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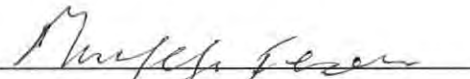
Linking Institutional Research and Extension to Farmers' Indigenous Knowledge and Practices for Sustainable Agriculture in Ethiopia. A Case Study from Dejen Woreda, Amhara Region.

BY

Getahun Fenta

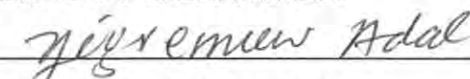
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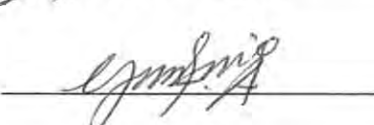

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**Linking Institutional Research and Extension to Farmers ' Indigenous
Knowledge and Practices for Sustainable Agriculture in Ethiopia: a Case
Study from Dejen woreda, Amhara Region**

**A Thesis Submitted to the School of Graduate Studies of Addis Ababa
University in Partial Fulfilment of the Requirements for Masters of Arts
Degree in Development Studies (Rural Livelihoods and Development)**

By
Getahun Fenta
March 2008

UNIVERSITY OF ETHIOPIA
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AMHARA REGION
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TABLE OF CONTENTS

	Page
Acknowledgement.....	i
Table of contents.....	ii
List of tables.....	iv
List of figures.....	iv
List of abbreviations.....	v
Abstract.....	vi
Chapter One: Introduction	
1.1. Background of the study.....	1
1.2. Statement of the problem.....	4
1.3. Research objectives.....	6
1.4. Significance of the study.....	6
1.5. Scope of the study.....	6
1.6. Research methods	
1.6.1. Research design.....	7
1.6.2. Samples and sampling procedure.....	7
1.6.3. Nature of data and data collection instruments.....	8
1.6.4. Data analysis and presentation.....	9
1.7. Limitations of the study.....	9
1.8. Organization of the paper.....	10
Chapter Two: Review of the literature	
2.1. Conceptual framework.....	11
2.2. Literature review.....	13
2.2.1. Indigenous knowledge and sustainable agriculture: concept and definition.....	13
2.2.2. Indigenous knowledge systems in Ethiopia.....	16
2.2.3. Overview of agricultural research and extension experience in Ethiopia.....	18
2.2.4. Research-extension- farmer linkage: some issues.....	23
2.2.5. Constraints of research-extension- farmer linkage.....	26
Chapter Three: Description of the study area	
3.1. Physical environmental setting	
3.1.1. Geography and location.....	28
3.1.2. Topography and soil.....	28
3.1.3. Climate and vegetation.....	30
3.1.4. Land use and the farming system.....	30
3.2. The human environment: farm household circumstances	
3.2.1. Demographic profile.....	32
3.2.2. Farmers' income level.....	33
3.2.3. Land holding.....	34
3.2.4. Household size and labor supply.....	34
Chapter Four: Farmers' indigenous knowledge and practices in the study area	
4.1. Farmers' indigenous knowledge and practices.....	36
4.1.1. Farmers' indigenous knowledge of soils.....	36
4.1.2. Farmers' perception of soil fertility and soil fertility management techniques.....	39
4.1.3. Indigenous methods of maintaining soil fertility.....	39
4.1.4. Indigenous methods of controlling weeds, pests and diseases.....	42
4.1.5. Farmers' informal experiments on crop production.....	43
4.1.6. Farmers knowledge of local seed systems and improved ones.....	44
4.1.7. Farmers' indigenous organizations.....	45
4.2. Strengths and weaknesses of indigenous knowledge and practices.....	46

Chapter Five: Attitude of stakeholders to farmer's indigenous knowledge and practices	
5.1. The perception of stakeholders on the importance of IKS and practices.....	48
5.2. The perception of stakeholders on the incorporation of IKS and practices in research and extension activities.....	51
Chapter Six: Constraints to research, extension and farmers' IKS linkage	
6.1. Limited input from farmers in setting priorities and formulating the research agenda.....	54
6.2. Under perceiving and disregarding indigenous knowledge systems and experiments.....	57
6.3. Disregarding the role of farmers' indigenous organizations.....	59
6.4. Technical deficiency of the extension service.....	60
6.5. One side initiation of activities.....	63
6.6. Complexity of the research environment and pressures from stakeholders.....	64
6.7. Failure to conduct participatory on-station, client oriented, adaptive research.....	65
6.8. Lack of effective popularization of improved technologies.....	66
6.9. Lack of accountable and responsible institute for the linkage.....	66
6.10. Lack of proper monitoring and evaluation systems.....	68
6.11. Resource constraints and weak administrative capacity.....	69
6.12. Communication problems and the existence of blaming culture.....	71
6.13. Motivation and commitment problems of the research and extension staff.....	72
6.14. Lack of adequate and organized trainings for farmers and extension workers.....	73
6.15. Lack of gender mainstreaming in extension and research activities.....	74
Chapter Seven: Linking research, extension and farmers' indigenous knowledge and practices	
7.1. Recognizing and recording farmers' indigenous knowledge systems and innovative capacities.....	75
7.2. Establishing indigenous knowledge resource centres.....	76
7.3. The use of farmers' and technology development groups.....	77
7.4. Identifying research problems in the woreda.....	78
7.5. The use of trial and demonstration plots.....	78
7.6. Giving emphasis for students field practicum.....	79
7.7. Reforming the extension and research practices through collaboration.....	79
7.8. Making linkage mechanisms independent of donor funds.....	80
7.9. Applying systems perspective.....	81
7.10. Giving the right information to linkage partners.....	81
7.11. Bringing a desirable change in the attitudes of stakeholders on the importance of IKS	82
Chapter Eight: Summary, Conclusion and recommendations.	
8.1. Summary and conclusion.....	83
8.2. Recommendations.....	85
References	89
Appendices	

List of Tables

Table 1.1 Total number of households and in the selected kebeles and samples taken.....	8
Table 3.1 Land use classification of the study area.....	32
Table 3.2 Age and sex composition of sample households.....	33
Table 3.3 Distribution of households by educational level.....	34
Table 3.4 Distribution of respondents by average annual income.....	34
Table 3.5 Distribution of respondents by land holding size.....	35
Table 3.6 Distribution of households by total household size and number of family labourers...	35
Table 4.1 Local soil types and their characteristics as perceived by farmers.....	38
Table 5.1 Mean score values on the perception of stakeholders regarding the importance of indigenous knowledge and practices.....	49
Table 5.2 Mean score values on the perception of stakeholders regarding the incorporation of IK and its practices into research and extension activities.....	52

List of Figures

Figure 2.1 Traditional research and technology transfer process.....	11
Figure 3.1. Location map of Dejen Woreda.....	30

List of Acronyms

ADDP	Ada District Development Unit
ADLI	Agricultural Development Led Industrialization
AKIS	Agricultural Knowledge and Information Systems
ARARI	Amhara Region Agricultural Research Institute
ARC	Adiet Research Canter
BDI	Biodiversity Institute
CADU	Chilalo Agricultural Development Unit
CPP	Comprehensive Package Program
EARO	Ethiopian Agricultural Institute
EEA	Ethiopian Economic Association
EMPID	Extension and Program Implementation Development
EPID	Extension and Program Implementation Development
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FRC	Forestry Research Centre
FREG	Farmers Research Extension Group
FSR	Farming Systems Research
IAR	Institute of Agricultural Research
IECAMA	Imperial Ethiopian College of Agriculture and Mechanical Arts
IKS	Indigenous Knowledge Systems
ISWCP	Indigenous Soil and Water Conservation Practices
MoA	Ministry of Agriculture
MPP	Minimum/ Maximum Package Program
NARS	National Agricultural System
NSL	National Soil Laboratory
PADEP	Peasant Agriculture Development Project
PADETES	Participatory Agricultural Demonstration and Training Extension System
PGRC	Plant Genetic Research Centre
PPRC	Plant Protection Research Centre
RARC	Regional Agricultural Research Centre
REFAC	Research-Extension-Farmer Advisory Council
RELC	Research Extension Liaison Committee
RKA	Rural Kebele Administration
ToT	Transfer of Technology
USAID	United States Aid for International Development
WADU	Walaita Agricultural Development Unit

Abstract

In Ethiopia the absence of effective linkage between research, extension and farmers has been identified time and again as one of the major problems that hinder the effectiveness of the development of agriculture in general and agricultural research and extension systems in particular. Considering such a problem, there had been various attempts both by extension and research organizations to devise linkages. Yet, the linkages remain as weak as the number of times solutions were sought to further strengthen it. If this is the case, why is a problem of weak linkage between agricultural research, extension and farmers persistent and pervasive in Ethiopia? What ways/mechanisms can be devised to complement agricultural research and extension activities with farmers' indigenous knowledge and practices? These two questions were the focus of the study in Dejen woreda of the Amhara Region. The area was selected due to the fact that it has impressive and diverse surface landforms where one expects a variety of indigenous knowledge systems and practice.

The study adopted a descriptive research design. The target populations for the study were agricultural researchers, extension workers, and farmers. Out of the total 19 RKAs in the woreda, 6 were drawn as sample kebeles by using simple random sampling technique. From a total of 7029 households in the six RKAs, 60 households were selected as a sample for the study using proportionate stratified sampling technique. The data were collected from primary (questionnaire survey, observation, interview and focus group discussion) and secondary (published and unpublished materials) sources. The collected data were analysed using both quantitative and qualitative techniques.

Some of the major bottlenecks that hinder effective linkage between agricultural research, extension and farmers include: limited input from farmers in setting priorities and formulating the research agenda; under perceiving and disregarding indigenous knowledge systems, experiments and organizations; technical deficiency of the extension service; large area coverage of the research centre; complexity of the research environment and pressures from stakeholders; lack of accountable and responsible institute for the linkage; idle and ineffective linkage mechanisms; lack of proper monitoring and evaluation systems; resource constraints and weak administrative capacity; communication problems and the existence of blaming culture; motivation and commitment problems of the research and extension staff; lack of adequate and organized trainings for farmers and extension workers; lack of gender mainstreaming in extension and research activities; and shrinking and fragmented land holdings

The policy implication of the study is that promoting indigenous knowledge in Ethiopia requires attitudinal, behavioral, and methodological changes to give it a scientific touch. The changing roles of extension workers and researchers are therefore very important for a true partnership in research and extension with farmer innovators. Thus, institutionalizing and internalizing indigenous knowledge into the existing research and extension systems should be the ultimate objective of all actors involved in the agricultural development process in Ethiopia.

Chapter One

Introduction

1.1. Background to the Study

Agriculture is the most important source of occupation for the majority of the population living in developing countries. In many developing countries, the proportion of rural people accounts for more than half of their total population. This proportion is even much higher in Africa, with most countries possessing more than three-fourths of their total population in rural areas (Todaro and Smith, 2003). Ethiopia is among the African countries where agriculture takes a lead in the economy. Hence, the growth of the agricultural sector is particularly important as it constitutes the bulk of the economy in terms of human and material resources (Beyene, 2005; Belay and Degnet, 2004; EEA, 2006). Agriculture in the country is dominated by rain fed, traditional and subsistence small holders that depend on methods of production where oxen drawn, wooden ploughs and manually operated tools are commonly used for seeding, weeding, harvesting, and threshing (Tesfaye, 1999). Agriculture is also characterized by low productivity of land and labor and it has been unable to produce sufficient quantities of food to feed the country's rapidly growing population and failed to make a substantial contribution to the country's economic growth (Belay, 2003; Tesfaye, 2003; Seifu, 1997).

The main causes for the low level of agricultural production and productivity in Ethiopia include the poor state of agricultural inputs, skills and know-how among the rural farmers who cultivate 95% of the farmland (Solomon, 1989). Traditional methods such as clearing land by fire and soil burning still prevail. Such methods and experiences do not contribute much to the evolution of sounder system of farming and more intensive output from the land. Besides the low level of agricultural productivity, the rapidly growing population surges the mutually reinforcing effects of poverty and environmental degradation, which in turn circumscribes the country's capacity to produce food and aggravate its food crisis resulting in perennial hunger and malnutrition. As a result, the country has been forced to receive large quantities of food grain which are increasing from year to year. Given this state of affairs, the country is identified as one of the highest food aid recipients in Sub Saharan Africa (SSA) with food insecurity becoming the daily lots of the population, despite the long history of agricultural practice and rich natural resource endowment (Tekolla, 1996; Belay and Degnet, 2004; EEA, 2006). Indeed, poverty is pervasive, deep and persistent in the country.

Alleviation of poverty in rural areas could become possible if and only if poor people's ability to derive sustenance and income from more productive and sustainable agricultural practices is improved (Ambler, 2000). Indeed, the agricultural sector has a long way to meet the expectations placed on it, that is, feeding adequately a growing global population and contributing to poverty alleviation while keeping an eye on sustainable resource utilization. Appropriate responses for this task have to be rooted in research endeavors and innovation processes that make use of both indigenous and newer (conventional) knowledge systems (Smith, et al, 2004).

Nevertheless, during the last decades, the development and implementation of agricultural technology in Africa have been shaped and modeled by modernistic approaches. Agricultural researchers, planners, implementers and extension agents have developed and transmitted agricultural information on the assumption that farmers' indigenous knowledge systems, strategies and capacities are limited and unsuitable for fast changing market economy (Lawas, 1997). However, those conventional development approaches have a track record of repeated failure as they have excessively focused on technological solutions and package type top down approaches with little or no regard to indigenous knowledge systems and farmers' practices (Negussie, et al, 2005).

Mattee and Lassalle (1999:105) argued that "farmers reject technologies not because they are conservative or ignorant, but because they rationally weigh the changes in incomes and risks associated with the given technologies under their natural and economic circumstances. Some of the major weaknesses for such problems include the top- down approach used or technological imposition, the less participatory nature or neglect of the land users, ignorance about the local biophysical condition and disregarding Indigenous Knowledge (IK) and practices of farmers (Lawas, 1997). One of the solutions which has been proposed to address these weaknesses is to link up institutional research and extension with farmers. This is because farmers have the capacity to take actions to improve their farming systems with or without the assistance of institutional research and extension. In addition, farmers' indigenous knowledge is dynamic and ever changing. It is something created by farmers as part of their changing local environments. Farmers will, therefore, fall back on their indigenous knowledge whenever the merits of new technologies are not obvious. Moreover, farmers can accept new knowledge and modify their indigenous knowledge, when new challenges or conditions render indigenous knowledge irrelevant or inadequate (Mattee and Lassalle, 1999).

Linkages between major institutional actors in agricultural knowledge and information systems (AKIS) are widely recognized as essential for an effective flow of technology and information between research, extension, and farmers. Poor performance of the system is often related to common and recurrent linkage problems among them and also with other stakeholders (Eponou, 2000). Many linkage problems between major institutional actors in agricultural knowledge and information systems (AKIS) are caused by lack of coordinated planning, poor communication between linkage partners, and absence of follow-up with actual linkage resource planning or implementation. In addition, there is typically little or no involvement of farmers or their organizations in linkage planning or cost sharing (Swanson, 1993)

It is also argued that agricultural research and extension activities have an important role to play in conducting a research about a problem and disseminating the results to farmers. But for solving a problem, farmers have a lot to teach researchers and extension agents. Therefore, the problem for research and extension activities becomes not how to transfer technology from research stations to farmers but how to close the gap between the two so that insights from both can be shared and built up on (Elliot, 1994). In other words, in order to have any impact on agriculture, there should be a strong linkage between institutional research, extension and farmers' indigenous knowledge systems and practices. Such an integrated approach underlines the importance of interactive and mutual learning between formal and informal knowledge/technology systems and stresses linkages with farmers so that they participate actively in agricultural technology innovation efforts.

More importantly, if agricultural development is to take place and if it is to be sustainable, it must rest on the enterprise and initiatives of people to generate change base on their own values and experiences (Tick, 1993). Rural peoples' knowledge can provide effective alternative to modern scientific know-how. Moreover, a blend of scientifically generated technical knowledge with indigenous practices is flexible in that it can adjust to agro climatic changes as well as to variable socioeconomic condition of farmers. This will, in turn, expedite the transfer, dissemination and utilization of technologies (Momen, 2000). In one way or another, it is now widely believed that the integration of indigenous agricultural knowledge and practices with newly introduced technologies increases the sustainability of agricultural systems (EEA, 2006).

Despite the recognition of the critical role of farmers in the agricultural development process, there still exists a lot of skepticism about farmers role in the research and extension process and hence there is a high dependence on external technological solutions in development programmes with out recognizing the important role farmers can play in the development, diffusion and utilization of agricultural technologies. Consequently, institutional research and extension has been criticized as having little success in generating and disseminating agricultural technologies to small scale resource poor farmers in developing countries of the world, where Ethiopia is not an exception. Thus, this study is an attempt to identify the reasons behind the poor linkage among linkage partners in the agricultural development process in Ethiopia.

1. 2. Statement of the problem

Agriculture is the prime mover of the Ethiopian economy. It constitutes the largest share of the national economy; accounting for about 45% of the GDP, 85% of exports and 50% of the total employment (FDRE, 1997). In Ethiopia, the growth of the agricultural sector is particularly important as it constitutes the bulk of the economy in terms both human and material resources. It is incumbent up on the sector to show dynamism and growth if it is to alleviate poverty and to promote economic development in the country. Primarily, it has to satisfy the food demand of the rapidly growing population and secondly it has to release adequate surplus to the other sectors of the economy (Beyene, 2005:3). In recognition to this, the existing economic development strategy of the country, namely, Agricultural Development Led Industrialization (ADLI) identifies agriculture as the 'lead growth sector'

The ADLI strategy sets agriculture as a primary stimulus to generate increased output, employment and income for the people and as a spring board for the development of the other sectors of the economy. To realize these development goals, support for the improvement of the small holder agriculture has been taken as a prime strategic direction. Hence, a wider dissemination of research results and technological options, and the diffusion of improved management practices and know how to the small holder farmers are strategies sought to be implemented by the government of Ethiopia (EEA, 2006; Beyene, 2005). The policy instrument chosen to attain these goals includes the new system of agricultural extension known as Participatory Agricultural Demonstration and Training Extension System (PADETES) which has been implemented since 1994/95. As a result, diffusion of agricultural technologies (mainly improved seeds, fertilizers, pesticides and herbicides) has been initiated from that time in almost all parts of the country (Beyene, 2005). In addition,

agricultural research is considered as a crucial and important wing in technology generation, dissemination /extension utilization continuum of agricultural development in Ethiopia (EEA, 2006).

Agricultural research and extension have a vital role to play in the process of agricultural development. However, an effective agricultural development in general and technology development, delivery and utilization in particular require a good linkage mechanism among actors involved in the agricultural development process. Hence, in order to ensure effective mechanism for technology development and transfer, as well as utilization there is a need for strong linkages between research, extension, farmers, technology multipliers and suppliers as well as agricultural educators. Good linkage helps to produce and harness knowledge and information from various sources for better farming and improved livelihoods (EEA, 2006; Belay, 2003).

Nevertheless, the absence of effective linkages between research- extension- farmers in Ethiopian has been identified time and again as one of the major problems that hinders the development of agriculture in general and the effectiveness of agricultural research and extension systems in particular (EEA, 2006; Belay, 2003). With due recognition of the problem, there had been various attempts both by extension and research organizations to devise linkages. Some of the attempts include the establishment of Farmers Research Extension Group (FREG), Research Extension Liaison Committee (RELC), and Research-Extension-Farmer Advisory Council (REFAC). Yet, the linkage remains as weak as the number of times solutions were sought to further strengthen it (EEA, 2006). The research conducted by the Ethiopian Economic Association indicates that frequent restructuring of the MoA, underdevelopment of infrastructure; weak link with research, credit and marketing institutions; failing to tap technical and ecological knowledge of farmers, unidirectional information flow are some of the problems for extension service in Ethiopia, which also acts as a barrier for effective linkage between research, extension and farmers (ibid). If this is the case, why is a problem of weak linkage between agricultural research, extension and farmers persistent and pervasive in Ethiopia? What ways/mechanisms can be devised to complement agricultural research and extension activities with farmers' indigenous knowledge and practices? These two research questions form the basis of the study that has been conducted in Dejen woreda of the Amhara region. The study area was selected owing to the existence of diverse landforms (agro-ecology) and a variety of indigenous knowledge systems and practices.

1.3. Research objectives

The over all objective of the study is to identify the factors that hinder the integration of farmers' indigenous agricultural knowledge and local practices with research and extension activities. The specific objectives of the study include: to

- a) identify the major indigenous knowledge and practices pertaining to farming;
- b) investigate the attitude of farmers', extension workers and researchers' towards the role and importance of farmers' indigenous knowledge and practices in sustaining agriculture;
- c) identify some major factors that influence the linkage between agricultural research, extension and farmers; and
- d) describe the ways/ mechanisms in which the expertise of agricultural research institutions and extension can be complemented with farmers' indigenous knowledge and practices.

1.4. Significance of the Study

For developing countries, importing sophisticated technology from advanced countries may be costly and very difficult for rural societies to operate and manage it for sustained agriculture. But extensive consultation and genuine collaboration with local communities can reduce the cost and make agriculture more sustainable. Thus, by identifying the major factors that hinder the integration of farmers' indigenous agricultural knowledge and local practices with research and extension activities and by pointing out the ways in which the expertise of agricultural research and extension can be complemented with the resourcefulness and determination of small scale farmers, the findings of the study can give insights and recommendations to different actors to consider IKS and its practices as options and choices for participatory technology development and its potential in promoting sustainable agriculture. The study will also help to fill the knowledge gap in previous studies in the country. On top of these, it may act as a spring board for other research works in the area.

1.5. Scope of the Study

The scope of the study spans from exploring farmers' indigenous knowledge and practices to exploring the attitude of farmers, extension workers and researchers towards the role and importance of farmers IK and practices in sustaining agriculture. It also explores the major factors that hinder the integration of indigenous knowledge and practices with agricultural research and extension and investigate the mechanisms by which research, extension and farmers can be effectively linked. Spatially, the study is confined to Dejen woreda, which, can serve as representative of the situation in the region.

1.6. Research methods

1.6.1. Research design

This study adopted a descriptive research design, which is concerned with the conditions or relationships that exist, options that are held, processes that are going on, effects that are evident and trends that are developed.

1.6.2. Samples and sampling procedure

The target population for the study comprises of agricultural researchers, farmers, extension workers, community elders and other concerned bodies. In the woreda, there are 19 rural kebele administrations (RKAs), of which 7 RKAs are found in the *kola* agro-ecological zone, 6 RKAs in the *dega* agro-ecological zone and the remaining 6 in the *woina dega* agro-ecological zone. In all the RKAs of the woreda, there are about 21, 227 households. With the assumption that the households are homogeneous in their socioeconomic and cultural aspects, 60 household heads were selected from the six randomly selected kebeles.

Multi-stage sampling technique was used to select the samples. First, a list of households along with their kebeles was taken from the woreda administration. Secondly, based on their agro-ecological location the households were stratified into three strata namely, *kola*, *dega* and *woina dega*. Thirdly, two kebeles were randomly selected from each of the three agro-ecological zones. As such, a total of six kebeles, namely, *Kurar and Gilgele* from *kolla*, *Zemetin* and *Tik Yetnora* from *dega*, and *Muyan, and Mushirit Dengay* from *woina dega*, were taken as sample kebeles. In the fourth stage, since women play a big role in agriculture, households in each selected kebeles were stratified as male and female-headed households. Finally, after categorizing households in each kebele as male and female-headed households, sample household heads were drawn from each stratum by using proportionate stratified random sampling technique (see Table 1.1 below)

Table 1.1. Total number of households in the selected kebeles and samples taken

No	Sample kebele	Total Number of Households			Samples taken		
		male headed	female headed	total	male headed	female headed	total
1	Kurar	700	303	1003	6	3	9
2	Gilgele	861	346	1207	7	3	10
3	Zemetin	661	249	910	6	2	8
4.	Tik Yetnora	1187	661	1848	10	6	16
5	Muyan	851	216	1067	7	2	9
6	Mushrit Dengay	904	90	994	7	1	8
	Total	5164	1865	7029	43	17	60

Source: Based on field Survey, March 2007

As to the sampling of researchers, extension workers and agricultural experts in the woreda, availability sampling techniques was used. Accordingly, 20 extension workers from the six study kebeles and 10 researchers from Amhara Region Agricultural Research Institute (ARARI) and Adiet Research Center (ARC) were taken as samples for the study and questionnaires were distributed to them. Similarly, to select focus group discussants and interviewee farmers, elderly people were selected purposefully. At the time of selecting focus group discussants and interviewee farmers, care was taken to involve both women and men headed households. The selection was assisted by extension workers for the fact that they know the people and the area in detail.

1.6.3. Nature of Data and Data Collection Instruments

The data inputs for the study were gathered from both primary and secondary sources. The data were collected using the following techniques:

i. Questionnaire survey: This was done on sampled farm household heads, extension workers and researchers. Two types of questionnaires were developed, which one of them designed for farmers and the other one for extension workers and researchers. The questionnaire survey was designed to generate socioeconomic and demographic characteristics of the respondents, indigenous knowledge and practices in the area, and issues related to research and extension activities. In order to measure the attitude of farmers, extension workers and researchers to indigenous knowledge, the questionnaire containing thirty one statements related to indigenous knowledge systems and practices was developed. For this purpose, Likert type scale with points ranging from 1 (strongly disagree) to 5 (strongly agree) was used.

