laboratory equipments, inadequate laboratory building and inadequate budget support were identified as the top constraints of the dairy research in order of their importance.

Researchers and extension workers rated the effectiveness of improved dairy practices generation process. The majority (40%) rated as rarely effective. The mean of improved dairy practices generated and published were 0.072 and 0.38/annum/researcher respectively.

Extension effectiveness in dairying

The dairy extension effectiveness index was developed combining the scores of extension effectiveness sub indicators such as personal characteristics, extension participation, extension infrastructure, extension management, responsiveness of improved dairy practices,

extension policy, social participation and financial capacity. About 74, 24 and 2 per cent of the respondents were in the ranges of low, medium and high levels of extension effectiveness index respectively. In combination, low and medium extension effectiveness index constituted 98 per cent of the respondents. The data revealed the low level of extension effectiveness in the field of dairying of the study area.

Infrastructure, extension policy, responsiveness of improved dairy practices and extension management were ranked as 1st, 2nd, 3rd and 4th respectively in order of their importance.

Ordered logistic regression revealed that personal characteristics, research/extension participation, infrastructure, responsiveness of improved dairy practices, research/extension management, policy environment and social participation were found to be positively and significantly influencing the effectiveness of dairy technology generation and dissemination process.

Ranking of extension constraints in dairying indicated that cost of improved dairy practices, shortage of animal feed, lack of need-based improved dairy practices and non-availability of appropriate improved dairy practices were the main constraints in dairy technology dissemination in order of their importance. Cost of crossbred is also unaffordable under the financial capacity of most farmers. It was also coupled with inadequate and irregular Artificial Insemination (AI) service, shortage of forage, sensitivity of crossbred to diseases, less technical capacity of farmers and development agents in estrus detection of cows and reluctance of farmers in practising improved dairy management.

Adoption status of improved dairy practices

The mean of livestock holding for adopters, partial adopters and non adopters was 4, 3, and 2 respectively. There is statistically significant mean difference among the group at $P<0.05$ for grazing land and land size; and $P<0.01$ for livestock holding. Livestock holding indicates a significant mean difference between adopters and non adopters ($P<0.01$); and between adopters and partial adopters at $P<0.05$.

Mean farm land size of adopters, partial adopters and non adopters were 1.6, 1.6 and 2.4 ha respectively. There is statistically mean difference among the group at $p<0.05$. There is significant mean difference in grazing land size between adopters and non adopters; and between partial adopters and non adopters at $P<0.05$. The data revealed that the non adopters have more grazing land size than adopters and partial adopters. It implies that absence of large grazing land could not negatively influence the adoption decision of the farmers.

Problem ranking of farmers indicated that lack of compatible improved dairy practices; shortage of animal feeds; inadequate improved dairy practices and cost of improved dairy practices were in the highest rank that affected the adoption of improved dairy practices.

Moreover, the main reasons for non adoption of improved dairy practices were that poor delivery of AI service, absence of market for milk production, focus of extension services only to progressive farmers living at accessible areas, absence of integration between agricultural production and marketing and less risk bearing capacity of the farmers. In addition to these constraints, farmers and dairy research have different objectives on dairy production. The farmers are rearing dairy for getting draught animals, in kind saving and indication of social status whereas, dairy research is undertaking for improving the genetic makeup of dairy animals and for improving dairy products. Thus, the dairy development of the study area was held back by the absence of shared vision between the key actors.

The mean contacts of extension agent for adopters, partial adopters and non adopters were 4, 3 and 2 days/month respectively. It indicates that adopters and partial adopters contacted the extension agent more than non adopters. There is significant mean difference among the category of the respondents at $P<0.01$. There is significant mean difference between adopter and partial adopters; and adopters and non adopters in frequency of contacting extension agents at $P<0.01$. Partial adopters and non adopters also have significant mean difference at $P<0.05$ indicating the positive influence of frequent extension contact on the adoption decision of farmers.

Training plays a key role in developing skills, knowledge and attitude of the end users which, in turn, improves their productivity. About 52.4, 35.4 and 16.7 per cent of adopters, partial adopters and non adopters got training respectively. There is statistically significant difference among the group of the respondents at $P<0.01$.

In the area where illiteracy is high, demonstration is a practical method of extension approach which, in turn, develops a farmer's confidence about the improved practices. Moreover, farmers were found to believe more about the productivity of the new practices when they learn from one another than the externals. About 64.3, 41.7 and 20 per cent of adopters, partial adopters and non adopters participated in demonstration respectively. The majority (60.7%) of the respondents did not participate in the demonstration and this led to the less popularization of improved dairy practices in the study area.

About 61.9, 25 and 10 per cent responded the availability of improved dairy practices from adopters, partial adopters and non adopters respectively. The large proportion of the

respondents (70.7%) indicated that the improved dairy practices were not available in the required time and quantity. There is statistically significant difference among the group at $P<0.01$.

In the categories of adopters, partial adopters and non adopters 73.8, 60.4 and 50 per cent exhibited the compatibility of the technology to their culture and social values respectively. About 26.2, 39.6 and 50 per cent of adopters, partial adopters and non adopters expressed the incompatibility of the technology respectively. There is statistically significant difference among the categories of the respondents at $P<0.05$.

Credit is an essential requirement of dairy farmers in the area where the farmers have less financial capacity to afford the high cost technologies. Unfortunately, only 26.2, 16.7 and 13.3 per cent of adopters, partial adopters and non adopters accessed the credit service respectively.

Multinomial logistic regression model revealed that age, education level of household head, farm experience, livestock holding, frequency of extension contact, availability of improved dairy practices and training were found to be positively and significantly influencing the adoption of improved dairy practices. Partial budgeting indicated that incremental net benefit of adopting crossbred cow with improved management practices increased by **26947.38** Birr/cow/annum.

Status of linkage in study area

The participation of farmers in all research activities was negligible. On Farmers' Research Group (FRG) and on-farm trial 86.7 and 77.3 per cent of the respondents did not participate respectively. Similarly, the majority of the respondents (88%) did not participate in identifying the research problem of their farming activities. It further has negative impact on adoption of improved dairy practices.

Though immense efforts were carried out to improve the linkage among the key actors of agricultural development, weak linkage was prevailing in the study area. Budget constraints, absence of commitment from the actors, coordination problem, frequent restructuring without in depth study, frequent shift of job (staff turnover), poor representations of actors, absence of external pressure from policy makers and absence of independent unit for taking responsibility of linkage activities were identified as the main causes for weak linkage.

The linkage between research and university was observed to be weak. Lack of collaboration research work and a common forum for research review meetings indicated for the presence of weak linkage between the organizations. There was weak linkage between agricultural

development office and university; livestock agency and university; farmer and private sector and farmers and university.

Dairy research activities of actors such as research center, university and NGOs of the study area have similarities. Though there were possibilities of creating convergence in the activities of problem identification, research review meetings, on-farm trial, demonstration and others; there were no collaborative efforts among the actors at field level. Closed system of each actor, less participation in shared vision, absence of ready market and less attention to coordinated efforts of actors could be among the causes for low dairy development of the study area.

Key contributions of the study to the existing knowledge and practices

1. Methodological improvement in combining index value with econometric model (Ordered logistic regression)
2. Theoretical framework for undertaking study on research and extension effectiveness of other agricultural sectors
3. Developed model for grass root level popularization of improved dairy practices
4. Index development for gauging the research and extension effectiveness

5.2. CONCLUSION

Dairy development is not the sole mandate of a single organization. The development of dairy subsector is the shared effort of all actors that explicitly and implicitly participate in the different activities of dairy development. It apparently indicates that the effectiveness of dairy research and improved dairy practices process of the study area is low. Research mainly needs effective research management, competent and committed staff, resource and infrastructure. In the absence of such requirements, expecting problem solving improved dairy practices are unattainable. Low adoption of crossbred revealed the ineffectiveness of improved dairy practices dissemination of the study area.

High cost of improved dairy practices coupled with wrong selection of model farmers highly impeded the dairy development. On the other hand, having interactions with actors involved in dairy development, initial capital; reducing cost of the technology are the most important factors for adopting the practices. By the same token, adoption facilitating activities (availability of improved dairy practices consistently, ready market, knowledge and skill based extension services, committed and visionary intervener) play a crucial role for adoption

of improved dairy practices. Adopting crossbred is highly profitable. Hence, a mindset of farmers on valuing number of cows and questioning of crossbred productivity need to be solved through intensive and strategically planned extension designs.

5.3. POLICY IMPLICATIONS

Research, extension and other actors are the major driving forces in the dairy development of the country. It necessitates the integrated action of multi-actors (research, input suppliers, animal health, marketing agency, livestock agency, cooperatives etc.). Well designed system in which these actors are clearly operating is the need of the hour. Likewise, capacitating researchers and extension workers needs to be a high priority task for realizing the expected output from the dairy subsector.

It is difficult for all farmers to expand dairy production as land holding is too small. Thus, the extension intervention needs to diversify the target group in dairying activities. Meanwhile, farmers should be facilitated to specialize on different activities such as feed production, fodder production, milk collection and value addition and marketing etc.

Evaluation of the organization and personnel need to be in the way that it promotes organizational interdependence. In the other way, the performance of the organization warrants to be appraised based on its performance of linkage with different actors. The reward systems for the staff should follow the same manner. In such way, linkage among the actors can be strengthened to attain the common goal.

For improving the adoption of improved dairy practices, it requires to have a dairy insurance scheme to cover the risk of crossbred loss in the event of disease outbreak and drought. The presence of such program would stimulate the better adoption of improved dairy practices. Adoption of improved dairy practices requires either subsidy or making the cost of generating the practices lower. It also necessitates for research, extension and farmers to have a common goal for dairy development which is probably the nucleus of all the solutions.

