

Practices, Challenges and Prospects of Agricultural Land Management in Machakel Woreda, East Gojjam Zone, Ethiopia

By: Bizuayehu Alemu

Advisor: Prof. Bekure W/Semayit



**A Thesis Submitted to
Department of Geography and Environmental Studies
Presented in Partial Fulfillment of the Requirements for the Degree of
Masters of Art in Natural Resources and Environmental Management**

**Addis Ababa University
Addis Ababa, Ethiopia**

October, 2014

Declaration

I, the undersigned, declare that this study entitled “Practices, Challenges and Prospects of Agricultural Land Management in Machakel Woreda, East Gojjam Zone of Ethiopia is my own original work. I have undertaken the research work independently with the guidance and support of the research advisor. This study has not been submitted for any degree or diploma program in this or any other institutions and that all sources of materials used for the thesis have been duly acknowledged.

Declared by

Name: Bizuayehu Alemu

Signature: _____

Date: October, 2014

Advisor: Prof. Bekure W/Semayit

Signature: _____

Date: _____

Addis Ababa University

School of Graduate Studies

This is to certify that the thesis prepared by Bizuayehu Alemu, entitled: *Practices, Challenges and Prospects of Agricultural Land Management in Machakel Woreda* and submitted in partial fulfillment of the requirements for the Degree of Masters of Arts (Natural Resources and Environmental Management) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the Examining Committee:

Advisor: Prof. Bekure Wolde Semayit **Signature** _____ **Date** _____

Internal Examiner: _____ **Signature** _____ **Date** _____

External Examiner: _____ **Signature** _____ **Date** _____

Chair of Department or Graduate Program Coordinator

AKNOWLEDGEMNT

First of all, I am very grateful to God for granting me courage, strength and health to finalize my study and success in this very important stage of my life.

I am extremely grateful to my advisor Prof. Bekure W/Semayit for his guidance, critical insight, and very strong commitment towards this study that played a pivotal role in the success of this endeavor. His, advice, corrections, valuable suggestions and devotion of his precious time throughout the whole processes are greatly appreciated. I have learned a lot from his advice that significantly improved my professional capabilities. I could not have done it without his help from beginning to end.

I would like to extend my sincere thanks to my brother, Dr. Ayalsew Zerihun who have been there throughout my academic career and always had a great advice, encouragement and financial support for the completion of this study. I would specially like to express deep appreciation to my caring parents for their initiation, encouragement and moral support throughout my academic career.

I am also indebted to all staff members of Machakel Woreda agriculture office for their giving relevant data. My appreciation also goes to all farmers those who filled survey questionnaires and to all interviewed farmers for their giving me time and permission to observe their farmlands.

I owe great respect and thanks to enumerator teachers and health center workers of the study area. They had a great effort and cooperation during my stay in the field work.

Table of Contents

	Page
AKNOWLEDGEMENT.....	i
TABLE OF CONTENTS.....	ii
LIST OF FIGURES	vi
LIST OF TABLES	vii
ACRONYMS	viii
ABSTRACT.....	x
CHAPTER ONE	
INTRODUCTION.....	1
1.1 General Background	1
1.2 Statement of the Problem.....	2
1.3 Objective of the Study	4
1.3.1 General Objective.....	4
1.3.2 Specific Objectives.....	4
1.4 Research Questions	4
1.5. Research Methodology	5
1.5.1 Study Design.....	5
1.5.2 Sources of Data	5
1.5.3 Sampling Technique and Sample Size Determination	5
1.5.4 Data Collection Techniques.....	7
1.5.4.1 Household Survey	7
1.5.4.2 Key Informant Interviews	7
1.5.4.3 Informal Group Discussions	8
1.5.4.4 Field Observations.....	9
1.5.5 Data Collection Procedures	9
1.5.6 Methods of Data Analysis	10
1.6 Significance of the Study	10
1.7 Scope and Limitation of the Study	11

1.8 Organization of the Thesis	11
CHAPTER TWO	
2. REVIEW OF RLATED LITRATURE.....	12
2.1 Operational Definition of Terms.....	12
2.2 Conceptual Literatures.....	12
2.2.1 Agricultural Land as a Resource.....	12
2.2.2 Agricultural Land Management.....	13
2.2.3 Principles of Sustainable Agricultural Land Management	14
2.2.4 Types of Agricultural Land Management.....	15
2.2.4.1 Management Related to Soil Care and Fertilization.....	15
2.2.4.2 Management Related to Climate Constraints.....	15
2.2.4.3 Management Related to Water and Crop Moisture supply.....	16
2.2.4.4 Management Related to Field Preparation and Crop Harvesting.....	16
2.2.5 The Role of Development Agents in Agricultural Land Management	17
2.3 Empirical Literatures.....	18
2.3.1 Challenges of Land Management.....	18
2.3.1. 1 Challenges Related to Inorganic Fertilizer Adaptation.....	18
2.3.1.2 Challenges Related to Manure and Organic Fertilizer application	18
2.3. 1.3 Policy Related Challenges	18
2.3.1.3.1 Limited Facilities for Effective Extension	19
2.3.1.3.2 The Ratio between Extension and Farmers.....	19
2.3.2 Agricultural Land Management in Ethiopia	20
2.4 Analytical Framework.....	21
CHAPTER THREE	
DESCRIPTION OF THE STUDY AREA.....	25
3.1 Geographic Location and Relief Features.....	25
3.2 Climate and Land Use System	26
3.3 Natural Resources.....	28
3.4 Farming system, Crops and Livestock	29
3.5 Population	30

CHAPTER FOUR

GENERAL CHARACTERISTICS OF FARM HOUSEHOLDS31

4.1 Demographic and Socio-Economic Characteristics of Respondents’	31
4.1.1 Sex and Age Proportion of Respondents’	31
4.1.2 Family Size and Educational Status of Farm Household Respondents’	33
4.1.3 Farmland Size and Agricultural Practice of Farm Households’	35
4.2 The Status and Problems of Agricultural Land in the study area	37
4.2.1 The Status of Agricultural Land in the Study Area.....	37
4.2.2 The Current Problems of Agricultural Land in the Study Area	38
4.3 Agricultural Land Management Practices in the study area	39
4.3.1 Management Practices Related to Soil Fertilization	39
4.3.1.1 Pattern of Organic Manure Application Time	43
4.3.1.2 Trend and Constraints of Inorganic Fertilizer Application.....	44
4.3.1.2.1 Trend in Application of Inorganic Fertilizer	44
4.3.1.2.2 Constraints in the Application of Inorganic Fertilizer	46
4.3.2 Management Related to Agronomic Practices.....	49
4.3.3 Management Practices Related to Water, Soil care and Crop Moisture	53
4.3.4 Agro-forestry Management Practices.....	55
4.3.5 Grazing Land Management Practices in the Study Area.....	57
4.4 The Role of Development Agents (DAs) in Agricultural Land Management Practices	61

CHAPTER FIVE

CHALLENGES AND PROSPECTIVE GROUNDS FOR AGRICULTURAL LAND MANAGEMENT PRACTICES.....65

5.1 Major Challenges for Effective Agricultural Land Management Practices	65
5.1.1 Challenges Related to Institutional Capacities	65
5.1.1.1 The Number of Experts and DAs in Agricultural Extension	66
5.1.1.2 Challenges Related to Access for Training.....	68
5.1.1.3 Challenges Related to Access to Credit Services	70
5.1.1.4 Challenges Related to the Provision of Incentives for (DAs)	71
5.1.2 Challenges Related to the Natural Resources in the Agricultural Fields	72
5.1.2.1 Slope Steepness of Agricultural Lands in the Study Area	72

5.1.2.2 Stony Characteristics of Agricultural Lands in the Study Area	73
5.1.3 Challenges Related to Technical Gaps	74
5.1.3.1 Technical Gaps on Crop Watering System and Canal Management practice in Irrigation Farmlands.....	75
5.1.3.2 Technical Related challenges during the Implementation of Managemnet Technologies	78
5.1.4 Challenges Related to Local Farmers' Attitude.....	80
5.2 Prospective Grounds to practice Effective Agricultural Land Management Technologies in the Study Area	82
CHAPTER SIX	
SUMMARY, CONCLUSION AND RECOMMENDATIONS.....	84
6.1. Summary	84
6.2. Conclusion.....	85
6.3. Recommendations.....	86
REFERENCES	
APPENDIXES	

LIST OF FIGURES

	PAGE
Figure 1: Discussion conducted with farmers at their farm land level.....	9
Figure 2: The effect of agricultural land management decisions in Soil erosion and productivity.....	21
Figure 3: Integrated systems, approaches and types of agricultural land management practices	22
Figure 4: Role path way of extension service on agricultural production.....	23
Figure 5: Map of Study Area	25
Figure 6: Mean annual temperature and annual total rainfall of the study area	27
Figure 7: Deforestation of Eucalyptus tree as a source of income for rural households	28
Figure 8: The problems in the agricultural land of the study area from farmers' point of view..	39
Figure 9: A farmer in collecting Wheat crop field residue for house roofing material	49
Figure 10: Agricultural land covered with local Gibto crop as fallowing management practice	51
Figure 11: Affected farmland started to cover in Eucalyptus tree	52
Figure 12: Farmers in practicing of Diversion ditch in the study area	54
Figure 13: Over grazed and degraded grazing lands in the study area	58
Figure 14: The practice of scientific identification of fodder grasses and trees ready to plant ..	60
Figure 15: Distribution of farm households' level of agreement on shortage of assistant experts.....	68
Figure 16: Agricultural fields difficult for the practice of field preparation and row planting...	74
Figure 17: Overflow crop watering system of maize planted farmlands.....	77
Figure 18: Poorly constructed irrigation canal with landslide problem	78

LIST OF TABLES

	PAGE
Table 1: The distribution of numbers of selected sample households	7
Table 2: land use land cover pattern in Machakel Woreda 2013/2014.....	27
Table 3: Distribution of Animal Resources in Mchakel Woreda	30
Table 4: Distribution of Farm Household Respondents' Sex and Age Proportion	33
Table 5: Distributions of Family Size and Educational Status of Farm Household Respondents	35
Table 6: Distribution of Sample Farm Household Respondents according to Land-ownership and their Agricultural Practices	36
Table 7: The Status of Agricultural Land in the Study Area from Farm Household Respondents Perspective	38
Table 8: Household Respondents' Response Distribution on Soil Fertilization and Agronomic	42
Table 9: Respondents Response Distribution on Patterns of Animal Manure Application Time.	44
Table 10: Farm Household respondents Response Distribution on the Trend of Inorganic Fertilizer Application	46
Table 11: Farm Household Respondents' Response Distribution on the Constraints Related with Inorganic fertilizer application	48
Table 12: Farm Households' Response Distribution on Water, soil care and Crop Moisture Supply and Agro-Forestry Management Practices.....	57
Table 13: Survey Households' Response Distribution on grazing land Management Practices .	61
Table 14: Distributions of Farm Household Respondents' Opinion and Response on the Role and Contribution of Development Agents.....	64
Table 15: Distribution of the Number of Agricultural Extension Experts under Each Departments of the Agricultural Sector	66
Table 16: Household Respondents' Response Distribution on Challenges Related to Access to Training and Credit Services	71

ACRONYMS

AAFRD:	Alberta Agriculture, Food and Rural Development
ANRS:	Amhara National Regional state
BAFIC:	Benson Agriculture and Food Institute Corporation
DAs:	Development Agents
EUUDP:	European Union Upland Development Program
FAO:	Food and Agriculture Organizations
GDs	Group Discussions
FTC	Farmer Training Center
IFPRI:	International Food Policy Research Institute
INTOSA:	International Organization of Supreme Audit
KgN/ha	Kilogram Nitrogen per Hectare
MoARD:	Ministry of Agriculture and Rural Development
MWCO:	Machakel Woreda Communication Office
NMA:	National Metrological Agency
SAADSRD:	South Africa Agriculture Department and Scientific Research and Development
SLMP:	Sustainable Land Management Practice
UN:	United Nations
UNEP:	United Nation Environmental Program
USDA:	United States Department of Agriculture
USSCS:	United State Soil Conservation Society
WGEA:	Working Group on Environment Auditing
WNRCD:	Woreda Natural Resources Conservation Department



ABSTRACT

The main concern of this study is on assessing practices, challenges and prospects of agricultural land management in Machakel Woreda. The research aimed at investigating the types of agricultural land management practice, the challenges that impede the practice of more effective agricultural land management and the role of development agents in agricultural land management. In order to achieve the above stated objectives both primary and secondary data were generated. The techniques of collecting primary data sources includes semi-structured household survey questionnaires with farm households, group discussion with farmers, field observations and in-depth interview with development agents, agriculture office officers and individual farmers. Secondary data were collected from published and unpublished materials like research reports, journals, books and electronic documents. The study used purposive sampling technique to select sample Kebeles. Simple random sampling technique was also employed to select farm household participants among the total farm households under each sample Kebeles. This was also to give equal chance of inclusion of farm households for household survey questionnaire. The data collected was analyzed using both statistical tools such as percentage mean value and frequency and qualitative approach. The finding of the study revealed that, farmers were widely practiced only agricultural land management options that are more associated with their agricultural practices like contour plowing, crop rotation, use of improved crop and diversion ditches. Additionally, farmers' use of organic sources fertilizer and their indigenous soil fertility management practices were found to be limited. The agricultural land in the study area was found to be under serious degradation problem indicted by the development of rill and gully areas over crop farm fields and communal grazing fields. It was identified that institutional capacity related constraints, technical gaps, unsuitable agricultural fields and the attitude of local farmers were among the major challenges that impede the practice of more effective agricultural land management options in the study area. Finally, in light of these findings, wider range of support and awareness creation, the provision of practical based trainings, urgent intervention to expand biological management practices and institutional capacity development help the practice of effective agricultural land management in the study area.