Prior to the final administration of the questionnaires, five farmers, two extension workers and two researchers were selected for pre-testing. Based on the result of per-testing, some amendments were made. Lastly, comments and suggestions from respondents were considered and incorporated in the final version of the questionnaires.

ii. Field observation: Observations were made on physical characteristics and conditions, the condition of crops, degraded or well conserved areas, individual activities in the farming plots, and the condition of forest or grazing land. Any observation about the area was discussed with the local people.

iii. Key informant interview: The key informants were selected from community elders, researchers, extension workers in the woreda and woreda agriculture and rural development office. The identification of farmers who know the area best is a very vital starting point to know the community in detail. Usually, elderly people have a deep rooted experience and knowledge about the community and the locality. Accordingly, three farmers (one from each agro –ecological zone) were selected purposefully and interviewed. In addition, two extension workers, one researcher, socioeconomic expert at ARARI and head of Dejen woreda agricultural and rural development office were selected purposively and interviewed.

iv. Focus group discussion (FGD): FGD was done to triangulate, supplement and enrich the results of the other methods. Three focus group discussions were held with the first one comprising of eight farmers, the second one five researchers and the third one seven extension workers.

v. Secondary data: The author gathered data and information from both published and unpublished sources including statistical abstract, reports and books. The information was expected to supplement the primary data collected.

1.6.4. Data analysis and presentation

The study generated both qualitative and quantitative data pertaining to the problem. Hence, both qualitative and quantitative analysis techniques were employed to analyze the data. Data from interviews and focus group discussions were transcribed, classified and presented in a narrative form. Analysis of quantitative data was done by using descriptive statistics such as percentage and frequency distributions. In addition, mean scores were computed for selected indigenous knowledge statements to determine the level of agreement as perceived by farmers, extension workers and researchers.

1.7. Limitations of the study

The study explores the constraints of linkage between research, extension and farmers' indigenous knowledge and practice and the ways of linking them. During the administration of the survey instruments, farmers were suspicious of the purpose of the study and showed a sort of reluctance to offer the correct response, particularly regarding farm holdings, income, assets, expenditure and also on matters related to research and extension activities. To minimize the unreliability of the data emerging from this problem, much effort was made by the author, officials in the woreda agriculture and rural development office and data collectors to orient respondents about the objectives of the study.

1.8.1. Organization of the paper

The paper is organized into eight chapters. Chapter one deals with introductory remarks. The second chapter consists of conceptual framework and review of the literature. Description of the study area is made in chapter three. In chapter four, farmers' indigenous knowledge and practices are depicted. The attitude of farmers, researchers and extension workers to farmers' indigenous knowledge and practices is described in chapter five. Chapter six deals about the constraints to farmers, researchers and extension workers linkage. Chapter seven describes some possible mechanisms of linking research, extension and farmers and the last chapter makes summery, conclusion and possible recommendations.

Chapter Two

Review of related Literature

2.1. Conceptual framework

Recent years have witnessed the growing strength of a new world view in agriculture, i.e. the transfer of technology. In the transfer of technology paradigm, research decisions are made by scientists and technology is developed on research stations and handed to extension workers to pass them to farmers. This approach has failed to consider local complexity and the adaptive response of farmers (Pretty and Chambers, 1994; Rolling, 1994; Mattee and Lassalle, 1999). Technologies that were successful in one context have been applied to other irrespective of context. Figure 2.1 below illustrates the process of traditional research and development and technology transfer process

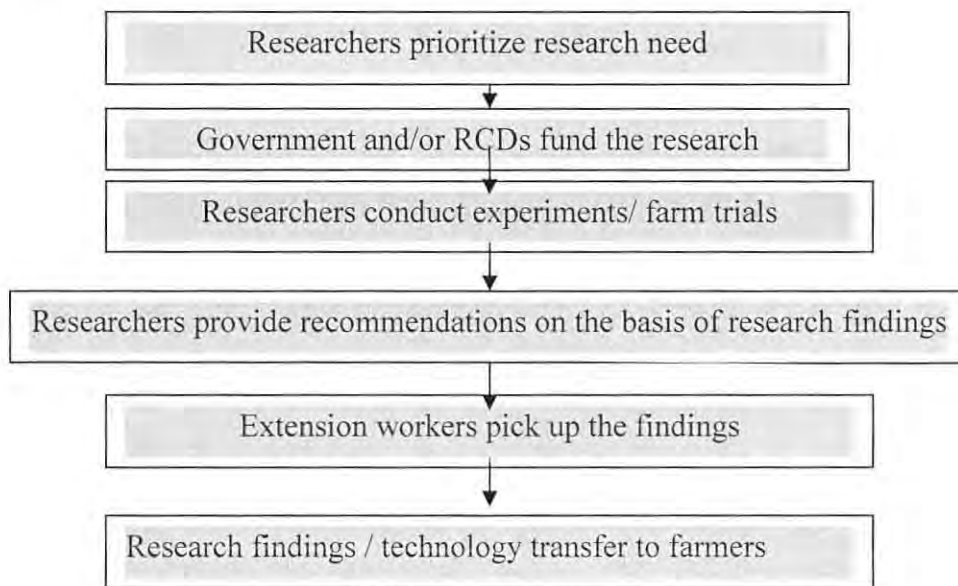


Figure 2.1 Traditional research and technology transfer process

Source: Maskey, et.al (2006). Linkages between Farmers, Extension and Research.

The above model of agricultural research and extension is based on the assumption that new agricultural research and technologies are developed and validated by scientists. These are then taken up by the extension agencies to promote the adoption of research results to farmers with the assumption that it will increase productivity at farm levels. This is commonly known as a linear top-down transfer of technology or linear adoption or diffusion model (Maskey, et.al, 2006). The transfer of technology model assumes that researchers are capable of identifying and prioritizing research needs; there is one way interaction between research and extension staff and farmers are the passive adopters of new research findings (ibid).

As noted by Rolling (1994), technology transfer focuses on technology generation by scientists and its transfer to farmers via extension. Farmers are basically considered as passive recipients of expertise from outside. The fact that technologies are developed by research institutes implies that the products are usually blanket recommendations, comprising routine, calendar based applications. The same source also noted that compared with conventional modern agriculture, sustainable agriculture is more complex, requiring the management of a greater ecological and economical diversity. Sustainable agriculture is information intensive instead of being physical input intensive (ibid). Information is critical in the management of highly complex systems for taking timely and multifaceted decisions in accordance with season, climate, crop needs, and pest and disease prevention. General principles must carefully be applied in local specific systems through active experimentation by local people. Farmers must know what they see and be able to anticipate outcomes on the basis of observation. This requires a great deal of knowledge about local conditions, seasonality and natural processes (ibid).

Rather than the technology transfer approach of conventional agricultural research, Chambers (1989) recommends the "Farmer First" approach whereby the knowledge, problem identification, analysis and priorities are done by the farmers as full participants. In comparing the transfer of technology and farmers first approach, Chambers cited in Dube and Musi (2002:2) states that: "with farmers first, the main objective is not to transfer knowledge, but empower farmers to learn, adapt, and do better". Analysis should not be done by outsiders, scientists, extensionists or NGO workers on their own, but by farmers assisted by outsiders. The primary location of research and development is not the experimental station, laboratory or green house (though they are necessary for some purpose), but farmers' field conditions. What is transferred by "outsiders" should not be perceptions but principles; methods rather than messages; a basket of choices from which to select but not a package of practices to be adopted. The menu, in short, should not be fixed but rather prepared based on response to farmers' needs which are articulated by them (ibid).

Now-a-days, it is realized that farmers are constantly engaged in the process of active innovation and invention and are constantly reworking and updating their knowledge in the light of new challenges and encounters with new forms of knowledge (Richards, 1986, 1987 cited in Mattee and Lassallee, 1999). As to Mattee and Lassallee (1999:106-107), this implies that: (1) Farmers have the capacity to take actions to improve their farming system, with or without the assistance of institutional research and extension; (2) Farmers' indigenous knowledge is dynamic and ever

changing, some thing created by farmers as part of their changing local environments, farmers will therefore always fall back on their indigenous knowledge whenever the merits of new technologies are not obvious; and (3) farmers will accept new knowledge and modify their indigenous knowledge when new challenges or conditions render their indigenous knowledge irrelevant or inadequate. Farmers are thus open to changes and are not as conservative as they are some times made out to be by institutional researchers and extension workers.

It is obvious, therefore, that farmers will place any new knowledge in deciding whether or not to adopt an innovation within the context of their indigenous knowledge. Hence, any development effort must start from and recognize the capacities of local people rather than relying exclusively on modern scientific knowledge. Unless people at the grass root level are consulted, involved and their knowledge subsumed, sustainable agriculture cannot be effective. It is for this reason that Gorjestani (2000:3) underlined “indigenous knowledge is an integral part of the culture and history of a local community”. As a result, we need to learn from local communities to enrich the development process. Needless to say, in order to have any impact, institutional research and extension must therefore start from and build upon the indigenous knowledge of farmers.

This study, hence, is based on the premise that the search for a solution to Ethiopia’s agricultural development and technology problems might be better served by building on a foundation of what people already know and what they have been practicing for a long period of time. This is not to argue, however, that indigenous knowledge systems and practices are the cure-all to the problem of sustainable agriculture in Ethiopia or that modern knowledge is incompatible with this process. On the contrary, both indigenous knowledge systems and practices and modern agricultural practices are critical components in the quest of sustainable agriculture. Indeed, integrating institutional research and extension activities to farmers’ indigenous knowledge and practices gives a solution to sustainable development of agriculture in Ethiopia.

2.2. Literature Review

2.2.1. Indigenous knowledge and sustainable agriculture: concept and definition

Sustainable agriculture is an integrated system of plant and animal production practices having a site specific application that will, over the long term, satisfies human food and fiber needs; enhances environmental quality and the natural resource base up on which the agricultural economy depends; makes the most efficient use of nonrenewable resources and on-farm resources; sustains the

economic viability of farm operations; and enhances the quality of life of farmers and society as a whole (Takiff, 1991). As it pertains to agriculture, the word sustainable denotes farming systems that are capable of maintaining their productivity and usefulness to society indefinitely. Such systems must be resource conserving, society supportive, commercially competitive and environmentally sound (Flora, 1992:38).

Different people have different meanings for the term sustainable agriculture. For some (e.g. Takiff, 1991) it means continuing present farming methods, while for others (Flora, 1992) it may mean a geological integrity at the expense of any other concerns. Ikerd (1990:43) defined sustainable agriculture as “a management” system for renewable natural resources that provides food, income and livelihood for present and future generations while maintaining or improving the economic productivity and ecosystem services of these resources”. Sustainable agriculture demands active stewardship on the part of people at the grass root levels and other concerned bodies. As to Pretty, et.al (1996), sustainable agriculture peruse: (a) through a minimization of the use of external and non renewable inputs that damage the environment or harm the health of farmers and consumers; (b) the participation of farmers and rural peoples in all process of problem analysis, technology development, adaptation and extension, and monitoring and evaluation; (c) a great predictive use of local knowledge , practice and resources and (d) an increase in self reliance among farmers and rural communities. The definitions discussed indicate that sustainable agriculture demands farmers’ local (indigenous) knowledge so as to make it sustainable.

The increasing attention indigenous knowledge is receiving by academia and development institutions has not yet led to a unanimous perception of the concept of indigenous knowledge. None of the definitions is essentially contradictory; they overlap in many aspects. But, there is some form of confusion between indigenous and local knowledge. Indigenous people are the original inhabitants of a particular geographic location, who have a culture and belief system distinct from the international system of knowledge. Some feel that such a definition is too narrow, in that it excludes people who may have lived in an area for a long period of time but are not the original inhabitants. This has led to widespread use of the term local knowledge, a broader concept which refers to the knowledge possessed by any group living off the land in a particular area for a long period of time. Under this approach, it is not necessary to know if the people in question are the original inhabitants of an area or not. The important thing is to learn how people in a particular area view and interact with their environment, in order that their knowledge can be mobilized for

the design of appropriate interventions (Langill, 1999). To simplify things, the two concepts (local knowledge and indigenous knowledge) are used interchangeably in this study to refer to the knowledge possessed by any group of people living on the land in a particular area for a long period of time.

Indigenous knowledge (IK) is the local knowledge-knowledge that is unique to a given culture or society. It contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities (Warren, 1991:5). Warren and Rajasekaran (1993:1) define indigenous knowledge as a knowledge that is unique to a given culture or society. It is the information base for a society which facilitates communications and decision making. Indigenous knowledge as perceived by them is the systematic body of knowledge acquired by local people through the accumulation of experiences informal experiments and intimate understanding of the environment in a given culture. Indigenous knowledge systems form the basis for decision making which is operationalized through indigenous organizations, and they provide the foundations for local innovations and experimentation (ibid). According to Thrupp (1993) and Brokensha, et al. (1980), indigenous knowledge systems are adaptive skills of local people usually derived from many years of experience that have often been communicated through oral traditions and learned through family members and generations. It is obvious that the most disadvantaged sectors of the society and rural dwellers are highly dependent on indigenous knowledge than the urban rich sections of the society to escape from the harsh life they are entangled with, thereby bring sustainable agriculture.

Indigenous knowledge, as stated by Gorjestani (2000), is used at the local level by communities as the basis for decision making to food security, human and animal health, education, natural resource management and other vital activities. He further noted that indigenous knowledge is a key component of the social capital of the poor and constitute their main asset in their efforts to gain control of their own lives. For these reasons, the potential contribution of indigenous knowledge to locally managed, sustainable and cost-effective survival strategies should be promoted in the development process. Similarly, Ghai and Vivian (1992: 34) stated that 'traditional (indigenous knowledge) systems have remained not only viable, but also active in many parts of the world. They further underlined the role of indigenous knowledge in protecting the surrounding environment

from some threats as although often dismissed as ‘intuitive’, it has in fact been distilled over centuries and is often the best guide to sustainable resource management”.

The pertinence of indigenous knowledge for farming is also noted as it has relevance combined with improved knowledge. With regard to the above notion, the former president of USA, George Bush (the senior), as noted by Tarkiff (1991), forwarded an idea that people at the grass root level should always be involved, consulted in order for sustainability to be achieved. It is pointed out that sustainable agricultural development could not be achieved when it is sponsored by outside donors, or by governments or by NGOs. Indeed, modern technologies usually come in bits and pieces, and in order to fit them effectively into and build upon the local systems, we need to have a thorough understanding of indigenous knowledge (Kajembe and Routatora, 1999). Emphasis should be given to the knowledge possessed by the rural people and their capabilities for assimilating, adapting, communicating and creating knowledge. Howes and Chambers (1979) noted that the richness and relevance of stock of indigenous knowledge often goes unrecognized...Rural people free of disciplinary blinkers usually not only know more about local conditions and needs but also take a more holistic view than specialists from outside. Their indigenous knowledge can complement organized conventional science

2.2.2. Indigenous knowledge systems and practices in Ethiopia

It is widely asserted that agricultural development in Ethiopia is hampered by lack of modern technologies. This view has been supported over the last two decades. Experience has shown that the problem is not in the lack of technology but in the process of its generation and dissemination. Usually technologies fail because they are developed without considering the changing and complex situation of the farmers. Conventional technology generation has resulted in undesirable outcomes, such as marginalization of indigenous knowledge, loss of self-confidence, and dependency on external resources (Mamusha and Mitiku, 2000). Increased attention has been given to indigenous knowledge in Africa very recently, leading to an increase in participatory research methodology, which emphasizes learning from farmers, involving them in problem prioritization, and including them directly in the experimentation process (ibid)

Ethiopia is very rich in different indigenous knowledge systems in such areas as architecture, medicine, agriculture and cottage industry. After a critical assessment and observation of IKS in different parts of Ethiopia, Wossen (2000) explained that the Konso people are famous for their

traditional skills in hillside terracing and banding. They also practice traditional irrigation to supplement the meager precipitation received during the cropping seasons. In Bale administrative zone, farmers prepare a trench around a potato plot to protect it from a porcupine. In Gonder, farmers shift their barn from one farmland to another to fertilize the land. The people in Wolqite, Wolisso and Tilili areas are skilled in horn-works. Around Debre Berhan and in Tigray it is common for the residents to build their houses from stone, mud and ash. The Stella of Axum, the rock-hewn churches of Lalibella, and the castles in Gondar are some of the standing monuments of civilization in ancient Ethiopia regarding architecture. With regard to metal works, what is today known as annealing and hardening is very common with every Ethiopian traditional blacksmith. To soften a metal piece, he/she puts it in a fire until it becomes red - hot and air cools it, and to harden a metal piece he/she puts it in the fire until it gets red-hot and immediately immerses it in cold water and withdraws it. In rural parts of Ethiopia, if some one is struck by lightening, the survivor will be brought immediately into contact with moist ground or dung. This practice is substantiated by static electricity theory though the rural people are unable to explain it (ibid).

Another example of IKS is derived from the work of Tafesse (2005) in Afar. The Afar people are one of the major ethnic groups raising camels in Ethiopia. Afars use mineral and different herbs to treat gastrointestinal diseases in camels. Traditional recognition of diseases, prevention and treatment to cure diarrhea, constipation and bloat in the Southern Afar region are other examples of IKS. The traditional practices are based on symptoms rather than on the causative organisms (ibid). Tafesse further noted that either several herbs now in use will be overexploited or the knowledge will be eroded with the advance of conventional medicine. Traditional veterinary medicine can make fast progress in research, since it is relatively easier to make participatory experiment with pastoralists, including conducting post-mortem examinations.

The family planning practice of the Surma people is another case in point (Amare, 2005). The Surma live in the Ethio-Sudanese border region subsisting on agro-pastoralism, hunting and gathering on precarious environment with insecure rainfall (averaging 480mm). Premarital sex is a common practice among the Surma. The girls will have a greater opportunity for marriage if they date many male partners, as this signifies popularity. Surma girls wear beads on their waist, make knots on ropes they carry, incise their lip and ear to communicate specific messages, all as part of an accepted norm. Mothers also teach their daughters when to have sex, how to avoid unwanted pregnancy and how to manage their sexuality. These and other indigenous ways of family planning

are followed by the Surma. In conclusion, the majority of the people in the rural areas does not know and/or do not use modern family planning methods nor are they concerned with family planning as such. They may, however, like the Surma, have indigenous mechanisms for birth spacing. Therefore, it is recommended to seek ways to understand local wisdom and techniques related to family planning and integrate this with the modern concepts of family planning (ibid)

Negash, et.al (2000) in their research work conducted in North Shoa of the Amhara Region, identified practices used to conserve the physical or quantitative soil and runoff water. Eleven ISWCP were identified in the study area namely: 1) *Golenta / Garda / Yewhabat / Gorfinkelbesha*; 2) *Wagemet / Boi-mekelbesha / Adengale*; 3) *Boi*; 4) *Yedengay Erken*; 5) *Afer Metebekia*; 6) *Dinber Shileta / Dinber Metew*; 7) *Local vegetative barriers*; 8) *Erken Meshar*; 9) *Degele*; 10) *Stone bund plus vegetation*; and 11) *Yedengay Kiter* (See the glossary for their meanings). In his research work on Digil watershed, Michael (2002:80) confirmed that a pool of indigenous land management practices are/were practiced by farmers. The indigenous physical soil conservation techniques that are applied to control erosion include construction of stone bunds, traditional ditches (feses), traditional water ways (bahlawi boi), traditional cut off drain (tekebkeb), and contour ploughing. In addition, different indigenous agronomic conservation practices are also employed for land management. These include inter-cropping, cover cropping, improved or seasonal fallowing, through cropping *gibto* (lupines lupine), manuring through animal parking, and crop rotation. These indigenous agronomic measures are also found to be important measures of enhancing the fertility of soils.

2.2.3. Overview of Agricultural Research and Extension Practices in Ethiopia

Agricultural research and extension work started in Ethiopia with the establishment of the Imperial Ethiopian College of Agriculture and Mechanical Arts. In the decade following its establishment, IECAMA was active in building the national agricultural research and extension systems. In 1963, the national agricultural extension work was transferred to the Ministry of Agriculture. Since then, the Ministry of Agriculture has been the sole authority responsible for the national agricultural extension system. Following the transfer of the responsibility for national extension administration to the Ministry of Agriculture, extension service became one of the departments in the Ministry. Over the years, the Ministry has implemented different extension approaches, such as the comprehensive package program (CPP), and the minimum package program (MPP) (Belay, 2003; Tesfaye, 2003; Belay and Degnet, 2004, Belay, 2006)

As a responsible organization for agricultural extension, MoA is the only institution that has direct link with the farmer. Over the years, MOA has followed different approaches to reach farmers. In the 1960s and early 1970s, intensive regional agricultural development projects were launched in the country. The first series of package programs were the maximum package programs (MPPI), which included the Chilalo Agricultural Development Unit (CADU) that was founded in 1967 through Swedish International Support (SIDA), the Wollaita Agricultural Development Unit (WADU) founded in 1971 through World Bank support and the Ada District Development Project (ADDP) which came into existence in 1971 through the USAID support. These projects focused on providing comprehensive support including infrastructure and technological input to specific regions where the projects were located. Their coverage was, therefore, limited to areas where the projects were located. This of course caused regional economic inequalities. Because of the high investment required and the need for skilled staff, it was found difficult to replicate the intensive MPPI project in other regions of the country (Belay, 2003; Tesfaye, 2003; Belay and Degnet, 2004; Belay, 2006).

Thus a more comprehensive minimum package program (MPPII) of the Extension and Program Implementation Development (EPID) was created within MoA in 1971 (Tefaye, 2003). All the intensive regional development projects like CADU, WADU and ADDP were included under EPID program as part of a national extension network. EPID's programs were assisted by FAO's Freedom from Hunger Campaign (FFAC) and its major focus was on fertilizer followed by improved seeds and pesticides (ibid). The richer farmers benefited from the regional projects and the MPPII of EPID. These approaches also helped in the development and expansion of commercial farms prior to the 1974 revolution (ibid). The majority of the farmers were not the beneficiaries of these projects, perhaps with the exception of model farmers and those along the roadside in the case of MPPII.

As a follow-up to MPPII, the Peasant Agricultural Development Project (PADEP) was launched in 1983. This project was intended to enhance input distribution, promote the role of cooperatives in rural development, improve linkage between research and extension, and improve the performance of extension based on Training and Visit (T & V) concept. The three key elements of T & V approach were to (a) promote effective communication with farmers; (b) strengthening linkage between research and extension; and (c) improving the performance of extension based on training and visit (Belay and Degnet, 2004:149). In the Ethiopian context, the T & V system bridged the

communication gap between the farmer and the extension agent, but the linkage between research and extension remained unchanged. As stated by Alemneh (1989:29) the training of extension agents on a bi-weekly basis was boring and redundant. The same author said that the system was not supported by effective and strong technology generating network.

In summary, there is consensus amongst some writers (Belay, 2003; Belay and Degnet, 2004: 148-149, Belay, 2006) who indicated that extension approaches prior to 1993 shared some common shortcomings. These include: inappropriate choice of extension approaches and strategies, lack of extension professionalism and relevant agricultural technologies, low research and extension linkages, and poor participation of farmers in generation and utilization of technologies. These situations led the new government to think reforming the extension service to assist its economic development policy, chief of which being the Participatory Demonstration and Training Extension System (PADETES) that began in 1995 (Belay and Degnet, 2004).

PADETES was adopted from the Sasakawa Global 2000 (SG 2000) Extension strategy. It was initiated in Ethiopia in 1993 by the Sasakawa Africa Association and the Global 2000 of the Carter Center. PADETES was developed after a critical evaluation of the past extension approaches and the experience of SG 2000. Its major objectives include increasing production and productivity of small-scale farmers through research-generated-information and technologies 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 (Belay, 2006). The system gave special consideration to the package approach in agricultural development. Initially, PADETES promoted cereal production packages and the beneficiaries were mainly those farmers who were living in high rainfall areas of the country. Over the years, however, the packages have been diversified to address the needs of farmers who live in different agro-ecological zones of the country (ibid).

A closer scrutiny of the different extension approaches reveals that they were planned and implemented without the participation of the very people for whom they have been designed. Apart from being biased against the livestock sub-sector, these approaches have captured farmers located only a few kilometers from both sides of all weather roads (Belay, 2003). The success of extension work depends partly on the quality and number of front-line workers. However, at present the

number of extension personnel in the country is very small compared to the number of farmers they are expected to serve (Belay, 2004).

As far as agricultural research is concerned, it was first initiated by IECAMA. In fact, for more than a decade, the College and its central experiment station in Debre Zeit had a national mandate to carry out and co-ordinate agricultural research. In 1966, the Imperial Government transferred the responsibility of agricultural research to the newly established Institute of Agricultural Research (IAR), which was established in February 1966 with a mandate to formulate the national agricultural research policy; to carry out agricultural research on crops, livestock, natural resources, and related areas in various agro-ecological zones of the country; and to coordinate national agricultural research (Negarit Gazeta, 1966 quoted in Belay, 2006). With the establishment of IAR, agricultural education, agricultural research and extension splitted up and became answerable to three separate and independent administrative structures. This structural change nipped in the bud the evolving linkage among agricultural research, extension and education systems. This weakness persisted until now during which there has been no clear mechanism of linkage among the Ministry of Agriculture, the national agricultural research system and agricultural institutions of higher education.