The selection of model farmers needs not to be necessarily from the better off farmers. It should be from the representatives of the majority of the farmers.

Research–extension and other actor linkage problem have been noticed since its establishment and several efforts were made to strengthen the linkage activities. However, the problems are persistently continuing due to lack of independent unit that fully takes accountability. Hence, linkage warrants its own independent structure in the organization that entirely takes roles and responsibilities of executing the activities of linkage. Otherwise the

strength and weakness of linkage relies on personal initiatives that could not exist in sustainable manner.

Urban and peri urban centered AI service did not bring significant impact on dairy development. Hence, AI service necessitates to be organized in the way that all farmers accessed the service. For the purpose, the district needs to be categorized into different dairy development zones and AI technicians can be assigned to each dairy development zones. AI service is also a good opportunity for creating job for rural youth. On the other hand, strengthening farmer-to-farmer extension would help to reduce the huge demand for extension workers. The approach can also be sustainable in serving the farmers as job shifting of farmers (turn over) is very less. Wherever possible, ICT should be harnessed to fasten the technology dissemination process. In addition public private partnership should be encouraged in dairying.

In the process of extension intervention, all actors approach the farmers independently. It needs appropriate system that provides the extension services to clientele as per the user's needs and priorities. Thus, any effort of extension intervention should be done through the extension channel of the system. In such way, the sustainability of the extension intervention by different actors of dairy development would be maintained. Extension also warrants implementing the model to be followed during the introduction of improved dairy practices (awareness and demand creation at FTC before disseminating the improved dairy practices to the farmers).

There is erratic supply of semen which emanates from absence of adequate semen collection centers in the country. Thus, selected agricultural research centers and universities need to participate in semen production to address the needs of the farmers in their respective areas.

Mainly, the educational background of development agents at front line was plant sciences, animal sciences and natural resource management. With limited agricultural extension knowledge and skills undertaking effective extension work is unfeasible. Thus, it necessitates launching post graduate diploma in agricultural extension.

The conception rate of cows through oestrous synchronization program was also found to be low and it requires further study for improving its effectiveness.

There are better milk yield providers among the local cows in the country. Thus, making selection among the local cows and identifying the breeds that are suitable for milk production need to be the target of the dairy researchers. It further paves the way to develop synthetic breeds and this necessitates also being the focal area of dairy research in Ethiopia.

ICT plays a significant role for promoting dairy development. As a result, establishing ICT/knowledge centers at district level would contribute to extension effectiveness of the dairy subsector.

As dairy subsector is a remunerative business area, youth group and private sectors warrant to be encouraged to invest in the dairy production and this could be one of the best ways of tapping the dairy potential of the area.

Obviously, milk is a useful nutritious product for human health. Thus, agricultural extension in collaboration with human health extension needs to launch an intensive behavioral change program on societal transformation and dairying as a potential venture in health and nutrition.

Privatization of extension in dairying, particularly, multiplying heifer and provision of AI services necessitates to be propped up as it has high contribution in enhancing dairy extension effectiveness.

Dairying in Ethiopia is still in nascent stage as far as technology generation and dissemination is concerned. The gaps in achieving the targets have been well identified along with challenges. Efforts should be put in right direction by strategizing the available resources and emerging opportunities for achieving equitable and profitable development of dairy farming in Ethiopia.

5.4. SUGGESTIONS FOR FUTURE RESEARCH

1. Dynamics of technology adoption under varying resource endowments
2. Perceived impact of climate change on dairying in Ethiopia
3. Gender role and women empowerment in dairy enterprise
4. Job satisfaction and job enrichment of dairy extension personnel in Ethiopia
5. Forecasting of dairying scenario in Ethiopia
6. Effectiveness of oestrous synchronization program
7. Effectiveness of Agricultural technology scaling up program in Ethiopia

BIBLIOGRAPHY

BIBLIOGRAPHY

Agbamu, J.U. 2000. 'Agricultural research–extension linkage systems: an international perspective'. Agricultural Research and Extension Network Paper No. 106a. London: ODI.

Aldernburg, T. 2007. Donor approaches to supporting pro-poor value chains. Report prepared for the Donor Committee for Enterprise Development Working Group on Linkages and Value Chains. German Development Institute, Bonn, Germany.

Alemu, G.W. Aemayehu, M., Sendros, D., Seyoum, B., and Alemu, T. 2000. Status of dairy research in Ethiopia. In: Proceeding of a workshop on the role of village dairy co-operatives in dairy development: prospects for improving dairy in Ethiopia, SDDP, MoA, Addis Ababa, Ethiopia.

Alfares H.K. 2006. Determining criteria weights as a function of their ranks in multiple-criteria decision making. Systems Engineering Department, King Fahd University of Petroleum & Minerals, Dhahran, Saudi Arabia

Amdissa T. 2006. Agriculture, Growth and poverty reduction in Ethiopia: Policy processes around the new Plan for Accelerated and Sustainable Development to End Poverty. A paper for the future Agricultures Consortium workshop, Institute of Development Studies, March 20-22, Addis Ababa, Ethiopia.

Anandajayasekeram P, Puskur R, Sindu Workneh and Hoekstra D. 2008. Concepts and practices in agricultural extension in developing countries: A source book. IFPRI (International Food Policy Research Institute), Washington, DC, USA, and ILRI (International Livestock Research Institute), Nairobi, Kenya. 275 pp.

Antholt C.H. 1992. Relevancy, responsiveness and cost effectiveness issues for agricultural extension in 21st century. World Bank Asian region. Technical department, World Bank, DC, USA.

ASARECA (Association for Strengthening Agricultural Research in Eastern and Central Africa), 2010. Turning Knowledge into Action. Strategic Plan for the Knowledge Management and Upscaling Programme, 2009–2014.ASARECA, Entebbe.

Axinn G.H. 1988. T & V extension infer parks, interchange, international agricultural, college of agriculture, university of Illinois at Urbanan-champaling.

Azage T., Berhanu Gebremedin, Dirk Hoekstra and Nigatu Alemayehu, 2006. Rural Urban Linkage in Market-oriented Dairy Development in Ethiopia: Lessons from Ada'a Dairy Cooperative, Addis Ababa

Belay K. 2003. Agricultural extension in Ethiopia: The case of participatory demonstration and training extension system *Journal of Social Development in Africa* **18** (1): 49-84.

Belay K. 2008. Agricultural research and extension linkages in Ethiopia: A historical survey. Available at www.oerafrica.org

Belay K. Abebaw D. 2004. Challenges Facing Agricultural Extension Agents: A Case Study from South-western Ethiopia. African Development Bank 2004, Published by Blackwell Publishing Ltd

Belete A., Azage, T., Fekadu, B. and Berhanu, G. 2010**.** Cattle milk and meat production and marketing systems and opportunities for market-orientation in Fogera woreda, Amhara region, Ethiopia. IPMS (Improving Productivity and Market Success) of Ethiopian Farmers Project Working Paper 19. ILRI (International Livestock Research Institute), Nairobi, Kenya. 65 pp.

Berhanu B. 2002. Analysis of factors affecting the adoption of crossbred dairy cows in the central highlands of Ethiopia: The case of two districts in North Show zone. Unpublished M.Sc. Thesis, Alemaya University, Alemaya.

Berhanu K. 2012. Market access and value chain analysis of dairy industry in Ethiopia. PhD dissertation, Haramaya University, Ethiopia.

Byerlee D., P. R. Hobbs, B. R. Khan, A.Majid, M. R. Akhtar, and N. I. Hashmi, 1986. Increasing wheat Productivity in the Context of Pakistan's Irrigated Cropping Systems. National Agricultural Research Center (NARC), Islamabad. (PARC/CIMMYT Paper 86-7.).

Center for Development Research, 2012. Facilitating agricultural technology adoption among the poor. ZEF working paper series 93, ISSN 1864-6638, University of Bonn

CIMMYT Economics Program. 1993. The Adoption of Agricultural Technology: A Guide for Survey Design. Mexico, D.F.: CIMMYT.

Cramb R.A. 2003. Processes Affecting the Successful Adoption of New Technologies by Smallholders. *In:* Hacker, B. (ed). Working with Farmers: The Key to the Adoption of Forage Technologies, pp.11-22. ACIAR Proceedings No. 95. Canberra: Australian Centre for International Agricultural Research

CSA, Central Statistical Agency. 2008. Agricultural Sample Survey. Volume II Livestock, and livestock characteristics). CSA, Addis Ababa, Ethiopia.

CSA, Central Statistical Agency, 2010. Agricultural Sample Survey. Livestock, Poultry and Beehives population (private peasant holdings). Federal Democratic Republic of Ethiopia Central Statistical Agency (CSA), Addis Ababa, Ethiopia.

CSA, Central Statistical Agency. 2011. Agricultural Sample Survey of the Federal Democratic republic of Ethiopian, Addis Ababa

CSA, Central Statistics Agency. 2013. Population projection of Ethiopia for all regions at district level from 2014-2017, Addis Ababa, Ethiopia.

CSA, Central Statistical Agency. 2013. Statistical abstract of the Federal Democratic republic of Ethiopian, Addis Ababa

Desalegn G., Merga B., Azage T. Kelay B. 2009. Status of Artificial Insemination Service in Ethiopia. 17th Ethiopian Society of Animal Production (ESAP) Proceedings. Addis Ababa, Ethiopia.

Doss C., W. Mwangi, H. Verkuijl, and H. de Groote. 2003. Adoption of Maize and Wheat Technologies in Eastern Africa: A Synthesis of the Findings of 22 Case Studies. CIMMYT Economics Working Paper 03-01. Mexico, D.F.: CIMMYT.

EARO (Ethiopian Agricultural Research Organization), 2006**.** Research-Extension- Farmer linkages strategy document. Addis Ababa

Ebrahim J. 2006. Adoption dairy innovations: its income and gender implications in adami tulu district. Unpublished M.Sc. Thesis, Haramaya University, Haramaya.