Key Words: Agricultural Land, Management Practices, Farm Households, Development gents

CHAPTER ONE

INTRODUCTION

1.1 General Background

Land is the most important limited natural resource that makes up the cardinal resource base in any agricultural production system; hence it needs to be managed effectively for the creation of wealth in many societies (Stein, *et al*, 2009). Nowadays there is an increasing substantial demands placed on land resources due to the enormous increase in the number of people living around it. It is obvious that the ability of land to support such enormous increase in the number of people living now is highly determined by the resilience of agricultural land in response to the increasing demand made up on land (FAO, 1994).

Large number of studies demonstrated that knowledge of farmers and scientists play a great role on how to manage this agricultural land productively and in sustainable manner. Decisions made on land management practices have also a significant effect on environmental quality, agricultural production and land conditions as a whole. These decisions also can be private decisions made by farm households and collective decisions made by groups of farmers and communities as a whole. For example, farm households make decisions about land use whether crop land or grazing land, the crop types to plant, the amount of labor to use, the types and amounts of inputs, investments and agronomic practices to use to conserve soil and water, improve soil fertility and reduce pest losses. On the other hand, communities also can influence land management practices through their collective decisions (Ehui, and Place, 2006).

Currently because of private and collective decisions on land management practices that fail to be in line with the response to the increasingly heavy pressure on land resources, agricultural production declines, the quality and quantity of land deteriorates. There is also increasing of competition for access to land (UNEP, 1999, cited by INTOSA, 2013). Particularly, land degradation becomes a major problem that reduce productive capacity of cropland, range land and wood land during the time of rising demand for food, fiber, fodder, fresh water, fuel, household energy and income in developing countries. The case became an alarm in Africa where land is a key asset of the rural poor society (FAO, 2009, cited by Woodfine, 2009).

According to FAO (2010), worldwide 75 billion tones of soil matter are lost because of water and wind erosion every year. At the same time significant quantities of nutrients about 22kg N/ha, 2.5kgP/ha and 15kgK/ha are depleted and lost in Sub-Saharan African countries. Particularly, such type of land degradation has been recognized as a serious problem in Ethiopian highlands (Belayhun, 2010). Since the poor are dependent on the environment especially natural resources' including land for the satisfaction of their basic necessities as a result sustainable natural resource utilization is a key for their poverty eradication (Mugisha, and Alobo, 2012).

To safeguard land, soil and the whole environment from any degradation always need achieving high agricultural production by more productive and conservation use of water and land where farmers need to intensify agricultural production on sustainable basis (FAO 2003). It is also necessary to undertake different land enhancing or land protecting investments even in non-degraded agricultural landscapes (Scherr and Yadav, 1996).

Large number of studies demonstrated that natural resource management, in general and agricultural land management, in particular can produce significant returns. Because agriculture always served as a shock absorber for socio-economic condition of rural poor societies those who are fully dependent on agriculture. It can also bring structural changes in industry and other economic sectors (Mitic, 2012). In return to this, Environmental degradation caused by agriculture also cause associated costs not only to rural poor societies but also to the whole society. For example, soil erosion, health hazards and groundwater pollution become better known and documented problems (Weinkauff, 2008). To come up with integrated agricultural land management approach that will lead to a win –win relationship between human being and nature so natural resource management is gaining relevance and importance.

1.2 Statement of the Problem

Ethiopia has been in continuous struggle to achieve the objectives of economic development and environmental protection. However, a significant increase in agricultural productivity could not be attained where the land resource base is continuously degraded. Hence, sustainable land management is necessary for agricultural growth in Ethiopia (Birhanu, *et, al*, 2010).

Sustainable agricultural land management can create multiple benefits including reduction in production costs, environmental benefits and at the same time increase food production

(Menale, *et al*, 2009). In parallel to this, it is very important to understand the challenges that resource poor farmers face to adopt agricultural land management technologies. For example, lack of proper extension services and participatory approaches that does not take in to account local social capital in implementing management technologies, technology application cost, transition in learning cost, and inability to integrate input and output market are identified as the major challenges for farmers in developing countries, including Ethiopia (Minale, *et al*, 2009).

It is obvious that agriculture plays a pivotal role in the Ethiopian economy, which is highly characterized by smallholder subsistent agriculture in which the country depends for its food supply, foreign exchange, labor force and raw material for the non-agricultural sector. However, as Getnet (2011) stated that the agricultural sector in Ethiopia is plagued by structural problems such as; fragile soil, environmental degradation, poor farm management and population pressure. For example, in Eastern African highlands including Ethiopia the average farmland size is about one hectare or less with six persons per household for a population density of around 600/ *km*² (IFPRI, 2006). Such high population pressure reduces the availability of grazing land and quality of farmlands.

Studies have been conducted in different parts of Ethiopia focusing on adoption behaviors, best practices and benefits and socio-economic related challenges of soil and water conservation practices at watershed levels (Fikru, 2009; Aklilu, 2006; Addisu, 2011). However, this study concerned on agricultural land management practices and incorporated irrigated lands and grazing fields as parts of agricultural lands. In addition, it also focused on assessing different technical challenges faced farmers' at farmland level, challenges related to farmers' access to experts support and the existing prospective grounds to implement more effective agricultural land management practices in Machakel Wereda, East Gojjam Zone of Ethiopia.

Machakel Woreda is chosen for the study because it experiences high agricultural population density (335.44p/km²) which led to the exertion of high pressure on the natural resource and rapid natural resource degradation. The Woreda is also facing declining soil fertility due to inappropriate farming practices and the predominance of highly sloping agricultural landscapes. In addition, similar studies related to practices and challenges of agricultural land management have not been conducted in Machakel Woreda so the researcher was inspired to assess agricultural land management practices in the study area.

1.3 Objective of the Study

1.3.1 General Objective

The general objective of this research is to assess the existing agricultural land management practices and challenges impeding the application of more effective agricultural land management in Machakel Wereda, East Gojam Zone of Ethiopia. To this end, the following specific objectives on the study were raised.

1.3.2 Specific Objectives

- i. Assess the types of agricultural land management practices adopted by farmers in the study area
- ii. Investigate the supporting role of agricultural development agents in agricultural land resource management
- iii. Identify the challenges impeding to practice more effective agricultural land management technologies

1.4 Research Questions

The purpose of this study was to answer the questions which are drawn from the objectives stated above.

- i. Are there any practices adopted to manage agricultural land?
- ii. What are the practices adopted and implemented for agricultural land management?
- iii. How is the role of development agents for agricultural land management practices in Machakel Woreda?
- iv. What are the major challenges behind the adoption and implementation of effective agricultural land management practices?

1.5. Research Methodology

1.5.1 Study Design

The study employed mixed approach, both qualitative and quantitative methods for the purpose of collecting and analyzing data on agricultural land management practices. It also attempted to understand the major challenges related to land management practices based on the survey conducted in the study area. In particular qualitative approach was employed to describe the data extracted from informal group discussions, key informant interviews held with development agents or experts and direct observations of the study area. In addition descriptive statistics such as percentages, mean values, and frequency distributions of the quantitative approaches were employed for summarizing the raw data extracted from household survey questionnaires. The questionnaires formulated carefully to provide answers to the research questions related to the objective of the study.

1.5.2 Sources of Data

The data for the study were obtained from both primary and secondary sources. The Primary data or first-hand information were collected from farm household respondents, Woreda agricultural experts and Kebele Development Agents (DAs) through household survey, informal discussions, and key informant interview including direct observation.

Regarding the secondary data sources, this study consulted available and relevant published and unpublished documents such as journals, articles, research reports, books and electronic documents to obtain necessary information about the problems under study.

1.5.3 Sampling Technique and Sample Size Determination

Currently, *Machakel Woreda* is divided in to 24 rural *Kebeles*. More than 97% the area is under the dominancy of Dega and Woyna Dega agro ecologies. Therefore, the researcher used purposive sampling technique to select three representative sample *Kebeles* named *Amanuel Zuria* and *Debre Kelemu* from *Dega* and *Yewlla* from *Woyna dega* agro ecologies. Behind this purposive sampling technique the researcher considered and included *Kebele* with more fragile agricultural landscape in the case of *Debre Kelemu Kebele*. On the other hand, *Amanuel Zuria*

Kebele is also selected based on the accessibility of reliable information for the study. Whereas in the case of *Yewlla Kebele*, the presence of extensive irrigated agricultural practice in relative to others was considered.

The selected samples Kebeles have a total of 1722 rural farm households (HHs). However, since it is difficult to collect the data from such a large number of HHs population, the researcher determined a sample size by the use of a mathematical sampling technique:

$$n = \frac{N}{1+N(\alpha)^2}$$

Where: n = the required total sample size

N = the total farm household population in all sample Kebeles

α = the margin of error from 93% of confidence level (Miller, 2003)

Since there was a large farm household population size, 93.5% level of confidence with 0.065 errors was used to select total participant respondent farm households using the procedure as follows:-

$$\begin{aligned} n &= 1722 / 1 + 1722 (0.065)^2 = 1722 / 1 + 7.27 \\ &= 1722 / 8.3 \\ &= \mathbf{206} \end{aligned}$$

From this total sample size the researcher used a simple random sampling technique to select sample farm households from respective sample kebeles. Based on this, 75 sample farm households were taken from *Yewlla Kebele*, 66 farm households from *Debrekelemu Kebele* with the balance 65 also drawn from *Amanuel Zuria kebele*. This comparable sample size among the *Kebeles* was determined in proportion to their farm household size using a principle of a simple proportion formula:

$$n1 \equiv N1/N(n)$$

Where: $n1$ = the required sample size from each Kebele

$N1$ = Total number of farm households in each Kebeles

N = Total number of farm households in all selected sample Kebeles

n = Total sample size selected from all sample Kebeles

Table 1: The Distribution of Numbers of Selected Sample Farm Households

Name of sample Kebeles	Total number of households in sample kebeles	Number of sample households	Percentage of Sampled farm households (%)	Remark
Amanel zuria	544	65	11.9%	$544/1722 \times 206 = \mathbf{65}$
Yewlla	627	75		$627/1722 \times 206 = \mathbf{75}$
Debre Kelemu	551	66		$551/1722 \times 206 = \mathbf{66}$
Total	1722	206		206

Source: Field survey, 2014

Once sample size was determined in each Kebeles and respondents were selected using a simple random sampling technique from the list of population (sampling frame) of each respective Kebele. Behind the determination of these large size sample households, the researcher gave a priority to get reliable data and to give effective representative conclusion for the study area about research findings.

1.5.4 Data Collection Techniques

This study employed different data collection instruments.

1.5.4.1 Household Survey

Household survey questionnaire composed of two parts. The first part contained question items related to respondents' demographic and socio-economic characteristics. While the second part comprised variables related with different agricultural land management technologies and challenges related to the practice of the land management technologies. The questionnaires were contained open and closed ended questions.

1.5.4.2 Key Informant Interviews

To collect reliable data from targeted respondents the researcher employed detail personal interviews particularly with experts and farmers working with the agricultural business in the

respective sample *Kebeles* of *Machakel Woreda*. This was done to collect relevant data besides other instruments. For example, Kothari (2006:97) explains the significance of personal interviews as:

“To collect the information personally from the sources concerned, it has to be on the spot and has to meet people from whom data have to be collected. This method is particularly suitable for intensive investigations”

In line with the above principle, interview had been held to extract information related to strategies of agricultural land management practices and challenges that impede the practice of agricultural land management technologies in the study area. Additionally, interviews had been held with individual farmers to extract some case story information.

1.5.4.3 Informal Group Discussions

This data-collecting instrument was employed to extract information related to attitudinal behavior of household respondents on the adoption of agricultural land management practices and on the common challenges what farmers share to adopt agricultural land management practices in their respective agricultural fields. To come up with the results on the above stated reasons, the researcher employed informal group discussions in all selected sample *Kebeles* with six participant farmers in each *Kebele*. The discussion with farmers was held at farmers' farmland where the national programs of soil and water conservation activities were practiced.