Since the establishment of IAR, Ethiopia has a national agricultural research system with an autonomous management possessing major and minor stations covering the major ecological zones, and the major commodity and discipline groups. Until its replacement by the Ethiopian Agricultural Research Organization (EARO) in 1997, the IAR remained the only organization in the country with a clear mandate solely devoted to agricultural research. Over the years, other organizations, which are involved in agriculture related research activities, have been established under the Ministry of Agriculture. These included: the Plant Protection Research Center (PPRC); which was established in 1972 and operated under the Ethiopian Science and Technology Commission that was later merged with IAR in 1995; the Plant Genetic Resources Centre of Ethiopia, which was founded in 1974 and later called the Biodiversity Institute (BDI); the Forestry Research Centre (FRC) that was established in 1975; the Wood Utilization Research Centre (WURC) founded in 1979; the National Soils Laboratory (NSL) established in 1989; and the Institute of Animal Health Research (IAHR), which became operational in 1992 (Getinet and Tadesse, 1999 quoted in Belay, 2006).

Agricultural research underwent significant reform in the 1990s when the current government committed itself to a decentralized political system in the country. More precisely, in 1993, some IAR centers were decentralized to create independent research centers run by the respective regional governments, namely the Regional Agricultural Research Centers (RARCs) that are administered by respective regional bureaus of agriculture (Belay, 2006). However, in the past five years, the Amhara, Oromia, Somali, Southern and Tigray Regions have established their respective Regional Agricultural Research Institutes (RARIs) that have agricultural research as their mandate they coordinate research activities of agricultural research centers within their respective regions (ibid).

As has been discussed above, agricultural research has been undertaken by different organizations without proper co-ordination. The end result was duplication of efforts and wastage of resources, which proved to be excessive for a country that can ill afford. The problem seems to be appreciated by the current government when it reorganized the national agricultural research system under the umbrella of the newly created Ethiopian Agricultural research Organization (EARO) in June 1997 Proclamation number 79/1997, which established EARO, has put the organization objectives as follows: (a) generate, develop and adapt agricultural technologies that focus on the needs of the overall agricultural development and its beneficiaries, (b) coordinate research activities of agricultural research centers or higher learning development needs; and (c) popularize agricultural research results (Belay, 2006 citing Federal Negarit Gazeta, 1997). The current National Agricultural Research System (NARS) is made up of three types of institutions: The Ethiopian Agricultural Research Organization (consisting of the different research institutions/centers that have been merged within the then EARO the now EIAR), the Regional Agricultural Research Centers/institutions (RARCs/RARIs) and agricultural institutions of higher education

The first two are the largest of the NARS institutions. The ARCs/RARIs conduct research that addresses the specific needs of a particular region. They promote multidisciplinary research at the regional level. Besides, they participate in collaborative national research programmes on one or more of the following programs: crop, livestock, and natural resource commodity (Belay, 2006). EARO funds the budget requested by the research projects after getting approval from a national review forum. Regional governments also fund the research projects that focus on the specific agricultural problems of the agro-ecological zones in each region. Currently, there are 39 regional Agricultural Research Centers. Some of these RARCs have been established over the last three years with the financial support from the World Bank supported Agricultural Research and Training

Project. Even though the number of RARCs has increased significantly over the last five years, attempts are still being made to cover agro-ecological zones that are not covered by EARO. Given the country's ecological diversity, it will still take years before technologies suitable to the different locations of the county are developed (ibid).

2.2.4. Research-Extension- Farmer Linkage: Some Issues

To date, most developing countries face a huge challenge of freeing their population from poverty, hunger and other forms of deprivations. Indeed, the agricultural research and extension institutions are expected to help increase agricultural productivity, which in turn contributes in reducing poverty and raising the living standards of people (FAO, 2000). Research-extension organizations are established as instruments for promoting agricultural development. They can operate successfully if there is commitment from governments. In a broader sense, research is understood as generating new technology to solve a particular constraint while extension as simplifying research information and deliver to farmers in a manner that is effective and easily understandable. The extension service is also considered as a feedback mechanism to revise researchers' research agendas based on problems faced by farmers (ibid). Neither research nor extension can fulfill its responsibilities without the other. As a result, good communication, strong interaction and effective collaboration stand as primary requisites. Research-extension- farmer linkages are important in transferring and utilizing developed technologies from those who generate them to the end users (ibid).

The linkage between research, extension and farmer are vital for successful technology development, delivery and utilization. The poor linkage between research output and technology transfer constitute a chronic problem in most developing countries. Such a problem is responsible for failure to disseminate research results to farmers. Linkages refer to channels for the two-way flow of knowledge, information and resources among research institutions and their partners or among the actors of rural/ agricultural development. Partners in this regard include all that are directly or indirectly involved in agricultural development initiatives ,viz. extension institutions, technology multiplying institutions, marketing institutions, financial institutions, farmers, input supplying institutions, policy makers and the like (Eponou, 1993a).

The purposes of linkages are therefore to: (a) channel information, knowledge and resources among actors; (b) coordinate diverse tasks among actors; and (c) improve efficiency in resource use (Eponou, 1993a). The ultimate objective of linkages is to establish a more responsive system that

can deal with the diversity and heterogeneity of its client groups. The specific objectives of linkages are, however, to: (1) build an efficient system and thereby ensure increased flow of relevant technologies to users, (2) build effective and efficient coordination and collaboration among the actors so as to ensure the smooth flow of information, knowledge and resources among them, (3) ensure better utilization of resources, and (4) enable different institutions to adapt to new requirements and challenges (*ibid*). Without linkages, each actor makes little impact. With linkages, however, the system is stronger and the total impact is greater than the sum of the output of each individual actor. Strong linkages ensure that: (a) researchers take users' priority needs and problems; (b) farmers and technology transfer workers keep up with research developments; (c) research results from research stations are applied to solving farmers' problems and expanding their opportunities; (d) available technologies are adapted to suit local agro- ecological and socioeconomic conditions; (e) successful technologies are promoted and distributed easily and widely to farmers; (f) users have access to the information, inputs and services required to support technology; and (g) researchers can capitalize on users' knowledge to obtain feedback on the relevance and performance of technologies (Akalu, et.al, 2005:6)

To communicate effectively, both research and extension should be efficient and must have well-qualified and motivated staff, who have an adequate resource-base to work from. The research-extension-farmer nexus should be viewed as an interdependent and inter-related continuum. The confidence of farmers is built through well-planned and gradual but comprehensive introduction of proven new technology. Extension and research arrangements in all developing countries reveal a large degree of similarity in terms of organization and underlying conceptual framework. However, national policy makers and donor organizations have identified weak links between research, extension and farmers as the major factor limiting technological change (World Bank, 1990). Technology transfer continues to be understood as the primary and often the single mandate of extension in most countries of the world. Inadequate technology adoption has been attributed to existing weaknesses in research, extension, farmer linkages. Notwithstanding these problems, several measures in many Asian countries have been taken during the last two decades to improve the linkage mechanism (*ibid*).

Linkage mechanism refers to any structural or managerial device or procedure used to enhance the complementarities of the technology generation and transfer processes. In addition to structural interventions, there are four basic types of mechanism to strengthen linkages: (a) joint planning and

review processes; (b) collaborative professional activities; (c) resource allocation procedures, and (d) communication device (Akalu, et.al, 2005: 8). The literature analysis shows that these various types of mechanisms are appropriate for different kind of linkage problems. Moreover, different types of technologies require different types of linkage mechanisms. To build effective links with technology user, it is preferable to use a combination of various mechanisms and apply them at different levels of the institutional hierarchy. A linkage mechanism should be put in place wherever a gap in the flow of information or resources is likely to occur. Linkage mechanisms are required for the following specific functions: planning and review; program formulation and priority setting; collaborative professional activities; exchange of resources to enhance capacity to obtain precise products; dissemination of knowledge and information and co-ordination of professional activities (ibid).

To serve the system well, linkage mechanisms must be relevant according to the function and the context, the size and the type of gap, accessibility to all actors, the financial capacity of the system and its components and the capacity of the mechanism to channel the needed information and/or resources. From this one may derive a conclusion that flexibility is essential in choosing the mechanisms because different technologies and different sets of farmers may require different types of mechanisms even for the same strategy. Careful selection, correct management and favorable linkage climate can avoid risks (Eponou, 1993b)

In one way or another, however, the interface between research, extension and technology transfer is an important one in determining the performance of the whole system. The research-extension-farmer relationship, although apparently ideal in theory, has not been successful in many parts of the world. It is well stated that bridging the gap between researches, extension and farmers is the most serious institutional problem in developing research and extension programmes and disseminating the results to farmers. Extension workers often see researchers as people working in an ivory tower generating technology not applicable to the farm, whereas researchers often question the ability of the extension agents to perform their jobs effectively (Rolling ,1990). The constraints which hinder research-extension and farmers linkage potentially affect the agricultural output of farmers. Rolling (1990:248) argues that, historically, research has stopped too early in what should be a continuous and dynamic process of developing and diffusing the new technology.

It is argued that although linkage mechanism has improved in recent years, there still exists some interface that no linkage method can bridge (Rolling, 1990). The status of functional differences between the two institutions of research and extension may be too wide given the divergent goals, competition for resources, etc. There are still some historical, organisational and structural impediments, which together with the traditional orientation of most of the research and extension entities make close linkages very difficult to establish. Nevertheless, the effective relationship between the 'developer of useful technology,' 'deliverer' and 'consumer' is indispensable and therefore should be examined and regional programme proposals should be designed and focused to help solve these problems(ibid).

2.2.5. Constraints to Research- Extension- Farmer Linkage

There is no dispute that research and extension efforts, particularly in developing countries, have not always achieved the desired results (Eponou, 1993b). As noted by Arnon (1989:749), the former chair of the Board for International Food and Agriculture Development, C. Wharton, emphasized the problem in the following statement: "If there is an area in which we have been most unsuccessful, it has been in the development of cost effective means for the delivery of scientific and technical knowledge to the millions of farm producers in the third world".

There are many reasons for this restricted progress. Shortcomings in the extension and research services can result from organizational and operational deficiencies ineffective personnel, economic constraints; poor linkages with other institutions; and political, cultural and social constraints (ibid). Extension services in developing countries are often badly under-equipped in terms of staff, transport and accommodation. They often lack the technical skills. Furthermore, in developing countries, where small scale agriculture is the norm than the exception, wide arrays of crops are grown in a particular region. This adds another dimension to the level of technical skills and expertise needed by the extensionists. The inadequacy of resources and skills reflects the low priority given by most governments to agricultural extension. It generates poor morale leading to general ineffectiveness. The same author attributes dilution of effort; coverage and mobility problems; lack of training; lack of ties with research; and low status in society (low pay, few incentives, and poor facility) as the primary causes for the malaise of the extension service and the poor coordination between research, extension and farmers(ibid).

The extension service is generally given the task of acting as an intermediary between researchers and the farming community. The extension agent is supposed to go out to the farm, collect information about perceived and unperceived needs of farmers and transmit it to scientists. The latter are then supposed to design appropriate solutions and give them to extension agents who are supposed to pass them back to the farmers. The system seldom works as designed. Extension workers generally fail to accurately perceive the situation of the farmers by either transmitting false information or failing to transmit information at all. Researchers consequently begin concentrating on research agendas which they find personally interesting, but for which there may be no practical application in the farmers' field. When findings that are generated under such circumstances are transmitted to extension agents they are seldom properly understood. At the end of the day, the farmers receive either no advice or advice for which they have no use or advice which, since it was only partially understood by the extension agent, is incomplete and difficult to apply (Akalu, et.al, 2005).

According to Arnon (1989), public agricultural research institutions often have poor relations with extension agencies and farmers. Bridging the gap between research and extension is the most serious institutional problem in developing a research and extension program. Arnon (1989) suggests that farmer involvement in agricultural research has been limited by inadequate funding, institutional policies and hierarchies, specialization and incompatible personalities and disregarding their innovative capacity and knowledge systems. Generally speaking, according to Albrecht, et.al (1989:186) and Arnon (1989:786-787), numerous causes of poor links between the three have been proposed. A short list of the proposals include the administrative separation of the research and extension functions, complex institutional structures, status differences between scientists and extension personnel, the geographical distance between farmers researchers and extension workers, different time horizons, different motivations and personal orientations, different educational levels and other personal characteristics, lack of accountability to clients, lack of resources and infrastructure, lack of relevant research results, institutional rivalries, inadequate planning and coordination, lack of research continuity, researchers' unwillingness to take unconventional actions, failure to involve small farmers in research planning and implementation, researchers' and extension workers ignorance of local knowledge, and their neglect of long term social and ecological effects (ibid).

Chapter Three

Description of the Study Area

In this part of the study, an attempt has been made to describe the physical and human environment setting of the wereda in general and the sample households in particular. The data were generated through questionnaire survey, observation and review of secondary sources.

3.1. Physical -Environmental Setting

3.1.1. Geography and location

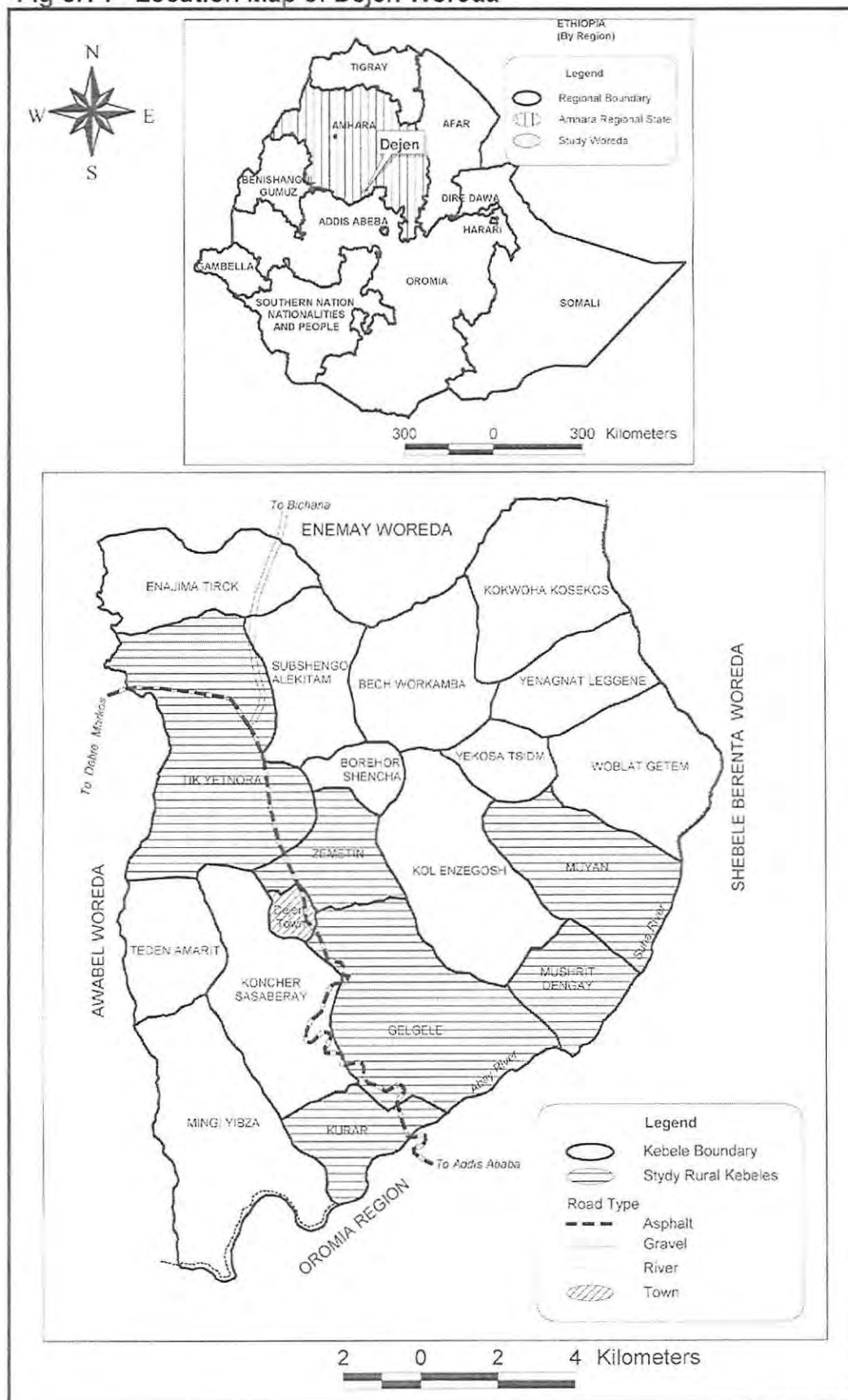
Dejen wereda is situated about 230 Kms north of Addis Ababa. The wereda is almost encircled by the Abbay River and its tributaries. It is one of the 14 weredas in East Gojjam zone with an area of 571 square kms. It is known to be the second smallest district in the zone with respect to its areal coverage. It is bounded by Awabel Woreda to the west, Debay-Tilatgin wereda to the north, Shebel Berenta and Inemay weredas to the north east and North Shewa administrative zone of Oromia Region to the south. The district has 19 rural kebele administrations and two-urban kebele administrative units.

3.1.2. Topography and soil

Dejen is part of the North Central Massifs of Ethiopia. It has altitude ranging between 1100m and 3400 meters above sea level. The wereda is characterized by rugged terrain and plain surfaces. Those kebeles that are found in the valley of the Blue Nile have highly undulated topography consisting of hilly lands and ridges. On the other hand, those which are found out of the valley have flat type of topography. The wereda is drained by Abbay River and its tributaries (Molla, 2005)

In terms of soil, the north western, south western, northern and central parts of the wereda are dominantly nithosols having colors ranging from red to reddish brown. They have deep profile and are easy to work structure. In some parts of the woina dega, one finds black soils displaying cracks and sticky characteristics during dry and wet seasons respectively. Soils that are found in kola zones are gray, red, and whitish. They are shallow and extremely stony (Endalkacew, 2001; Molla, 2005).

Fig-3.1 :- Location Map of Dejen Woreda



Source:-CSA

3.1.3. Climate and vegetation

On the basis of altitudinal variation, the woreda has been categorized in to three temperature zones- *kola*, *woina dega* and *dega* having elevation 1100-1600 m, 1600-2400m and 2400-3400m respectively; and average annual temperature of 21-24⁰c, 16-21⁰c and 11-16⁰c, respectively (Tadesse, 1989). The lowland rural kebele administrations experience frequent drought, and hence moisture stress is the binding problem for their agricultural production. The mid-altitude rural kebeles, on the other hand, receive relatively sufficient amount of rainfall and are more productive.

With regard to vegetation, the area comprises various types ranging from gallery forest in the lowlands (*kola*) to bamboo forest in the Dega zone in response to the variation of soils, climate and human activities. Currently, matured and naturally grown trees are observed in the aged church compounds and in some homesteads only. In the remaining areas, natural vegetations are very much degraded. However, some of the major indigenous tree/shrub species which still survive in the area include: "*Warka*" (*Ficus vasta*), "*Bisana*" (*Croton macrostachys*), "*Cheba*" (*Acacia* species), "*Digitta*" (*Calpurnia aurea*), "*Girawa*" (*Vernonia amygdalia*), "*Kosheshila*" (*Acanthus sennii*), "*Agam*" (*Carissa edulis*), "*Woirra*." (*Olea africana*), etc. besides, important exotic tree/shrub species such as "*Nech Bahir Zaf*" (*Eucalyptus globules*), "*Key Bahir Zaf*" (*Eucalyptus camallulensis*), "*Yeferenge tid*" (*Cupressus lusitanica*), "*Shiwshiwe*" and (*Casuarina equistifolia*) are commonly observed in the area (Molla, 2005)

Deforestation has been going on over a long period of time. People have destroyed the vegetation for varying seasons such as for settlement, cultivation, firewood and charcoal and construction. This removal of the vegetation has vividly exacerbated soil erosion in the area, more specifically in the rugged parts of the woreda (Endalkacew, 2001; Molla, 2005).

3.1.4 Land use and farming systems

Land, with no doubt, is a critical resource particularly for people residing in the rural areas. Hence, to acquire the maximum possible benefit from the existing size of land, it should be categorized and devoted into purposes for which every plot is best suited to. However, the land use type of the study site does show merely the current purposes to which a given size of land is devoted. According to the information collected from the woreda agriculture and rural development office, the land use type and the area coverage of the woreda are listed in Table 3.1.

Table 3.1. Land Use Classification of the Study Area

Land use type	Area (Hectare)	% of total
Land devoted for annual crops	27, 518	48.19
Land devoted for perennial crops	462	0.81
Grazing land	3796	6.65
Forest and bush/scrub land	7893	13.82
Currently unproductive land	10,915	19.12
Land devoted for settlement and infrastructures	6509	11.40
Total	57,093	100.00

Source: Annual Report of Dejen Woreda Agriculture and Rural Development Office, 2007

The land use system is mainly influenced by land tenure. Regarding the land tenure system, all farm households in the study area, as in the rest of the country, are entitled to use their holdings but not allowed to mortgage or sale it. In light of this, farmers were asked to state whether the existing land tenure system has a negative effect in their participation to extension or not. The result has shown that 41 sampled farmers (68.3%) replied no for the question. They said that, though the land is the property of the government, as far as we do not sell or mortgage the land, we do have the right to use the land for whatever purpose we like and we feel that the land is ourselves.

The farming system in the region is characterized by mixed farming. The agro-climatic condition of the region is favorable for growing diversified types of crops and to rear different species of animals. Teff, maize, sorghum, wheat, barely, oilseeds and leguminous plants are grown in the woreda. Production is undertaken during the summer season, once per year. If rain is not sufficient in amount and do not keep its normal cycle, farmers in the area often face hazards of drought and hence food shortage. As observed in the field, farmers in the study area use their land mainly to produce cereals, oil seeds and leguminous crops and to some extent to graze their animals. They never leave their lands fallow because there is an obvious trend of shrinking land size from time to time.

3.2. The human environment: farm household circumstances

3.2.1. Demographic profile

According to the 1994 national census of Ethiopia, the population size of the woreda was about 87,469 of which 42,440 (48.5%) and 45,029 (51.5%) were males and females, respectively. The same source indicated that about 33.4% of the total population was literate ranging in level from elementary to tertiary education. As indicated in Table 3.2 below, of the 60 farm households surveyed, 43 (71.7%) are male headed households and 17 (28.3%) are female headed households. The same table shows that the overwhelming majority of the respondents are in the economically active age group, i.e. 42 (70%) of the respondents are with in the age range of 35-54, the rest 12 (20%) and 6 (10%) are with in the age range of > 55 and 25-29 respectively. The mean age of the respondents was 45.88 with minimum and maximum age of 27 and 72. This age distribution is an indication that the great majority of the farmers are in the working age group and thus it can not be a limit for involvement in agricultural activities. All the respondent farmers are orthodox by religion.

Table 3.2. Age and Sex Composition of Sample households

Age group	Male		Female		Total	
	Frequency	% of total	Frequency	% of total	Frequency	% of total
25-29	3	6.98	0	0	3	5.0
30-34	2	4.65	1	5.88	3	5.0
35-39	7	16.28	5	29.41	12	20.0
40-44	6	13.95	3	17.65	9	15.0
45-49	9	20.93	3	17.65	12	20.0
50-54	7	16.28	2	11.76	9	15.0
> 55	9	20.93	3	17.65	12	20.0
Total	43	100.00	17	100.00	60	100.00

Source: Based on field survey, March 2007

The distribution of respondents according to educational level (Table 3.3) shows that 23 (38.3%) were illiterate, 12 (16.7%) can read and write only and the rest 18 (30%), 2(3.3. %) and 5 (8.3%) attended primary, junior secondary and high school, respectively. In sum, 25 (41.7%) of the respondents have attended formal education. With regard to marital status, 41(68.3%) of the sample farmers were married, 10(16.7%) widowed, and the rest 9 (15%) divorced. All widowers and divorcees are female headed households.

Table 3.3 Distribution of Sample households by educational level

Educational level	Frequency	% of total
Illiterate	23	38.3
Read and write only	12	20.0
Primary school complete	18	30.0
Secondary school complete	2	3.3
High school complete	5	8.3
Total	60	100.0

Source: Based on field survey, March 2007

3.2.2. Farmers' income level

Table 3.4 below indicates the average annual income of respondents. As shown on the table, 13(21%) of the farmers had an average monthly income of < 3000 Birr, 23(38.3%) 3001-6000 Birr, the rest 12 (20%), 11(18.3%) and 1(1.7%) had average annul incomes of 6100-9000, 9100-12000, and 12000-16000, respectively. In sum, the sample households have an average annual income of 6022.33 Birr (SD + 3382.09). The high standard deviation indicates that there is a significant income variation among farmers. This is because, as farmers respond, some farmers who do have the potential are engaged in a variety of extension packages than others. Those engaged in different packages got better income than those who do not.