Endrias G. 2003. Adoption of Improved Sweet Potato Varieties in Boloso Sore Woreda, Southern Ethiopia. An M. Sc. Thesis Presented to the School of Graduate Studies of Alemaya University.

Ehui S.K., Ahmed M.M., Berhanu G., Benin S.E., Nin-Pratt A. and Lapar Ma.L. 2003. Ten years of livestock policy analysis. Policies for improving productivity, competitiveness and sustainable livelihoods of smallholder livestock products. ILRI, Nairobi, Kenya

Ehui S.K., Lynam J. and Okike I. (eds). 2004. Adapting social science to the changing focus of international agricultural research. Proceedings of a Rockefeller Foundation. ILCA social science research fellows workshop held at ILCA, Addis Ababa, Ethiopia, 14-18 November 1994. ILCA, Addis Ababa, Ethiopia.

FAO Statistical Database, 2011. World milk production. Retrieved from (http://www.milkproduction.com)

FDRE (The Federal Democratic Republic of Ethiopia), 1999. Agricultural Research and Training Project: Ethiopian Research-Extension-Farmer Linkages Strategy, vol. I, Addis Ababa

Feder L., R.E., Just and O. Zilberman, 1985. Adoption of Agricultural Innovationin Developing Countries:"A Survey" Economic Development and Cultural Change, 32 (2): 255-298.

Forum for Agricultural Research in Africa (FARA), 2006. Framework for African agricultural productivity, Accra, Ghana

Future Agricultures Consortium (FAC), 2011. Policy Brief 04, Future Agricultures Consortium Secretariat at the University of Sussex, Brighton

Gavaian S. and Gemechu D. 1996. The profitability of wheat production in Ethiopia. The case of Tiyo area in Arsi zone. *Ethiopia journal of agricultural economics* 1 (1):38-62.

Getachew F. 2003. A Review of the Small Scale Dairy Sector- Ethiopia. FAO Prevention of Food Losses Programme: Milk and Dairy Products, Post-harvest, Losses and Food Safety in Sub-Saharan Africa and the Near East.

Getahun D., M. Mwangi, H. Verkuijil and A. Wondimu, 2000. An Assessment of the Adoption of Seed and Fertilizer Packages and the Role of Credit in Smallholder Maize Production in Sidama and North Omo Zones, Ethiopia. EARO, CIMMYT, November 2000.P.24.

Greene W. 2003. Econometric analysis, 5.th edition, New Jersey: Prentice Hall

Greene W. 2008.Econometric Analysis, 6th Edition, Englewood Cliffs, Prentice Hall

Gujarati D.N. 1995. Basic Economics, 3rd edition.McGraw-Hill,Inc: Newyork.

Habtemariam A. 2004. The comparative influence of intervening variables in the adoption behaviour of maize and dairy farmers in Shashomene and Debrezeit, Ethiopia. PhD Thesis, University of Pretoria.

Hagmann J., E.Moyo, E.Chuma, K.Murwira, J.Ramaru and P.Ficarelli, 2003. Learning about developing competence to facilate rural extension process. In Wettasinha, C., L.Van Veldhuizen and A.Waters-Bayer (Eds), Advancing participatory technology development: case studies on integration into agricultural research, extension and education. Silang, Cavite, Phillipines:IIRR/ETC ECOCULTURE/ CTA, pp21-38.

Hassen R., M. and Kiarie Njoroge, 1998. Adoption and Performance of Improved Maize in Kenya. Maize Technology Development and Transfer. Londen.59pp.

Havelock R.G. 1986. Linkage: a Key to Understanding the Knowledge System. In: Beal, G.M. Dissanayake, W .and Konoshima, S. (eds) *Knowledge Generation, Exchange and Utilisatio*n. Boulder, Colorado: West view Press

IFPRI (International Food Policy Research Institute), 2010. In-Depth Assessment of the Public Agricultural Extension System of Ethiopia and Recommendations for Improvement .Discussion Paper 01041, Addis Ababa, Ethiopia

Jancy G. and Ummed S. 2006. Mapping of the knowledge system and linkage in dairying . *Indian Journal of Extension Education.* **42** (3 &4): 8-13

Johannes L.(ed), 2012. Scaling up in agriculture, rural development and nutrition. International Food Policy Research Institute. Washington

Kaimowitz David, 1991. The evolution of links between research and extension in developing countries, " in agricultural extension worldwide: A critical turning point . Agriculture extension worldwide institutional evolution and forces for change, eds. W. Rivera and Dan Gustafsen, New York, Elsevier

Kaimowitz D., Snyder, M., and Engel, P. 1989. A Conceptual Framework for Studying the Links Between Agricultural Research and Technology Transfer in Developing Countries. The Hague, Netherlands; International Service for National Agricultural Research.

KAM (Knowledge Assessment Methodology) 2012. The World Bank Knowledge for Development (K4D) website

Kassahun M. and Jeilu Jemal, 2012. Dairy technology impacts on livelihoods of dairy producers in central Ethiopia. *International Journal of Food and Agricultural Economics.* ISSN 2147-8988 **1** (1): 109-118

Ketama H. 2000. Dairy development in Ethiopia. In The role of village dairy co- operatives in dairy development. Smallholder Dairy Development Project (SDDP) Proceeding. Addis Ababa, Ethiopia: Ministry of Agriculture (MOA)

Langyintuo A. and Mulugeta Mekuria, 2005. Modelling Agricultural technology adoption using soft ware stata, International Maize and Wheat Improvement Center IMMYT).Harare, Zimbabuwe

Leeuwis C. 2004. Communication for rural innovation. Rethinking agricultural extension. Blackwell science, oxford

Legesse D., Burton, M., and Ozanne, A. 2004. Duration analysis of technological adoption in Ethiopia agriculture . *Journal of agricultural economics,* **55 (** 3): 613-631.

Liao T.F. 1994. Interpreting Probability Models: Logit, Probit, and Other Generalized Linear Models. Sage University Paper Series on Qualitative Applications in the Social Sciences. Thousand Oaks.CA:Sage

Lutfi M.A. Musa, Mohamed-Khair A. Ahmed, Kurt J. Peters, Birgit Zumbach and Kamal E. A. Gubartalla. 2005. The reproductive and milk performance merit of Butana cattle in Sudan. *Arch.Tierz., Dummerstorf* ,**48 (**5):445-459

Makokha M., H. Odera, II.K.Martim, J.R. Okelabo and D.M.Iruria,1999. Farmers' Perception and Adoption of Soil Management Technologies in Western Kenya. *African Crop Science Journal,* **7** (4):549-558

Million T. and Belay Kassa, 2004. Factors influencing adoption of soil conservation measures in south Ethiopia: The case of Gununo area. *J.Agric.and Rur.devel.in the Tropics and sub tropics. **105**(1):49-62.*

MoA and ILRI. 2013. Livestock extension vision and strategy for Ethiopia. Addis Ababa, Ethiopia: Ministry of Agriculture and International Livestock Research Institute.

Motamed M. K and Singh B. 2003**.** Correlation of Adoption of Improved Sericulture Practices. *Indian Journal of Extension Education XXXIX* (**1** and **2**):51-57.

National Agricultural Research Organization, 2004. The effect of technology dissemination on adoption, technical report. Uganda.

Oladele O. 2010. Research-Extension-Farmers Linkage System on Banana and Plantain (Musa spp.) in Nigeria: the Diffusion of Innovations, University of Ibadan Nigeria.

Omiti J.M., Partan K.A. Senden, J.A,and Ehui, S.K., 1997. Economic Contribution of Livestock to the Subsistence Economy of Rural Households. The Case of Ethiopia

Philipsson J. 1999. Sustainability of dairy cattle breeding systems utilizing artificial insemination in less developed countries - examples of problems and prospects in Workshop on Developing Breeding Strategies for Lower Input Animal Production Environments, Bella, Italy, 22-25 September, 1999, jointly organised with FAO (AGAP) and the Swiss Agency for Development and Co-operation, ICAR Technical Series 3, 551-562.

Ponnusamy K and M. Kumaran. 2008. Agricultural extension vis-avis emerging agricultural scenario. In: Extension Strategies for Fostering Knowledge Centric Agricultural Growth (Eds.) by Vasanthakumar, J., C.Bhaskaran and H.Philip. Society of Extension Education, TNAU, Coimbatore-641 003

Ponnusamy K**.** and S.M. Pillai. 2014. Evaluation of factors contributing to adoption of management practices productivity and net income in shrimp farming in Gujarat, India. *Indian Journal of Fisheries.* **61**(4): 79-83.

Ponnusamy K, N Sriram, S Prabhukumar, E Vadivel, R Venkatachalam and B Mohan, 2016. Effectiveness of cattle and buffalo expert system in knowledge management among the farmers. *Indian Journal of Animal Sciences* **86** (5): 604–608

Rahman S. 2007**.** Adoption of improved technologies by the pig farmers of Aizawl district of Mizoram, India

Ray G. L. 2001. Extension Communication and Management. Naya Prokash, Calcutta.145-162pp.

Rogers E.M. 1981. Diffusion of Innovation. New York: Free Press

Rogers E.M. 1983. Diffusion of Innovation. 3rd ed. New York: Free Press

Rogers E.M. 1995. Diffusion of Innovation. New York: Free Press.

Rolling N. 1989. Why Farmers Matter: The role of user participation in technology development and delivery. ISNAR, The Hague

Rölling N. 2006. Conceptual and Methodological Developments in Innovation. In: Pascal, C. S.Waters-Bayer, A., Kaaria, S., Njuki, J., and Wettasinha, C. (eds), Innovation Africa: enriching farmers' livelihoods. Earthcan, London, pp 9-34

Salim M. 1986. Rural innovation in agriculture. Chugh Publications, New Delhi.