Figure1. Discussion conducted with farmers at their farmland in Amanuel Kebele, (photo during discussion, 2014)

1.5.4.4 Field Observations

Field observation was made in different agricultural fields under different agricultural practices to check the types of agricultural land management practices what actually implemented in the field. In addition it used to identify what farm level problems are really existed over the agricultural fields in the study area. Therefore, based on the observation made on the study area, the researcher's view was integrated in the analysis part.

1.5.5 Data Collection Procedures

The questionnaires prepared for the rural household respondents were translated in to Amharic language. This is because farmers in the study area speak Amharic. On the other hand, interview was largely held with Development Agents and agriculture office experts in accordance with their language skill. Using draft questionnaires to be administered only to some sample respondents, ambiguous and unclear statements are detected based on the suggestion from respondents. Regarding to individual interviews and informal group discussions the researcher gave an instruction at the beginning of the interview and the discussion to guide the participants on the scope of the interview as well as the discussion. Particularly, farmers were also encouraged to express their conceptions in their own way. Overall, the researcher tried to make

clear the objective of the study to all respondents to avoid confusion and to conclude with effective data administration. Finally, the researcher collected survey questionnaires with a great collaboration of enumerators particularly health extension workers and teachers who work with the local communities of the study area.

1.5.6 Methods of Data Analysis

The collected data was analyzed using both quantitative and qualitative methods of data analysis. Quantitative methods concerned descriptive statistics such as mean values, frequency tables, percentages and figures using computer programs of Statistical Package for Social Sciences (SPSS, version 21). This was used to analyze data collected from farm household respondents using questionnaire. Five Point Likert-type scales test also employed to analyze the responses of farm households' particularly on their level of practices to maintain soil fertility and their responses on the level of development agents' supporting role in agricultural land management practice. On the other hand, results generated from in-depth interview and informal group discussions were analyzed in qualitative approach. The qualitative analysis was made to supplement the responses given and the results obtained from household survey questionnaires. Qualitative data was analyzed in the form of narrative description. Individual ideas and some case stories are also presented and narrated thematically. Similarly, data collected using observation including pictures taken from agricultural fields of some selected farm households was compiled and used to substantiate the responses obtained through various means. Farm households and agricultural development agents are units of analysis used for this study.

1.6 Significance of the Study

Agricultural land management is critical in achieving social and economic transformation on the majority of rural poor society in Ethiopia. For *Machakel Wereda* to achieve these objectives the land under agricultural practice should be managed appropriately. In line with this, this study concerned itself with assessment of practices, challenges and prospects of agricultural land management. The student researcher feels that, the study results have the following general benefits:

- Provide valuable information on the actual management status of agricultural land, which enables also all stakeholders with agriculture including policy makers to take corrective

measures on the problems of agricultural land management based on the finding, that the study indicated.

- Serve as an input for future in-depth studies in the area, of related issue.

1.7 Scope and Limitation of the Study

The study was conducted to assess and analyze the different types of agricultural land management practices and challenges in the study area. The study collected data from farm households (FHHs) and experts from Wereda agricultural office (WAO) including from development agents at sample Kebele level. As it indicated above, the geographic scope of the study was limited to Machakel Woreda, East Gojjam Zone, Amhara National Regional State (ANRS) of Ethiopia.

As far as limitation of the study is concerned, the researcher was encountered with difficulties to collect survey questionnaires as well as to find documents of secondary data from the agriculture office. Particularly to hold an interview with the Woreda head of agriculture office was really a challenge because of other routine activities as per the response from Woreda agriculture office.

1.8 Organization of the Thesis

This paper is organized in to six different chapters dealing with different topics as part of the research methodology and as a research body. The first chapter dealt with the general background, statement of the problem, and objectives of the study, research questions, research methodology, significance and the scope of the study with limitations what the researcher encountered for in the process of the study. Chapter two dealt with the review of literatures related to the objective of the topic under the study. Chapter three describes the geography of the study area. Chapter four dealt with the general characteristics of farm households and their agricultural land management practices. In addition, chapter five also dealt with the challenges and prospective grounds for agricultural land management on the study area. Whereas, the last chapter which is the final part of this thesis provides summary and conclusion of the main points of the research work, and recommendations based the research findings.

CHAPTER TWO

2. REVIEW OF RLATED LITRATURE

This chapter provides an overview of key literatures, which have been influential in defining the direction of the proposed research project. In organizing the literature review, particular attention was given to theoretical, conceptual, and some empirical literatures on Ethiopian context related to the problem at hand.

2.1 Operational Definition of Terms

Land: land refers to natural resources such as soils, water, and living organisms which are available in pre- defined spatial unit (land unit) (Hurni, 2000)

Agriculture: In relation to crop farming and livestock farming, the term “*agriculture*” may be defined as the art and science of growing plants and other crops and the raising of animals for food, other human needs, or economic gain (Bareja. 2011).

Management: is a process of designing and maintaining an environment in which individuals, working together in groups, accomplish efficiently selected aims (Weihrich, 1993)

Practice: refers to the act of continually doing something in order to get better at it (Oxford dictionary)

2.2. Conceptual Literatures

2.2.1 Agricultural Land as a Resource

Agricultural land is a complex system that combines natural ecology and social economy, and the health of agricultural land directly influences national economic development (Jinming yan 2012). Land management relates to the activities associated with the management of land as a resource from both environmental and economic aspects towards sustainable development (UN, 1999). Agricultural land embraces a wide view of connections that encompasses biological economic, political, social and cultural aspects. Within the economic system, agricultural land is competing with other users for resources, labor, capital and management. However, the position

of agriculture is also concerned with the environment for, from a systems view point, agricultural land as resource and, its quality is the result of man's activity on the natural environment (Meli, 1993).

Land resource is very important to the livelihood of all people those who are dependent on agriculture and as the output of agriculture purely depends on land resource. Thus, lack of access to agricultural land increases incidence of poverty in rural areas and quality land has a direct bearing on the productivity of agriculture (Singh, 2008). According to USDA (2009), agricultural land as a resource provides many types of value to the landowners, private citizen's communities and societies at large.

2.2.2 Agricultural Land Management

According to USDA (2011), agricultural land management is a complex issue and process, and it needs sensible resource management for sustainable agriculture. It also stands on its own as a local or national policy goal to mitigate land fragmentation and haphazard development. Agricultural land management programs always need to be motivated to preserve production agriculture for national food security. In this case, the following characteristics should be considered to give a priority for agricultural land management: soil quality and productivity, agricultural infrastructure, farming methods including conservation practices, size of land parcel for available agricultural activity, proximity to other protected land for critical mass to achieve effectiveness, and importance to local agricultural and economic vitality. Productivity potential of agricultural land and its susceptibility to degradation are also dependent on the management strategies employed on land resource under agriculture (FAO, 2010).

Therefore, within the sphere of agriculture, land management includes maintenance of soil productivity. This requires the combination of soil treatment including application of mineral and organic fertilizers with soil and water conservation measures (implementation of agronomic, soil management, and physical measures such as contour ridging, terracing or providing ground cover through mulching, use of plants and leaving crop residue (Woodfine, 2009). Therefore, like any limited and non renewable resources, it is also important to properly manage agricultural land because good quality agricultural land is always the most suitable for farming and also

essential. For example, food production, domestic, international, local and regional prosperity, valuable export earning, preserving the social fabric of rural communities, and for the Growth of secondary economic activities as a source of raw material are some of the most important returns that one country can benefit from appropriately managed agricultural land.(Queensland Gov't,2004).

2.2.3 Principles of Sustainable Agricultural Land Management

Agricultural land management practices include soil and water conservation, composting, cover crops, residue management, reduced tillage and agro forestry with the following guiding principles that bring its sustainability. Therefore, any sustainable agricultural land management should carry out in accordance with the following principles:-

- Assist smallholder farmers to reach on their objectives like productivity, food security and climate resilience. This also starts with the transfer of the necessary information and knowledge through direct participation of remote agrarian society. And align it with effective agricultural production based advisory system
- Cost effective and needs to be adapted to the existing farming system like to diversified farming system and farm size.
- And also need to be suitable with the surrounding environment, the existing resources and capacity constraints of smallholder farmers even the capacity of poor developing countries (Hooda, and Tennigkeit, 2012). Generally sustainable agricultural land is explained as follows:

“A sustainable agricultural land management is one which involves the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to insure the attainment and continued satisfaction of human needs for present and future generation. Such sustainable management conserves land, plant, water and animal genetic resources, and is economically viable and socially acceptable and these social acceptability, economical viability and environmental security are the most important pillars of sustainable agricultural land management” (Dennis, 1994).

2.2.4 Types of Agricultural Land Management

2.2.4.1 Management Related to Soil Care and Fertilization

Soil is a land user's most vital asset, but it is also a finite and often fragile resource. Soil is not only the basic resource for plant growth (supplying water, air, and nutrients); it also provides a filtering and buffering action to protect water supplies and the food chain from potential pollutants (Anne woodfine, 2009).

Soil management in general soil nutrient management in particular is critical to successful agriculture. Soil management includes all activities that reduce nutrient loss and increase its availability in the root zone of crops (Namara, *et al.*2007). Fail to take care of soil resources leads to poverty of agricultural land in losing its fertility because of erosion and soils become at risk in its macronutrients if fertilization takes place without suitable soil testing to assess the need of crop growth. Good soil management is a key to sustainable farming operation. In most cases, there is no conflict between good, profitable farming, improving or maintaining soil fertility and good environmental management, since they all require that soils are maintained and improved, since every soil related management always benefits all the economic production and at the same time the environmental quality. It is also clear that bad soil management can vary quickly reduce the value of land for agriculture and lead to environmental problems (Unilever, 2010).

Applying organic matter improves soil structure, which in turn increases infiltration and soil water holding capacity also increases the nutrient level and increases the activity of soil organisms. This all includes the use of compost which is effective in improving depleted soils, the use of green manure legume crops which is important to improve soil fertility and applying the combination of manure and organic fertilizer to enrich soil in its fertility status (Kinyangi, *et, al*, 2012).

2.2.4.2 Management Related to Climate Constraints

Climate smart agriculture has potential to provide stable and healthy environment and increasing productivity. For this also agro- forestry, practices have a great potential for climate related constraints that threats agricultural productivity in a long run. This agro forestry system also

allows diversified production opportunities, which can reduce risk under a fluctuating climate and allows diversifying and increasing farmers' income cultivating diversified crops having diversified market value and diversified resistance to an ever-changing climatic condition.

In addition to this, at farm level improved manure management and its appropriate handling can also allow to reduce the loss of nutrients through vaporization, reduce methane emission which intern allows reduce and avoid green house gas emissions (FAO 2012). According to USSCS, (2003), a changing climate primarily will affect soil and water resources on agricultural land in many ways. However, the availability of weather fore cast information provides opportunities for farmers to consider a number of adjustments to management practices based on seasonal conditions predicted. For example; if there is no enough rainfall within the growing season in rain fed agriculture, it leads to loss of harvest, and finally results loss of income and food insecurity (Kinyangi *et al*, 2012). According to the writer, timely and early climate related warning information provides benefit to farmers to take risk reduction decision and action against climatic constraints.

2.2.4.3 Management Related to Water and Crop Moisture Supply

Water management in soil and water conservation program is gaining recognition in the world. Water management is an all-comprehensive concept, which deals about regulation, control, use and harvesting of water in agricultural land. It also refers to efficient and economical management of available water in agriculture and use of surface and sub-surface water resources in agricultural production (Mutunga, 1999).

Better management of rainwater, soil moisture and supplemental irrigation are the key in helping the greatest number of smallholder farmers in improving yield, give farmers security to invest in fertilizer and seed and also allow farmers to grow higher value crops (Dillaha, 2008).

2.2.4.4 Management Related to Field Preparation and Crop Harvesting

Management related with field preparation particularly preparation of soil is the first and most important step in agricultural practice (Ahuja, 2013). Farmers always should remove weeds and debris, which help crops grow well and prevent organic poisoning (IFSA, 2005). Field preparation or preparing the land for crop production serves many purposes related with

productivity. The most important purposes include for the creation of suitable seedbed where planted seed are in contact with the soil moisture that helps to germinate quickly and have normal growth, Weed control for successful computation of crops for moisture, for the incorporation of crop residues and fertilizers in to the soil and for the purpose of field preparation keeps soil moisture in improving water penetration and infiltration even soil aeration when hard soil structure is broken during plowing activity (BAFIC,2004).