Table 3.4 Distribution of respondents by average annual income

Average Annual income(Birr)	Frequency	% of total
< 3000	13	21.7
3100-6000	23	38.3
6100-9000	12	20.0
9100-12000	11	18.3
12100-16000	1	1.7
Total	60	100

Source: Based on field survey, March 2007

3.2.3. Land holding

During the field observation, it was observed that all the arable lands available were devoted for crop production. Hence, opportunities for households to cultivate new lands were negligible. The distribution of farm size among the surveyed households is depicted in Table 3.5. The average land holding size was 1.43 hectares (SD. $\pm$ 0.57). Taking the average household size of the sample households, the per capita land holding size was 0.24 hectare. There was a significant variation in the size of land holdings among households. Of the total sampled households, the majority, i.e. 33 (55%), possessed between 0.6-1.5 hectares of land, 5% of the farmers (3) had more than 2 hectares while others, i.e. 8 (13.3 %) had < 0.5 hectare.

Table 3.5. Distribution of respondents by land holding Size

Total land held (ha)	Frequency	% of total
< 0.5	8	13.3
0.6-1.0	12	20.0
1.1-1.5	21	35.0
1.6-2.0	16	26.7
> 2.0	3	5.0
Total	60	100.0

Source: Based on field survey, March 2007

3.2.4. Household size and labor supply

Like in other areas of Ethiopia, in the study area household members are the suppliers of labor needed for the implementation of agricultural practices. Indeed, both male and female family members share the responsibility for crop production in the area.

Table 3.6 Distribution of respondents' by total household size and number of family laborers

Household size (number)	Frequency	% of total	Family laborers	Frequency	% of total
< 3	10	16.7	< 3	29	48.3
4-6	27	45.0	4-6	25	41.7
7-9	17	28.3	7-9	5	8.3
> 10	6	10	> 10	1	1.67
Total	60	100.0	Total	60	100.0

Source: Based on field survey, March 2007

As can be seen in the above table (3.6), 45% of the households had 4-6 family members and 28.3 had 7-9 members. The mean number of family size per household was 6.05 ($SD \pm 2.47$) with a range of 0-12 number of individuals per household. The mean number of family farm laborers¹ per household was found to be 3.72 adults ($SD \pm 2.03$ adults) with the mean number of male laborers 2.08 ($SD \pm 1.21$) per household which is greater than their female counter parts, i.e. 1.37 ($SD \pm 0.49$). Here one thing is clear, i.e. the number of family laborers is not proportional to the family size. For instance, 48.3% and 41.7% of the respondents had < 3 and 4-6 family laborers respectively, while the percentage of respondents with family size < 3 and 4-6 members were 16.7 % and 45.0 %, respectively. This indicates that the number of family laborers is by far lower than the total family size of the sample households indicating the existence of large number of unproductive family members.

Farmers were asked to tell whether they need more children in addition to what they have or not. 39 of the respondents (65%) replied that they don't like to have more children for a number of reasons. Firstly, they said that land is scare and feeding additional children is very difficult. Secondly, the living condition is becoming worse compared to the previous times and thus nurturing and educating additional children is impossible. Thirdly, what they earn and what they spend do not match. This in one way or another indicates that farmers are aware of limiting their family size as per the resources they have. This needs to be encouraged by the concerned governmental and nongovernmental bodies so that a balance can be created between family size and income level of farm households.

Similarly, farmers were asked whether their family labor is sufficient to accept and practice extension activities or not. Accordingly, 38 (63.3%) of the farmers replied that their family labor is sufficient to undertake extension related agricultural activities and those who replied insufficient, i.e. 22 (36.7%) reported that they were using other sources of labor like share-cropping, locally called *Kurcha* (giving certain amount of produce from what is produced after harvest); using labor sharing organizations like *debo* and *wenfel* and from indigenous and informal social organizations like *idir*, *mahber*, *senbete*.

¹ Family laborers in this study refers to those household members who are involved in agricultural and non -agricultural activities

Chapter Four

Farmers' Indigenous Knowledge and Practices in the Study Area

Local people are the caretakers of indigenous knowledge systems (IKSs). These indigenous knowledge systems may appear simple to outsiders but they represent mechanisms to ensure minimal livelihoods for the rural resource-poor people. However, farmers' needs, priorities and innovations are not always considered while developing and disseminating technologies (Rajasekaran and Martin, 1990).

Understanding farmers' knowledge allows a framework of reference for posing technical and scientific questions in research. It also provides the basis for evolving technological options that are not imposed as unknown 'packages' which contradict existing practices (Scoones, 1989). For such reason, identifying, documenting and incorporating farmers' indigenous knowledge systems and practices into agricultural extension and research organizations is essential in order to achieve sustainable agricultural development. Therefore, in this section of the study various indigenous knowledge systems and practices of farmers in the study area are identified and presented. The data were collected through questionnaire survey, observation, interviews and focus group discussions. To substantiate the primary data collected, secondary sources were consulted.

4.1. Farmers Indigenous Knowledge and Practices

4.1.1. Farmers' indigenous knowledge of soils

In Ethiopia researchers issue blanket recommendations for fertilizer applications and crop types, covering large areas of the country (Belay, 2003). While these are useful as a general guide, the best amounts and types of fertilizer and organic matter will vary from place to place, even within a very short distance. Extension services do not have the staff or resources to test the soil in every field to develop specific recommendations for that field. But by drawing on the farmers' knowledge about their soil types and matching this with the scientific knowledge soils, extension workers and researchers can suggest new crops or crop varieties, recommend fertilizer rates and ways of improving the soil fertility, or work with farmers to test new technologies. This calls for knowing farmers indigenous knowledge of soils.

Farmers in the study area have their own indigenous ways of classifying, describing and characterizing local soil types in their fields, including soil characteristics, problems, and their suitability for various crops. They use many different criteria to distinguish one soil from another. Farmers in the study area have their own indigenous ways of classifying, describing and characterizing local soil types in their fields. The way they classify the soils is likely to reflect features that they have found important in growing crops. They have developed local system of soil classification based on their long time experience of the potential and constraints of their soils. Accordingly, farmers in the study area identified four types of soils, locally known as *ashalma*, *borebor*, *debay* and *borenke*. These soils are identified by their color, stoniness; fertility status, topographic location, and suitability for agriculture (see Table 4.1)

Table 4.1 Local soil types and their characteristics as perceived by farmers

Soil type	Characteristics of the soil				
	Color	Stoniness	Location	Fertility Level	Consistency
Ashalma	Grey	Stony	Abbay escarpment	Less fertile	Moderate
Borebor	Red	Not stony	Plain	Moderate	Less sticky
Borenk	White	Moderate	Abbay escarpment	Less fertile	Less sticky
Debay	Black	Not stony	Plain	Fertile	Sticky

Source: Based on field survey, March 2007

By their very nature, the above soil types are suitable for different types of crops. For example, *debay* (which becomes sticky during rainy season and crack & during dry season) is very suitable for the production of *teff*; chick peas, vetch and lentil. *Borebor* is suitable for *teff*, wheat, barley and maize. Similarly, *ashalma* is conducive for the production of maize, sorghum, sun flower, etc.

Farmers reported that among the indicated soil types, *borenk* needs high level of treatment. This is because firstly, it is shallow and develops dominantly on sloppy areas. It requires erosion protection mechanisms, such as the construction of terraces and diversion channels. Secondly, it needs the application of fertilizer, repeatedly for the reason that the soil by its nature is less fertile and the nutrient in the fertilizer especially nitrogen can easily be removed. Thirdly, it is found in kola areas where there is relatively high temperature and soil moisture retention capacity. To improve its moisture holding capacity farmers in the low-lying areas of the woreda have been practicing mulching and manuring.

4.1.2. Farmers' perception of soil fertility and soil fertility management techniques

Soil is a very crucial resource for the life of farmers in general and agricultural production in particular. In order to produce more, the fertility of the soil should be maintained by using different techniques, which can either be modern or indigenous or both. In relation to this, farmers in the study area were asked whether soil fertility in their field is declining or not. Accordingly, 46 farmers (76.7%) replied that the fertility of soil in their fields has declined in the past years. Farmers attributed the decline of soil fertility to a number of reasons. The primary cause of fertility decline in the study area was the growing number of human population and the consequent diminishing farm size which leads to the over cultivation of farm lands and the overgrazing of grazing lands. Soil erosion by water and wind, the utilization of crop residuals for livestock feeding and the continuous use of inorganic fertilizer were also mentioned among the reasons for the decline of soil fertility.

Farmers in the study area perceive soil fertility in terms of soil capacity for long term productivity, its permeability, water holding capacity, drainage, tillage, manure requirement and cultivability. Farmers employ different indicators of knowing whether the soil is fertile or not. The major indicator mentioned by farmers is the amount of crop yield. In addition, the appearance of some weed species like *Mech* (*Gizatia scabre*), *Adyo* (*Carcopsis* spp.), and *Asendabo* (*Setaria verticulate*) were mentioned as indicators of soil fertility decline. Nevertheless, the qualitative information collected from farmers indicated that though the presence of weeds is considered as indicator of soil fertility decline, it may not always hold true because weeds may occur in fertile soils if the frequency of tilling is very low.

Farmers in the woreda apply both indigenous and modern methods of maintaining soil fertility. Among the modern ones, the use of artificial fertilizer is the most common. Asked whether they use artificial fertilizer or not, about 56 farmers (93.3%) stated 'yes'. But, during group discussions, farmers repeatedly complained about high price and untimely and insufficient supply as the major constraints on the use of artificial fertilizers in their fields. Farmers were also asked whether the use of artificial fertilizer is the lasting and sole measure of maintaining soil fertility or not. All farmers have unanimously signaled a 'no' answer. They argued that relying on organic and indigenous fertilizers is preferable because (a) artificial fertilizer is costly to purchase and even its price is increasing from time to time and thus not reliable; (b) continual use of fertilizer on one field makes the land dry and less productive with out using it; (c) it increases production for only one harvest

season (i.e. not for two or three harvesting seasons) and damages the living organisms in the soil, and (d) it is not available all the time. Conversely, as confirmed by farmers, indigenous soil fertility management practices are mostly of organic origin and do not damage the soil, they are economically affordable and sustainable and they do not need external knowledge. Hence, despite some inconveniencies farmers prefer to use them.

From the above discussion, we can learn that though farmers use artificial fertilizer to increase crop production, they are aware that relying on commercial fertilizer can not sustain agriculture. In relation to this, farmers were asked whether indigenous soil fertility management practices are inferior from modern ones. Accordingly, 38 farmers (63.3%) confirmed that indigenous soil fertility management techniques are not inferior to modern ones. They further substantiated that the use of indigenous soil fertility maintaining practices can give a sustainable solution to the problem of soil fertility. This, in one way or another, indicates that farmers give due recognition and value for their indigenous knowledge and practices to sustain agriculture. Though farmers valued indigenous soil fertility management practices, they are heavily dependent on artificial ones due to the fact that indigenous soil fertility management practices (as discussed hereafter) are labor intensive and the application of these practices is closely associated to other resources like land and livestock. The number and size of these resources is declining from time to time making the application of indigenous techniques difficult

4.1.3. Indigenous methods of maintaining soil fertility

A variety of soil fertility management techniques were/are practiced by farmers in the study area. During the questionnaire survey, interview and focus group discussion, farmers were asked to mention the local/ indigenous measures that they have used or are using to maintain soil fertility. The following methods were mentioned as important indigenous soil fertility management methods by the farmers.

(a) Crop Rotation

Crop rotation is one of the indigenous methods of maintaining soil fertility. It is a system by which nitrogen restoration is effected by alternating different types of crops on the same cultivated land. This practice is considered as effective in maintaining the nitrogen status of the soils where leguminous plants are included in the rotation (Belay, 1998 cited in Michael, 2002)

Farmers always use crop rotation for those parcels of land which are distant to their homesteads where they receive little or no manure. Farmers' choices of which crops to grow during rotation are largely based on their personal preference as well as the suitability of the soil type for the crop to be grown. A study conducted in East Gojjam (Digil Watershed) by Michael (2002) indicated that farmers' choices of which crops to grow in rotation depends on how crops adapt the soil condition, the rainfall pattern as well as economic consideration such as the price of crops to be chosen. The major crop rotations practiced by farmers in the woreda are, for example, teff (*Eragrotis teff*) with wheat, barley; wheat or teff with nigger seed, chick pea, horse bean.

(b) Manuring

Manuring is another method of maintaining soil fertility. Formerly, it was practiced through animal parking called *chichit* in extensive areas. But now-a-days farmers are applying only a limited amount of manure near their homesteads for the reason that the dung of animals is also used as a source of energy due to shortage of fuel wood in the area. In addition, the application of animal manure is declining from time to time because of decline in livestock population. But, the qualitative information obtained from farmers revealed that, since there is relatively high fuel wood and livestock in the low lying areas compared to the highland, the utilization of animal dung for maintaining soil fertility is relatively better. A study made by Michael (2002) noted that the fragmentation of land is one of the most important factors that hinders the application of manure. This is because it becomes expensive and labor intensive to transport it to different fields located far away from the homesteads.

Some interviewed farmers were applying green manuring instead of animal dung for the reasons mentioned above. The application of green manure is relatively high in the low land areas as compared to the highlands for the reason that in the former there is relatively large amount of green matter such as plants, grass, shrubs. Green manuring is the ploughing under or soil incorporation of any green manure crops while they are green or soon after they flower. Green manures are forage or leguminous crops that are grown for their leafy materials needed for soil conservation. It improves soil fertility, adds nutrients and organic matters, and improves the soil structure. It also improves soil aeration, controls insect/mite pests, and helps to control weeds. Farmers in the study area improve their soils by uprooting and heaping weeds in their croplands. They usually incorporate grasses and weeds in to the soil as green manure (Chambers, 1989).

(c) Mixed Cropping

Mixed cropping is another commonly used indigenous method of maintaining soil fertility in the study area. Mixed cropping is the growing of two or more crops simultaneously on the same piece of land with or without row management. Mixed cropping system creates favorable conditions for soil, water and nutrients and provides excellent environmental conservation and sustainability. Farmers in the study area, for example, combine cereals (like maize) with oil crops, such as rape seed and grain such barley with legumes (e.g. horse bean). This combination is frequent in highland parts of the area. In low-lying areas, teff is usually combined with sun flower.

Mixed cropping ensures the soil coverage and protects it from rain so that the soil particles may not be disintegrated and washed by erosion (Michael, 2002). As to Chambers (1983:86), mixed cropping has many advantages, including: (1) different rooting systems exploit different levels of moisture and nutrients in the soil profile; (2) one crop may provide a favorable micro-climate for another; (3) nitrogen fixing plants fertilize non- nitrogen fixing plants; (4) labor requirements are less especially in reducing weeds (5) returns are higher per unit of land; (6) crops which are scattered among others are less vulnerable to pest attacks than single stands.

(d) Fallowing

Fallowing is a traditional farming system that helps farmers to sustain production for generations (Mekonnen, 1999). According to the information received from farmers, crop yields may decline if the land is continuously cultivated without a respite. Thus, previously the farmlands in the study area were left uncultivated for certain periods (usually two to three years) so that they can regain their fertility. Currently, however, this practice is abandoned due to population pressure and the diminution of land holdings. It was also noted that the introduction of fertilizer and improved seeds has led to reductions in fallowing due to farmers increased desire to cultivate large areas using commercial fertilizer. A study by Mekonnen (1999) revealed that repeated tillage not only affects the fertility of croplands but also leads to deterioration of the quality of seeds and their resistance to pest infections. Information gained from focus group discussions indicated that though farmers are aware that fallowing improves the fertility of soils and increases output, they are abandoning its application (Chambers, 1983)

(e) Planting Legumes

Farmers in the area have been practicing planting legumes crops in their fields. The majority of the informants covered by the survey assured that they have been practicing various cropping methods. The most common cropping practice in the study area is planting of legumes like horse bean, nigger seed, chickpeas, pea, vetch, etc. The respondents noted that when the productivity of their cropland turns down they grow legumes on their plots. Planting such crops is beneficial for farmers at different angles. Firstly, growing legumes do not require too much ploughing and the preparation of fine seedbeds like other cereals. Secondly, legumes have nitrogen fixing effect. Thirdly, legumes maintain the fertility of the soil rapidly than the other techniques (Michael, 2002)

Generally, one thing which should be clear here is that indigenous practices relating to organic fertilizer and different fertility maintenance techniques have become less common as farmers dependence on commercial fertilizer has increased, which at the end of the day will force farmers to completely abandon the indigenous ones and to depend on the modern ones.

4.1.4. Indigenous methods of controlling weeds, pests and diseases

The study revealed that farmers in the study area have a wealth of traditional practices for the control of pests, weeds and diseases. These include the use of various botanical pesticides such as plant and animal extracts as well as mechanical process.

To prevent and control weed in their crop lands, farmers use different techniques, such as mixed cropping, crop rotation, mulching, hand weeding, slash and burn, frequent ploughing of crop land and what is locally known as *tiktako* (making cattle to move many times on the plot ready for sowing). The latter is used by farmers to bury the weed and deter its removal. The other method which is particularly applied for maize is what is locally called *digera* (i.e. using oxen for inter row ploughing). The main purposes of *digera* are weed control, loosening of the soil and good aeration, maintaining the desired plant population and covering crop roots to protect against lodging.

Farmers in the area also practice different pest and disease control techniques. The major ones include spraying animal urine; dusting the seed with ash and pepper; mixing animal urine, donkey waste, poisonous plant leaves and ash and spraying it on the crop land where disease and pest occur; repeated ploughing, cutting and getting rid of infected plant, crop rotation, use of resistant variety, burning and smoking, and use of resistant variety.

4.1.5. Farmers' informal experiments on crop production

Perhaps the least recognized aspect of rural people's knowledge is its experimental nature. Rhodes and Babington (1988) identified three types of farmer experiments: curiosity, problem solving, and adaptation experiments. Curiosity experiments are experiments that farmers did out of their curiosity. Adaptation experiments are those which are conducted by farmers to adapt new technologies to their circumstances, whereas problem solving experiments are those experiments carried out by farmers when they face problems. Rhodes and Bebbington (1988) identified two kinds of adaptation experiments: testing unknown technology in a known environment and testing a known technology in a new environment. In the study area, farmers in most cases tried to perform problem solving and adaptation experiments.

All surveyed extension workers and researchers confirmed that farmers conduct their own indigenous local and informal experiments which include, among others, the application of botanical pest control techniques, testing the productivity of different crops by applying commercial and non-commercial fertilizers, increasing and decreasing the rate of fertilizer application in different crops and fields. To conduct such informal experiments, farmers used local and improved seeds, artificial and indigenous methods of maintaining soil fertility, using their own farm plot, labor and local farm equipments.

One best example of farmer experimentation practiced in the study area (qualitative information obtained from focus group discussant farmers and extension workers) was comparing local and improved seed varieties by applying different types of soil improvement techniques on the same plot of land. Firstly, farmers plant improved seeds by using organic fertilizer and local seeds with artificial fertilizer. Secondly, they planted improved seeds with inorganic fertilizer and local seeds with organic fertilizer. In the end, what they have noticed was that improved seeds gave fewer yields compared to local ones in the first case. In the second case, however, improved seeds gave higher yields than their local counterparts. The yield of local seeds was found to be more or less the same with the application of both organic and inorganic fertilizers. This indicates that (a) since improved seeds are produced and tested by using inorganic fertilizer they are less suitable for organic fertilizers for the reason that nutritionally artificial fertilizer may be more concentrated than the organic one and (b) improved seeds could not give high yield without the application of inorganic fertilizer which implies that they are less adaptive to the organic ones. Nonetheless, the local ones can adapt to both organic and inorganic fertilizers.

Another example of informal experiment that was carried by farmers is the comparison of improved and local seeds by replanting both on the same field. The result they have found was that while local seeds retain their original character, the improved ones lose their original nature. An example for this is the color change from white to some what mixed and the taller growth of stalks. In addition, farmers replant improved seeds and what they found was that the yield declines from time to time. All the aforementioned examples indicate that farmers have been engaged in various types of informal experiments as per their socio-economic, cultural and environmental contexts. Unfortunately, however, these experiments and practices are not recorded, published and distributed to the stakeholders as conventional knowledge. Interviewed extension workers and researchers confirmed that farmers' informal experiments are strong in view of the fact that farmers use the findings immediately and give timely solutions to farmer problems. The findings of farmers' local experiments can easily be disseminated to other farmers. In short at this juncture it is to be noted that they are conducted without the need of any external assistance, i.e. from the extension or research staff

4.1.6. Farmers knowledge of local seed systems and improved ones

In terms of indigenous knowledge and practices, the use of local seed varieties and informal seed systems are very important. The study revealed that farmers cultivated different varieties of local seeds for different types of crops. The planting of *teff* in the high land part and sorghum in the lowland are commonly practiced in the study area. The local varieties of *teff* include *monute*, *emlabash*, *amaregna* and *gemor*. The local varieties of sorghum include *jemele*, *achiro*, and *morate*. Of the local *teff* varieties, *monute* is white in color and is resistant to drought. *Emlabash* is red in color, fast-maturing and grows in red soils. As to sorghum varieties, *achiro*, as the name indicates is short in size, is relatively fast maturing; and has white color; *amorate* is tall in size, white in color, and is growing around the Abbay gorge; *jemele* is of medium size and is used for the preparation of local drinks.

Farmers do have their own knowledge of seeds and seed systems. Their choice and use of either local or improved seed varieties largely depends on their compatibility with the existing norms, environmental adaptability and cultural practices. They consider taste, color, durability, and resistance to drought and pests while selecting the seeds. In line with this, the study revealed that 54 sample farmers (90%) in the study area cultivated both local and improved seed varieties. Their

reason for growing both seeds was that the local varieties and the improved ones have different characteristics. By so doing they would minimize risk by avoiding total crop failure after planting.

Farmers have also attributed the use of both local and improved seeds to the following reasons. Firstly, sometimes one of the two may fail to give yield so the use of both is advantageous. Secondly, most improved seeds are not suitable for the local environment and fail to give the expected output and involve high risk, while local seeds are risk free (i.e. risk of adaptation to a given environment, risk of settling seed and fertilizer dues). Under such circumstances, farmers use local seeds. Thirdly, farmers fear that since improved seeds are not replanted, they may lose local seeds. In this regard, all the interviewed farmers did not abandon the use of indigenous seeds. Fourthly, in most cases improved seeds may not be available at the right time inducing farmers to grow local seeds. Fifthly, improved seeds can not be grown without the application of fertilizer. By contrast, local seeds can be grown without fertilizer. Moreover, some crops do not have improved seed varieties. Local seeds are accustomed to the local environment thus lessening worries about their adaptation. Farmers were also asked to indicate their seed preferences. The results have shown that 42 farmers (70%) prefer growing local seeds to improved ones.

In the study area, there used to be a wide range of practices and sources for local seed. Farmers reported that the primary source of local seed is their own stock. In addition to household storage, the other seed acquisition mechanisms were borrowing, market purchase, and exchange with other seeds. Interviewed farmers explained that for improved seeds such informal acquisition mechanisms did not work because it can be obtained from the woreda agricultural office only.

4.1.7. Farmers' indigenous organizations

Indigenous farmer organizations are organizations governed and owned by farmers as to their socio economic and cultural context and they work for farmers interests. They are organizations by farmers for farmers. They can ensure effective social and economic development of the agricultural sector on sustainable basis. They are cost effective ways of getting information and services to farmers (Yigremew, 1999; Yigremew, 2000). In the study area, farmers do have different indigenous organizations having different purposes. The major ones include *iddir* (organization giving mainly funeral service), *iqub* (saving and credit service), *mahiber* (religious organization used for spiritual purposes and information exchange), and *debo* (traditional labor sharing arrangement). These organizations are used by farmers for different purposes such as resource

mobilization and management (for example labor sharing like debo and wenfel; monthly and weekly savings in each and every mahiber), provision of services (credit services through iqub) and information exchange.

These indigenous rural organizations are very vital for the sustainable development of agriculture because they are the information and resource foundations of the farmers. In light of this, Yigremew (1999:281) noted that indigenous rural organizations have important roles in farmers' survival in general and food security and resource management in particular. In the study area, like other parts of Ethiopia, these indigenous organizations are used for sharing labor for agricultural activities, information exchange on new technologies, resource sharing and for spiritual festivals.

4.2. Strengths and weaknesses of indigenous knowledge and practices

Knowing the strengths and weaknesses of indigenous knowledge and practices of farmers is very vital because it may give important clues for taking the strong sides and correcting the weaknesses so that they can be integrated and work closely with modern ones. Here under, the strengths and weaknesses of indigenous knowledge and practices will be discussed.

Indigenous knowledge and practices are very effective and efficient in many ways compared to modern ones. The information gathered from interviews, focus group discussions and questionnaire survey revealed the following strong sides of IKSs and practices. Firstly, IKSs and practices require low finance and are low external input dependent. They don't require imported materials from abroad since they depend on locally available materials. For example, all local fertility management practices do not require external input and they are not too costly to be covered by resource poor farmers.

Secondly, IKS and practices do have multiple benefits. As noted by Michael (2002), the multi functionality and multiple benefits of indigenous land management practices are the reflections of the basic strategies developed by land users in response to the great variability of bio physical and socioeconomic conditions. According to the sampled farmers, for example, practices such as crop rotation and mixed cropping are used to maintain the fertility of soils and control and prevent weed, insects and disease infestations. In addition, ash is used to protect the seed from pests and used to improve soil fertility. The third strong side of indigenous knowledge and practices is their compatibility to farming systems and their environmental sustainability. For example, the

application of crop rotation, manuring and other soil fertility management practices are part of the prevailing farming system in the study woreda and serve the purpose of production and protection at the same time.