Schultz T.W. 1995. The value of the ability to deal with disequilibrium. J.Econ.Liter.**13**:827-846.

Simeon k, Ehui and Nega G/silassie, 1997. The Contribution Of Livestock To The Sustainability of Technology And Policy Issues. Proceedings Of The 3rd Conference Of The Society Of Agricultural Economics of Ethiopia, 2-3 October, 1997, AA, Ethiopia pp. 37-55

SNV. 2008. Study on Dairy Investment Opportunities in Ethiopia, SNV, Addis Ababa

Sumberg J. 2004. Systems of innovation theory and the changing architecture of agricultural research in Africa. The School of Development Studies. University of East Anglia, Norwitch, UK. Food Policy **30**(2005) 21-41

Swanson B.E, Bentz RP, Sofranko AJ. 1998. Improving agricultural extension. A reference manual. Strengthening research-extension-farmer linkages Chapter 19 FAO.

Tanvir A., Saeed A. Khan, Niaz H. Malik, Munir Ahmad & Imran Saleem, 1994. Investigation into some common factors which affect agricultural research and extension work in developing countries. *Pak. J. Agri. sa*. **31** (3):245-249

Tesafye L., R. Puskur, Azage T. and D. Hoekstra, 2008, April 7-9. "Exploring innovation capacity in the Ethiopian dairy systems." Paper presented on the international conference on: Advancing Agriculture in Developing Countries through Knowledge and Innovation, International Food Policy Research Institute, Addis Ababa.

Tesfaye Z., Bedassa T. and Shiferaw T. 2001. Determinants of Adoption of Improved Maize Technologies in Major Growing Region of Ethiopia. Second National Maize Workshop of Ethiopia. 12-16 November, 2001. P. 125-136.

Ulfina G., Jiregna D., Alganesh T. ,Shiv P. and Mulugeta K. 2013. Dairy Production Potential and Challenges in Western Oromia Milk Value Chain, Oromia, *Ethiopia Journal of Agriculture and Sustainability,* ISSN 2201-4357 **2 (**1): 1-21

Van den Ban, A.W. and Hawkins H.S, 1996. Agricultural Extension Black well Science Ltd, UK

Vince A. 2005. The challenges of change for agricultural extension in Ethiopia, a discussion paper , Addis Ababa

Workneh A. 2011. Financial Benefits of Box Hive and the Determinants of Its Adoption in Selected District of Ethiopia. *American Journal of Economics.* **1**(1): 21-29, December 2011 DOI: 10.5923/j.economics.20110101.03.

Workneh A. and K. Ponnusamy, 2015. Challenges of generation and dissemination of improved dairy practices: Evidence of literature from Ethiopia. *Global Journal of Agricultural Economics, Extension and Rural Development* ISSN: 2408-5480, **3** (7):270-277

Yapa L. and C. Mayfeld. 1978. Non-adoption of Innovations: evidence from discriminate analysis. Economic Geography. **54** (2): 145-156.

Yilma Z., G.B. Emannuelle and S., Ameha. 2011. A Review of the Ethiopian Dairy Sector. Ed. Rudolf Fombad, Food and Agriculture Organization of the United Nations, Sub Regional Office for Eastern Africa (FAO/SFE), Addis Ababa, Ethiopia, pp 81.

Zuidema L. 1988. Managing research-extension linkages. *ISNAR Staff Notes*

APPENDICES

APPENDEX-1

BIOGRAPHICAL SKETCH

The author was born in Jimma Arjo district, East Wollega Zone of Oromia (Ethiopia), in September 1974. He attended his primary and secondary school education at Mekonen Demisew (Jima Arjo District) and completed his secondary school at Nekemte comprehensive secondary school (Nekemt) in 1993. After successful completion of Ethiopian School Leaving Certificate Examination, he joined Ambo University the then Ambo college of Agriculture, in 1993 and graduated with Diploma in General Agriculture in July 1995 and was employed as a technical assistant in the same college. After two years service, he joined Haramaya University the then Alemaya University in September 1997 and graduated with B.Sc. degree in Agricultural Extension in July 2000. After his graduation, he was employed at Oromia Agricultural Research Institute, Holetta Bee Research Centre as assistant researcher in Research-Extension-Farmers Linkage Division. He also joined Harmaya University for his graduate study in 2005 and graduated with M.Sc. degree in Rural Development and Agricultural Extension in July 2007. After one year of service in the centre, he joined Ambo University as lecturer in 2008. He was serving as head of the department, instructor and researcher with the academic rank of assistant professor until he pursues his Ph.D study. Then, he joined ICAR-National Dairy Research Institute, Karnal (India) for his Ph.D. degree in Agricultural Extension Education, in January 2014.

Place: International Hostel, Karnal sign. 

Date: _____ Workneh Abebe Wodajo

APPENDIX-2

STATEMENT OF THE AUTHOR

I hereby declare that this thesis is my bona fide work and that all sources of materials used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for PhD degree at ICAR-National Dairy Research Institute (Deemed University) and is deposited at the University Library to be made available to borrowers under the rules of the library. I solemnly declare that this thesis is not submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate.

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Place: International Hostel, Karnal sign. 

Date: _____ (Workneh Abebe Wodajo)

APPENDIX-3

Questionnaire for researcher

Questionnaire for Studying

Effectiveness of Technology Generation and Dissemination Process in Dairy Production in West Shewa Zone of Oromia, Ethiopia

Introduction

This questionnaire is prepared to achieve part of the research objectives which examine effectiveness of improved dairy practices generation and dissemination from the system perspective. The research finding that will be emanated from this research work contributes much for enhancing the quality of improved dairy practices among the various stakeholders involved in its generation and dissemination. Likewise, your genuine response is also decisive for achieving the intended objective of the study.

1. Personal Information [Please tick (√) the relevant point]

1.1. Sex_:_____ 1. Male 2. Female 1.2 Age _____years

1.3. Experience _____ years

1.4. Level of education 1.Under-graduate 2.MSc. 3.Ph.D

1.5. Marital status 1. Single 2. Married 3. Widow 4. Divorced

1.6. Family size _____

2. General information

2.1. How do you rate the current dairy technology generation process in solving the Problem of end users? 1. Ineffective 2. Rarely effective 3. Moderately effective 4. Highly effective

2.2. How do you rate the current dairy technology dissemination process in solving the Problem of end users? 1. Ineffective 2. Rarely effective 3. Moderately effective 4. Highly effective

2.3. Compared to other subsector, is the budget allocated for dairy research subsector adequate?

1. Yes ☐ 2. No ☐

2.3.1. If yes, the budget allocation is (1) More than adequate, (2) exact requirement, (3) moderately adequate

2.4. What are the key constraints of dairy research subsector? 1. Lack of clear strategy 2. Inadequate research skills 3. inadequate infrastructure 4. Lack of motivation 5. Frequent shifting of job 6. If any other _____

2.5. Is the dairy research set up adequate enough to use your maximum capacity in generating improved dairy practices? 1. Yes ☐ 2. No ☐

2.5.1. If yes; Extent of adequacy (1) Very High (2) High (3) Medium
2.5.2. If no, then what are the improvement you suggest?

_____
_____
_____

2.6. How do you rate the incentive mechanisms of your organization?
1. Not exist 2. Low 3. Medium 4. High
2.6.1. Elaborate for the relevant point 2, 3 & 4 as ticked by you

_____
_____
_____

2.7. What is the total time you devote to research work per day _____hrs
2.7.1. The duration of working hours from _____ to _____hrs
2.8. How do you rate your research skills in generating improved dairy practices?
1. Not sufficient 2. Sufficient 3. More than sufficient

2.8.1. If insufficient indicate the areas of improvement in your research skills

_____
_____
_____

2.8.2. If your response is sufficient or more than sufficient, what are the key constraints still affecting generation of improved dairy practices?

_____
_____
_____

2.9. Do you have your own business? 1. Yes ☐ 2. No ☐
2.9.1 If yes; indicate the type of business.

_____
_____

2.10. Do you have additional assignments? 1. Yes ☐ 2. No ☐
2.10.1. If yes, indicate the additional assignments

_____
_____

2.10.2. How many hours do you devote for additional assignments per day? _____hrs.
2.10.3. Do you feel that additional assignments affect your research productivity?
1. Yes ☐ 2. No ☐
2.10.3.1. If yes, to what extent?