2.2.5 The Role of Development Agents in Agricultural Land Management

Extension workers have a role of transferring knowledge from research stations to farmers by using different individuals, groups and mass media methods. It is recently that Development Agents play technology development role in linking research with community needs (Chamala and Shingi, 1997). Developments Agents have a role of providing training, information, knowledge and the necessary support systems for the rural agrarian society to enable them to improve their productivity and develop their capacity to conserve, protect and manage their land and natural resources in general.

“Development Agents are needed for the government to respond technology needs of farmers, facilitate decision making on the technology adaptation, as education component that will enable farmers to participate in planned change, to link knowledge generation and knowledge use and to mobilize communities and groups”(EUUDP, 2005).

In line with this, agricultural land management practices are more appreciated only when farmers are supported by more practical demonstrations on how to manage their own farmland in accordance with its unique agro ecological characteristics and supported by extension organizations and Development Agents in transferring the necessary knowledge and information in the activities of overall agricultural business in general and in the agricultural land management in particular (Anissa, 2011).

According to Roling and Pretty (1997), the most important roles expected from Development Agents in agricultural sector are: first, farmers need to be aware about the state of the environment and the status of their own current farming practice. Second, development agents should use the knowledge of farmers gained through prolonged experience since it can be an important for the introduction of farther important technologies for agricultural land management. Third, development workers also should help farmers during the time of difficulty

in adopting new technology throughout their farming activity, this also includes working for the transfer of technology through learning and make to productivity, therefore this is the task of Development Agents working with farmers.

2.3 Empirical Literatures

2.3.1 Challenges of Land Management

2.3.1. 1 Challenges Related to Inorganic Fertilizer Adaptation

The request of physical or material asset and abstract possession which is the required knowledge are essential challenges behind for technology adaptation. Lack of asset is the most important challenges impeding technology adaptation in general and inorganic fertilizer adaptation of farmers in particular (Muvhunzi, *et al*, 20012). The price of fertilizer should allow farmers in general smallholder farmers in particular sufficient and reliable returns from their investment in fertilizer, since its access in high cost lead to limited adaptation and application of such important agricultural land management technology (Benson *et al*, 2013).

2.3.1.2 Challenges Related to Manure and Organic Fertilizer Application

Manure can be valuable resource if handled properly. It is an excellent source of nutrient and can improve soil structure and water holding capacity (AAFRD, 2004). However, unless manure application is properly managed, excess nutrients may be applied to agricultural land. For example, if one fails to incorporate manure into the soil, runoff may carry both soluble and sediment associated nutrients to surface water and it may lead to water pollution (Wascom, 1992). Organic fertilizer application is also highly challenged by Unavailability of manure resource in the required amount particularly in areas there is no large number of livestock population, its usefulness as an alternative source of energy, lack of transport from the pen to the field, which needs economically sound system and technical challenges in its storage and treatment (Rahman, *et,al*, 2009).

2.3. 1.3 Policy Related Challenges

Agricultural production sustainability can be challenged by not only in long-term insecurity of land, water, and forest resource bases, but also challenged by specific policies formulated to

protect these resource bases to enhance agricultural productivity and improve the live hood of rural dwellers(G. Rozanov, 1986). In particular the challenge in this regard relates to developing the necessary capacity in terms educational, professional, and institutional standards for the agriculture sector (Enemark, 2005).

2.3.1.3.1 Limited Facilities for Effective Extension

Agricultural extension is critical for the growth of agricultural sector and food security. However making the extension services systematic, effective and demand driven responsive to the need of the diverse set of producers also a critical challenge in the development of agricultural sector in general and to manage agricultural land in particular (Ulimwengu, *et, al*, 2013). Extension workers also need to get incentives specially workers those who working in remote districts.

The national agricultural extension system also requires care full analysis of national policy and policy makers directly challenge the existing national extension system fulfillment of facilities for its effectiveness. Example, limited development and application of information technology tools to facilitate the work of extension service in agricultural land management is on e of the challenge related with national policy (Kalim Qamar, 2005).

The extension policy in agriculture needs to establish systematic communication system and involve farmers themselves in the process of extension. Particularly incentive system should be developing to reward staff being in the field and working closely with farmers. In addition, there must be a well-defined link between the well-being of field officers and extension system based on the client's view of the value of extension and field workers performance in carried out over all tasks in the agricultural business (Shankariah Chamala and P. M. Shingi, (1997).

2.3.1.3.2 The Ratio between Extension and Farmers

Extension agent to farmer ratios is the common challenge in the communal farmers with large numbers of producers on a subsistence level. This is due to decisions related to irrelevant ratios that could not consider the local conditions, circumstances and variations of the rural farming system (SAAD and SRD, 2005). According to South Africa Agricultural Development report documented in (2005), such poor access of extension service also lead to poor agricultural practices, insufficient use of inputs, and low adoptive capacity for use of research and based technologies including information that could help to increase productivity.

2.3.2 Agricultural Land Management in Ethiopia

As studies show that, land management practice in Ethiopia is not a recent experience, rather it goes back to ancient times. Since 400 years ago rural societies from different parts of Ethiopia stayed in practicing different indigenous land management practices traditionally, but it was before four decades ago that advanced land management technologies have been introduced in the country (MoARD, 2010). However, according to the Ministry of Agriculture report documented in (2010), the management practices that had been practiced before were limited in their spatial coverage. This is due to poor habit of documenting the then adopted land management practices and transferring the technologies to other areas, and it was limited in its sustainability to integrate economic profitability, social security and environmental suitability.

The adoption of the intervention is also still considerably low. This is due to top-down approach in extension activities, lack of awareness of land degradation by the land users and land security issues. This implies that extension on land and natural resource management in Ethiopia stayed neglected and even today there are also gaps needs to be addressed particularly issues related with the following indicators of land management problems:

- Participatory versus top down planning and communication approach
- Stimulus versus dependency,
- facilitation role versus controlling
- Sustainability versus short term benefits of agricultural land management (Mitiku, *et, al* 2006).

As all physical and economic evidences shows that, the supply of productive land in Ethiopian highland become diminished because of decreasing productivity of agricultural land due to increasing degradation of agricultural land caused by the combined effect of different factors (Samuel, 2006). Particularly, in the highland parts of the Ethiopia where there is intense population, density leads to over cultivation without proper management and greatest livestock density leads to over grazing, the area is highly affected by land degradation (Berry, 2003). Though the problem is severe, it was since in the last the thirty five years that soil resource conservation in particular and land resource management in general has been given policy

attention (Hailelassie *et al*, 2005 cited by Aklilu, 2006). Particularly, soil erosion is mentioned as the major cause of soil nutrient loss in Ethiopia.

As empirical evidences shows that Ethiopia losses about \$139 million every year from soil nutrient loss due to the fact that loosing appropriate concentration on sustainable land management in general and agricultural land management in particular (Bojo and Cossells, 1995 cited by Christina , 2012). However, if effective natural resource management is implemented particularly in agricultural lands, it is possible to safeguard the country from such costs and even can improve the living standard of the rural poor peoples of Ethiopia (Demese, *et, al* 2010)

2.4 Analytical Framework

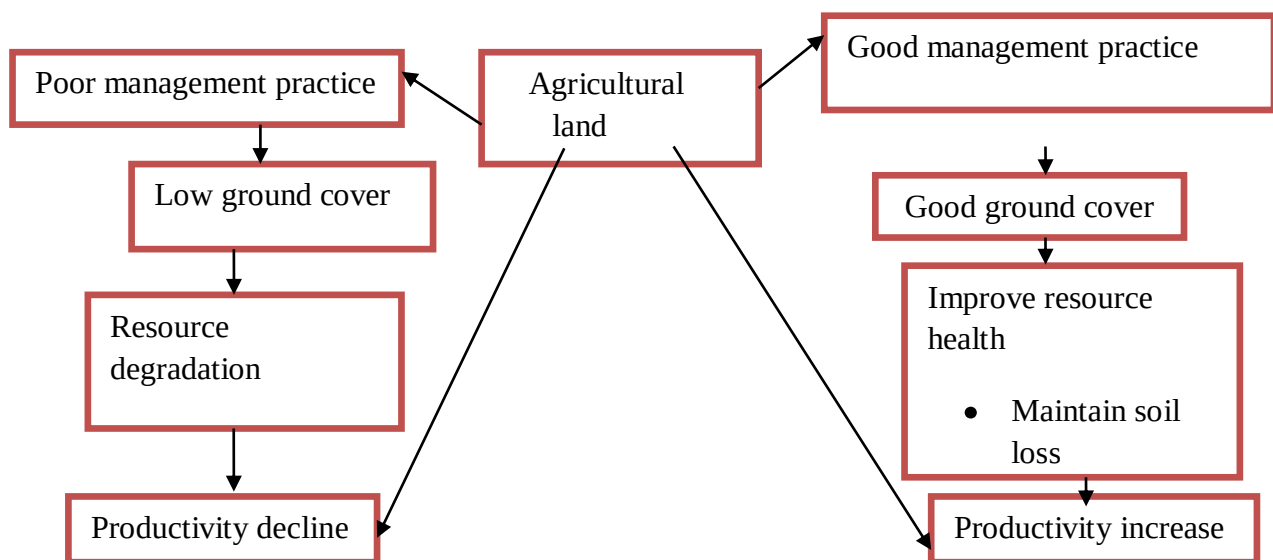


Figure 2: Analytical frameworks on the effect of decision of agricultural land management practice in Soil erosion and moisture and productivity (Sharon Pepperdin, 2013 and modified by the researcher)

As shown in figure (3) the choice of Land management practice has always a significant impact on the condition of resources in general and soil resource condition in particular. Improved agricultural land management can reduce soil loss in the form of erosion by different agents and maintain its moisture availability, which has multi function in the soil system. Whereas in contrary, poor land management practice like over grazing and other activities which cannot ensure long lasting benefit for the society themselves leads to decrease the level of ground cover contributing to soil loss, again which also leads to contamination of other resource systems like air and water.

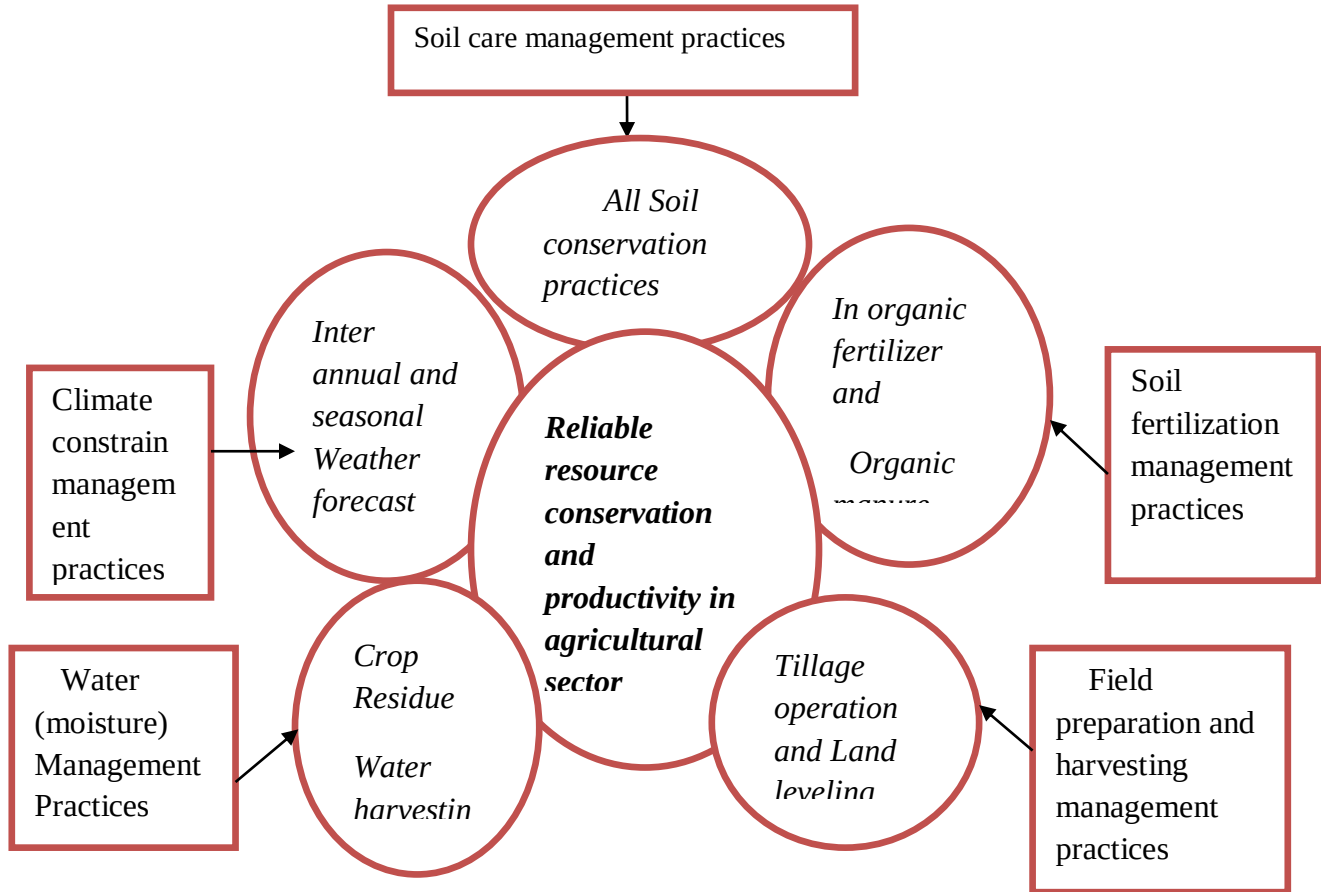


Figure 3: Integrated systems, approaches and types of agricultural land management practices (developed by the researcher, 2013)