Despite the above strengths, some indigenous knowledge systems and practices are not free of limitations. For example, the fertility management practices such as manuring require large number of livestock and green matter while fallowing needs large farm size. That is why these techniques are today on the verge of disappearance, most particularly by most of the resource poor farmers. Similarly, the indigenous pest and disease control methods are weak in a sense that they can protect the crops from disease and pests for a short period of time or they fail to totally relieve the crop from diseases and pests. In other words, they can be used as preventive not as curative technique. In addition, the information gained from the questionnaire survey revealed that although all indigenous practices need less money, they need more labor force and hence they are labor intensive. This result is consistent with other research findings. For example, Michael (2002:74) noted that indigenous fertility management practices such as manuring require more labor force to transport the manure to fields that are located long distance away from the homesteads which are by far beyond the capacity of most individual families.

Chapter Five

Attitude of Stakeholders to Farmers' Indigenous Knowledge and Practices

The attitudes of key actors, namely, farmers, extension workers, and researchers play a major role in influencing the attention given to indigenous knowledge systems and practices and the efforts made by research and extension to use it (Nigussie, et.al. 2005). In order to identify the perception of the stakeholders to indigenous knowledge and practices in the study area, thirty one statements related to indigenous knowledge systems and practices were developed and distributed. While the response of extension workers and researchers were analyzed together, the response of farmers is analyzed independently (see Table 5.1)

5.1. The perception of stakeholders on the importance of IKS and practices

Table 5.1 Mean scores values on the perception of stakeholders regarding the importance of indigenous knowledge and practices

<i>Indigenous Knowledge statements</i>	<i>Farmers</i>	<i>Researchers and extension workers</i>
	Mean	Mean
Scientific knowledge provides a sustainable solution to agricultural problems than IK	2.63	3.60
Farmers IK increases cultural pride and thus motivation to solve local problems with local ingenuity and resources	3.97	4.07
Indigenous knowledge and practices are major obstacles to agricultural development	1.73	1.63
Farmers by their own nature are resistant to adopt improved technologies since they stick to traditional practice	1.88	3.53
Farmers are technology users than experimenters	3.28	2.23
Farmers IK systems are time tested agricultural practices that pave the way for sustainable agriculture	4.00	3.83
Farmers do have the potential to determine what technology is useful to them	3.80	3.93
Farmers IK systems are backward, conservative and lack innovative ability	2.47	1.67
Farmers are innovators who have developed ways of experimenting through trial and error	3.62	3.90
IK offers a low cost approach with potentially high benefits	2.60	3.27

Since IK changes through time, it is difficult to relay up on it	2.60	2.40
IKS are socially desirable	4.00	3.93
IKS are economically affordable	3.98	3.80
IKS involve minimum risk to farmers	3.63	4.00
Whenever new constraints appear as a result of human and natural processes, new solutions have to be, and often are devised by farmers based on their IK	3.63	3.67

1= *strongly disagree*, 2= *disagree*, 3= *neutral*, 4= *agree*, 5= *strongly agree*

Source: Based on field survey, March 2007

Table 5.1 above shows the mean ratings and standard deviations on the perception of stakeholders regarding the importance of indigenous knowledge and practices. For the statement, ‘scientific knowledge provides a sustainable solution to agricultural problems than indigenous knowledge’, the majority, i.e. 21 (70%) of the researchers and extension workers agree with a mean rating of 3.60. On the contrary, 36 farmers (60%) believe that scientific knowledge can not provide a sustainable solution to agricultural problems with a mean rating of 2.60. This clearly indicates the variations in the perceptions of the stakeholders on the issue at hand. In that, while researchers and extension workers trust scientific knowledge as the base for sustainable development of agriculture, farmers believe that scientific knowledge can not give sustainable solutions to agricultural problems. This result is consistent with the finding of Nigussie, et.al (2005) who has found that the extension personnel and researchers are inclined to view modern technologies as the primary remedy for farming problems

In a similar fashion, respondents were asked to rate the statement, ‘indigenous knowledge and practices are major obstacles to agricultural development’. The result has shown that 52 farmers (86.67%) and 26 (80%) of the researchers and extension workers disagree for the same with the low mean rating of 1.73 and 1.63, respectively. But the statement, “farmers’ indigenous knowledge increases cultural pride and thus motivation to solve local problems with local initiative and resources” was rated high by both farmers and researchers and extension workers with the mean rating of 3.97 and 4.07, respectively. In other words, 54 (90%) of farmers and 24 (80 %) of the researchers and extension workers believe that indigenous knowledge increases cultural pride and thus motivates them in solving local problems with local ingenuity and resources.

Similarly, the statement, 'farmers by their own nature are resistant to accept and adopt improved agricultural technologies since they stick to indigenous knowledge and practices' was rated low by the majority of farmers, i.e. 52 (86.67%) with a mean score of 1.88. However, this statement was rated high by 20 researchers and extension workers (66.67%) with a mean rating of 3.53. This result implies that researchers and extension workers perceive farmers as resistant to accept and adopt improved agricultural technologies. As to the statement, 'farmers do have the potential to determine what technology is useful to them', 22 of the researchers and extension workers (73.3%) and 48 of the farmers (80%) agree. The mean rating was 3.93 and 3.80 for both groups, respectively. The statement, 'farmers IK systems are time tested agricultural practices that pave the way for sustainable agriculture' was rated high by 47 farmers (78.3%) with a mean score of 4.00 and 20 of the researchers and extension workers (66.67%) with a mean score value of 3.83. Whenever new constraints appear as a result of human and natural processes, new solutions have to be, and often are, devised by farmers based on their IK. This was another statement given for respondents for rating. The result has shown that 46 farmers (76.67%) and 21 researchers and extension workers (70%) agree that farmers devise their own way out to solve problems. The mean score for both groups was found to be 3.63 and 3.67, respectively

With a mean score of 4.00, 52 farmers (86.67%) agree that IK systems are socially desirable. Similarly, with a mean rating of 3.93, about 23 of researchers and extension workers (76.67%) perceive that IK systems are socially desirable. About 46 farmers (76.67%) and 22 researchers and extension workers (73.33%) with a mean rating of 3.98 and 3.80, respectively, agree that IK systems are economically affordable. Likewise, 31 farmers (51.67%) with the mean rating of 3.63 and 23 researchers and extension workers (76.67%) with an average score of 4.00 agree that IK systems involve minimum risk to farmers. Supporting this, Kothari (1995:42) emphasized that indigenous knowledge systems and technologies are found to be socially desirable, economically affordable, and sustainable and involve minimum risk to rural farmers and producers, and above all, they are widely believed to conserve resources. There are situations in which modern science is not appropriate, and use of simpler technologies and procedures may be required. Thus, IK provides basis for problem solving strategies for local communities, especially the poor.

5.2. The perception of stakeholders on the incorporation of IKS and practices in research and extension activities

Table 5.2 Mean score values on the perception of stakeholders regarding the incorporation of IK and practices into research and extension activities

Statements regarding the incorporation of IK and its practices in research and extension activities	Farmers	Researchers and extension workers
	Mean	Mean
Incorporating IK in research and extension can contribute to local empowerment , self sufficiency and self determination	4.25	4.77
Lack of farmers involvement in research and extension leads to the production of inappropriate agricultural technologies	4.67	1.97
Agricultural research agenda should be determined based on the interest of researchers and extension workers than farmers	1.33	1.37
Researchers and extension workers have the knowledge and skills ready at hand to make necessary decisions independently of farmers	1.87	3.97
Farmers indigenous knowledge should be incorporated in research and extension because rapidly changing conditions require local capacities to adapt quickly	4.42	4.20
The participatory technologies that are developed through the integration of IK will enable diversified technological solutions to farmers	4.42	4.33
IK provides mechanisms for facilitating, understanding and communication between extension, research and farmers	3.95	4.23
The involvement of farmers in research and extension is irrelevant since it needs high transaction cost	1.40	1.73
Recognition of farmers IK in extension and research raises farmers self esteem in agriculture	3.77	4.43
Real knowledge is the sole domain of researchers and extension workers	3.93	3.33
Farmers' indigenous knowledge and practices should be incorporated in research and extension because rapidly changing conditions require local conditions to adapt quickly	4.42	4.20

1= strongly disagree, 2= disagree, 3= neutral, 4=agree, 5= strongly agree

Source: Based on field survey, March 2007

As can be seen in Table 5.2, the statement, ‘incorporating indigenous knowledge and practices in research and extension activities can contribute to local empowerment and self determination’ was rated by the majority, i.e. 51 farmers (85%) positively with a mean score of 4.25. About 28 researchers and extension workers (93.33%) also rated the same statement highly with a mean rating of 4.77. From this we can learn that both groups perceive the inclusion of farmers’ knowledge in research and extension practices as vital for agricultural development. Similarly, the statement, ‘farmers’ indigenous knowledge should be incorporated in research and extension because rapidly changing conditions require local capacities to adapt quickly’ was perceived positively by both farmers (96.67%) and researchers and extension workers (80%) with a mean rating of 4.42 and 4.20, respectively.

As to the statement, ‘lack of farmers’ involvement in research and extension leads to the production of inappropriate agricultural technologies’, 42 farmers (70%) with a mean rating of 4.67 perceived it positively. However, all the researchers and extension workers disagreed with a mean score of 1.97. Here there is a stark difference between the two groups. From this, we can learn that though researchers and extension workers acknowledged the importance of farmers’ indigenous knowledge and practices in agriculture, they failed to agree with the idea that lack of farmers’ involvement do not lead to the production of inappropriate technologies.

For the statement, ‘agricultural research agenda should be determined based on the interest of researchers and extension workers than farmers’, 56 farmers (93.33%) and 28 researchers and extension workers (93.33%) disagree with the respective average rating of 1.33 and 1.37. Here, we can learn that the majority of farmers, researchers and extension workers perceived the involvement of farmers in determining the research agenda positively since they can reflect their interests and priorities. Likewise, farmers with a mean score of 1.87 disagree with the statement, ‘research and extension workers have the knowledge and skills ready at hand to make necessary decisions independently of farmers’. Conversely, researchers and extension workers with an average rating of 3.97 agree with the statement

‘The participatory technologies that are developed through the integration of indigenous knowledge will enable diversified technological solutions to farmers’ was another statement posited for respondents rating. The results have shown that 58 farmers (96.67) with the average score of 4.42 and 26 researchers and extension workers (86.67%) with a mean score of 4.33 agree with the statement. This finding tells us that farmers, extension workers and researchers positively perceive

the involvement of farmers in research and extension activities so as to get diversified technological solutions to agriculture. The statement that reads 'the involvement of farmers in research and extension is irrelevant since it involves high transaction cost' was rated negatively by farmers, i.e. 54 (90%), with a mean score of 1.40. In addition, 24 (80%) of the researchers and extension workers also disagreed with the same statement with a mean rating of 1.73. From this we can learn that farmers, extension workers and researchers agree that whatever the transaction cost is, farmers should be involved in research and extension activities.

Generally speaking, the above analysis indicates that the majority of researchers and extension workers and almost all the farmers interviewed perceived and believed that farmers' indigenous knowledge and practices are very vital to contribute to the effectiveness of extension and research activities. With respect to incorporating indigenous knowledge systems in to agricultural research and extension activities, there was unanimity between the two groups with both conforming the issue. In light of this, Rajasekaran and Martin (1992) argued that it is evident that agricultural research and extension progress effectiveness would be improved if extension workers have greater awareness of indigenous knowledge systems.

Despite the prevailing issue, researchers and extension workers in the study area have mixed views. For example, some argue by saying that scientific knowledge provides a more sustainable solution to agricultural problems than indigenous knowledge. Supporting this, Nigussie, et.al (2005:75-76) concluded that researchers had mixed views regarding the importance and value of farmers' indigenous knowledge and practices. Most of them were of the opinion that modern agricultural technologies are far better and that farmers need to adopt them if they opt to cope with the changing environment. Extension workers and researchers also perceived farmers as resistant to adopt technologies. In addition, though farmers' indigenous knowledge is vital for research and extension activities, researchers and extension workers argued that lack of farmers' involvement in research and extension does not lead to the production of inappropriate agricultural technologies. From this, one can learn that researchers and extension workers believe that technologies produced without the consultation of farmers are appropriate. This, in one way or another, underestimates the value of indigenous knowledge systems and thereby creates a problem of effective linkage between farmers, researchers and extension workers.

Chapter Six

Constraints to Research, Extension and Farmers' IKS Linkage

Agriculture occupies a strategic position in the economic development of Ethiopia. Realizing its importance, Ethiopia is in the process of modernizing its agriculture through the application of improved practices based on science and technology. To achieve a high standard of agricultural production, a country has to have strong research and extension systems. In so doing, the infrastructure and resources for research and extension are being strengthened and reorganized in the country so that more relevant and appropriate research can be conducted to solve farmers' problems and increase agricultural production. As a result, improvements in agricultural technology generation and diffusion have been taken place in Ethiopia. Nevertheless, despite the availability of different packages, a huge gap exists between what agricultural researchers have achieved on experimental farms and research stations and what average farmers obtain on their fields (Belay, 2003; Belay and Degnet, 2004). This, in one way or another, indicates the existence of a wider gap among various actors in agricultural development which calls for a need to identify the major bottlenecks for the linkage. In so doing, the data were collected using a variety of methods such as questionnaire survey, interview, focus group discussions, observation and through consulting secondary sources. Accordingly, different factors are identified as the major constraints hampering the linkage among various actors in agricultural development. These factors are self reinforcing and explained in this section.

6.1. Limited input from farmers in setting priorities and formulating the research agenda

In many countries, agricultural extension and research are being reoriented to provide more demand based and sustainable services by taking into account the diversity, perceptions, knowledge and resources of end users. This approach calls for a bottom-up approach of planning, implementation and evaluation of extension and research activities. Participatory extension and research approach is based on the premise that the effectiveness of agricultural research and extension work can be improved if local knowledge and resources are tapped to diagnose problems and suggest solutions (when researchers, extension workers and farmers become like partners in technology generation and dissemination) (Belay and Degnet, 2004).

Farmers' involvement is often important to know what they need in relation to their farm realities. They have to be part of the technology development and dissemination decision-making process. In response to this, farming systems diagnosis survey was developed in the Amhara Region, with objectives of describing and understanding the current production system and identifying the key farmer problems and a range of ideas on how to solve these problems. In the Amhara Region, Farming System Research (FSR) was conducted to characterize and analyze the constraints and opportunities of the farming system. Since the introduction of the FSR approach into research system of the region, it contributed to the development of research program which is focused on farmers' problems and priorities. As confirmed by the socioeconomic expert in ARARI, even though FSR has made positive contributions in improving the efficiency of the research system, farmer participation in technology generation and dissemination was incomplete. In addition, as reported by the head of the woreda agricultural and rural development officer, there was also no mechanism to involve all stakeholders, especially farmers, in problem identification, planning, implementation, monitoring and evaluation of research output in the study area.

As has been mentioned earlier, the extension approach of the country is PADETES. Participatory extension and research approach aims at giving farmers a maximum role in developing technologies that work and in successfully spreading tested technologies to interested farmers. Participatory extension and research methods are based on flexible use and continuous adaptation to the situation of participatory tools and techniques to initiate and guide the process of joint learning as well as common planning and execution of extension and research and extension activities. In this respect, farmers were asked to respond to the question: who makes decisions in the development and dissemination of improved agricultural technologies? Consequently, all farmers replied that they are not part of the decision making process in the development and dissemination of improved agricultural technologies. Rather, they claimed that every thing is decided by the researchers and extension workers at the top-level. This indicates that farmers are disenfranchised when it comes to priority setting of research and extension agenda. This is in part because researchers and extension workers consider themselves as the only ones capable of both initiating and undertaking the development and dissemination of improved agricultural technologies.

Qualitative information obtained from the extension workers also substantiate that researchers consider themselves as having superior knowledge in giving decisions regarding the development of agricultural technologies. In a similar fashion, 54 of the sampled farmers (90%) reported that technology development and transfer is not at all participatory. This is against the general consensus(e.g., Chambers, et.al 1989)that problem identification forms the first step during the process of developing sustainable agricultural technologies and that problems should be identified jointly by researchers and extension workers in consultation with farmers. During this stage as argued by the same author, farmers' perceptions regarding needs and priorities should be taken into account. Farmers should be viewed as co-researchers, developers and extension workers who can provide crucial inputs to determine what problems to address and how to proceed so that technologies that address farmers' problems, resources, and practices can be developed.

In deed, the nature of varied ecological diversities and the varieties of resource endowments, constraints, opportunities, and managerial skills within the same agro-ecological zone call for the development and promotion of appropriate packages suitable to the diverse agro-ecological and heterogeneous preferences of farmers in the country. It is also striking that the promotion of uniform packages of technologies/ practices to heterogeneous groups of farmers will tend to marginalize resource poor farmers who lack financial resources to pay for the newly introduced technologies. In the study area, 46 farmers (76.67%) replied that both extension workers and researchers do not consider and accurately perceive the situation of farmers. Similarly, 19 of the researchers and extension workers (63.33%) believe that extension workers do not accurately perceive the situation of farmers. This is so mainly because there is no regular contact between the extension staff and farmers. They also lack the knowledge about the existing farming systems in their localities. On top of these, extension workers lack the courage to undertake such actions. Consistent to this finding, Wiggins (1986) cited in Belay and Degnet (2004) confirmed that research stations in Africa have tended to develop ideas with too little attention to small-holder labor supplies, the riskiness of innovations, the likely availability of inputs or the presence of markets, and the economic attraction of recommendations. For 58 of the sampled farmers (96.67%) improved technologies do not address the resource constraints and risks faced by farmers. The latter argued that improved technologies are costly and thus they are beyond their purchasing power. They also need much time and energy and expose them to risks.

Some studies, for instance, Belay and Degnet(2004), indicate that the conventional extension system that is heavily influenced by the transfer of technology paradigm considered farmers as a homogeneous mass and thus failed to categorize them into different groups with different resources, problems, opportunities and requirements. As a result, the system fails to select appropriate technologies and fit them to the specific groups of farming populations. Similarly, Rolling (1994:246) noted that “the application of top-down adoption approach has tended to reinforce existing social inequalities within the farming population, since the producers benefiting most from the adoption process have generally been those better endowed than others in material, intellectual and social resources”.

6.2. Under perceiving and disregarding indigenous knowledge systems and experiments

The very vital step during the process of developing sustainable agricultural technologies is to record the indigenous knowledge systems of farmers which contribute to the solution of the agricultural development problems. Even if the awareness of extension workers and researchers on the importance of indigenous knowledge systems in agricultural research and extension was more or less been perceived as positive (see chapter 5), they failed to bring into play indigenous knowledge systems in research and extension activities. They do not record and document indigenous knowledge systems and experiments. Relating to this issue, Rajasekaran and Martin (1990) noted that non-utilization of indigenous knowledge results in the inefficient allocation of resources and manpower to inappropriate planning strategies that could do little to alleviate rural poverty. With little contact to rural people, planning experts usually attempt to implement programs which do not meet the goals of rural people. Indeed, such a measure results in the efficient utilization of human and natural resources in rural areas. As such, there will be little association between planning objectives and realities facing rural people.

Farmers innovate due to necessity and/or changing conditions and curiosity, and/or by undertaking informal experiments on new ideas either from their own initiative or learned from other farmers, researchers, extensionists and other information sources, like the mass media. However, research and extension pay little attention to the importance of local innovation for agricultural development. During the process of technology development, farmers' informal experimentations are not considered as a source of innovation. The great majority of farmers (96.67%) confirmed that extension workers and researchers do not record and evaluate farmers' experiments. Again, 76.67 %

of the farmers accounted that extension workers and researchers do not encourage farmers to examine their experimentation and helping them to explore more systematic forms experimentation.

In a similar fashion, for 21 extension and researcher staff (70%), extension workers do not create opportunities for farmers to share their innovations. As reported by the research and extension staff, this is attributed to lack of knowledge, skills and facilities on the part of the extension workers to record and document farmers' innovations. In addition, extension workers do not use their full time for extension work rather they are busy in other non-extension activities. Moreover, they are not equipped with the basic concepts of indigenous experiments and their integration with the modern ones. In relation to this, the FGD panelist farmers noted that their informal experimentation is being obscured by the activities of organized research institutions for the reason that their endeavors remain unnoticed and thus neglected by researchers and extension workers. Farmers also reported that researchers and extension workers are more devoted in disseminating their research findings to farmers than observing, recording and disseminating local experiments to stakeholders. In relation to this view, Chambers (1983: 76) noted that....“It is a common assumption that the modern scientific knowledge is sophisticated, advanced and valid and conversely that whatever rural people may know will be unsystematic, imprecise, superficial and often plain wrong and remain unnoticed”.

Further, for 19 of the research and extension staff (63.33%), extension workers do not help/encourage farmers to examine indigenous experimentation methods and help them to explore more systematic forms. This is for the reason that extension workers assume experimentation is the task of the researchers and not of the extension staff. Besides, the element of indigenous knowledge and experimentation is not included in the curriculum of their training. That is why they are not responsive to their role in agriculture. Likewise, 21 extension workers and researchers (70%) replied that extension workers do not offer alternatives to farmers to compare conventional practices with the local ones. This is because there are no demonstration plots in the woreda to compare the conventional technologies with the local ones. Furthermore, since the top-down flow of information is the dominant extension approach in the study area, extension workers are doing what they are told or ordered to do by their bosses. Still, 25 of the researchers and extension workers (83.33%) stressed that extension workers and researchers do not record and evaluate farmers' experiments for the reason that such a system was not developed.

6.3. Disregarding the role of farmers' indigenous organizations

Ideally, when seeking farmer involvement in agricultural research and extension efforts, one can deal with rural people who are already organized and used to working together (Uphoof, 1994). Working with farmers' organizations is known to improve the effectiveness and efficiency of technology development and dissemination efforts (EEA, 2006). The focus group discussant farmers in the study woreda confirmed that although they can play an active role in the woreda's extension and research system, they have been given no attention. Let alone organizing new groupings and associations, the researchers and extension workers do not even mobilize and make use of the existing farmers' indigenous organizations for both extension and research endeavors.

The Indian experience of getting farmers organized into groups and then to build associations shows that assisting farmers to organize themselves is by itself an important intent in extension work. These farmer associations can progressively take some of the responsibilities of the public extension (EEA, 2006). Besides, such associations increase the bargaining power of individual farmers. Pertaining to this, Yigeremew (2000:45) noted that: "a major constrain of rural development in Ethiopia has been the absence of adequate institutional structures through which rural people can articulate their needs, protect their interests, manage resources and have access to resources". Of course, the utilization of farmer organizations can give a solution to these problems.

Agricultural extension is vital to the growth of the agricultural sector. The extension service is responsible to simplify research information and deliver it to farmers in an effective and easily understandable manner. The extension service also provides a feedback mechanism to researchers and others concerned on problems faced by farmers. For this reason, the research/extension/farmer relationship should be viewed as an interdependent continuum. Extension workers must be committed and should work in close liaison with the farmers they serve. Confidence of the farmers can be achieved by well planned and gradual introduction of proven new technology. Useful means of introducing new technologies have included demonstration plots, field tours, and meetings. However, in the study area the utilization of these opportunities does not exist.

6.4. Technical deficiency of the extension service

The extension service is generally given the task of acting as a bridge between researchers and the farming community. The agents should be always with farmers to help them in accepting and adopting technologies. Asked about their knowledge of the existence of extension workers in their village, 58 of the sampled farmers (96.7%) know that extension workers are present in their kebeles and the majority, i.e. 56 farmers (93.3%) have contacted them at one point or another. In turn, asked where they have met the extension workers, most farmers replied that they met them in churches, informal farmer associations, mahiber, iqub, market place, and the like. From this, we can discover that extension workers do not frequently get farmers in their farmland and advise them what they can do there. Regarding communication of new technologies, the focus group discussants reported that extension workers mostly used group and mass communication methods in disseminating new techniques and practices. But extension workers reported that they are contacting farmers individually in their farms.

Even though mass and group extension methods may help to reach a large number of farmers in relatively short time, their impact in terms of getting the techniques/practices adopted by target beneficiaries leaves a lot to be desired (Belay and Degnet, 2004). As noted by Belay and Degnet (2004), the possible explanation for the utilization of these methods is the relatively large number of farmers that extension workers are expected to serve which makes the utilization of individual methods less possible. This is not, however, applicable in the study area where there are three extension workers in each kebele (one in plant science, one in animal science and one in natural resource management). Hence, an extension worker is expected to serve 386 farmers on the average. Thus, the farmer extension worker ratio in the study RKAs is fine. Notwithstanding this fact, extension workers reported that they are over-loaded for the fact that they are often required to be involved in various non-extension activities, like loan distribution and repayment. With regards to this issue, Belay (2003) noted that over the years the involvement of extension agents in activities other than extension work has played against their standing as development agents. Many people in rural areas look up on extension agents as government prosecutors rather than facilitators in the process of rural development.