_____
_____

2.11. From where do you get research problems? 1. Personal experience 2. Field observation
3. Previous studies 4. ADPLAC meeting 5. If any other_____
2.12. How do you evaluate the existing research review process of your organization?
1. Helps in improving the research work 2. Lengthy 3. Full of professional bias
4. If any other _____
2.13. How do you evaluate the existing dairy technology releasing process?
1. Lengthy 2. Has clear releasing strategy 3. No clear strategy
4. If any other _____
2.14. How many improved dairy practices have you generated since your employment? _

2.14.1 Indicate the technologies generated by you

_____
_____
_____
_____

2.14.2. How many of them were disseminated to the end users?_____

2.14.3. How many of them being adopted by the farmers?_____ Indicate them

_____
_____
_____
_____

2.14.3. How many of them were rejected by the farmers?_____ Indicate them

_____
_____
_____
_____

2.14.4. How many publications do you have since you joined research organization?
Journal articles_____ proceedings _____ extension materials (leaflet, poster, production guideline etc_____

2.14.5. How many ongoing research works including new research proposals do you have as a first author?_____

3. Linkage related

Please indicate your response using `√`mark in the space provided and rank in terms of their importance

Do you participate in the following linkage activities?	**Regularly**	**Occasionally**	**Rarely**	**Never**	**Rank**
1. Regular meeting of stakeholders					
2. Research problem identification					
3. Setting of research agenda					
4. Joint research review					
5. Joint planning					
6. Joint on farm trial					
7. Joint field day					
8. Research result review meeting					
9. Field visit					
10. Joint monitoring and evaluation					

4. Research activities related

Please indicate your response using `√`mark in the space provided

Do you participate in the following research activities?	Regularly	Occasionally	Rarely	Never
1. Participation in research strategy development				
2. Participation in research problem identification				
3. Participation in research review meeting				
4. Participation in Farmers Research Group (FRG) meeting				
5. Participation in improved dairy practices training				
6. Participation in field visit				
7. Participation in ADPLAC meetings				
8. Participation in improved dairy practices evaluation				
9. Participation in on-farm trial				

5. Please indicate your response using `√`mark in the space provided

Dairy research status	**Always**	**Occasionally**	**Rarely**	**Never**
1. Are improved dairy practices relevant to farmers` needs?				
2. Are improved dairy practices problem solving in nature?				
3. Are improved dairy practices affordable by farmers?				
4. Is dairy research participatory?				
5. Does dairy research have clear strategy?				
6. Is the dairy research strategy translated into action?				
7. Is the dairy research strategy directing towards generating problem solving improved dairy practices?				
8. Does research thematic area leading to generate improved dairy practices that solve the problem of farmers?				
9. Is the research thematic area facilitating participation of researcher, extension and end users?				
10. Does dairy subsector get adequate attention from government?				
11. Is the linkage among farmer, extension, research and other stakeholders strong?				
12. Can farmers obtain improved dairy practices as				

per their demand?				
13. Does Agricultural Development Partners Linkage Advisory Council (ADPLAC) forum contribute for the improvement of dairy subsector?				
14. Does farmers have role in setting research agenda?				
15. Does extension have role in setting research agenda?				
16. Do farmers visit your office for demanding improved dairy practices?				
17. Are the dairy extension workers well oriented on improved dairy practices?				
18. Are improved dairy practices adequate for dissemination?				
19. Is the dissemination program well designed?				
20. Have the dissemination program helped to increase the number of adopters?				
21. Is there any improved dairy practice still on shelf?				

6. Statement of indicators for measuring effectiveness of dairy technology generation

Sr. no.	Effectiveness indicators	Items	Response
1	**Personal characteristics**	1. Education level of researcher	1.B.Sc 2.M.SC 3.Ph.D
		2. Relevance of your education level to livestock production	1.Less related 2.Moderately related 3.Highly related
		3. Work experience in dairy research	1.1-3 years 2.4-6years 3.7-9 years 4.10 years and above
		4. Work experience in dissemination of improved dairy practices	1.1-3 years 2.4-6years 3.7-9 years 4.10 years and above
		5. Perception about dairy research	1.Less 2.Moderate 3.High
		6. Exposure to collaborative research works with other research organizations	1.Less 2.Moderate 3.High
		7. Number of research projects	1.Less 2.Moderate 3.High

		formulated for external fund sources	
		8. Number of research projects that secured fund from external sources	1.Less 2.Moderate 3.High
		9. Number of research projects that secured external fund	1.Less 2.Moderate 3.High
		10. Level of research skills	1.Less 2.Moderate 3.High
		11. Habit of research article writing	1.Less 2.Moderate 3.High
		12. Level of commitment to dairy research	1.Less 2.Moderate 3.High
		13. Level of your satisfaction in dairy research	1.Less 2.Moderate 3.High
2	**Research Participation**	1. Participation in research strategy development	1. Never 2. Rarely 3. Occasionally 4. Regularly
		2. Participation in Farmers Research Group (FRG)	1. Never 2. Rarely 3. Occasionally 4. Regularly
		3. Participation in research review meeting at working center level	1. Never 2. Rarely 3. Occasionally 4. Regularly
		4. Participation in research review meeting at regional level	1. Never 2. Rarely 3. Occasionally 4. Regularly
		5. Participation in research review meeting at national level	1. Never 2. Rarely 3. Occasionally 4. Regularly
		6. Participation in Agricultural Development Partners Linkage Advisory Council (ADPLAC) meeting	1.Never 2. Rarely 3. Occasionally 4. Regularly

		7. Experience sharing with other research centers	1.Never 2. Rarely 3. Occasionally 4. Regularly
		8. Participation in extension worker training	1.Never 2. Rarely 3. Occasionally 4. Regularly
		9. Participation in collaboration research that is external funded	1.Never 2. Rarely 3. Occasionally 4. Regularly
		10. Participation in national research workshop	1.Never 2. Rarely 3. Occasionally 4. Regularly
		11. Participation in research workshop at abroad	1.Never 2. Rarely 3. Occasionally 4. Regularly
		12. Participation in research paper publications	1.Never 2. Rarely 3. Occasionally 4. Regularly
3	**Infrastructure**	1. Adequacy of laboratory set up	1.Low 2.Medium 3.High
		2. Adequacy of laboratory equipment	1.Low 2.Medium 3.High
		3. Adequacy of transport facility	1.Low 2.Medium 3.High
		4. Adequacy of office facility	1.Low 2.Medium 3.High
		5. Adequacy of sub research stations	1.Low 2.Medium 3.High
		6. Adequacy of communication facilities	1.Low 2.Medium 3.High
		7. Availability of adequate reference materials	1.Low 2.Medium 3.High
		8. Availability of online reference materials	1.Low 2.Medium 3.High
		9. Availability of adequate office	1.Low 2.Medium 3.High

		10. Availability of adequate experimental sites	1.Low 2.Medium 3.High
		11. Adequacy of research inputs (experimental animal, feed and others)	1.Low 2.Medium 3.High
4	**Responsiveness of improved dairy practices**	1. Affordability of improved dairy practices	1.Low 2.Medium 3.High
		2. Number of improved dairy practices generated	1. None 2. One 3.Two 4.Three 5.Four and above
		3. Number of improved dairy practices reached the end users	1.None 2.one 3.two 4.three 5.four and above
		4. Number of improved dairy practices adopted	1.none 2.one 3.two 4.three 5.four and above
		5. Number of improved dairy practices rejected	1.none 2.one 3.two 4.three 5.four and above
		6. Number of improved dairy practices discontinued	1.none 2.one 3.two 4.three 5.four and above
		7. Demand of improved dairy practices by farmers	1.low 2.medium 3.high
		8. Relevance of improved dairy practices to farmers` needs	1.low 2.medium 3.high
		9. Releasing process of the technology	1.low 2.medium 3.high
		10. Manageability of the technology at farmers level	1.low 2.medium 3.high
		11. Awareness level of farmers to adopt new technologies	1.low 2.medium 3.high
	Research	1. Appropriateness of planning	1.low

5	**management**	to the achievement of organizational goal	2.medium 3.high
		2. Availability of the required research units	1.low 2.medium 3.high
		3. Status of staffing as per the demand of each research units	1.low 2.medium 3.high
		4. Level of directing towards the achievement of the organizational goal	1.low 2.medium 3.high
		5. Level of research work supervision	1.low 2.medium 3.high
		6. Organizational status in motivating staff	1.low 2.medium 3.high
		7. Efficiency of research review process of the organization	1.low 2.medium 3.high
		8. Adequacy of recurrent budget for generating improved dairy practices	1.low 2.medium 3.high
		9. Adequacy of capital budget for generating improved dairy practices	1.low 2.medium 3.high
		10. Efficiency of budget utilization	1.low 2.medium 3.high
		11. Budget releasing process	1.low 2.medium 3.high
		12, Fairness of budget allocation for each research project	1.low 2.medium 3.high
		13. Level of the organization in retaining the staff	1.low 2.medium 3.high
6	**Policy environment**	1. Presence of national dairy research policy and strategies	1.low 2.medium 3.high
		2. Presence of organizational research strategy	1.low 2.medium 3.high
		3. Priority Level of dairy research attention at national	1.low 2.medium 3.high

		level	
		4. Research thematic area in addressing the needs of farmers	1.low 2.medium 3.high
		5. Presence of strategically designed linkage with stakeholders	1.low 2.medium 3.high
		6. Presence of discussion forum with stakeholders	1.low 2.medium 3.high
		7. Presence of memorandum of understanding with national research centers	1.low 2.medium 3.high
		8. Presence of memorandum of understanding with regional research centers	1.low 2.medium 3.high
		9. Presence of memorandum of understanding with international research centers	1.low 2.medium 3.high
		10. Level of research monitoring and evaluation	1.low 2.medium 3.high
7	**Social participation**	1. Level of interaction with research staff	1.low 2.medium 3.high
		2. Level of discrimination due to your ethnic group	1.low 2.medium 3.high
		3. Level of interaction with your immediate supervisor	1.low 2.medium 3.high
		4. Level of interaction with dairy farmers	1.low 2.medium 3.high
		5. Presence of social club in the organization	1.low 2.medium 3.high
		6. Level of participation in social gatherings of your organization	1.low 2.medium 3.high

		7. Level of your interaction with the surrounding community in your working area	1.low 2.medium 3.high
		8. Level of your participation in social issues of your residential area	1.low 2.medium 3.high
		9. Presence of conflict in the work area	1.low 2.medium 3.high
		10. Presence of family conflict	1.low 2.medium 3.high
		11. Level of your social acceptance due to being a dairy researcher	1.low 2.medium 3.high
8	**Financial capacity**	1. Adequacy of salary for household expenditure	1.low 2.medium 3.high
		2. Presence of financial support from other sources	1.low 2.medium 3.high
		3. Adequacy of household assets	1.low 2.medium 3.high
		4. Level of having own car	1.low 2.medium 3.high
		5. Availability of school for children in the vicinity	1.low 2.medium 3.high
		6. Level of having own house	1.low 2.medium 3.high
		7. Presence of institutional support in purchasing own car	1.low 2.medium 3.high
		8. Presence of institutional support in building own house	1.low 2.medium 3.high
		9. Level of satisfaction in your current economic status	1.low 2.medium 3.high
		10. Level of job security	1.low 2.medium 3.high

7. What are the major problems for generating improved dairy practices?

No	Problems	Rank
1	Inadequate laboratory facility	
2	Inadequate availability of lab equipments	
3	Lack of clear research strategy	
4	Limited research skills	
5	Inadequate research staff	
6	High cost of generation of improved dairy practices	
7	Frequent shifting of researchers	
8	Inadequate budget support	
9	Lack of team spirit among staff	
10	Inadequate research materials	
11	Inadequate incentives	

Please rank the following sub indicators of effectiveness of dairy technology generation process.