As the above figure depicts that different types of agricultural land management practices can be employed on the agricultural landscape using the approaches of detail management practices under each management types that works together as one entity in the system to bring reliable resource conservation and insure productivity in the agricultural business. For example, agricultural land management practice related to climate constraint on the agricultural activity can be employed at small holder farm and farmer level using the approaches such as, adopting inter annual and seasonal weather forecast services, adopt to use diversified crops friend to the incoming climatic condition and the use of windbreaks to the existing windy weather condition. Management practice related to *moisture and water* can be employed using the approaches of harvesting rainwater for crops and livestock and managing crop residue on the agricultural field are important approaches. In addition, management of agricultural land in soil fertilization

aspects is primarily carried out by incorporating both organic and inorganic fertilizers that enables to increase productivity of soil in agricultural landscape. Additionally, agricultural land management related with *soil care* can be employed with the use of all possible soil conservation methods, which are appropriate with the existing agro-ecological zones. In addition to this, field preparation and harvesting aspects of management are very important for the productivity of one's agricultural land. These include tillage operation that enables to control weed problem of a given farmland. Land leveling in a way suitable for seed germination by controlling water logging problem and drying of farm lands due to its uneven nature and maintain some structural conservation methods like bunds that maintain loss of moisture and nutrients of soil from farm fields are some of the approaches that need to be employed in farm fields.

To make the objective of this paper understandable, this figure also illustrates the role of agricultural extension on the agricultural production.

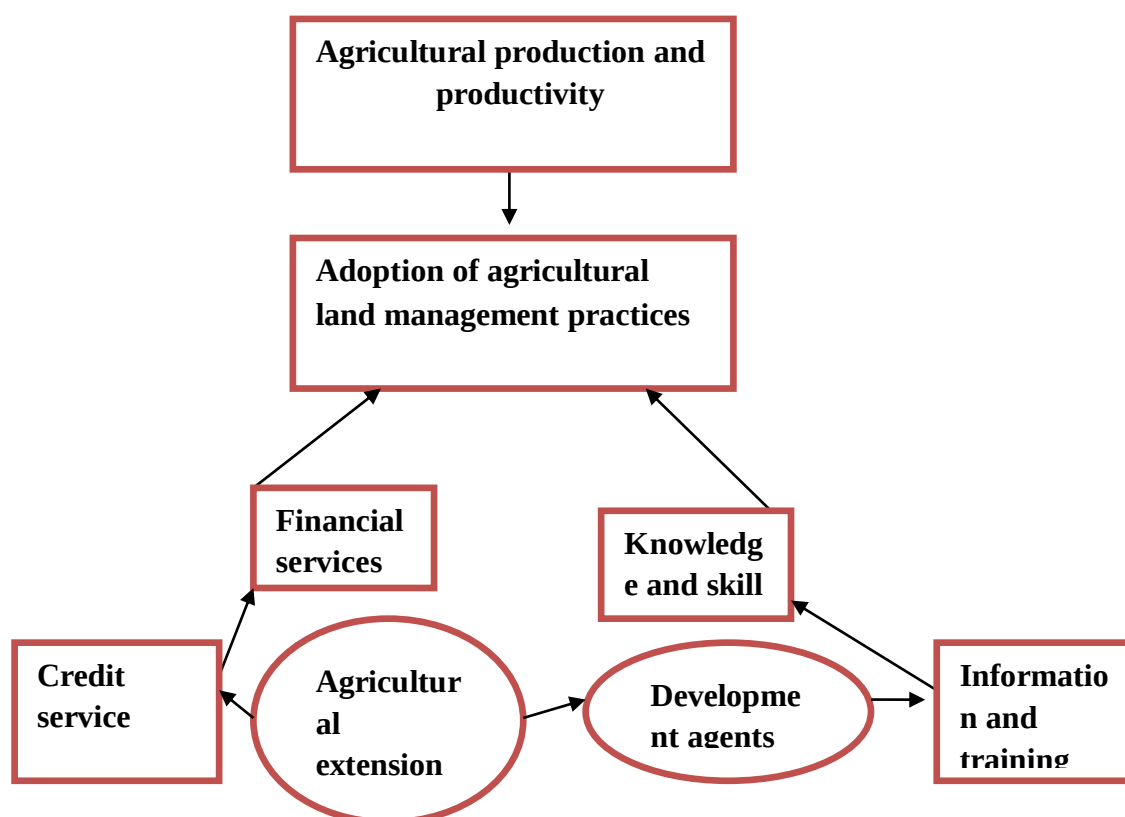


Figure 4: The Role Path Way of Extension Service and Development Agents on Agricultural Production, Adopted from (Asres Elias 2013) and Modified by the Researcher

As the above diagram clearly depicts that agricultural extension service plays important role for agricultural production through providing financial credit services by the help of financial

institutions. For example Access to credit may enable farmers to purchase inputs or acquire physical capital, thus contributing to technology adoption and increased capital and input intensity in agriculture (Feder, 1985 cited by pender,et al, 2003). This may promote increased production and production of high value crops or intensification of Livestock production and a reduction of subsistence food crop production. Providing information and training that brings knowledge and skill for rural poor farmers by the help of development agents can also insure improvement in agricultural land management practices which are also impactful on agricultural production.

CHAPTER THREE

DESCRIPTION OF THE STUDY AREA

3.1 Geographic Location and Relief Features

Machakel Woreda is found in East Gojjam Administrative Zone of Amhara National Regional State of Ethiopia. Geographically the Woreda is located at $10^{\circ} 19' 75''$ to $10^{\circ} 41' 00''$ N latitude and $37^{\circ} 16' 46''$ to $37^{\circ} 45' 42''$ E longitude (see Figure 5). In its relative location, Machakel woreda is surrounded by Dembecha Woreda in the West, Gozamen Woreda in the East Debre Alias Woreda in the South and Sinan Woreda in the Northern direction.

It is 330km far from north Western part of Addis Ababa, 237 km away from Southern part of Bahrdar the capital city of Amhara Regional State and 30km far from western part of Debre Markos town, the administrative city of East Gojjam Zone. Machakel Woreda is divided in to 24 rural Kebles and 1 urban Kebele centered Amanuel as an administrative town. The Woreda has a total of area of 795.59 square kilometers with an elevation ranges from 1200-3200m a.m.s.l (meter above mean sea level) (WAO, 2014).

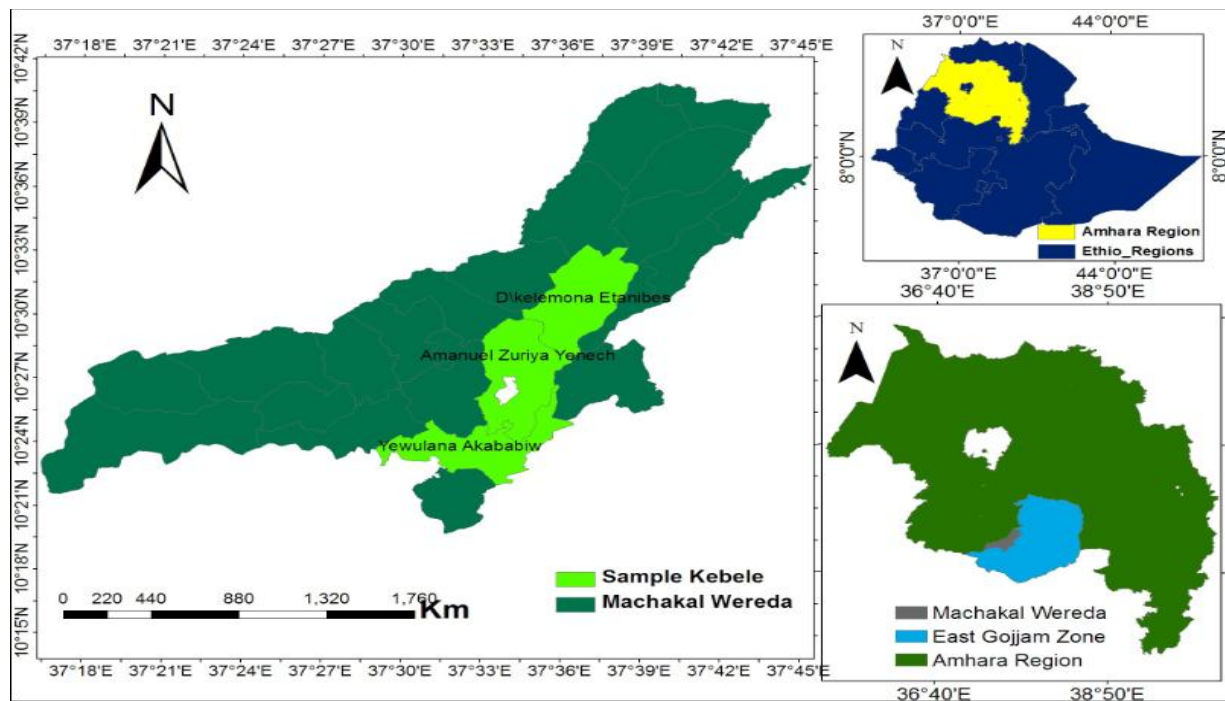


Figure 5: Location Map of Study Area

The study area is characterized by rugged and hilly relief features. About 48.0% of the total area is mountainous landscape; about 50.0% of the total area is characterized by plain landscape whereas about 2.0% of the area also dominated by valley landscapes. Generally, most of the agricultural fields are dominated by rugged topography and sloppy area that need careful management practices.

3.2 Climate and Land Use System

Based on the local agro- ecological classification of Ethiopia, 58.76% of the study area experiences Dega climatic condition, about 39.1% of the area experiences Woyna Dega, 2.12% of the area experiences Wurch climatic condition whereas the remaining 0.02% of the area falls under kola climatic condition. Mostly the area has mean annual temperature ranges from 20°C to 24°C with total annual rainfall ranges from 1130 to 1751mm.

The rainfall has high intensity and short duration with dominantly uni-modal pattern extends from June to September. The situation accompanied by sloppy landscape lead to the occurrence of low infiltration of rainwater and flow of excessive surface runoff. This also caused sheet and gully erosion hazards in the agricultural fields of Machakel Woreda during summer season. Since rainfall amount and severity levels of erosion hazards are dependent on the areal altitudinal differences described above and the availability of vegetation cover in the area, the problem is more severe in Dega agro-ecology of Machakel Woreda where there is excessive rainfall with bare steep slope agricultural landscapes.

The data from National Metrological Agency indicated that the temporal distribution of amount of annual rain fall in the study area fluctuated on average by 310 mm every year since 2009 up to 2013.