With regards to the frequency of contact, 41 farmers (68.3%) got extension workers during seed season and at the time of distributing improved seeds and fertilizers. These farmers also reported that extension workers frequently avail themselves to farmers' house during the time of loan repayment and collection of land rent. In the view of 50 farmers (83.3%), extension workers do not establish trustful and friendly relationship with them based on equity. The reasons mentioned for this include: (1) extension workers waste most of their time in urban areas and thus there is no frequent contact; (2) extension workers are highly engaged in fertilizer and improved distribution services; (3) they do not treat all farmers equally rather they give attention to few rich farmers; and (4) lack of interest and motivation among extension workers. Contrary to this, research and extension staff respondents, i.e. 18 (60%) believed that they establish trustful and friendly relationship with farmers based on equity, with the rest (40%) confessing their failures in establishing friendly relationship with farmers based on equity. The involvement of extension workers in the distribution of fertilizer, improved seeds and loan repayment rather than technical provision for farmer problems make farmers suspicious of the role of extension workers. Unsurprisingly, therefore, extension workers are considered as unfriendly by farmers.

Adoption of technology by farmers can be influenced by educating farmers about things such as, improved varieties, cropping techniques, optimal input use, prices and market conditions and more efficient methods of production management. To do so, extension agents must be capable of more than just communicating messages to farmers. They must be able to comprehend the complex situations and possess the technical ability to mark and possibly diagnose problems. Available studies (for example, Belay and Degnet, 2004) have proven that higher rates of technology adoption are achieved when extension agents possess adequate knowledge and work closely with farmers. Moreover, field demonstration, farmers' days and farm visits are expected to enhance the adoption of new technologies/practices through the creation of awareness, exchange of ideas and skill acquisition. In this respect, farmers were asked about the problem solving skills of extension workers. The results have shown that 48 of them (80%) believed that extension workers do not have practical skills to solve the problem of farmers. Likewise, 25 of the research and extension staff (83.33%) reported that extension workers do not have sufficient problem solving skills. They are not readily available at farm plots and could not give immediate solutions for farmer problems at the right time. Even those who try to solve problems do only reporting to the woreda agriculture and rural development office. All focus group discussants reported that extension workers do not get the required theoretical and practical training before they graduate from TVET. They further noted that

extension workers are usually trained by fresh and inexperienced graduates of the universities who lack the skills and experiences. Additionally, the connection between training institutions, extension working environments and research stations is poor.

In the opinion of 52 sampled farmers (86.7%), extension workers are not well equipped with planning concepts to design proper extension activities through the participation of farmers. Also, 23 of the researchers and extension group (76.67%) are of the conviction that extension workers are not well equipped with planning concepts to design proper extension activities through the participation of farmers. This is consistent with the information received from researchers, who believe in the lack of knowledge and skill of communication to interact with farmers and their deficiencies in planning concepts. They further argued that extension workers do not have sufficient practical training as such deterring them to translate what they have learnt in theory to practice. As a result, they fail to receive the trust of farmers. Here, we can learn that, if farmers' loose confidence and trust on extension workers, their participation in extension activities could deteriorate. On top of these, information collected from the woreda agriculture and rural development head and researchers (through interview) confirmed that extension agents rarely receive training in interpersonal and communication skills, which are essential for the efficient transmission of information for persons having different education levels. Even worse, extension workers do not have the knowledge of what participatory planning is all about and its approach. In conformity with these, 19 researchers and extension workers replied that extension workers (63.33%) do not have the knowledge, connections and skills to be able to gain the trust of farmers and perform their jobs accurately. Similarly, 52 farmers (86.7%) reported that extension workers do not have the knowledge, connections and skills that help them to be able to gain the trust of farmers and to perform their jobs accurately.

Perceiving farmers as passive receivers of message is another constraint for effective linkage between the linkage partners in the agricultural development process. The farmers as well as the woreda agriculture and rural development head confirmed that farmers are mainly seen as the recipients of technical messages but not the originators of either technical knowledge or improved practice. The technical messages from extension workers focus mainly on seed packages utilization for different crops grown in the woreda and on the application of fertilizers. Resource conservation strategies such as, agro-forestry, soil conservation and market information rarely form part of the technical messages of extension workers.

In addition, technical messages from extension do not reflect local crop production conditions. Regarding this, farmers argued by saying that instead of consulting us about the local environment, extension workers order us to do what they are told by the research staff. Consistent with this result, Opio-odongo (2000) cited in Belay and Degnet (2004) argued that extension workers in Sub-Saharan Africa have behaved as if the farmers can only benefit from innovations that are external to their farming systems. The same authors (147) further noted that “extension workers have tended to treat farmers as if they were empty vessels to be filled with knowledge and expertise”. Some technical messages also tend to be blanket recommendations which have evolved from the research and cannot be adapted to heterogeneous farming conditions. For instance, all the surveyed farmers applied 100 Kg Dap and 100 Kg Urea per hectare in their farm plots. This is in contrast to the fact that nitrogen, phosphorous, and potassium content of soil varies widely from village to village, in many cases from plot to plot. On the other hand, while 16 of the research and extension workers (53.33%) believe that the technical messages & farmers receive from extension workers reflect local crop production conditions, the rest, i.e. 14(46.67%) reported that extension workers do not reflect farmers local crop production conditions for the reason that the concern of extension workers is the teaching of improved crop production techniques.

6.5. One sided initiation of activities

From the information collected through interviewing researchers in the region, one can learn that even if the different linkage mechanisms like the Farmers Research Extension Group (FREG), Research Extension Liaison Committee (RELC), Research-Extension-Farmer Advisory Council (REFAC) try to serve all the stakeholders in the agricultural knowledge and information system of the mandate area, the research division is the only accountable body to organize and facilitate the council’s activities. The other actors are passive participants in the entire activities of the council. They come to the scene only during the review & monitoring and evaluation meeting days. Surprisingly, the zonal level head of rural development is also the chairman of the council. His/her role, however, is not more than chairing the meeting. If the research center covers more than one zone, the chairmanship rotates among the zones. This scenario paralyzes the proper functioning of the committee.

6.6. Complexity of the research environment and pressures from stakeholders

As confirmed by the socioeconomic expert of ARARI, the existence of undue pressure from different stakeholders is another bottleneck for effective linkage. Stakeholders in this regard refer to farmers, extension organizations, donors, NGOs and policy makers. Each has got its own agenda and demand within its own boundary. This, in turn, results in creating pressure on the proposed linkages and linkage mechanisms. The complexity of the environment puts extra demands on linkages because of more complex set of tasks, need for location specific focus, flexibility at operational level to enable appropriate response, decentralization of authority for innovation, and more open communication system. Due to shortage of research staff, budget and other necessary infrastructures, conducting research in different environments is difficult and challenging.

In addition, farmers in Dejen woreda are served by the Adet research center. Due to the large area covered by the center, it has not been possible to make the review and evaluation program participatory by all the actors of the agricultural knowledge and information system. For example, Adet Agricultural Research Center is involved in five zones of the Amhara Region. It becomes very difficult to invite all the stakeholders in the council meeting from the mandate areas. This in turn, becomes a cause of poor linkage. As a result, as clearly stated by the woreda agriculture and rural development head many of the technologies produced by research are unwelcomed by farmers in the region because they are not responsive to farmers' true needs. This scenario is also reflected in the woreda. In many cases, as has been reported by focus group discussant farmers, they have adopted less than the expected number of crop varieties presented to them. One reason for this is that researchers tend to focus on yield improvement, when other factors, such as early maturity, resistance to drought and pests, taste, storability, and their response to market are more important to farmers. Lack of available relevant technology is associated with the inability of institutional research to develop and adapt technology that is appropriate for many of the diversified farming systems. This is related in most cases with poor understanding by researchers and extension staff on the circumstances of farm households in the woreda and poor linkages between researchers, extension staff and farmers.

6.7. Failure to conduct participatory in site, client-oriented, adaptive research

To make agricultural technologies used by farmers, farmers should participate in in-site client oriented adaptive research. Participatory research is a two-way flow which should bring in scientists to farmers' fields and farmers to research stations. Hence, however daunting the task may be, involving farmers while conducting on-station research is essential. Direct links with farmers can be created through on-farm research (Rajasekaran, 1992). Accordingly, on-farm evaluation and demonstration of improved technologies on farmers' fields are one of the linkage mechanisms used by ARC, which also serves the study woreda, to create a linkage between research, extension and farmer. The specific objectives of these activities are to evaluate the performance of the technologies, to demonstrate the package of the technology to extension personnel and farmers and to collect the feedback from the participants about the technologies (Akalu, et.al, 2005). Accordingly, the center has undertaken lots of demonstrations in the different location of the region but as reported by farmers not in the woreda. Even in those areas where demonstrations have been carried out, the overall impact of these activities on the livelihood of farmers is very scant. One of the most important reasons for this is lack of strong linkage during planning and implementation process among the major actors in the agricultural knowledge and information system.

On-farm research employs several mechanisms to link existing on-station research with extension services, including joint problem diagnosis and collaborative priority-setting and planning exercises; joint programming and review meetings; joint decision making on release of recommendations; periodic joint visits to the field; formal collaboration in trials and surveys; assignment of responsibility for coordination to a specific individual or group; formal guidelines for allocating time to collaborative activities; specific allocation of funds for collaboration; and facilitation of informal consultation(Rajasekaran, 1992). As has been discussed in the previous sections of this chapter, all of these mechanisms are non-existent. Qualitative information collected from extension workers and the woreda agriculture and rural development office head confirmed that research systems do not have formal processes for formulating their research program or for setting priorities. As a result, researchers do not frequently contact extension workers and farmers and hence cannot incorporate input from these two groups into the research agenda.

6.8. Lack of effective popularization of improved technologies

Popularization of improved technologies can serve as a linkage mechanism between research, extension, and farmers in an agricultural system. In areas where the demand for improved technologies is created as a result of pre-extension demonstration, popularization activities can be undertaken with a large number of farmers. This strategy may help to reach more number of users with improved technologies and to also improve the availability of seed for the farming community. But the strategy is not effective as expected because of farmers' unwillingness to take part in the process. In addition, there is lack of follow up on the status of these technologies, which may be a cause and result of weak linkage between research, extension and farmers.

6.9. Lack of accountable and responsible institution for the linkage

The key challenge to rural development intervention is to create a functional network, which strengthens the complementary role of researcher, extensionists and farmers, and adapts various methods of participatory research inquiry that reverses the transfer of technology model. Attempts of linking the three actors (farmers, researchers and extension workers) through FREG, RELC were devised by the Amhara Region Agricultural Institute. FREG, for example, is organized to enhance the generation and transfer of improved technologies and to improve the linkage among farmers, researchers and extension workers. Accordingly, different departments of Adet Agricultural Research Center have adopted FREG approach to technology generation and dissemination. And yet the interviewed socioeconomic expert and researcher in ARARI clearly indicated that the very challenge of the FREG is that it is not institutionalized. Moreover, clarity on the concept of FREG lacks among the research staff and other stakeholders.

The same expert also stated that even if almost all the major stakeholders of the council are found under the umbrella of the Bureau of Agriculture and Rural Development, there is no responsible and accountable body to forge the linkage. Most of the linkage activities are hence undertaken on the goodwill of the participants. The research division and extension wings are doing their business without thinking about their coordination. In addition, since researchers and extension workers are found in different government departments, there are differences in orientation and work style, competence and level of contact between research and extension personnel. Where as researchers are more oriented towards the generation of improved technologies, extension workers are devoted in the dissemination of technologies recommended by the research staff. This results in the absence

of a functional linkage between the two with the concept of linkage remaining more theoretical than practical. Furthermore, institutional incompatibilities, such as the presence of research centers at few sites (for example, one research center for five zones), extension in each and every kebele and different customers or different time schedules for planning and budgeting, seriously impedes linkage development among actors.

In the Amhara Region, the Research-Extension Liaison Committee (RELC) was put in place at regional and zonal levels for more than ten years. Its function was to review and approve research and extension proposals; identify training needs of the extension staff; and monitor the operation of research, extension and farmer linkage in the respective zones. Though it has functioned for more than a decade, as noted by the socioeconomic expert of ARARI, it had not been effective enough in bringing research, extension and farmers closer to each other for a number of reasons. these include:(1)the membership of the working group from both extension and research sides include basically management groups rather than technical staff, who would have been more familiar with the actual field situation;(2)farmers were not represented;(3)high turnover of the committee members;(4) committee members have considered their tasks more as part-time assignment than their duties; and (5) the committee did not have adequate financial resources for monitoring field activities and to cover the cost of regular meetings.

Formal mechanisms for cooperation may, of course, exist through different arrangements. Mechanisms for program formulation and priority setting via meetings are typical examples. Research and extension are theoretically supposed to formulate and meet the research program together. The problem lies in the fact that there were no frequent meetings between researchers, extension workers and farmers. These linkage mechanisms are idle and ineffective. Most of the meetings are occasional and less planned. As noted by focus group discussant extension workers, during some of the extraordinary meetings only the researchers present their plan of activities and results of research by excluding extension workers and farmers, who are considered as empty vessels supposed to hear what is to be presented by researchers. In other words, researchers may have their own prearranged plans, which give little or no room to inputs from extension and farmers. Even, many linkage mechanisms, such as annual planning, technology review meetings, or publication of annual reports, are no longer strong and functional in the study area. Participation of representatives from different institutions depends on the availability of external finance. This

directly raises the question of the existence of these coordination bodies, their sustainability and the willingness of actors to maintain them

6.10. Lack of proper monitoring, evaluation and feedback systems

Technology evaluation is a very vital element in the successful development, dissemination and utilization of agricultural technologies. In light of this, farmers were asked to air out their views regarding the issue at hand. Accordingly, 44 sampled farmers (73.3%) pointed out that extension workers and researchers do not investigate the impact of technologies they develop and disseminate. The interviewed researcher at ARARI also confirmed that since impact assessment of technologies needs a great deal of money and qualified personnel, it is difficult to conduct impact assessment frequently. This is because research and extension activities are hampered by lack of finance and also owing to high turn over of both the research and extension staff. Thus, as reported by the same informant, technology evaluation is shown only in the written report of extension workers.

Likewise, one of the determinants of the success of extension and research work is the existence of a well organized feedback system. Such a system ensures that extension programmes match the preference, resources and specific conditions of the beneficiaries and that the programmes utilize local skills and knowledge. In the study area, after technology dissemination is operationalized, feedback from farmers regarding the characteristics of the introduced technologies is not often recorded. Development of technologies in research stations has become a continuous process irrespective of what is happening in the field. The interviewed head of the woreda agriculture and rural development office confirmed that researchers feel their responsibility ends once the technologies are released to the extension system. He also stated that agricultural extension personnel perceive that dissemination of technologies to farmers is their only responsibility. The dissemination of technologies to farmers is taken as an end in itself. Focus group discussant farmers further complained that their comments on the technologies do not reach to the concerned bodies for proper adjustment. The questionnaire survey of farmers revealed the same result. The majority, i.e. 48 farmers (80%) replied that extension workers do not frequently evaluate and take our feedback to the concerned bodies. They added that even those extension workers who try to get farmers feedback are mainly concerned with fertilizer and improved seeds distribution and utilization and merely on whether production has increased or not.

By contrast, information received from extension workers revealed that they frequently prepare and submit written reports to their immediate supervisors about the problem they faced while working with farmers and also farmers' opinions to technologies. Further, the majority of the extension workers and researchers, i.e. 60%, replied that extension workers take farmers feedbacks on technologies to the concerned bodies via reports, review workshops and field visits. In spite of this, the delay in the feed back system delays its arrival to the concerned bodies on time. The rest, i.e. 40%, reported that extension workers do not take the response of farmers to the concerned bodies for the reason that there are no formal systems that facilitate the effective transfer of feedbacks from farmers to researchers and then back to farmers via extension workers.

6.11. Resource constraints and weak administrative capacity

Sufficient financial resources that can facilitate linkages such as publications, generation of new technologies, testing and dissemination of research results and training of researchers, extension workers and farmers is of a paramount importance. With reference to this, the information received from the socioeconomic expert at ARARI confirmed that the beginning of some linkage mechanisms such as, the Research-Extension-Farmer Advisory Council (REFAC) is by its nature donor driven and hence its sustainability is questionable. For example, REFAC has been funded by the International Federation of Agricultural Development (IFAD) for more than 5 years. Due to lack of fund, the council stopped its functions for some year. It means that the council has not undertaken its annual review and held its monitoring and evaluation meeting. It implies that the sustainability of the council is highly dependent on the availability of fund.

According to the information obtained from the socio economic expert of ARARI, the major bottleneck of the advisory council is that it has no fixed fund from the government budget. In addition, as noted by the head of the woreda agricultural and rural development office, since donor resources are often made available to only one actor in the agricultural system, the linkage mechanisms may be put in place to achieve a high degree of effectiveness for only a short period, often for the duration of a project. No sooner the project phased out, linkage performance decreases. It improves again only when donor resources become available. Thus, weak linkages between the stakeholders are partially attributed to donor dependence.

Indeed, research efforts in diverse environments have to be more widely dispersed. These pose more complex technical problems, requiring more location-specific analysis of problems and adaptation of technology in the woreda. Thus, well qualified personnel in quantity and quality are very crucial. Nevertheless, the scarcity of qualified staff in both the research and extension wings is a major difficulty for not fulfilling such assignments as required. In addition, lack of the necessary infrastructure and other necessary facilities may force researchers and extension personnel to adopt alternative technologies which may not be appropriate for the woreda. Thus, under resource constraint circumstances, linkage activities suffer most, as they have to compete with research and extension functions to obtain a share of the available resources. Moreover, since resources are inadequate, the linkage function will probably be not be able to attract much funding, and hence be unable to attract and keep both the research and extension personnel. Besides, the difficulties related to timely release and proper utilization & reporting of the meager financial resources have become chronic problems in the woreda. Often, as reported by the head of woreda agriculture and rural development office, government budgets reach the woreda very late and different donors have their own procedures and milestones to release the fund. The capacity of the woreda to effectively utilize available resources and to submit plans and reports timely needs a sole searching effort.

In addition to financial matters, land is a basic resource that makes farmers experiment and innovate as well as accept improved technologies. Farmers in the study woreda, however, argued that their land holding is decreasing from time to time. Diminution of land holdings has many implications for agricultural development. One serious concern with this phenomenon is that given the level of farming technology in the country, peasants with such small plots will not be able to produce sufficient food surplus for the market or even for their families (Yigremew, 1999:169). The same author further noted that another impact of diminutive holdings is related to agricultural technology. The low level of agricultural technology is one of the causes mentioned for the low level of agricultural production and productivity, and hence for food insecurity. Although sometimes the reluctance of peasants is given as an excuse for not adopting new technologies, it is associated more with resource endowment than with attitude. Modern technologies are expensive and sometimes even risky; at other times they need economies of scale. Thus diminutive holding means less resource and inefficient use of resources committed to new technology. Relating to this, Yigremew (1999: 165) citing the work of Mulat, et.al (1995), concluded that the most important factor determining the quality of fertilizer use is average farm size. As farm size increases, so does the intensity of fertilizer use. Small farms need help in intensifying their use of fertilizer in order to

make broad based improvements in farm productivity. In the study area, diminution of land holdings resulted in shortage of land for demonstration, experimentation and seed multiplication.

Related to the land holding issue, a question was raised for farmers whether their farm plots are found on the same site or not. The results have revealed that, 48 farmers (80%) have their farm plots in different locations and the remaining 12 (20%) replied that their lands are found on the same location. This implies that, for most of the farmers land is fragmented, which as it is often argued has negative effects on the intensity with which land can be utilized and crops managed. The small and fragmented holdings are, generally, neither conducive to the optimization of agricultural practices nor the application of land management measures (Woldeamlak, 2002).

Farmers were also asked whether land fragmentation has any adverse effect in extension participation. The results have shown that 42 farmers (70%) replied land fragmentation has a negative impact in extension participation and the adoption of new technologies. The reasons given indicate that the management of crops at different locations is very tough and tiresome and moving from one plot to another might take time. In addition, they argued that the application of irrigation and water harvesting schemes in different plots is difficult. On the other hand, 18 sampled farmers (30%) are in favor of having their plots at different sites due to the fact that they can produce different crops at different sites. This renders advantage in terms of having different soils, climate and in terms of minimizing total crop failure at the time of the occurrence of natural disasters. Of the respondents who considered land fragmentation as having a negative impact in extension participation, 54 (90%) of them are extension participants, who are engaged in crop production, animal fattening, and bee keeping.

6.12. Communication problems and the existence of blaming culture

Technological innovations which solve real problems must be designed with a clear understanding of the problem they are meant to resolve. Researchers must have a clear understanding of how small-scale farming systems function and relate this to their surrounding environment before beginning a program of research. It is obvious that education levels between farmers and the research community and extension workers vary. Researchers tend to be confined in research centers, which are generally located in or near cities and are thus far from the farming community. As such, they are not likely to encounter many farmers in their daily businesses (Rajeskeran, 1992).

The extension service is generally given the task of acting as a bridge between researchers and the farming community. Thus, the extension agent is supposed to go out to the farm, collect information about perceived and unperceived needs of farmers and transmit same to researchers. The latter are then supposed to design appropriate solutions and submit them to extension agents, who are supposed to pass them back to the farmers. From informal discussions and observations made, wider differences in value systems, educational backgrounds and communication methods between research and extension workers have been identified. For example, extension workers perceive researchers as professionals, who have good academic qualifications and training that help them to produce appropriate technologies, which are useful at farm level. On the other hand, researchers question extension workers' capability to understand research outcomes, communicate properly with farmers and provide valuable inputs.

6.13. Motivation and commitment problems of the research and extension staff

The effectiveness of agricultural extension and research work highly depends on the availability of research and extension professionals who are qualified, motivated, committed, and responsive to the ever-changing social, economic and political environment. Information collected from both the research and extension staff depict the reality on the ground that researchers and extension workers are less motivated and as a result there is high turn over of staff. Thus, individuals may have little incentive to perform such linkage activities as adaptive field trials and preparation of written materials for farmers. Inadequate career structure, low salary and poor working conditions are some of the motivation problems and disincentives among extension workers and researchers.

A review of the working condition of extension agents reveals that in developing countries the majority of extension personnel are working under difficult and disadvantageous conditions. Field work is also characterized by circumstances that foster low morale, lack of mobility, virtually no equipment and extremely low salaries. For many extension workers, getting additional income source is a question of physical survival. All these, combined in one, contribute to a high turnover rate (Nagel, 1997 cited in Belay and Degnet, 2004). The same source further noted that one of the serious problems of extension organizations in developing countries is the absence of clearly defined systems of reward and penalty. In many developing countries, reward and incentive systems that can attract retain and motivate extension personnel as well as researchers is absent. Besides, training and promotional opportunities are either poor or totally lacking. Many countries do not have provisions for rewarding superior performance or a wage system based on merit.

6.14. Lack of adequate and organized trainings for farmers and extension workers

It is obvious that poor educational background of extension personnel and the rapid changes occurring in the extension environment require regular in-service training to help extensionists to develop their knowledge, skills and attitudes necessary to meet an increasing set of diverse demands. These could also be used as a medium for assessing feedback about the released technologies from different stakeholders. Trainings are also tools employed to upgrade technical competence of extension workers and farmers. To do so, as confirmed by the socioeconomic expert of ARARI, Adet ARC has organized training on various topics for different stakeholders. However, the impact of the trainings on the behavioral, attitudinal and skill change is not assessed and also it was not well organized

Interviewed extension workers confirmed that in-service training and orientation training for new staff, refresher course and specialized training to meet the dynamic nature of extension work requirements and career development training are rare in the study area and often inadequate (if there are some). Extension agents are typically trained in only the basic aspects of the technology they are expected to disseminate. They said that their training is highly theoretical and even the practical aspect is for the sake of fulfilling the requirement for graduation. Hence, they seldom understand the underlying philosophy of technology dissemination and consequently lack the flexibility needed to convince farmers while disseminating technologies.

Equally, farmers' ability to use their land more effectively and efficiently and accepting improved technologies are influenced by factors such as personal views, technology, profitability, public opinion, research and development agents (EEA, 2006). Some of these influential factors can be alleviated through the provision of adequate training. To this end, training farmers is one component of an agricultural research and extension system. As such, the government established Farmers Training Centers (FTCs). As reported by the head of the woreda agriculture and rural development, there are 17 FTCs in the woreda. The generic problem of these FTCs is that except the buildings, one finds no trained farmer trainers assigned. As such, they remain with no function. The interviewed farmers replied that they have been trained neither by researchers nor extension workers.

6.15. Lack of gender mainstreaming in extension and research activities

Women in Ethiopia are engaged in various economic activities, including land cultivation and harvesting, food storage, marketing, gardening, construction of housing and animal husbandry. They possess a wide variety of indigenous knowledge systems and practices. While rural women in Ethiopia are engaged in a range of productive activities that are essential to household welfare, agricultural productivity and economic growth, their contribution continues to be systematically marginalized and under valued in agricultural and economic analyses and policies. Men's contribution remains the central and often the sole focus of attention and hence agricultural extension services still do not attached equal importance to reach women farmers (EEA, 2006)

Observation of the extension and research staff composition in the area revealed that the share of females currently serving in the extension and research activities is very low. The female focus group discussant farmers heavily stressed that research and extension activities are male dominated and work mainly with male farmers. They argued that the distribution of improved seeds, fertilizers and other farm implements is given priority to male-headed households than female-headed ones. Yet they reported that extension workers do not visit their farm plots relative to males. This is consistent with research results reported conducted by EEA (2006), which confirmed that since women, particularly female-headed one are among the poorest of all farmers, their chances to be selected by extension workers for extension services are very low.