R. No.	**Research Effectiveness Indicators**	Rank
1	Personal characteristics	
2	Research Participation	
3	Infrastructure	
4	Technological status	
5	Research management	
6	Policy environment	
7	Social participation	
8	Financial capacity of researcher	

Check list for discussion with researchers

1. How do you evaluate the existing dairy research strategy?
2. What looks the existing dairy breeding policy/strategy, how is its implementation?
3. Do you think that the breeding strategy followed by the research significantly contributes for the improvement of dairy subsector?
4. What are its strengths and weaknesses?
5. How is dairy research program organized to generate improved dairy practices?
6. How did you evaluate the existing improved dairy practices in addressing the needs of the users?

7. How does researcher identify research problem?
8. How do you evaluate the existing different research projects of dairy in solving the problem of end users?
9. How is the research work communicated to end users?
10. How is the status of farmer to farmer extension practices?
11. How does the researcher make follow up on the released improved dairy practices?
12. How often the researcher visits dairy farmers?
13. How many of improved dairy practices adopted?
14. Is there any rejected /discontinued improved dairy practice? Why?
15. Information flow from researcher to end users and vice versa
16. How is the trend of cross breed dairy population?
17. How is the trend of milk yield, demand, and price?
18. Why is dairy research not more influencing the surrounding farmers?
19. How is research collaboration effort locally and globally?
20. How do you evaluate dairy subsector of neighboring countries (Kenya and Sudan), any efforts that is made to learn from their success history?
21. Who are stakeholders in dairy production?
22. What are your link areas with different stakeholders?
23. How is the strength of the link (strong, medium, weak, none)
24. Is there any binding rule for strengthening farmers, research, extension and other stakeholders' linkage?
25. How do you evaluate Agricultural Development Partners Linkage Advisory Council (ADPLAC)?
26. Is there any well perceived common goal for ADPLAC?
27. What are the key constraints for generating need-based improved dairy practices?
28. What are the key constraints of stakeholders for disseminating improved dairy practices? (Research, extension, university, dairy cooperative, private sectors, NGO, farmers)
29. What are your key professional suggestions for further improvement of dairy technology generation and dissemination? (at policy, research, university, extension, farmers and others stakeholders levels)

APPENDIX-4

Questionnaire for extension workers

Questionnaire for Studying

Effectiveness of Technology Generation and Dissemination Process in Dairy Production in West Shewa Zone of Oromia, Ethiopia

Introduction

This questionnaire is prepared to achieve part of the research objectives which examine effectiveness of improved dairy practices generation and dissemination from the system perspective. The research finding that will be emanated from this research work contributes much for enhancing the quality of improved dairy practices among the various stakeholders involved in its generation and dissemination. Likewise, your genuine response is also decisive for achieving the intended objective of the study.

1. Personal Information

1.1. Sex_____ 1. Male 2. Female 1.2 Age_____years

13. Experience _____ years

1.4. Level of education 1.Certificate 2.Diplpma 3.B.Sc./BA 4. M.Sc./MA

1.5. Marital status 1. Single 2. Married 3. Widow 4. Divorced

1.6. Family size_____

1.7. District 1. Ambo 2. Toke Kutaye

2. General information

2.1. How do you rate the current improved dairy practices generation process in solving the Problem of end users? 1. Ineffective 2. Rarely effective 3. Moderately effective 4. Highly effective

2.2. How do you rate the current improved dairy practices dissemination process in solving the Problem of end users? 1. Ineffective 2. Rarely effective 3. Moderately effective 4. Highly effective

2.3. What are the improved dairy practices identified for dissemination program?

_____

_____

_____

2.4. How many farmers are using improved dairy practices through dissemination program? _____

2.5. What are the improved dairy practices currently farmers using?

_____

_____

_____

2.6. How many farmers are using best practices through dissemination program?_____

2.6.1. Please indicate the best practices

_____

_____

_____

2.7. Compared to other subsector, is the budget allocated for dairy extension subsector adequate?

1. Yes ☐ 2. No ☐

2.7.1. If yes; the budget allocation is (1) More than adequate, (2) exact requirement, (3) moderately adequate

2.8. What are the key constraints of dairy extension subsector?

1. Lack of clear strategy 2. Communication skills 3. Infrastructure 4. Lack of motivational 5. Frequent shifting of job 6. If any other _____

2.9. Is the existing infrastructure sufficient to use your maximum capacity in dissemination of improved dairy practices? 1. Yes ☐ 2. No ☐

2.9.1. If no, what are the infrastructures that are not fulfilled?_____

_____

_____

2.10. How do you rate the incentive mechanisms of your organization?

1. Not exist 2. Low 3. Medium 4. High

2.10.1.Elaborate for the relevant point 2, 3 & 4 as ticked by you_____

_____

_____

_____

2.11. What is the total time you devote to extension work per day? _____hrs

2.11.1. The duration of working hours from _____ to _____hrs

2.12. How do you rate your communication skills in dissemination of improved dairy practices?

2. Low 2. Sufficient 3. More than sufficient

2.12.1. If insufficient, indicate the areas of improvement in your communication skills.

_____

_____

_____

2.12.2. If your response is sufficient or more than sufficient, what are the key constraints still affecting dissemination of improved dairy practices?_____

_____

_____

2.13. Do you have your own business? 1. Yes ☐ 2. No ☐

2.13.1. If yes; indicate the type of business._____

_____

_____

2.14. Do you have additional assignments from the office? 1. Yes ☐ 2. No ☐

2.14.1. If yes, indicate the additional assignments_____

_____

_____

2.14.1. If yes, how many hours do you allocate for additional assignments per day? _____hrs.

2.14.2. Do you feel that additional assignments affect your extension activities?

1. Yes ☐ 2. No ☐

2.14.2.1. If yes, to what extent?_____

_____

_____

2.15. What are the main dairy extension activities that you are undertaking?

1. AI service 2. Animal feed 3. Improved management practices 4. Veterinary service

2.16. How many improved dairy practices do you have for dissemination program?

_____indicate them

_____

_____

_____

2.16.1. How many of them disseminated to the end users?_____ indicate them_____

_____

_____

_____

2.16.2. How many of them adopted by the farmers?_____

2.16.2.1. What are the adopted improved dairy practices?_____
_____
_____
_____
2.16.3. How many of them discontinued by the farmers?_____
2.16.3.1. What are the discontinued improved dairy practices?_____
_____
2.16.3. How many of them rejected by the farmers?_____
2.16.3.1. What are the rejected improved dairy practices?_____
_____
_____
_____
2.16.4. If rejection and discontinuance of using improved dairy practices exist, what are the possible reasons?_____
_____
_____

3. Linkage related

Please indicate your response using `√`mark in the space provided and rank in order of their importance

Do you participate in the following linkage activities?	**Regularly**	**Occasionally**	**Rarely**	**Never**	**Rank**
11. Regular meeting of stakeholders					
12. Research problem identification					
13. Setting of research agenda					
14. Joint research review					
15. Joint planning					
16. Joint on farm trial					
17. Joint field day					
18. Research result review meeting					
19. Field visit					
20. Joint monitoring and evaluation					

4. Research activities related

Please indicate your response using `√`mark in the space provided

Do you participate in the following research activities?	Regularly	Occasionally	Rarely	Never
Participation in research strategy development				
Participation in research problem identification				
Participation in research review meeting				
Participation in Farmers Research Group (FRG) meeting				
Participation in improved dairy practices training				
Participation in field visit/demonstration/verification				
Participation in improved dairy practices evaluation				
Participation in on-farm trial				

5. Please indicate your response using `√` mark in the space provided

Dairy research and extension status	Always	Occasionally	Rarely	Never
Are improved dairy practices relevant to farmers` needs?				
Are improved dairy practices problem solving?				
Are improved dairy practices affordable by farmers?				
Is dairy research participatory?				
Does dairy extension have clear strategy?				
Is the strategy translated into action?				
Is the strategy directing towards disseminating problem solving improved dairy practices?				
Does dairy subsector have attention by government?				
Is the linkage among farmer, extension, research and other stakeholders strong?				
Can farmers obtain improved dairy practices as per their demand?				
Does ADPLAC forum contribute for the improvement of dairy subsector?				
Does farmers have role in setting research agenda?				
Does extension have role in setting research agenda?				
Do farmers visit your office for demanding improved dairy practices?				
Are the dairy extension workers well oriented on improved dairy practices?				
Are improved dairy practices adequate for dissemination?				
Is the dissemination program well designed?				
Have the dissemination program increased number of adopters?				