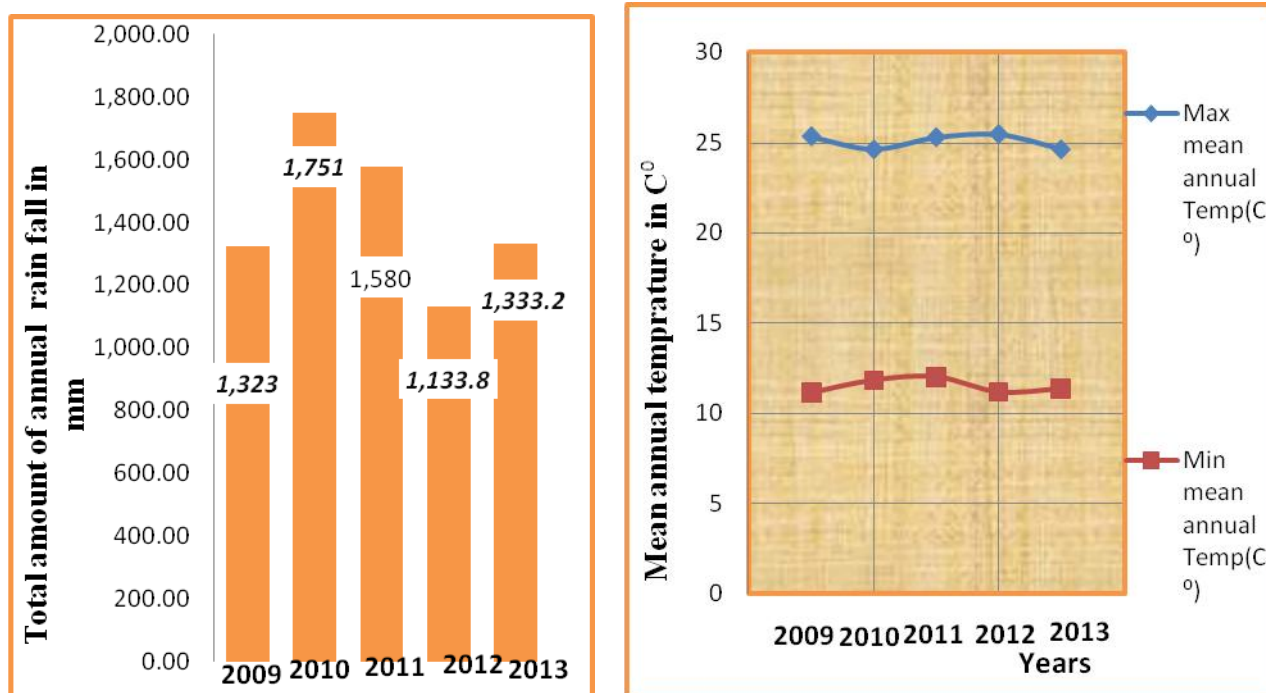


Figure 6: Mean annual temperature and annual total rainfall distribution of the study area (NMA, 20014)

Regarding to the land use land cover system of Machakel Woreda, the total land area is found under different land use systems as depicted in the Table below:

Table 2: land use land cover pattern in Machakel Woreda 2013/2014

Land use types	Areal coverage in (ha)	Areal coverage in (%)
Cultivated land	32501	41.0
Uncultivated land	8374.78	11.0
Grazing land	7648.59	9.6
Forest land	4654.05	6.0
Settlement areas	26379.58	32.4
Total area	79,558	100.0

Source: (MWAO), 2014

3.3 Natural Resources

In the study area, soil resources are developed from highly weathered volcanic Rocks. According to MWAO (2014) the major dominant soil resources include reddish-brown (Nitisols) which covers about 85% of the total agricultural landscape developed along the steeper slopes (Dega) agro- ecology and black basaltic soils (Vertisols) developed along gentler slopes (Weyna Dega) agro- ecology. However, the quantity and quality these soil resources in the study area become decline. For example soils in the steeper upper slopes are generally less deep because of severe erosion hazard occurred on the agricultural fields (WNRCD, 2014).

According to Woreda communication office, currently the total land area covered with forest resource is only about 4654.05 hectare (6.0%) of the total land mass. This is mostly dominated by single species of eucalyptus trees. Woreda agricultural department of natural resource conservation (2014) also reported that the coverage of forest resource in the Woreda is not as per the land use land cover plan. It was due to high rate of deforestation had been in the past years. Because of an increasing demand for arable land, fuel wood, construction and other uses, it was also noted that still difficult to rehabilitate deforested areas.

As many of the informants also noted that eucalyptus tree planting has increased in the study area. Because, farmers have the practice eucalyptus tree plantation in demanding it as a source of income. This is also due to its short -term economic gain to the farmers. On the other hand, the land size covered with forest species that have environmental benefits become decline.



Figure 7: Cutting of Eucalyptus tree as a source of income for rural households (Photo by the researcher, 2014)

3.4 Farming system, Crops and Livestock

Agriculture is the most important economic activity in which more than 92% of the total population livelihood is directly depends on it. Agriculture in Machakel Woreda is mostly characterized by subsistence-based agricultural production system. Sometimes some smallholder farmers are unable to secure their own annual food consumption because of their poor farmlands to support the growth of annual crops enough to farmers' annual food consumption.

Agricultural soil degradation indicated by the development of deeper and wider gullies over the agricultural fields can be one of the factors for the decline of agricultural production in the study area.

The rainfed agricultural practice in Machakel Woreda is only dependent on *Meher* season cultivation (begin in *April* and ends in *October*). Always agriculture is highly subjected for the fluctuation of rainfall intensity and duration with spatial and temporal variations. Therefore, Since the Rainfall distribution pattern in Machakel Woreda is unimodal, it may cause for the decline of agricultural production.

The major land use types of the study area are cultivated land, pasture, wood lots, and settlements. The agricultural system in the Woreda is mixed farming system involving both rain-fed crop productions as a major with livestock production as supplementary in the system. **Teff, Barley, Wheat, Maize, Oat** locally known as **Engido, Bean, Pea** and the local **Gibto** crop are the major crops grown and cultivated in the study area. **Potato** and **Maize** are also the only major crops cultivated in the area using small-scale irrigation agricultural practice. Oxen are important animals used for plowing, crop harvesting and seed bed preparation for **Teff** crop. The land is tilled three to six times before planting based on the crops need of land preparation.

According to the report from experts who work in department of Woreda animal and grazing land development (2014), As compared to the available grazing fields Livestock density is very high,. Because animals are commonly graze on the communal grazing land due to lack of private owned grazing lands. It was after the harvest of rain-fed crops crop residues on private cultivated lands become available for free grazing.

Mostly farmers in Machakel Woreda practiced both keeping of domestic animals such as Cattle, Donkeys, Mules Goats, Sheep and Chickens, and crop farming. According to MWCO, Cattles and Chickens have hybrid species where as the rest animals are endemic species.

Table 3: Distribution of Animal Resources in Mchakel Woreda

Animal types	Endemic species	Hybrid species
Cattle	89,467	1775
Donkey and Mule and horse	13,370	-
Sheep and Goats	30,273	-
Chickens	30,557	1827

Source: MWCO, 2014

3.5 Population

The total human population of the study area is about 118,097. Out of the total population, 92.6% or about 109,354 of the population live in rural areas. Females made up of 50.4% of the total population in the study area. About 7.8% of the total populations are also urban dwellers. The population distribution trend of the study area measured in crude density is about 148.4p/ km^2 . Whereas the agricultural density of *Machakel Woreda* is also about 335.44p/ km^2 . From this agricultural density one can understand that exertion of high pressure on the natural resource is inevitable and it is one of the problems in the study area.

CHAPTER FOUR

GENERAL CHARACTERISTICS OF FARM HOUSEHOLDS

This chapter consists of three parts. In the first part, the demographic and socio-economic characteristics of farm household respondents such as sex, age, educational status family size, farmland size and types of agricultural practice were dealt with. In the second part analysis of the major agricultural land management practices are discussed. Whereas the third part of this chapter also deals with the supporting role of development agents in agricultural land management practices.

4.1 Demographic and Socio-Economic Characteristics of Respondents

Out of total of 206 household survey questionnaires, 184 (89.3%) of the questionnaires were returned and collected filled appropriately as a response rate from participant farm household respondents. However, about 13(6.3%) of questionnaires are not returned. Whereas about 9 (4.4%) of the questionnaires are discarded for inappropriate fill up of the questionnaires. Therefore, a total of 184 farm household respondents were used for data analysis.

Regarding some results and characteristics among the three *Kebeles*, *Sample Kebeles* are treated as one when necessary. However, it is reasonable to treat different results and characteristics of sample population among sample *Kebeles* independently.

4.1.1 Sex and Age Proportion of Respondents

As population structures, Sex and Age are the most important indicators of demographic characteristics of household respondents. As it represented below in (Table 4), among the total household respondents about 157(85%) were males while 27(15%) were females. Here it is possible to say that the agricultural practice is more headed by male farm households. This shows less participation of females in the direct practice of agricultural land resource management.

In addition to this, during the researcher's observation on randomly selected farm households of sample *Kebeles* the researcher was able to learn that among the three observed female household respondents two of them are found that their farm land is rented for the second person.

According to the report of land owner female households, because of absence of their direct participation, the productivity of their farmland is become decline. Because, the second person is not as wise as the owner of the land to manage all agricultural land resources. This is in agreement with the study by Adimassu (2005) cited by Aklilu (2006) reported that soil and water conservation investments were limited in rented operated lands. As respondents explained during the interview session, mostly women were primarily engaged in the domestic sphere. However, their participation is only limited in weed removing activities in the agricultural fields during crop planting.

This also shows as it compared with the participation of males, the direct participation of women in the agricultural practice in general and their agricultural land resource management practice in particular is going to be neglected. This also directly related with an all-comprehensive report by FAO (2010) stated that rural Women have only use rights mediated by men particularly in many developing countries.

With respect to the age of farm household respondents', out of the total farm household respondents about 22 (12.0%) of farm household respondents were found in the age group between 20-29, 48(26.1%) of the respondents were in between 30-39, 65(35.3%) respondents were also found in age group between 40-49 whereas about 49(26.6%) of the household respondents belonged to in the age group ≥ 50 years old (See Table 4). From this survey result it is possible to conclude that majority of farm household respondents were adult group. This also indicates that majority of farm household respondents are matured and relatively experienced and they may provide reliable information for what they were asked in the questionnaires. In addition this can be considered as an opportunity for the adoption and the practice of different agricultural land management technologies. Because some research findings reported that farmers under inactive working age group face a challenge to respond for land management technologies than adult age groups and experienced farmers. Therefore, farm households in the study area can practice agricultural land management technologies using their prolonged experience in farming activity.

Table 4: Distribution of Farm Household Respondents' Sex and Age Proportion

Variables	Category	Respondents						Total	
		Yewlla n =68		Amanuel Zuria n =61		Debre Kelemu n =55		n =184	
		Freq	%	Freq	%	Freq	%	Freq	%
Sex	Male	64	94.2	55	90.2	38	69.1	157	85.3
	Female	4	5.8	6	9.8	17	30.9	27	14.7
	Total	68	100.0	61	100.0	55	100.0	184	100.0
Age	20-29	12	17.6	7	11.5	3	5.4	22	12.0
	30-39	23	33.8	16	26.2	9	16.4	48	26.1
	40-49	19	27.9	25	41.0	21	38.2	65	35.3
	50and above	14	20.7	13	21.3	22	40.0	49	26.6
	Total	68	100.0	61	100.0	55	100.0	184	100.0

Source: Field survey, 2014

4.1.2 Family Size and Educational Status of Farm Household Respondents

Regarding family size of farm household respondents', the field survey shows that about 19(10.3%) of respondents have a family size < 3 and the rest 38 (20.6%), 83(45.1%), 40(21.7%) and about 4 (2.2%) of the household respondents also have a family size of 3- 4, 5-7, 8-9, and > 10 respectively (See Table 5). From this one can understand that respondents have an average family size of six members with in a household. This can be an opportunity to come up with a solution for some research findings mentioned that socio-economic in general and shortage of labor force in particular as constraints of agricultural land management particularly for labor-intensive management practices. However, from natural resource utilization and management perspective increasing trend in family size of farm households' has also its own contribution in deteriorating the natural resources in general and agricultural land resources in particular. Because of having large average family size in farm households of the study area, the agricultural density of Machakel Woreda was about $335.44p/km^2$. This may not fit with that of environmental carrying capacity.

In relation to the educational status of farm household respondents', it is obvious that education may increase households' understanding on the cost and impact of land degradation. Education helps farmers to take care and manage natural resources directly tied with their agricultural business as a base of their livelihood. Farm households' improvement in education implies that, improving their adaptation of management technologies including fertilizers, composting, performing soil conservation measures, planting trees and fences, and it increases households' access to information and credit to purchase agricultural inputs that have better contribution for more effective agricultural land management practices (Ervin, 1982, cited by Getachew, 2005). In line with this argument, the educational level of farm household respondents was assessed in the study area.

Results of the analysis shows that 111 (60.3%) of the farm household respondents are illiterate, 39(21.2%) were able to read and write from their informal education, 28(15.3%) were also attended their primary education. whereas it was only about 6 (3.3%) of the total sample farm household respondents were attended their high school education (See Table 5). This implies that respondents those who are illiterate took higher proportion of the total population and can understand that they have limited adaptation on land management technologies as it underpin by the above cited literature.