Chapter Seven

Linking Research, Extension and Farmers' Indigenous Knowledge and Practices

Despite continuous importance given to the linkages between research-extension-farmer when developing, disseminating, and utilizing sustainable agricultural technologies, several factors act as constraints to carry out an effective linkage in the woreda. There is no single, ideal and easy formula for improving the nexus between research, extension and farmers' indigenous knowledge and practices. Some strategies and a mix of mechanisms can, however, be employed. Linkages can be facilitated when research institutions, extension agencies and farmers in the field recognize the value of shared or complementary information and promote group or team approaches to problem solving. Reviewing the experience of different countries and considering the reality of Ethiopia in general and the study area in particular, the author suggests the following possible solutions as a mechanism of integrating the use of IKS with the activities of institutional research and extension.

7.1. Recognizing and recording farmers' indigenous knowledge systems and innovative capacities

In the process of technology development, knowledge about indigenous livelihoods is indispensable. Indigenous knowledge may not be as sophisticated as scientific knowledge. It is often concrete and dynamic. It relies strongly on perception, directly perceivable evidence, and an accumulation of historical experiences (Farrington and Martin, 1988). It also reflects the dignity of the local community and puts its members on an equal footing with the outsiders involved in the process of technology development. Indigenous knowledge systems provide mechanisms for facilitating understanding and communications between outsiders, i.e. extensionists, researchers, and insiders, i.e. farmers. Improved understanding and communications enhance participatory approaches to problem identification (Warren, 1992). Once problems are identified, the next step during the process of developing sustainable agricultural technologies is to record the indigenous knowledge systems of farmers, which will contribute to the solution of the problem.

Methods to record indigenous knowledge systems are vital in order to create awareness in the attitudes of researchers and extensionists. Though the awareness about indigenous knowledge systems is positive and is rapidly increasing, lack of trainings and knowledge on methods of creating them creates a vacuum. Thus, trainings on identifying relevant indigenous knowledge

systems and practices should be given to all concerned in the development, diffusion and utilization of improved agricultural technologies.

Farmers do not sit and wait for the creation of research institutes before improving their farming systems through innovation. They do have their own local knowledge systems and experiments. These knowledge systems and their capacity for innovation have, however, been downplayed and ignored by both researchers and extension workers in the development and dissemination of agricultural technologies (see chapter 6). Notwithstanding these problems, identifying local knowledge systems and innovations undertaken on farmers' own initiative is a first step towards changing the way research institutions and extension workers look upon farmers and interact with them. Local innovations are locally developed to fit a particular biophysical and socioeconomic setting and usually cannot be transferred in exactly the same form to other locations like the blanket recommendations of conventional technologies. Nevertheless, the documentation and wider sharing of local innovations can provide ideas and morale for others to do their own experimentation and to adapt new ideas to other settings. Local experimentations offer entry points for linking local knowledge and conventional knowledge. For extension workers and researchers, learning to recognize and value local innovation and informal experimentation by farmers is an important step towards engaging in participatory development and the diffusion & utilization of agricultural technologies.

7.2. Establishing indigenous knowledge resource centers

Establishing regional, zonal and woreda level indigenous knowledge resource center forms the starting point for the entire framework of incorporating indigenous knowledge systems into agricultural research and extension. The concept of establishing resource centers was developed by Michael Warren, the Director of the Center for Indigenous knowledge for Agriculture and Rural Development (CIKARD). As Warren(1992:10) noted the functions of national indigenous knowledge systems resource centers include 1) provide a national data management function where published and unpublished information on indigenous knowledge are systematically documented for use by development practitioners; 2) design training materials on the methodologies for recording indigenous knowledge systems for use in national training institutes and universities; 3) establish a link between the rural people of a country who are the originators of indigenous knowledge and the development community; 4) facilitate the active participation of rural people in the conservation, utilization and dissemination of their specialized knowledge through their knowledge banks,

involvement in research and development activities, farmer-to-farmer training, and farmer consultancies; and 5) act as a two-way conduit between the indigenous knowledge-based informal research and development systems and formal research. Organizing and managing such resource centers at regional, zonal and woreda levels are indispensable.

7.3. The use of farmers' and technology development groups

Farmers groups have been used in various areas to facilitate research/extension worker/farmer linkage (Mattee and Lassalle, 1999). Farmers groups are instrumental in facilitating dialogue between farmers and professionals in the process of articulating farmers' needs, problems and interests when designing programmes to solve problems (ibid). Once the village situation has been analyzed and described and priorities set the extension workers and researchers operate with existing farmer organization to undertake various activities which will solve their priority problems. As noted by the same authors, the experience in Tanzania indicates that the use of farmer groups have proved to be very effective in: 1) facilitating communication between institutional research and extension workers on one side and farmers on the other; 2) facilitating communication among farmers themselves, including within communities and between communities. Thus, a process of sharing knowledge and experiences is created (ibid).

Forming technology development group is another possible way for creating linkage among the three actors. The purpose of technology development group is to bring farmers, researchers, extensionists, and other governmental and NGO representatives together in order to classify the identified problems and indigenous knowledge systems and to set research and extension agenda based on them. As has been discussed in chapter six, researchers in the region do have their research plans already established, closing the gates to receive inputs from extension and farmers. At the time of technology review meetings, personnel representing the extension agencies may be regional, zonal or woreda officials who have little direct knowledge of farmers' conditions in rural areas. Moreover, even when extension workers' perceptions are some what correct, researchers may perceive them to be uninformed or subjective. In that researchers may be reluctant to accept them because they consider inputs from extension workers as having lower status and researchers' low esteem for the extension agent's abilities.

Therefore, forming a technology development group can serve as an important stepping stone to give equal importance to problems and indigenous knowledge systems as recorded by researchers and extensionists and to respect extension workers' and researchers intimate contact with farmers. As such, the specific tasks of the technology development group may include: (a) discuss all problems and indigenous knowledge systems as perceived by local people; (b) prioritize problems and indigenous knowledge systems with active participation from farmers; and (c) decisions on who should work on what problem area(Rajasekeran, 1992).

7.4. Identifying research problems in the woreda

Problem identification forms the first step during the process of developing sustainable agricultural technologies. Problems should be identified jointly by extension workers and researchers in consultation with farmers. At this stage, farmers' perceptions regarding needs and priorities should be taken into account. As stated by Chambers, et.al (1989) farmers should be viewed as co-researchers, developers, and extensionists who can provide crucial inputs to determine what problems to address and how to continue. Working with various groups of local people separately is important while identifying problems since each group of local people perceive the same problem differently. The extension workers in coordination with researchers and others concerned should define the recognized problems in clear terms.

7.5. The use of trial and demonstration plots

One of the decisions which have to be made by farmers' groups together with the research and extension staff is on the type of technologies to be tested for subsequent adoption on farmers' fields. A trial and demonstration plot should therefore be widely established in the woreda considering the different agro ecological zones. It should be undertaken jointly by farmers and extension workers. On the trial and demonstration plot, farmers should continuously be involved in assessing all the technologies at all stages. The role of researchers should be to provide information and the necessary inputs and to assist in the design, monitoring and evaluation of results. The trial and demonstration plots serve as places for joint experimentation by researchers, extension workers and farmers. They will be used not only as techniques to generate information, but also to draw the farmers into the process of knowledge creation, control and utilization (Mattee and Lassalle, 1999).

7.6. Giving emphasis for students field practicum

Before graduation, extension workers should be involved in intensive practical training. This participation should consist of the placement of each extension student in an area having different environments and hosted by a farm community for a minimum of two years. This opportunity gives the student to participate in all the agricultural activities in the family in particular and the area placed in general. Through participant observation and continuous discussion with the farm family, the student will be able to analyze the situation of the farmer, describing IKS and its practices, identifying their weaknesses and strengths and proposing alternative solutions to improve the farm. The student should be required to prepare a detailed report on what he/she has done in the area. The report should be reviewed and discussed with the community members before it is finalized. The application of this technique in Tanzania, as documented by Mattee and Lassalle (1999:111), helped a lot in: a) bringing students and farmers physically and psychologically together; b) enabling the students to learn directly from farmers based on their long experiences with the local farming system which is based on farmers IKS and practices, and likewise enabling the farmers to learn some modern knowledge from the students; c) giving students a practical and realistic perspective on small holder agriculture; d) giving students an opportunity to test their classroom learning in light of practical experiences.

7.7. Reforming the extension and research practices through collaboration

Research and extension agendas in the study area are often set by researchers, extension agents and other technocrats who are placed in the top hierarchy of the agricultural technology development system. Realities on farmers' resource are often not adequately considered in research and extension works. Sometimes the institutional mechanisms that allow face to face discussions are not there. But, in order to attain their goals, research and extension systems must be farmer-centered, demand-driven and relevant and appropriate for the poor small producers. The technology and accompanying support structures must be within easy reach of and affordable by the intended consumers with low risk-tolerance threshold. To do so, improving the responsiveness of agricultural research to the needs of the farmers should be done through farmers' participation in the identification and planning of research areas.

Research and extension systems must also respond to farmers' organizations. Farmers' participation in research planning and the identification of improved technologies generates the potential for their diffusion and is thus an essential component of the extension process. The participation of extension agents in agricultural research, an element lacking in the study area, is equally important for the diffusion of innovations. Investigation of newly introduced agricultural technologies with the farmers in their socio-cultural context is the first phase of diffusion. At this stage, researchers and extension agents should demonstrate the appropriate technological options to farmers and provide guidance.

Likewise, partnership between researchers, extension workers and farmers should not end with farmers' adoption of an innovation, as has been the case in the study area. But, this simply marks the beginning of technology development and dissemination phase. Following this, impact assessment leading to new planning that starts the next improvement phase should start. Unfortunately, the extension and research practice in the study area lack such activities. Generally, extension systems should be more flexible and ready to serve farmers and their specific needs rather than the need of researchers.

Extension workers should by definition be always with farmers gaining vast experiences on what works and what does not, where new problems crop up and how farmers adapt new things to fit their own condition. These insights are very valuable in any type of agricultural research. These insights tend could, however, be lost if there are no systematic feedback mechanisms. Further, research results need to be produced and translated first into information usable for extension workers and then to farmers level. While the step from extension to farmer level is usually the task of extension, the first step may involve collaboration between research and extension. The difficulty, in the study woreda, lies in the inability of extension workers to accurately perceive the context of technologies.

7.8. Making linkage mechanisms independent of donor funds

Different linkage mechanisms have been developed like FREG, RELC, REFAC, in the region in general and in the study area in particular. The operation of these mechanisms is however linked with donor funds. Although donor projects have played a positive role in improving linkages, they can also have negative effects when they decide which linkage strategies and mechanisms should be used. One such negative effect is the difficulty of achieving a consensus among component

organizations when each of them responds to different donor requests. Since different donors have different priorities and approaches, the interface between research and technology transfer funded by different donors can be difficult to manage. The lack of stability in the way organizations are involved in linkages results from linkages being made solely for donor-funded projects. The system has to adjust itself to the linkage strategy defined for each project. Therefore, in order to make the linkage efforts as sustainable as possible, they have to be free of donor funds. This can be achieved by creating awareness on farmers and making them active participants in technology development and diffusion endeavors

7.9. Applying systems perspective

One of the basic causes of poor linkages between research, extension and farmers is the absence of a systems perspective in the agricultural technology system. Policy decisions, with regard to the professional status of extension staff, incentives for staff, resource-allocation procedures, as well as the attitude and behavior of individual staff members, especially researchers, indicate poor adherence to systems principles. Yet, systems principles are a prerequisite to successful cooperation among the different members of an agricultural technology development, dissemination and utilization system

7.10. Giving the right information to linkage partners

Due to factors such as, limited resources, the difficulty of finding appropriate representatives of the farming community (given the complexity and diversity of farming systems), and the cultural and educational gap between researchers, extension agents, and farmers, linkage mechanisms are not always properly used. The outcome of the use (or non-use) of linkages is also often overlooked because of the lack of monitoring and evaluation system. With regard to representation, for example, representatives chosen from farmers' organizations and technology transfer are often not suitable because they do not have the information they need. They are selected purely on an administrative basis, rather than by using the criteria of effectiveness. For instance, farmers' representatives are selected from richer categories of people ignoring the poorer ones.

7.11. Bringing a desirable change in the attitudes of stakeholders on the importance of IKS

Training programs on indigenous knowledge systems are invaluable tools for bringing a desirable change in the attitudes of researchers and extension workers. If the extension personnel and agricultural extension officers are provided training on scientific technological innovations, but have not learned to regard farmers as their colleagues, their potential to support farmers' local research efforts will be comparatively lower. Thus, training programs on the role of indigenous knowledge in agricultural development help to remove the impression among the extension workers and researchers that researchers are the only generators of technological innovations and extension workers job is to merely transmit those innovations. In addition, the role of indigenous knowledge systems in sustaining agriculture should be incorporated in the curriculum of higher learning institutions. The curriculum should address the essence and significance of IKS, ways of documenting and recording, mechanisms of integrating IKS with conventional ones.

Chapter Eight

Summary, Conclusion and Recommendations

8.1 Summary and Conclusion

Agriculture is the most important economic activity in Dejen woreda in particular and the Amhara Region in general. The woreda is typical of the mixed and ox-plough cereal belt in the northwestern Ethiopian highlands. The overall farming system is strongly oriented towards grain production and is dependent on the use of oxen for land preparation. Livestock are grazed on traditional communal lands. However, despite the efforts made by research and extension activities, the production of the agricultural sector is low. As pointed out by different research works, one of the problems lowering agricultural production is the lack of strong linkage between research, extension and farmers in the development, dissemination and utilization of improved agricultural technologies. This study attempted to investigate factors that mitigate effective linkage among the three stakeholders (actors) and suggest possible ways of linking them in the development of agriculture.

Farmers in the study area have their own indigenous way of classifying, describing and characterizing local soil types in their fields based on their characteristics, problems, and their suitability for various crops. Farmers in the study area identified four types of soils locally known as *ashalma*, *borebor*, *debay* and *borenk* based on their color, stoniness; fertility status, topographic location, and suitability for agriculture. They also perceived that the fertility of soil in their fields has declined during the past years owing to mainly the growing number of human population and the consequent diminishing farm size which leads to the over cultivation of farm lands and overgrazing of pasture lands. In addition, soil erosion by water and wind, the utilization of crop residuals for livestock feeding and the continuous use of inorganic fertilizer were mentioned as other reasons for the decline of soil fertility.

Farmers perceive soil fertility in terms of the capacity of soils for long term productivity; their permeability, water holding capacity, drainage, tillage, manure requirement and cultivability. Farmers employ different indicators of knowing whether the soil is fertile or not. The major indicator mentioned by farmers is crop yield reduction. Both indigenous and modern methods of maintaining soil fertility are used by farmers in the study area. Among the modern ones, the use of artificial fertilizer is the most common. Despite the fact that farmers use artificial fertilizer to increase crop production, they are aware that relying on commercial fertilizer can not sustain

agriculture. They also believe that the use of indigenous soil fertility maintaining practices can give a sustainable solution to the problem of soil fertility. This can, in one way or another, indicate that farmers give due recognition and value for their indigenous knowledge and practices to sustain agriculture.

A variety of indigenous soil fertility management techniques were/are practiced by farmers in the study area. Some of these include crop rotation, manuring, mixed cropping, fallowing, and planting legumes. Similarly, farmers in the area practice different pest and disease control techniques, with the major ones being spraying animal urine; dusting the seed with ash and pepper; mixing animal urine, donkey waste, poisonous plant leaves and ash and spraying it on the crop land where disease and pest occur, repeated ploughing, cutting and getting rid of infected plant, crop rotation, burning and smoking, and use of resistant variety.

In the study area, farmers in most cases tried to perform problem solving and adaptation experiments. All surveyed extension workers and researchers confirmed that farmers conduct their own indigenous (local) and informal experiments. The application of botanical pest control techniques, testing the productivity of different crops by applying commercial and non-commercial fertilizers, increasing and decreasing the rate of fertilizer application in different crops and fields and finding the differences between the two were some of the local experiments conducted by farmers as mentioned by farmers, extension workers and researchers. In terms of indigenous knowledge and practices, the use of local seed varieties and informal seed systems were most important. The study revealed that farmers cultivated different varieties of local seeds for different types of crop.

Indigenous knowledge and practices are very effective and efficient in many ways compared to scientific ones. IKSs and practices are strong from the point of view of their low financial requirement and low external input dependence. They don't require imported materials from abroad since they depend on locally available materials. For example, all local fertility management practices do not require external input and they are not too costly to be covered by resource poor farmers. In addition, IKS and its practices do have multiple benefits. Moreover, indigenous knowledge and practices are compatible to farming systems and environmental sustainability. Despite the strengths, some indigenous knowledge systems and practices are, however, not free of limitations. The fertility management practices such as manuring require large number of livestock population and green matter while fallowing needs large farm size. That is why these techniques are

today on the verge of being abandoned by most of the resource poor farmers. Although all indigenous practices need less money, they need more labor force and hence they are labor intensive.

The attitudes of key actors- farmers, extension workers, and researchers- play a great role in influencing the attention given to indigenous knowledge systems and practices and efforts by research and extension to make use of it. Researchers and extension workers and almost all farmers interviewed perceived and believed that farmers' indigenous knowledge and practices are very vital to contribute to the effectiveness of extension and research activities. Despite such beliefs and attitudes, IKSs and its practices are not linked effectively with research and extension endeavors. The study came up with the following constraints which work against effective linkage between research, extension and farmers: limited input from farmers in setting priorities and formulating the research agenda; under perceiving and disregarding indigenous knowledge systems, experiments, and organizations; technical deficiency of the extension service; technical problems of the research wing such as large area coverage of the research centre and complexity of the research environment and pressures from stakeholders; lack of accountable and responsible institute for the linkage; lack of proper monitoring and evaluation systems; resource constraints and weak administrative capacity; communication problems and the existence of blaming culture; motivation, incentive and commitment problems of the research and extension staff; lack of adequate and organized trainings for farmers and extension workers; and lack of gender mainstreaming in extension and research activities; and

In conclusion, due to the above mentioned factors, indigenous knowledge systems and practices in the region in general and the study woreda in particular are not given due attention in extension and research endeavors. Consequently, there exists a gap between the three actors.

8.2. Recommendations

In light of the findings, it is imperative that policy makers pay at most attention to the constraints that the current research, extension and farmers linkage is grappled with:

- Farmers IKSs can provide a frame of reference for strengthening agricultural extension programmes that can lead the researchers to develop a framework for incorporating IKSs into agricultural extension organizations. Nevertheless, the role and importance of

indigenous knowledge systems and practices in the sustainable development process is not given due attention by researchers, extension workers and other concerned bodies. Thus, in order to avail improved agricultural technologies to farmers, the research and extension activities should build upon local people's knowledge and practices that are acquired through various processes such as farmer-to-farmer communication, and farmer experimentation. To this effect, indigenous knowledge systems should be recorded and documented by the researchers, extension workers and others concerned using farmer participatory methods such as, participant observations and unstructured interactions. Beyond recording and documenting, IKS should be incorporated in the training manuals (modules) of researchers and extension workers. This may serve as a start up to link the agricultural universities with farmers and thereby research and extension endeavors.

- Identifying local innovations and engaging in joint experimentation help researchers, extension workers and farmers to change their attitudes and behavior toward each other. This may, in turn, enable them to view interaction within a complex innovation system and to strengthen their capacities to engage with each other and innovate more quickly. Thus, joint effort by researchers and extension workers should be made to identify and make use of local experimentations in research and extension activities.
- Lack of motivation, incentive and commitment among research and extension staff is considered as a problem in creating effective linkage between the three actors. But, to create effective linkage among the three actors there should be internal motivation by researchers, extension workers and farmers. The partnership for institutionalizing participatory approaches will be sustainable only if they are driven by internal momentum and energy, i.e. genuine motivation of each and every partner, rather than being driven by external donors. In addition, there should be sincere commitment from all partners. Through personal and institutional interaction and joint work, the different actors can learn about each others strengths and weaknesses and how their contribution can complement each other. During the process, mutual trust and commitment can grow and the partners (researchers, extension workers and farmers) increasingly care about the state of the partnership as a means to achieve their own and joint aims. Moreover, shared responsibility among actors should be there. This is because partnership can function well only if all members realize that it should not and can not depend on only one individual or one organization. Responsibilities and leadership must be shared. On top of these, openness and transparency between all partners is vital. At the very beginning and to the greatest extent possible, the partners need to make

their interests and expectations clear, i.e., articulate what is at stake. The resources that can be made available from internal and external sources and the benefits that could be gained should openly be discussed. To do all these, the Amhara Region in collaboration with the Federal Government should devise proper mechanisms to penalize or reward research and extension staffs as per their level of performance so that they can be motivated and high turn over of the staff can be minimized

- As has been frequently raised by researchers and extension workers, shortage of resources (financial, human and physical) is a principal bottleneck, which hinders the linkage between the actors in agricultural development. The Amhara Region in collaboration with the Federal Government should look for solutions to guarantee secured sources of funding for the linkage. Making technology development and diffusion participatory by involving farmers can also reduce the size of resources needed
- In the study area there are no plots reserved for seed multiplication, demonstration and adaptation trial. To avoid such problem, the woreda officials should discuss and convince farmers to assign plots for demonstration, adaptation trial and the like.
- The regional government should strengthen the capacities of regional research and extension organizations by assigning qualified and well trained researchers through devising attractive working environment. Plus, higher learning institutions should give due attention to practical trainings.
- Lack of research results that address the resource levels, risks, needs and priorities of farmers appears as a constraint for creating the desired connection among actors. The research wing should generate technological options rather than fixed technical packages by involving farmers in the generation of technologies. Outlining areas that research and extension organizations need to concentrate during the process of technology development and diffusion should be done by working with farmers. This can be done by having a round table talk with farmers who are the originators of IKS. To this end, the concerned bodies (regional, zonal and woreda level) should form technology development group to bring farmers, researchers, and extension workers together well ahead of the process of technology development.

- Absence of responsible institution for the linkage is one problem for poor linkage between research, extension and farmers. Thus, in the region in general and in the woreda in particular there should be an independent institution designed merely for linkage activities. The institution should be staffed with motivated, committed and experienced professional staff. This independent institution has to be responsible to run linkage activities. Of course, this institution should follow the systems perspective so that it can address the challenges facing each linkage partner and search solutions for the problems.
- Farmers' indigenous organizations are very vital in the dissemination of agricultural information among farmers themselves. Thus, the capacity of these organizations should be enhanced by making them to be formally organized and to be accountable for themselves.
- Extension workers who are assumed to have a day to day contact with farmers should encourage farmer-led experimentation by using different mechanisms: a) creating opportunities for farmers to share their innovations, as these provide ideas for other farmers to try out; b) offering alternatives to compare with current practices or local innovations; c) filling local knowledge gaps: increasing farmers' awareness of resource management principles and providing information on phenomena that farmers cannot observe on their own so that farmers can develop local ways of applying the principles in farming practice; d) facilitating mutual learning: creating opportunities for groups of farmers to critically analyze both local and external ideas for improving agriculture and to assess the results of farmer-led participatory research, e.g. through farmer learning groups or exchange visits.

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Appendix A

Glossary of terms on Indigenous Soil and Water Conservation Practices

- a) *Golenta / Garda / Yewhabat / Gorfmekelbesha* - A wide waterway which controls the runoff that comes from upland and which is usually constructed at the edge / between the adjacent farmlands and has a wide width (40 - 50m).
- b) *Wagemet / Boi-mekelbesha / Adengale*: Medium sized traditional ditch that dissects the farmland and connects two different sides of *Golenta*. There could be two or more in a farmland and it has lesser width than *Golenta*. It reduces the runoff speed by diverting the excess water.
- c) *Boi*: Small sized traditional ditch that connects two or more *Wagemet* ditches. It has a very narrow width and it is used to dispose excess water from *Wagemet* ditches.
- d) *Yedengay Erken*: It is a single line of very close stones used to retain both runoff and soil deposits it is usually made on a flat land with 0 - 2 % gradient.
- e) *Afer Metebekia* - Some tree species planted at the edge of the field to protect the washable soil deposits. It is constructed on slope lands.
- f) *Dinber Shileta / Dinber Metew*: is a land between two adjacent farmlands left unploughed for longer period forming a stoppage to water erosion.
- g) *Local vegetative barriers* - It is similar with grass strips but it differs both in the selection of plant species and in planting method.
- h) *Erken Meshar*: it is just a shifting of the terraces to a cultivable land. Terraces used for this purpose are those constructed only in the middle of the slope while the upper and lower terraces remain untouched.
- i) *Degele*: Patches of grasses established on unploughed piece of land left purposely on the newly beginning waterways. The patches could be many in number.
- j) *Stone bund plus vegetation*: A combination of traditional stone bunds and grass or perennial plant species used for the control of water erosion from the farmland on slopes with more than 16% gradient.
- k) *Yedengay Kiter*: It is unique to the Ankober peasant farmers. There are two types *Yedengay Kiter* (stone terrace). The first is called '*Andanjet*' meaning made of a single block of stones and the other is called '*Huletanjet*' meaning made of two blocks of stones. The height of the terrace extends to 4 meters.

Appendix B
Addis Ababa University
School of Graduate studies
College of Development Studies

Household Survey Questionnaire Designed for Farmers

The purpose of this questionnaire is to gather information on factors that hinder the incorporation of farmers' indigenous knowledge into institutional research and extension and foreword possible solutions for better linkage. The response that you give is very vital for the success of the research and I can assure you that your response is utilized for research work only. Please give your honest response for the questions raised.