6. Statement of indicators for measuring effectiveness of improved dairy practices dissemination

Sr. no.	Effectiveness indicators	Items	Response
1	**Personal characteristics**	Education level of extension worker	1.12 complete 2.12+3 3. B.Sc. 4. M.Sc.
		Relevancy of your educational qualification with livestock production	1.Less 2.Moderate 3.High
		Work experience of extension worker in dairy production	1.1-3 years 2.4-6years 3.7-9 years 4.10 years and above
		Perception about improved dairy practice dissemination	1.Less 2.Moderate 3.High
		Level of communication skills	1. Less 2. Moderate 3. High

		Habit of preparing extension materials such as leaflet, extension folder, poster etc	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Level of commitment to dairy extension work	1. Less 2. Moderate 3. High
		Level of satisfaction in dairy extension work	1.Less 2.Moderate 3. High
		Level of commitment to work at peasant association level	1.Less 2.Moderate 3.High
		Exposure in getting experience from other extension organizations	1. Never 2.Rarely 3.Occasionally 4.Regularly
2	**Extension participation**	Participation in district level extension planning	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Participating in farmers in extension planning	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Participation in Farmers Research Group (FRG)	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Participation in research review meeting	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Participation in Agricultural Development Partners Linkage Advisory Council (ADPLAC) meeting	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Level of using farmer -to- farmer extension	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Participation in improved dairy practices training	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Participation in national extension workshop	1.Never 2.Rarely 3.Occasionally 4.Regularly
		Participation in regional extension workshop	1.Never 2.Rarely 3.Occasionally 4.Regularly

		Participation in zonal extension workshop	1.Never 2.Rarely 3.Occasionally 4.Regularly
3	**Infrastructure**	Availability of all weather road from village to town	1.Less 2.Moderate 3.High
		Availability of transport facility like motor cycle	1.Less 2.Moderate 3.High
		Accessibility of village with mobile phone	1.Less 2.Moderate 3.High
		Availability of market in the locality	1.Less 2.Moderate 3.High
		Availability of demonstration site in the village	1.Less 2.Moderate 3.High
		Adequacy of adequate of office facility	1.Less 2.Moderate 3.High
		Adequacy of teaching materials	1.Less 2.Moderate 3.High
		Availability of milk collection centre the district	1.Less 2.Moderate 3.High
		Adequacy of office building for extension work	1.Less 2.Moderate 3.High
		Adequacy of house for extension workers at Village level	1.Less 2.Moderate 3.High
4	**Responsiveness of improved dairy practices**	Availability of improved animal feed adequately	1.Less 2.Moderate 3.High
		Level of AI service in the district	1.Less 2.Moderate 3.High
		Availability of improved shed/housing	1.Less 2.Moderate 3.High
		Availability of animal health service	1.Less 2.Moderate 3.High
		Availability of milk storage facility	1.Less 2.Moderate 3.High
		Availability of adequate number of crossbred heifer	1.Less 2.Moderate 3.High

		Average number of crossbred cows per adopter	1. none 2. one 3. two 4.three 5.four and above
		Average number of improved dairy practices adopted	1.none 2.one 3.two 4.three 5.four and above
		Average number of improved dairy practices discontinued	1.none 2.one 3.two 4.three 5.four and above
		Number of improved dairy practices rejected	1.none 2.one 3.two 4.three 5.four and above
		Average milk yield of crossbred per day	1. 1-3liters 2. 4-6 liters 3. 7-9 liters 4. 10 liters and above
		Availability of demand for milk production	1. Never 2. Rarely 3. Occasionally 4. Regularly
5	**Extension management**	Appropriateness of planning to the achieve organizational goal	1.low 2.medium 3.high
		Level of Organizing extension at district level	1.low 2.medium 3.high
		Status of staffing as per the demand of activities	1.low 2.medium 3.high
		Level of directing towards the achievement of the organizational goal	1.low 2.medium 3.high
		Level of extension work supervision	1.low 2.medium 3.high
		Organization status in motivating staff	1.low 2.medium 3.high
		Adequacy of recurrent budget for disseminating improved dairy practices	1.low 2.medium 3.high
		Adequacy of capital budget for disseminating improved dairy practices	1.low 2.medium 3.high

		Efficiency of budget utilization	1.low 2.medium 3.high
		Budget releasing process	1.low 2.medium 3.high
		Fairness of budget allocation	1.low 2.medium 3.high
		Level of the organization in retaining the staff	1.low 2.medium 3.high
6	**Policy environment**	Level of implementing national extension policy and strategies	1.low 2.medium 3.high
		Level of implementing organizational extension strategy	1.low 2.medium 3.high
		Priority Level of dairy extension attention at national level	1.low 2.medium 3.high
		Priority Level of dairy extension attention at regional level	1.low 2.medium 3.high
		Level of strategically designed linkage with stakeholders	1.low 2.medium 3.high
		Level of organizing discussion forum with stakeholders	1.low 2.medium 3.high
		Availability of guiding extension principle in your organization	1.low 2.medium 3.high
		Availability of memorandum of understanding with regional research centers	1.low 2.medium 3.high
		Clarity of extension workers role and responsibility	1.low 2.medium 3.high
		Clarity of job description for extension workers	1.low 2.medium 3.high
7	**Social participation**	Level of interaction with extension staff	1.low 2.medium 3.high
		Level of interaction with your immediate supervisor	1.low 2.medium 3.high
		Level of interaction with dairy farmers	1.low 2.medium 3.high
		Presence of social club in the organization	1.low 2.medium 3.high

		Level of participation in social gatherings of your organization	1.low 2.medium 3.high
		Level of your interaction with the surrounding community in your working area	1.low 2.medium 3.high
		Level of your participation in social issues of your residential area	1.low 2.medium 3.high
		Presence of conflict in the work area	1.low 2.medium 3.high
		Presence of family conflict	1.low 2.medium 3.high
		Level of your social acceptance due to being extension worker	1.low 2.medium 3.high
8	**Financial capacity**	Adequacy of salary for household expenditure	1.low 2.medium 3.high
		Presence of financial support from other sources	1.low 2.medium 3.high
		Adequacy of household assets	1.low 2.medium 3.high
		Level of saving culture	1.low 2.medium 3.high
		Level of paying school fee for children	1.low 2.medium 3.high
		Level of building own house	1.low 2.medium 3.high
		Level of institutional support in building own house	1.low 2.medium 3.high
		Frequency of getting salary increment (promotion)	1.low 2.medium 3.high
		Level of satisfaction in your current economic status	1.low 2.medium 3.high
		Level of job security	1.low 2.medium 3.high

7. What are the major problems for disseminating improved dairy practices?

No	Problems	Rank
1	In adequate improved dairy practices	
2	Lack of need-based improved dairy practices	
3	Prevalence of Disease	
4	Shortage of animal feed	
5	Shortage of farm land	
6	Inadequate extension support	
7	Inadequate budget	
8	Death of cattle	
9	Inadequate AI service	
10	Inadequate input suppliers	
11	Lack of well organized market for dairy products	
12	Farmers resistance to change	
13	Cost of improved dairy practices	

8. Perception of extension worker towards relative advantage and disadvantage of improved dairy practices

Indicate by rating the following relative advantages of improved dairy practices using `√`

Advantages	Very low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
High yield					
Increase income					
Increase social status					
Produce quality milk					

Indicate by rating the following disadvantages of improved dairy practices using ` √`

Disadvantages	Very low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
High cost					
Needs high skill					
Needs close supervision					
Inadequacy of dairy technology					

Please rank the following sub indicators of effectiveness of dairy technology dissemination process.

R. No.	**Extension Effectiveness Indicators**	Rank
1	Personal characteristics	
2	Extension participation	
3	Infrastructure	
4	Technological status	
5	Extension management	
6	Policy environment	
7	Social participation	
8	Financial capacity of extension workers	

Check list for discussion with extension workers

1. Why is dairy extension not more influencing the surrounding farmers?
2. How is dissemination program designed to reach the whole farming community?
3. What are its strengths and weaknesses?
4. How is AI service organized to provide service for the farmers?
5. How do you evaluate the existing improved dairy practices in addressing the needs of the users?
6. Is there any rejected/discontinued improved dairy practice? Why?
7. Perception of dairy farmers on different improved dairy practices
8. How often researchers visit dairy farmers?
9. How often do you visit dairy farmers?
10. Success history of dairy farmer in dairy production
11. How is farmer to farmer extension activity of the study area?
12. How often do you visit research center?
13. Source of information
14. How information reaches each farmer?
15. How is the trend of dairy population?
16. How is the trend of milk yield?
17. Who are stakeholders in dairy production?
18. What are your link areas with different stakeholders?
19. How is the strength of the link (strong, medium, weak, none)
20. Is there any binding rule for strengthening farmers, research, extension and other stakeholders' linkage?
21. Do you think that the dissemination of improved technologies and best practices followed in the district significantly contributes for the improvement of dairy subsector?
22. What are the key constraints of stakeholders for disseminating improved dairy practices? (Research, extension, university, dairy cooperative, private sectors, NGO, farmers)
23. What are your key professional suggestions for further improvement of dairy technology dissemination? (at policy, research, university, extension, farmers and others stakeholders levels)

APPENDIX-5

Interview schedule for farmers

Instruction

1. Understand clearly all the questions before stating the interview
2. Introduce yourself to the respondents and make them clear about the objective of the interview
3. Be patient during the interview and express yourself in understandable way to the respondents
4. Reliable information leads to right generalization. Hence, please write the farmers own response properly for each questions

Date of interview_____
Peasant Association_____
Code_____

1. Personal Information

1.1 . Name of enumerator_____
1.2 . Name of household head_____
1.3. Sex_____1.4. Age_____ 1.5. District 1. Ambo 2. Toke Kutaye
1.6. Marital status 1. Single 2. Married 3. Widow 4. Divorced
1.7. Have you attended formal education 1.Yes ☐ 2.No ☐
1.7.1. If yes, what is the highest grade you attended? _____
1.7.2. If no, 1. Cannot read and write 2. Read and write
1.8. What is your religion? 1. Muslim 2. Orthodox 3. Protestant 4. Wakefata 5. Any other_____
1.9. What is your year of experience in dairying? _____years
1.10. Total household size _____1.10.1. Total household size in the age group of 15-64 years_____

2. Resources

2.1. Do you own land? 1. Yes ☐ 2. No ☐
2.1.1. If yes, what is your total land size? _____hectare
2.1.2. If yes, what is the total size of grazing land_____ hectare
4. Do you own dairy cows? 1. Yes ☐ 2. No ☐
4.1 If yes, what is the number of dairy cows you own currently? local_____cross breed_____