Table 5: Distributions of Family Size and Educational Status of Farm Household Respondents'

Variable s	Category	Yewlla n =68		Amanuel zuria n =61		D/kelemu n =55		Total n =184	
		Freq	%	Freq	%	Freq	%	Freq	%
Family size	<3	8	11.7	1	1.6	12	21.8	19	10.3
	3-4	9	13.2	7	11.5	20	36,4	38	20.7
	5-7	30	44.1	39	64.0	14	25.4	83	45.1
	8-9	18	26.4	13	21.3	9	16,3	40	21.7
	>10	3	4.6	1	1.6	0	0.0	4	2.2
	Total	68	100.0	61	100.0	55	100.0	184	100.0
Educatio nal status	Illiterate	41	60.3	27	44.3	43	78.1	111	60.3
	Reading and write	12	17.6	21	34.4	6	11.0	39	21.2
	Primary education	10	14.7	13	21.3	5	9.0	28	15.2
	H. school education.	5	7.3	0	0.0	1	1.9	6	3.3
	Total	68	100.0	61	100.0	55	100.0	184	100.0

Source: Field Survey, 2014

4.1.3 Farmland Size and Agricultural Practice of Farm Households

As the table below indicates that, the average farmland size of majority of total farm household respondents (38.0%) varies between 0.5ha and 1ha. Whereas, about (21.7%) and (26.8%) of the total farm household respondents indicated that they have farmland size varies between 1-2ha and less than 0.5 ha respectively. On the other hand, only few farm household respondents (7.6%) and (6.5) responded as they hold farmland size greater than 2ha and as they hold nothing respectively (See Table 6). From this response distribution, one can understand that smaller land size in areas of high demand might be a constraint for the adoption of land management practices for such smallholder farmers. Because, many research findings reported that land holding size is one of the most severe constraints in the adoption of agricultural land management practices. For example, farmers with larger farm land size are more likely to practice long-term land management approaches that insure long-term productivity like; fallowing, crop rotation, applying organic manure and incorporating crop residues. However, farmers with less farm size

are more likely to practice nothing or short-term management methods that insure only short-term productivity (Nkonya, *et al* 2008).

Regarding the agricultural practice of farm household respondents', majority proportion of farm household respondents (59.2%) were practitioners of only rain fed agricultural practice whereas about (20.7%) and (19.6%) of the total sample farm household respondents practiced only irrigation agriculture and both irrigation and rain fed agriculture respectively. It was only about (0.5%) of the respondents reported that their livelihood is dependent only on animal raring (See Table 6). From this, one can understand that similar with majority of Ethiopian farmers most of farm household respondents in the study area have no supplementary irrigation agricultural practice. This also may lead framers to expose for shortage of food due to crop failure at a time of harsh weather condition. Additionally, since the agricultural activity is more subjected to weather and climate variability related problems, farmers are expected to carry out effective and appropriate agricultural land management practices to reduce their crop failure.

Table 6: Distribution of Sample Farm Household Respondents' Land-ownership Agricultural Practices

Variables	Category	Yewlla n =68		Amanuel zuria n =61		D/kelemu n =55		Total n =184	
		Freq	%	Freq	%	Freq	%	Freq	%
Farmland size	Landless	3	4.4	9	14.7	-	-	12	6.5
	< 0.5ha	18	26.5	13	21.3	17	31.0	48	26.8
	0.5 – 1ha	26	38.2	21	34.4	23	41.8	70	38.0
	1 -2 ha	13	19.1	16	26.2	11	20.0	40	21.7
	> 2ha	8	11.8	2	3.3	4	7.3	14	7.6
	Total	68	100.0	61	100.0	55	100.0	184	100.0
Agricultural practices	Only rain fed agriculture	29	42.8	47	77.1	33	60	109	59.2
	Only irrigation agriculture	28	41.1	6	9.8	4	7.3	38	20.7
	Both rain fed and irrigation	11	16.1	6	9.8	18	32.7	35	19.6
	Only animal raring	-	-	2	3.3	-	-	2	0.5
	Total	68		61	100.0	55	100.0	184	100.0

Source: Field Survey, 2014

4.2 The Status and Problems of Agricultural Land in the Study Area

In the study area, the status and problems of agricultural land was assessed based on farm household respondents' understanding. Because in order to have a meaningful sense on the agricultural land management practices, assessing the status and the existing problems of agricultural land in the study area is very important.

4.2.1 The Status of Agricultural Land in the Study Area

The majority of the total farm household respondents (73.9%) reported that their agricultural fields are undergoing soil erosion with severe hazard. About (46.1%) and (42.3%) of the total farm household respondents also responded that this erosion hazard followed the decline of crop yield productivity. On the other hand, of the total respondents only (26.1%) of the respondents responded that soil erosion is not a problem in their farmlands. In the study area, about (16.3%), and (31.5%) of the total respondents also reported that erosion has minor effect on crop productivity and crop productivity also increased over time respectively. In addition, only (3.8%) of the total respondents responded that soil erosion has no any effect on crop yield productivity. Whereas about (26.2%) of the respondents reported that crop yield productivity is remain constant (See Table7). As can be understand from the response distribution, majority of farm household respondents confirmed the presence of soil erosion hazard in the agricultural fields of the study area.

It is obvious that severity level of soil erosion hazard and crop yield productivity is a matter of geographic issues and highly dependent on spatial differences. Therefore as can be shown in (Table 7), the frequency of respondents' response distribution shows variation among sample Kebeles. For example, about 85.2% the respondents in *Amanuel zuria Kebele* and all the respondents in *D/iKelemu Kebele* reported that their farmland is going under soil erosion hazard. This implies that following their geographic location under *Dega* agro-ecology most of their farmlands are more susceptible for soil erosion hazard and imply that such areas need more emphasis to practice more agricultural land management technologies. Additionally about 52.7% and 22.0% of farm households in *Amanuel zuria* and *D/Kelemu Kebele* responded that such severe erosion hazard has moderate or minor impact on crop productivity respectively. This also indicates that some farm household respondents' level of understanding on soil erosion

problem to decline crop yield found to be low. Nevertheless only 35.3% of the respondents in *Yewlla Kebele*, found under *Woyna dega* agro-ecology and in relatively gentle slope reported that soil erosion is not a problem on their farmlands. As a result of this, 45.5% of the respondents also reported that crop productivity of their farmland increased over time.

Table 7: The Status of Agricultural Land in the Study Area from Farm Household Respondents' Perspective

Respondents view on The status of agricultural land	Respondents						Total	
	Yewlla n =68		Amanuel Zuria n =61		D/Kelemu n =55			
	Freq	%	Freq	%	Freq	%	Freq	%
Do you think your agricultural fields are found under soil erosion hazard?								
YES	24	35.3	52	85.2	55	100	136	73.9
NO	44	64.7	4	14.8	0	0.0	48	26.1
How do you see severity level of soil erosion impact on crop yield?								
Severe	13	19.1	29	47.3	43	78.1	85	46.1
Moderate	27	39.7	23	38.0	12	22.0	62	33.8
Minor	21	31.0	9	14.7	0	0.0	30	16.3
It has no effect	7	10.2	0	0.0	0	0.0	7.0	3.8
How is the over time trend in crop yield?								
Increasing	31	45.5	16	26.2	11	20.1	58	31.5
Declining	24	35.2	28	46.0	26	47.2	78	42.3
Remain the same	13	19.3	17	27.8	18	32.7	48	26.2

Source: Field Survey, 2014

4.2.2 The Current Problems of Agricultural Land in the Study Area

As the figure below indicates that soil erosion due to slope steepness of the agricultural landscape can be considered as, the first problem in the study area. Out of the total surveyed respondents, about 181 (98.2%) of the total sample farm household respondents responded and ensured that soil erosion and slope steepness are the current problems observed in their agricultural lands. This implies that majority of farm household respondents observed and

understand that currently soil erosion problem is become increasing. Furthermore as the response given by 113(61.4%) of farm household respondents indicated that poor soil fertility status also could be mentioned as the second problem in the study area. This is also the direct reflection of soil erosion problem in the study area. During informal discussions, farm households also generally agreed that there had been a decreasing trend in fertility levels of their plot of lands. On the other hand about 57 (31.0%) of sample farm household respondents also put difficulty to plow as a problem observed in their agricultural fields. Particularly the stony characteristics of the agricultural fields make their plowing activity difficult. In general terms, it is also possible to conclude that farmers were well aware of the existing problem of soil erosion in the study area.

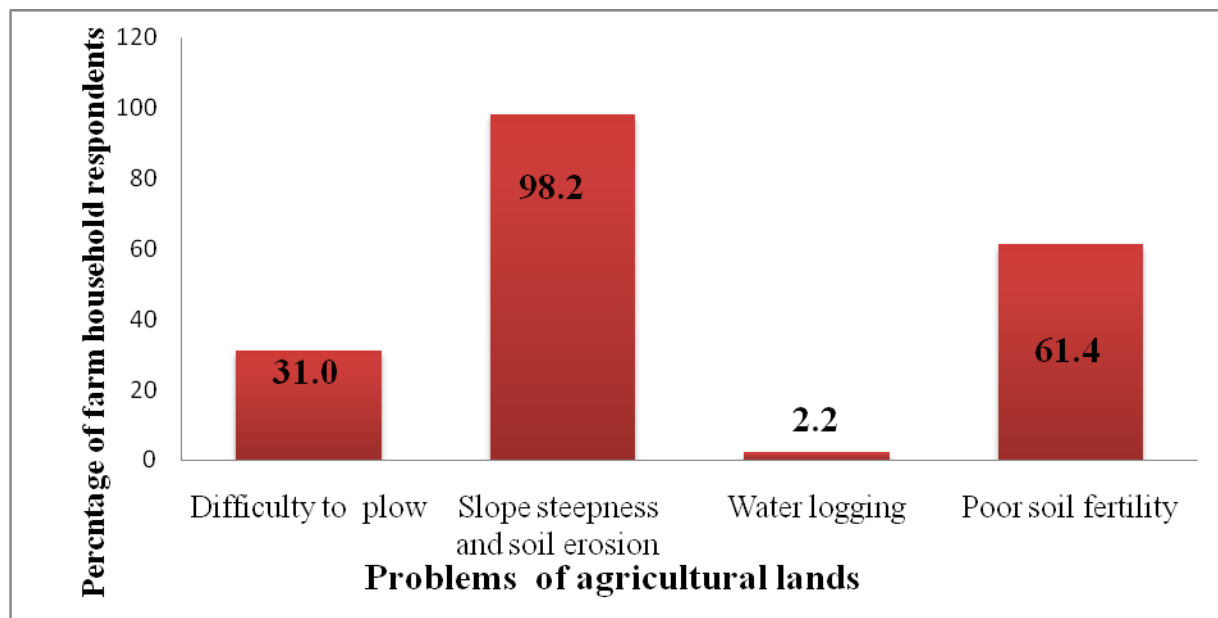


Figure 8: The current problems in the agricultural land of the study area from farmers' point of view (percentage values are not added because of multiple responses), Field survey, 2014)

4.3 Agricultural Land Management Practices in the Study Area

4.3.1 Management Practices Related to Soil Fertilization

Most farmers' soil fertility management practices were targeted in gaining short-term benefit of agricultural yield. In the contrary, they gave less emphasis for management practices that insure long-term benefit of agricultural yield. As a result, all farmers in the study area used inorganic chemical fertilizer application as the only source of nutrients to fertilize soils on the agricultural fields. Organic and inorganic sources of nutrients and agronomic management practices are

crucial to improve soil fertility status in particular and for the productivity of agricultural lands in general.

To this end, the study area has been assessed in relation to the practice of agricultural land management technologies particular to the improvement of soil nutrient status like; use of chemical fertilizer, compost, animal manure and green manure, and agronomic management practices such as; use of improved crops, fallowing and crop rotation activities practiced by farmers.

To examine farm households' level of adoption of soil nutrient management technologies practiced in their agricultural fields, surveyed farm household respondents were asked to rate their level of practice for the above soil fertilization technologies and agronomic management options. Their level of practices rated using five point Likert type scale descriptive test with response options and its assigned scores (Always =5; Frequently =4; Sometimes =3; Rarely =2; and Not at all =1). These values were added to obtain 15 and divided by 5 to obtain a mean score of 3.0 which serves as a benchmark. Because 3.0 average mean score value is the average result of the maximum mean score value 5 and the minimum mean score value 1 in this Likert type scale descriptive test. Therefore, any response distribution with a response mean score greater than or equal to 3.0 on a variable of the given management technology implied that farm household respondents have good practice of that particular soil nutrient management technology and agronomic practices in the study area. Whereas, any response mean score values less than the above-determined mean score value implies that farm households have poor practice of that particular soil fertility management and agronomic practice options.

As shown in (Table 8), farm household respondents were asked to indicate soil fertility management technologies practiced in their agricultural fields. In this regard, the response revealed that the response mean score for inorganic fertilizer as a management method of soil fertilization practice was 4.37 which is far above the pre-determined ideal mean score value 3.0. Thereby implying the farm households have a good level of practice of inorganic fertilizer as soil fertilization mechanism. However, as the survey result shown in (Table 10) and as it noted from informal group discussion and interview, the application trend of inorganic fertilizer was not as per the recommendation of experts. Most of the farmers followed inorganic fertilizer application efficiency using their own decision. This implies that though farmers develop a good practice in

use of inorganic fertilizer, it could not be effective unless their application is as per the recommendation of experts to regulate soil nutrient toxicity and deficiency over the agricultural fields with respect to the nature and types of crops under cultivation.