PART I. SOCIOECONOMIC AND HOUSE HOLD CHARACTERISTICS

A. Household Characteristics

1. Personal Information

Household head

Age _____

Religion _____

Sex _____

Educational Level _____

Marital Status _____

yearly income _____

Number of household members _____ Male _____ Female _____

Number of family laborers _____ Male _____ Female _____

2. Do you want to have more children? 1. Yes _____ 2. No _____

3. If Yes, how many? _____

Why _____

4. If no, why _____

5. Do you think that your family labor is sufficient to practice improved agricultural practices? 1. Yes _____ 2. No _____

6. If no, why? _____

7. Where and how do you get extra labor force to accept and apply improved agricultural practices in your farm plots? _____

B. Land Holding and Land Fragmentation

1. What is the size of your land holding (in hectares)? _____

2. How did you obtain your plot of land? _____

3. Are your plots of land found in the same location or isolated? _____

4. Do you believe that your land ownership affects your involvement in research and extension activities? 1. Yes _____ 2. No _____

5. If yes, how does it affect? _____

6. If no, why not? _____

7. In your opinion does fragmentation of plots have any adverse affect on your involvement in extension activities? 1. Yes _____ 2. No _____

8. If yes, what are these effects? _____

9. If no, why not? _____

PART II. Farmers' indigenous knowledge and practices pertaining to crop production

A. Farmers Knowledge of Soils

1. How many types of soils do you know in your locality? _____

2. What are their names and characteristics? _____

No	Soil type(local Name)	Characteristics(color, fertility condition, stoniness, consistence, etc)	Location
1			
2			
3			

3. Which types of soils are suitable for which type of crops and Why? _____

No	Soil type(local Name)	suitable crop type	Reason
1			
2			
3			

B. Farmers Indigenous knowledge of soil fertility management

- How do you assess the fertility level of your cultivated land?
 - Increasing
 - Decreasing
 - Remains the same
- If it is increasing, what do you think are the reasons? _____
- If it is decreasing, what are the reasons behind? _____
- Which soil type/s requires intensive soil fertility management? _____
Why? (mention the reasons) _____
- Which types of indigenous soil fertility management measures are you practicing to improve the fertility status of the soils of your plot? _____
- Why do you prefer the above soil fertility management practices compared to others? _____
- Of the indigenous soil fertility management practices, which ones do you think are inefficient? _____
- What are their major weaknesses? _____
- Which indigenous soil fertility management practices are not currently practiced? _____
- Why have these measures been abandoned from the system? _____
- Do you use artificial fertilizers on your fields? 1. Yes 2. No
- If no, what are the reasons? _____
- If yes, indicate the type and you use

No	Type of fertilizer	Amount per hectare
1		
2		
3		

- Do you think that the use of fertilizer alone is a lasting solution for soil fertility decline?
 - Yes
 - No
- If yes, why? _____
- If no, what do you think is the lasting solution? _____
- Do you think that indigenous soil fertility management practices are inferior to conventional ones?
 - Yes
 - No
- If yes, in what respect? _____
- If no, what are the relative strengths of the conventional ones? _____

C. Farmers Knowledge and Practice of Crops and Crop Production

- What type of seeds are you using for your production?
 - Local seed varieties
 - Improved seeds
 - Both
- If you are using both, what are the reasons? _____
- What factors influence you to choose either improved or local seeds? _____
- If you are using indigenous (local) seed varieties, what are the reasons? _____
- What type of local varieties are you using? What are their qualities and characteristics?

No	Local seed(crop) type	Characteristics of seeds(crop)

- How many varieties are there for each of the above crops? What are their names?

No	Crop type	Variety Name			
		1	2	3	4
1					
2					
3					
4					

- What are the qualities and characteristics of each of the seed varieties mentioned for the above crop types?

No	Seed type	Variety Name			
		Characteristics(qualities)			
1					
2					
3					
4					

5. If you are using improved seeds, for what type of crops are you using them? _____

6. How many varieties are there for each of the above crops? What are their names?

No	Crop type	Variety Name			
		1	2	3	4
1					
2					
3					
4					

7. What are the qualities and characteristics (qualities) of each of the seed varieties mentioned for the above crop types?

No	Seed type	Characteristics(qualities)			
1					
2					
3					

8. What kind of difference have you noticed between local and improved seed varieties? _____

9. From local and improved seeds which ones are good for you? _____
Why? _____

10. If you are utilizing improved seeds, have you totally abandoned the use of local seed varieties?
1. Yes 2. No

11. If ye, why? _____

12. If no, why not? _____

13. Do you replant improved seed varieties? 1. Yes 2. No

14. If yes, what results did you find? _____

15 If no, why not? _____

16. What is the most reliable source of seed for you? _____

17. What indigenous seed preservation techniques do you use? _____

18. What are their strengths and weaknesses?

Weaknesses _____

Strengths _____

19. In your locality, in which months is land preparation made? How many times for which type of crops and Why?

No	Type of crop	Month	Frequency of Plowing	Reason
1				
2				
3				

20. What factors determine the frequency of plowing? _____

D. Farmers' Indigenous knowledge and practices of Pest and Weed Control Techniques

1. What Indigenous weed control techniques do you use? _____

2. What are their weaknesses and strengths?

Weaknesses _____

Strengths _____

3. What conventional weed controlling techniques do you use? _____

4. What are their weaknesses and strengths?

Weaknesses _____

Strengths _____

5. Which ones are good and efficient for you? _____

Why? _____

6. What indigenous pest and disease control methods do you use in your plot? _____
7. What are their weaknesses and strengths?
 - Weaknesses _____
 - Strengths _____
8. What conventional pest and disease control methods do you use in your plot? _____
9. What are their weaknesses and strengths?
 - Weaknesses _____
 - Strengths _____
10. Which ones are good and efficient for you? _____
- Why? _____
11. What indigenous farmers' institutions are there in your locality? _____
12. What are their roles in agricultural development? _____
13. What informal communication channels do you use so as to disseminate agricultural Information? _____

PART III. AGRICULTURAL RESEARCH AND EXTENSION ACTIVITIES

A. Extension

1. Do you participate in extension activities? 1. Yes 2. No
2. If no, what are the reasons? _____
3. If yes, in which packages are you participating?
 - 3.1. _____
 - 3.2. _____
 - 3.3. _____
 - 3.4. _____
4. Where do you get extension information? _____
5. Do you know that there are extension workers in your locality? 1. Yes 2. No
6. If yes, have you met them? 1. Yes 2. No
7. If no, what is the reason? _____
8. If you have met them, how many times? _____
9. Where did you get them? _____
10. Do extension workers establish trustful and friendly relationships with you based on equity?
 1. Yes
 2. No
11. If no, what is the reason? _____
12. Do extension workers create opportunities for farmers to share your innovations?
 1. Yes
 2. No
13. If no, why not? _____
14. Do you believe that extension workers are well equipped with planning concepts to design proper extension plan through the participation of farmers? 1. Yes 2. No
15. If no, what is the reason? _____
16. Do extension agents offer alternatives (eg demonstrations) to compare conventional practices with local ones? 1. Yes 2. No.
17. If No, why not? _____
18. If yes, how? _____
19. Do extension workers stimulate farmers to examine their experimentation methods and helping you explore more systematic forms of experimentation? 1. Yes 2. No
20. If no, why not? _____
21. If yes, how do they help you? _____
22. Do extension workers have the knowledge, connections and skills to be able to gain the trust of farmers and perform their jobs accurately? 1. Yes 2. No
23. If yes, could you explain? _____
24. If no, what is the reason? _____
25. What types of information do you receive from extension workers?
 - 25.1. _____
 - 25.2. _____
 - 25.3. _____
 - 25.4. _____

26. What sorts of information fail to reach you?

- 26.1. _____
26.2. _____
26.3. _____
26.4. _____

27. Do you believe that extension workers do have sufficient problem solving skills?

1. Yes 2. No

28. If no, what do you think are the reasons? _____

29. Do you believe that the technical message you receive from extension workers reflect local crop production condition? 1. Yes 2. No

30. If yes, how? _____

31. If no, why not? _____

32. Do extension workers take your feed backs on technologies to concerned bodies?

1. Yes 2. No

33. If yes, how? _____

34. If no, what are the reasons? _____

35. Do you continue to participate in extension activities? 1. Yes 2. No

36. If no, for which packages? _____

37. What are the reasons? _____

38. Do extension workers accurately perceive the situation of farmers? 1. Yes 2. No

39. If no, why not? _____

40. Is your produce (yield) increasing or decreasing, in general, over the past years?

1. Yes 2. No

41. If it increases, do you think that it is the result of your involvement in extension?

1. Yes 2. No

42. If it decreases what do you think are the reasons for that would be? _____

43. What extension methods are development agents using? _____

B. Research Activities

1. Do you conduct local and informal experiments in your locality to improve crop Production? 1. Yes 2. No

2. If no, why not? _____

3. If yes, what local and informal experiments do you conduct in your locality? _____

4. What resources do you use to conduct such local experiments? _____

5. What are the strengths and limitations of your informal experiments? _____

6. Do extension workers and researchers understand record and evaluate your local/ informal experiments? 1. Yes 2. No

7. If yes, how? _____

8. If no, why not? _____

9. Do you work in collaboration with extension workers and researchers to produce improver seeds for multiplication and distribution? 1. Yes 2. No

10. If no, what are the reasons? _____

11. If yes, how and on which activities? _____

12. Are there farm trials in your locality to test the validity of improved agricultural technologies?

1. Yes 2. No

13. If no, why not? _____

14. Are the technologies and information provided by researchers and extension workers demand driven? 1. Yes 2. No

14. If no, why not? _____

15. If yes, how do they entertain your demands? _____

16. Do extension workers and researchers give you a chance to choose a particular technology from a set of technological options? 1. Yes 2. No

17. If no, why not? _____

18. If yes, how? _____

19. Is technology development and transfer participatory? 1. Yes 2. No

20. If no, why not? _____

21. Who makes decisions in technology development and dissemination? _____
 1. Researchers 2. Extension workers 3. Farmers 4. Others (specify) _____
22. If your answer is 1, 2, or 4, what do you think are the reasons? _____
23. Is technology development and transfer practical? 1. Yes 2. No
24. If no, why not? _____
25. If yes, how? _____
26. Do you think that improved technologies address the resource constraints and risks faced by farmers? 1. Yes 2. No
27. If yes, How? _____
28. If no, why not? _____
29. Do you think that research and extension services start where farmers are and with what they have? 1. Yes 2. No
30. If yes, how? _____
31. If no, why not? _____
32. Do extension workers and researchers investigate the impact of technologies they develop? 1. Yes 2. No
33. If no, why not? _____
34. If yes, what factors do they consider in the process of evaluation? _____
35. Do you take your own strategies to overcome problems of agricultural production? 1. Yes 2. No
36. If yes, what strategies do you take? _____
37. If no, what are the reasons? _____
38. Do researcher and extension agents understand farmers' resource levels and risks? 1. Yes 2. No
39. If no, why not? _____
40. If yes what mechanisms do they use to assess your resource levels? _____
41. Do you collaborately work with other farmers for technology development and dissemination? 1. Yes 2. No
42. If yes, in what respect? _____
43. If no, why not? _____

PART IV. ATTITUDE TO INDIGENOUS KNOWLEDGE AND PRACTICES

For farmers, extension agents and researchers

Rate the following questions by putting a (X) mark based on the level of your agreement and disagreement where

- 1 stands for strongly disagree
 2 stands for disagree
 3 stands for neutral
 4 stands for agree
 5 stands for strongly agree

No	Items	5	4	3	2	1
1	Scientific knowledge provides a sustainable solution to agricultural problems than IK					
2	Farmers IK increases cultural pride and hence motivation to solve local problems with local ingenuity and resources					
3	Incorporating IK in research and extension can contribute to local empowerment, self sufficiency and self determination					
4	IK and practices are major obstacles to agricultural development					
5	Farmers have a wealth of IK concerning the management of ecological, technological and organizational factors related to food production under specific local conditions					
6	Preserving IK capital can enrich global community and contribute to the cultural dimension of development					
7	Farmers by their own nature are resistant to adopt improved technologies since they stick to traditional practices					
8	Lack of farmers involvement in research and extension leads to the production of inappropriate agricultural technologies					

9	Agricultural research agenda should be determined based on the interest of researchers and extension workers than farmers					
10	Farmers are technology users than experimenters					
11	Farmers' IK systems are time tested agricultural practices which pave the way for sustainable agriculture					
12	Farmers' do have the potential to determine what technology is useful and relevant to them					
13	Farmers have their own knowledge to follow a number of conscious strategies which aim at coping with problems of agriculture					
14	Researchers and extension workers have the knowledge and skills ready at hand to make necessary decisions independently of farmers					
15	Farmers' indigenous knowledge should be incorporated to research and extension because rapidly changing conditions require local capacities to adapt quickly					
16	Farmers IK provides a point of departure for joint exploration and learning firmly embedded in local realities					
17	Farmers IK systems are backward, conservative and lack innovative ability					
18	Since farmers are uneducated and lack knowledge, they always need instruction from research and extension to increase agricultural production					
19	The participatory technologies that are developed through the integration of IK will enable diversified technological solutions to farmers					
20	Farmers know about their own reality and their land use systems					
21	Farmers are innovators who have developed ways of experimenting through trial and error					
22	IK offers a low cost approach with potentially high benefits than modern knowledge based approaches					
23	IK provides mechanisms for facilitating understanding and communication between extension, research and farmers					
24	IK provides a framework of reference for strengthening agricultural research and extension programmes and this leads to reorganization of interventions made by extension personnel.					
25	The involvement of farmers in research and extension activities is irrelevant since it needs high transaction costs					
26	Recognition of farmers IK in extension and research raises farmers self-esteem in agriculture					
27	Since IK changes through time, it is difficult to rely up on it					
28	Indigenous knowledge systems are socially desirable, economically affordable, and sustainable ;involve minimum risk to rural farmers and producers, and above all, they are widely believed to conserve resources					
29	Learning from IK can improve understanding of local conditions and provide a productive context for activities designed to help the communities					
30	the use of IK 'assures that the end user of specific agricultural development projects are involved in developing technologies appropriate to their needs'					
31	Whenever new constraints appear as a result of human or natural processes, new solutions have to be, and often are, devised by farmers based on their IK					
32	Real knowledge is the sole domain of the researchers and extension workers					

General questions

- 1. How do you evaluate the integration between research, extension workers and farmers in your locality?
- 2. It is frequently discussed that there is a missed link between research, extension and farmers in the agricultural development endeavor. What do you think are the problems for such missed linkage?

Problems	Yes	No	Description (what are they?)
Policy related			
Institutional			
Research related			
Extension related			
Farmer related			

- 3. What do you think are the possible measures to redress the problems you mentioned above?

Measures	Description (what are the measures to be taken?)
Policy related	
Institutional	
Research related	
Extension related	
Farmer related	

Appendix C
ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
College of Development Studies

TO BE FILLED BY EXTENSION AGENTS AND RESEARCHERS

The purpose of this questionnaire is to gather information on factors that hinder the incorporation of farmers' indigenous knowledge into institutional research and extension and foreword possible solutions for better linkage. The response that you give is very vital for the success of the research and I can assure you that your response is utilized for research work only. Please give your honest response for the questions raised.

Thank you in advance for your cooperation

1. Personal information

1.1. Age _____ 1.2. Sex _____
 1.3. Qualification _____ 1.4. Position: _____

2. Rate the following questions by putting a (X) mark based on the level of your agreement and disagreement: **Options:**

1. Strongly disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly agree

No	Items	1	2	3	4	5
1	Scientific knowledge provides a sustainable solution to agricultural problems than IK					
2	Farmers IK increases cultural pride and thus motivation to solve local problems with local ingenuity and resources					
3	Incorporating IK in research and extension can contribute to local empowerment , self sufficiency and self determination					
4	IK and practices are major obstacles to agricultural development					
5	Farmers have a wealth of IK concerning the management of ecological, technological and organizational factors related to food production under specific local conditions					
6	Preserving IK capital can enrich global community and contribute to the cultural dimension of development					
7	Farmers by their own nature are resistant to adopt improved technologies since they stick to traditional practices					
8	Lack of farmers involvement in research and extension leads to the production of inappropriate agricultural technologies					
9	Agricultural research agenda should be determined based on the interest of researchers and extension workers than farmers					
10	Farmers are technology users than experimenters					
11	Farmers' IK systems are time tested agricultural practices which pave the way for sustainable agriculture					
12	Farmers' do have the potential to determine what technology is useful and relevant to them					
13	Farmers have their own knowledge to follow a number of conscious strategies which aim at coping with problems of agriculture					
14	Researchers and extension workers have the knowledge and skills ready at hand to make necessary decisions independently of farmers					
15	Farmers' indigenous knowledge should be incorporated in research and extension because rapidly changing conditions require local capacities to adapt quickly					
16	Farmers IK serves as a bridge joint exploration and learning firmly embedded in local realities					
17	Farmers IK systems are backward, conservative and lack innovative ability					
18	Since farmers are uneducated and lack knowledge, they always need instruction from research and extension to increase agricultural production					
19	The participatory technologies that are developed through the integration of					

	IK will enable diversified technological solutions to farmers					
20	Farmers know about their own reality and their land use systems					
21	Farmers are innovators who have developed ways of experimenting through trial and error					
22	IK offers a low cost approach with potentially high benefits than modern knowledge based approaches					
23	IK provides mechanisms for facilitating understanding and communication between extension, research and farmers					
24	IK provides a framework of reference for strengthening agricultural research and extension programmes.					
25	The involvement of farmers in research and extension activities is irrelevant since it needs high transaction costs					
26	Recognition of farmers IK in extension and research raises farmers self-esteem in agriculture					
27	Since IK changes through time, it is difficult to relay up on it					
28	Indigenous knowledge systems are socially desirable					
29	Indigenous knowledge systems are economically affordable, and sustainable					
30	Indigenous knowledge systems involve minimum risk to rural farmers and producers					
31	Learning from IK can improve understanding of local conditions and provide a productive context for activities designed to help the communities					
32	the use of IK 'assures that the end user of specific agricultural development projects are involved in developing technologies appropriate to their needs'					
33	Whenever new constraints appear as a result of human or natural processes, new solutions have to be, and often are, devised by farmers based on their IK					
34	Real knowledge is the sole domain of the researchers and extension workers					

A. EXTENSION RELATED QUESTIONS

1. Are farmers willing to participate in extension activities? 1. Yes 2. No
2. If no, what are the reasons? _____
3. If yes, in which packages are they participating in your locality? _____
4. Do extension workers establish trustful and friendly relationships with farmers based on equity?
1. Yes 2. No
5. If no, what is the reason? _____
6. Do extension workers create opportunities for farmers to share their innovations?
1. Yes 2. No
7. If no, why not? _____
8. Do you believe that extension workers are well equipped with planning concepts to design proper extension plan through the participation of farmers? 1. Yes 2. No
9. If no, what is the reason? _____
10. Do extension agents offer alternatives to farmers to compare conventional practices with local ones? 1. Yes 2. No.
11. If No, why not? _____
12. If yes, how? _____
13. Do extension workers stimulate farmers to examine their indigenous experimentation methods and helping them explore more systematic forms of experimentation? 1. Yes 2. No
14. If no, why not? _____
15. If yes, how they help farmers? _____

16. Do extension workers have the knowledge, connections and skills to be able to gain the trust of farmers and perform their jobs accurately? 1. Yes 2. No
17. If yes, how you dare to say so? _____
18. If no, what are the reasons? _____
19. What types of information do farmers receive from extension workers? _____
20. What sorts of information fail to reach farmers? _____
21. Do you believe that extension workers do have sufficient problem solving skills?
1. Yes 2. No
22. If no, what do you think are the reasons? _____
23. Do you believe that the technical message farmers receive from extension workers reflect local crop production condition? 1. Yes 2. No
24. If yes, how? _____
25. If no, why not? _____
26. Do extension workers take farmers' feed backs on technologies to concerned bodies?
1. Yes 2. No
27. If yes, how? _____
28. If no, what are the reasons? _____
29. Do extension workers accurately perceive the situation of farmers? 1. Yes 2. No
30. If no, why not? _____
31. Is farmers' produce (yield) increasing or decreasing, in general, over the past years?
1. Yes 2. No
32. If increasing, do you think that it is the result of farmers' involvement in extension activities?
1. Yes 2. No
33. If decreasing what due think the reasons would be? _____
34. What extension methods are development agents using top teach farmers about extension activities? _____

B. RESEARCH RELATED QUESTIONS

1. Do farmers conduct local and informal experiments in their locality to improve crop Production? 1. Yes 2. No
2. If no, why not? _____
3. If yes, what local and informal experiments do farmers conduct in their locality? _____
4. What resources do farmers use to conduct such local experiments? _____
5. What are the strengths and limitations of farmers' informal experiments? _____
6. Do extension workers and researchers understand, record and evaluate farmer experiments?
1. Yes 2. No
7. If yes, how? _____
8. If no, why not? _____
9. Do farmers collaboratly work with extension workers and researchers to produce improver seeds for multiplication and distribution? 1. Yes 2. No
10. If no, what are the reasons? _____
11. If yes, how and on which activities? _____
12. Are there farm trials in your locality to test the validity of improved agricultural technologies?
1. Yes 2. No
13. If no, why not? _____
14. Do technologies and information provided by researchers and extension workers based on the demand of farmers? 1. Yes 2. No
15. If no, why not? _____
16. If yes, how do you entertain farmers' demands? _____
17. Do extension workers and researchers give farmers a chance to choose a particular technology from a set of technological options? 1. Yes 2. No
18. If no, why not? _____
19. If yes, how? _____
20. Is technology development and transfer in your locality participatory? 1. Yes 2. No

21. If no, why not? _____
22. Is technology development and transfer practical? 1. Yes 2. No
23. If no, why not? _____
24. If yes, how? _____
25. Do you think that the improved technologies address the resource constraints and risks faced by farmers? 1. Yes 2. No
26. If yes, How? _____
27. If no, why not? _____
28. Do you think that research and extension service start where farmers are and with what they have? 1. Yes 2. No
29. If yes, how? _____
30. If no, why not? _____
32. Do extension workers and researchers investigate the impact of agricultural technologies they develop? 1. Yes 2. No
33. If no, why not? _____
34. If yes, what factors do they consider in the process of evaluation? _____
35. Do farmers take their own strategies to overcome problems of agricultural production? 1. Yes 2. No
36. If yes, what strategies do you take? _____
37. If no, what are the reasons? _____
38. Do researcher and extension efforts understand farmers' resource levels and risks? 1. Yes 2. No
39. If no, why not? _____
40. If yes, what mechanisms do they use to assess farmers resource levels? _____
41. If no, why not? _____

GENERAL QUESTIONS

1. How do you evaluate the integration between research, extension workers and farmers in your locality? _____
2. It is frequently discussed that there is a missed link between research, extension and farmers in the agricultural development endeavor. What do you think are the problems for such missed linkage?
- Policy related problems? _____
- Institution related Problems? _____
- Research related problems? _____
- Extension related problems? _____
- Farmer related problems? _____
3. What do you think are the possible measures to redress the problems you mentioned above?
- Policy related measures? _____
- Institution related measure? _____
- Research related measures? _____
- Extension related measures? _____
- Farmer related measure? _____

Appendix D

INTERVIEW AND FOCUS GROUP DISCUSSION GUIDELINES FOR FARMERS, EXTENSION WORKERS AND RESEARCHERS

1. How do you evaluate the general condition of agriculture in Ethiopia and the study area in particular?
2. What looks like the condition of linkage between research, extension and farmers indigenous knowledge?
3. What do you think are the problems for weak linkage between research, extension and farmers?
4. What measures have been taken so far to address the problems?
5. How do you assess the condition of improved agricultural technologies?
6. How do you examine farmers' adoption of improved agricultural technologies and associated problems
7. What are the institutional and policy related problems that affect agricultural development?
8. How do you see general condition of extension workers and researchers
9. What looks like the perception of stake holders on indigenous knowledge and practices?
10. What looks like the general nature of formal research and informal experiments conducted by farmers and their complementary nature
11. What looks like farmers involvement in research and extension activities?
12. How do you see the contribution of farmer organizations in the diffusion and utilization of agricultural technologies?
13. What are Research and extension program implementation and management strategies?
14. What looks like the training of farmers, researchers and extension agents?
15. What Problems faced extension workers, farmers and researchers in their work?

Appendix E

Name List of Interview Informants

1. Akalu Getaneh, Socio economic expert at Amhara Region Agricultural Research Institute
2. Dr. Enyew Adgo, Researcher at Amhara Region Agricultural Research Institute
3. At Bante Gedamu, Head, Dejen Woreda Agriculture and Rural Development Office
4. Ato Abate Mekonnen, Farmer
5. Ato Getachew Mengistu, Farmer
6. Ato Tessema Amente, Farmer
7. Ato Habtamu Genet, Extension Worker
8. Ato Mengesha Abebe, Extension Worker

Declaration

I, the undersigned, declare that the thesis is my original work and has not been presented for a degree in any other university. All the sources of materials used for the thesis have been dully acknowledged.

Name: Getahun Fenta

Signature: 

Addis Ababa University

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