Improved Dairy Practices

5.5. Do you use improved dairy practices? 1. Yes ☐ 2. No ☐
5.5.1. If yes, which improved dairy practices are you using?
1. Cross breed 2. Improved feed 3. Veterinary service 4. Improved management practice 5.four of them
5.5.2. If yes, when did you start utilizing improved dairy practices? _____ E.C

5.5.3. From where did you learn about improved dairy practices?

1. Extension agent
2. Radio
3. Field day
4. Neighbor
5. Printed material

5.5.4. If no, why did you not use improved dairy practices?

1. It is expensive
2. It is not available
3. It needs skill
4. It is not relevant
5. If any_____

5.6. Can you get improved dairy practices whenever you want? 1. Yes ☐ 2. No ☐

5.6.1 If you have one or two cross breeds, why did you not increase?

1. It is expensive
2. It is not available
3. No forage
4. Lack of land
5. Their management is difficult
6. If any_____

5.7. Do you supply concentrate for your cows? 1. Yes ☐ 2. No ☐

5.7.1. If no, what are the possible reasons? 1. It is expensive 2. It is not available 3. Any other_____

5.8. Do you get veterinary service for you cows? 1. Yes ☐ 2. No ☐

5.8.1. If no, what are the possible reasons? 1. It is expensive 2. It is not available 3. Any other_____

5.9. Do you use improved housing for your cows? 1. Yes ☐ 2. No ☐

5.10. Is there any improved dairy practices that you discontinued using 1. Yes ☐ 2. No ☐

5.10.1. If yes, which is it? (One or more answer is possible)

1. Cross breed
2. Animal feed
3. Veterinary service
4. Improved housing

5.10.2. If yes, what are the reasons for discontinuing?

1. It is expensive
2. It is unavailable
3. It is not profitable
4. Its management is difficult
5. Any other_____

5.11. Is there any improved dairy practice that needs more skills? 1. Yes ☐ 2. No ☐

If yes, mention the practices_____

_____

_____

5.12. How do you rate the profitability of improved dairy practices?

1. Highly profitable 2. Profitable 3. less profitable 4. Not profitable

5.13. Is the existing improved dairy practices consistent with your previous experience of dairy farming? 1. Yes ☐ 2. No ☐

5.14. Is there any incidence of dairy cows death? 1. Yes ☐ 2. No ☐

5.14.1. If yes, how often it occurs? 1. Frequently 2. Sometimes 3. Rarely

5.14.2. What are the main causes for dairy cows death in the area?

_____

_____

5.15. How do you rate the cost of improved dairy practices? 1. High 2. Medium 3. Less

5.16. How do you rate the existing demand for cow milk? 1. High 2. Medium 3. Less

6. Dairy extension

6.1. Do you have contact with extension agent? 1. Yes ☐ 2. No ☐

6.1.1. If yes, how many times do you contact per month? _____

6.3. Which extension media helped you most to learn about improved dairy practices?

1. Extension agent 2. Radio 3. Field day 4. Printing materials 5.Any other_____

6.4. Did you ever get training on improved dairy practices? 1.Yes ☐ 2. No ☐

6.4.1. If yes, from where did you get the training?

1. Research center
2. Agricultural development office
3. Non Governmental Organization (NGO)
4. Any other (specify)_____

6.4.2. The duration of the training is _____ to _____ days

6.4.3. Was the training in line with your needs? 1.Yes ☐ 2. No ☐

6.4.3.1. if no, what was the limitation of the training?_____

_____

_____

6.5. Have you ever visited dairy demonstration site? 1.Yes ☐ 2. No ☐

6.6. Who assisted you for utilizing improved dairy practices? Show in rank

No	Category	Rank
1	Agricultural development office	
2	Non-Governmental Organization	
3	Research Center	
4	University	
5	Dairy cooperative	
6	Neighbor	
7	Relatives	

6.7. Which extension media helped you most to learn about improved dairy practices?

No	Category	Rank
1	Extension agent	
2	Radio	
3	Field day	
4	Television	
5	Printing materials	

7. Milk yield

7.1. How many times do you milk your cow per day? _____times

7.1.1. Total amount of milk per cow/ day _____liters

7.1.2. Lactation period of a cow _____months

8. Credit

8.1. Have you ever used credit for dairy? 1. Yes ☐ 2. No ☐

8.1.1. If yes, from where did you get the credit?

a. 1. From government
b. 2. From non government
c. 3. From friends
d. 4. Any other (specify)_____

8.1.2. If no, what was the reason?

1. Not available
2. Interest rate is high
3. Lack of collateral
4. Any other (specify)_____

9. **Market**

9.1. Is there ready market for your dairy products 1. Yes ☐ 2. No ☐

9.1.1. If yes, where do you sell your dairy products?

1. At market found in nearby town
2. At farm gate
3. Cooperative
4. Any other (specify)_____

9.2. How far the market place from your farm gate? _____km

10. Financial

10.1. Cost

		Cost (annually)	
No.	Items	Cross breed	Local breed
1	Transport cost		
2	Opportunity cost of capital		
3	Labor cost		
4	Service charge for AI		
5	Veterinary cost		
6	Feed cost		

10.2 Benefit

		Income (annually)	
No.	**Items**	**Cross breed**	**Local breed**
1	Milk sale		
2	Calf sale		
3	Cow dung		

11. What are the major problems for adopting improve dairy practices?

No	Problems	Rank
1	In adequate improved dairy practices	
2	Lack of problem solving improved dairy practices	
3	Prevalence of Disease	
4	Shortage of animal feed	
5	Shortage of farm land	
6	Inadequate extension support	
7	Death of cattle	
8	Inadequate AI service	
9	Lack of milk storage facility	
10	Farmers resistance to change	
11	Cost of improved dairy practices	
12	Lack of milk collection center	

12. Linkage related

Please indicate your response using `√`mark in the space provided and rank in terms of the order of importance

Do you participate in the following linkage activities?	Regularly	Occasionally	Rarely	Never	Rank
1. Regular meeting of stakeholders					
2. Research problem identification					
3. Setting of research agenda					
4. Joint research review					
5. Joint planning					
6. Joint on farm trial					
7. Joint field day					
8. Research result review meeting					
9. Field visit					
10. Joint monitoring and evaluation					

13. Research activities related

Please indicate your response using `√`mark in the space provided

Do you participate in the following research activities?	Regularly	Occasionally	Rarely	Never
1. Participation in research problem identification				
2. Participation in research review meeting				
3. Participation in Farmers Research Group (FRG) meeting				
4. Participation in improved dairy practices training				

5. Participation in field visit/demonstration				
6. Participation in ADPLAC meetings				
7. Participation in improved dairy practices evaluation				
8. Participation in on-farm trial				

14. Please indicate your response using `√` mark in the space provided

Dairy research and extension status	Regularly	Occasionally	Rarely	Never
1. Are improved dairy practices relevant to your needs?				
2. Are improved dairy practices problem solving?				
3. Is dairy research participatory?				
4. Is improved dairy practice affordable?				
5. Is the linkage among farmer, extension, research and other stakeholders strong?				
6. Do you obtain improved dairy practices as per your demand?				
7. Does ADPLAC forum contribute for the improvement of dairy subsector?				
8. Do you have role in setting research agenda?				
9. Do you visit the extension office for demanding improved dairy practices?				
10. Have the dissemination program helped you to adopt improved dairy practices?				

15. Perception of farmers towards relative advantage and disadvantage of improved dairy practices

Indicate by rating the following relative advantages of improved dairy practices using `√`

Advantages	Very low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
High yield					
Increase income					
Increase social status					
Produce quality milk					

Indicate by rating the following disadvantages of improved dairy practices using ` √`

Disadvantages	Very low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
High cost					
Needs high skills					
Needs close supervision					
Inadequacy of dairy technologies					

Check list for discussion

1. What are the improved dairy practices you adopted?
2. How did you get information about improved dairy practices?
3. Are there farmers learning about improved dairy practices from one another? (Farmer to farmer extension)
4. Do you have communication with extension worker? How often do you visit extension office?
5. Do you have satisfaction with the information that you get from extension on your inquiry?
6. Do you participate in extension activities like planning, demonstration---
7. Have you got an opportunity to discuss with researcher about your dairy production?
8. Do you have satisfaction with the improved dairy practices that are generating by research?
9. How do you evaluate the linkage among farmer, research, extension, private sectors, NGO etc
10. What are the main constraints and opportunities that exist among different stakeholders?
11. How do you evaluate zonal and district ADPLAC?
12. Role perception of different stakeholders
13. Existence of common goal of stakeholders/existence of synergy
14. Feedback mechanism on improved dairy technologies
15. Are improved dairy practices generated by research in line with your needs?
16. What are improved dairy practices that you need from research, university and other stakeholders?
17. How the farmers value use of improved dairy practices? What is societal image about improved dairy practices?
18. What are the benefits that you got due to using improved dairy practices? Milk, income, social status---)
19. Why farmers are not using improved dairy practices?
20. How do you evaluate AI service, Animal Health service?
21. How do you evaluate the existing improved dairy practices?
22. Adopted, discontinued, rejected improved dairy practices
23. ITK on dairy production
24. Best practices on dairy production
25. Success history of dairy farmer in dairy production
26. How do you see the trends of milk production and cattle population over the last ten years? Increasing/ decreasing/ why?
27. What are the main constraints for using improved dairy practices?
28. Is there any communication that you have with input suppliers, NGOs, private sectors ----
29. What are your link areas with different stakeholders?
30. How is the strength of the link (strong, medium, weak, none)
31. What do you suggest for the improvement of dairy research and extension?

Appendix 6: Some field pictures