Regarding the practice of compost, animal manure and green manure soil nutrient management technologies, mean score values of responses from farm household respondents were 2.22, 2.85 and 1.87 respectively. Since all results are less than the pre-determined ideal mean score value 3.0, farm household respondents have relatively poor practice of compost, animal manure and green manure of agricultural land management technologies in their soil fertilization activity. Particularly, the practice of green manure as soil fertility mechanism is found to be extremely poor. Because, the mean score value of the responses 1.87 is far below the pre-determined ideal mean score value 3.0 which serve as a benchmark in this descriptive test survey result. For this also participant farmers in focused group discussions and farmers during interview indicated that farmers in the study area were never seen and hear green manure as management practices. This indicated that farmers have information gap related to the adaptation and implementation of green manure management practice to increase the status of soil fertility.

In addition to this behind poor practice of compost as a mechanism of soil fertilization activity, during interview some farmers have reported that untimely order from experts to prepare compost was mentioned as a challenge for its effectiveness. It is obvious that compost preparation is more effective in a time when there is enough moisture supply to facilitate the decomposition rate of organic matters. However, not only the above justification given by some farmers but also farmers' perception towards the preparation of compost as it is a source of disease have been identified as a challenge in the practice of compost to fertilize soil. For instance, during discussion and interview held with farmers most of the farmers perceived that compost preparation is a source of disease locally known as **Mich** for farmers and their chickens.

In addition to this, farmers in the study area had been practiced their own indigenous soil fertility maintaining mechanisms. Among these traditional soil fertilization practices, parking of animals belongs to the surrounding community on the agricultural fields during night time locally known as **Ehura** and parking of animals belongs to the community near to the homestead during night time locally known as **Beret** were the most important soil fertilization mechanisms practiced for a long period of time in the study area. However, the discussion conducted with farmers and

interview held with development agents indicated that currently traditional soil fertility management practices particularly *Ehura* become ignored by farmers. Because, farmers perceived that this traditional soil fertility management practice has no value since the application of inorganic fertilizer is inevitable. In principle, the practice of such traditional soil fertility management activities can ensure the long run productivity of agricultural lands through their organic sources. Further, farmers can also reduce their expenditure on the cost of inorganic fertilizer. To conclude the findings on soil fertility management practices in the study area, soil fertilization activity was more dependent on the application of inorganic fertilizer which cannot alone ensure long run productivity of the land under cultivation. Mostly the combined use of both organic and inorganic fertilizer that ensures the long run productivity of agricultural lands found to be poor even farmers' use of traditional soil fertility management practices are also neglected.

Table 8: Household Respondents' Response Distribution on Soil Fertilization and Agronomic Practices

Soil fertility management practices	Frequency alternatives n = 184					Statistics	
	Always	Frequently	Sometimes	Rarely	Not at all	Mean	SD.
Use of inorganic fertilizer	109	48	18	9	0	4.37	0.82
Use of compost	15	24	20	58	67	2.22	1.26
use of animal manure	17	32	63	53	19	2.85	1.09
Use of green manure	1	14	27	61	81	1.87	0.94
Items related to agronomic management practices							
Use of improved crop	42	60	59	22	1	3.64	0.97
Fallowing	9	16	48	70	41	2.35	1.04
Crop rotation	59	68	42	14	1	3.91	0.92

Source: Field Survey, 2014

4.3.1.1 Pattern of Organic Manure Application Time

From the nutrient management perspective, animal manure application time in farm lands has its own problem in causing nutrient volatilization, oxidation during dry season and leaching problem during rainy season. However, these problems may occur when it fails to be applied on the right application time and when it is not incorporated in the soil effectively. In line with this, the study area has been assessed in its pattern of organic manure in particular animal manure application time.

As shown in (Table 9), about the common practice of animal manure application time, 101(54.8%) of sample farm household respondents followed the application pattern of before crop planting. About 36 (19.6%) of the total farm household respondents responded as they applied during the time of crop planting, which has a probability to be incorporated with the soil effectively. About 19(10.3%) of the respondents also reported that they were not adopted the application of animal manure. Whereas 7 (3.9%) of sample farm household respondents reported as they followed the application time of animal manure, sometimes before and sometimes after crop planting.

As farmers explained during individual interview session, most of the time farmers used manure application on their farm fields some weeks before planting and late to incorporate it with the soil. This implies that, the application of manure was highly exposed for direct sun light that causes nutrient volatilization during dry season and leaching during rainy season. In principle knowledgeable farmers always followed the application of manure at the time of crop planting and incorporated it in the soil (Rajan, *et al*, 2010). From this one can understand that farmers in the study area have some knowledge gap related with these unobservable soil nutrient losses (volatilization and leaching.) during animal manure application time.

Table 9: Farm Household Respondents’ Response Distribution on Patterns of Animal Manure Application Time.

Response item on pattern of animal manure application	Respondents n = 184	
	Freq.	%
How is your application time of animal manure in your farm fields?		
Before crop planting	101	54.8
During crop planting	36	19.6
After crop planting	21	11.4
Sometimes after and sometimes before crop planting	7	3.9
I don’t have any adaptation of Animal manure application	19	10.3
Total	184	100

Source: Field Survey, 2014

4.3.1.2 Trend and Constraints of Inorganic Fertilizer Application

4.3.1.2.1 Trend in Application of Inorganic Fertilizer

As shown in (Table 10), majority of sample farm household respondents (63.2%) in *Yewlla* ,(85.3%) in *Amanuel Zuria* and (89.1%) in *D/kelemu* Kebeles in the study area indicated that trend in the application of inorganic fertilizer on their farmlands increased over time. It was only few respondents about (28.0%), (11.5%) and (10.9%) of sampled farm households in *Yewla*, *Amanuel Zuria* and *D/ kelemu* also agreed that their inorganic fertilizer application is going to be declined over time.

Generally, according the survey result, over time increase in the application of inorganic fertilizer was the direct reflection for the increase of soil degradation and depletion of important nutrients from the profile of soil over the agricultural fields in the study area. According to the report by majority of the DAs and agricultural experts in the respective sample *Kebeles*, since it belongs to an elevated landscape, over 65% of the agricultural lands are highly susceptible for erosion hazard. During interview Woreda agricultural experts have explained that majority of the agricultural fields are mostly found under sloped landscapes and also found under severe

degradation resulted from poor farming practices by majority of farmers and deforestation in the study area.

The percentage values from the response distribution also indicates that over time increase in the application of chemical fertilizer was more observed in *Dega* agro ecologies of the study area (*Amanuel Zuria* and *D/ Kelemu Kebeles*). This is also due to high rate soil erosion from elevated agricultural fields and removal of soil nutrients year after year (see Table 10).

Additionally, even if there was an increase trend in the application of inorganic fertilizer in the study area, this trend of inorganic fertilizer application was not applied as per the recommendation of experts. Totally about (98.9%) of farm household respondents responded that the application trend of inorganic fertilizer was not applied as per the recommendation of experts. Participants of group discussion reported that most of the time farmers used their own prolonged experience to adjust the dose of inorganic fertilizer needs to be applied on crop farm fields. As a result farmers added relatively efficient amount of inorganic fertilizer especially for only selected crops considered as basic by farmers such as ***Teff*** and ***Wheat***. In relation to this, 72.2% of the total sample farm household respondents confirmed that they could not apply inorganic fertilizer for all crops. Farm household respondents reported that this is due to the increasing trend on the price of inorganic fertilizer which is not easily affordable by such smallholder subsistence-farming actors.

Table 10: Farm Household respondents' Response Distribution on the Trend of Inorganic Fertilizer Application

Response items	Respondents						Total	
	Yewlla n =68		Amanuel Zuria n =61		D/Kelemu n=55		n = 184	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
How is the trend of inorganic fertilizer application over time?								
Increasing	43	63.2	52	85.3	49	89.1	144	78.3
Decreasing	19	28.0	7	11.5	6	10.9	32	17.4
Remain the same	6	8.8	2	3.2	0	0.0	8	4.3
Do you apply inorganic fertilizer as per the recommendation of experts?								
Yes	2	3.0	0	0.0	0	0.0	2	1.1
No	66	97.0	61	100.0	55	100.0	182	98.9
Do you apply inorganic fertilizer for all crops?								
Yes	17	25.0	22	36.1	12	21.8	51	27.8
No	51	75.0	39	64.0	43	78.2	133	72.3

Source: Field Survey, 2014

4.3.1.2.2 Constraints in the Application of Inorganic Fertilizer

As shown in (Table 11), about (59.2%) and (83.7%) of the total sample farm household respondents reported that removal of the top soil with the applied fertilizer and inability to afford the cost for the application of sufficient fertilizer respectively were put as constraints that impede agricultural land management practices related to inorganic fertilizer application in the study

area. Based on the respondents' response distribution, constraint particularly related to removal of top soil with the applied inorganic chemical fertilizer was a serious problem in Debre Kelemu and Amanuel Zuria Kebeles found under *Dega* agro ecologies dominated by sloppy agricultural landscapes that are also highly susceptible for soil erosion hazard (see Table 11).

On the other hand, (45.6%) and (18.5%) of sample farm household respondents also put access to experts support to recommend the efficiency of inorganic chemical fertilizer use and removal of fertilizer through leaching due to excessive rain fall as constraints to soil fertilization management practices respectively. The survey result from group discussion reported that, application of inorganic fertilizer was not applied as per the recommendation of the experts this also the direct reflection of farmers in ability to afford sufficient fertilizer. In addition to this, during individual interview held with framers, one farmer explained his view as follows:-

...”when I am under a serious constraint to afford sufficient inorganic fertilizer and when I have frequent fertilizer application far below the experts recommendation, sometimes I am going to decide to leave my plot of land out of crop cultivation“

As the above response indicates that for many poor rural farmers with similar constraint and trend, this situation leads to shortage in the provision of annual food consumption. Additionally, it indicates also farmers in the study area were not adopted the combined use of inorganic fertilizer and organic fertilizer rather they were more rely on the application of inorganic fertilizer in soil fertilization management practices.

Table 11: Farm Household Respondents' Response Distribution on the Constraints Related with Inorganic fertilizer application in Machakel Woreda (Multiple Responses are Possible)

Constraints on the use of chemical fertilizer	Farm household responses in sample kebeles						Total responses n =184	
	Yewlla n =68		Amanuel Zuria n =61		D/Kelemu n=55			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Removal of top soil and crop damage by erosion	17	25.0	49	89.1	43	70.5	109	59.2
Inability to afford sufficient fertilizer	54	79.4	53	96.4	47	77.0	154	83.7
Increasing of soil acidity	0	0.0	0	0.0	3	4.9	3	1.6
Lack of support from experts to use as per the recommendation	29	42.6	31	56.4	24	39.3	84	45.6
Loss of fertilizers by volatilization and leaching	4	5.6	23	41.8	7	11.4	34	18.5

Source: Field Survey, 2014 (percentage values are not added because of multiple responses)

Additionally to avoid unnecessary cost for inorganic fertilizer application, natural soil fertilization process needs to be considered through leaving crop residues in the agricultural fields after harvesting and keeping cow dugs drop in the animals grazing fields. Because, such residue management can increase organic matter in the soil through litter decomposition and soil moisture content through retaining more water. In relation to this, in the study area, farmers generally were not attempt to use and keep crop field residues and cow dugs to improve soil fertility through nutrient recycling. The survey result shows that most of the rural households used the pre-defined measures for the sake of off plot purposes. For example during field observation, the researcher observed only small amount of crop field residues left over the agricultural fields after harvest and farmers were also found in harvesting crop field residue by cutting down it near to its root zone.



Figure 9: A farmer in cutting and collecting Wheat crop field residue for house roofing material in D/Kelemu kebele (Photo by the researcher, 20 14).

During interview farmers have explained that, because of shortage of animal fodder, fuel wood, and house roofing materials, residues from *Wheat* and *Barley* crops used as the most important roofing materials. Residues from *Teff* and *Maize* crops were also mentioned by farmers as the most important source of animal's fodder and household's fuel energy respectively.

Additionally, some farmers also complained against the crop field residues left in their agricultural fields after harvesting. Because, farmers perceived that leaving crop field residues on the agricultural fields makes the residue to become a source of Pests and Weeds for the next cultivation season locally known as (***Yemeret Awal***). Therefore, to avoid these problems most of the farmers have reported that they preferred to burn crop field residues left over their agricultural fields. However, such practices highly limit the natural fertilization of soils over the agricultural fields and may also reduce the amount of recycled nutrients with in the soil.

4.3.2 Management Related to Agronomic Practices

Results from the survey indicated that agronomic management practices in the use of improved crops and crop rotation are widely practiced in all sample *Kebeles*. As shown in (Table 8) the responses mean score values obtained for the practice of improved crop and crop rotation

agronomic practices were found to be 3.64 and 3.91 respectively. Since these mean score values were greater than the pre determined ideal mean score value (3.0), it is possible to understand that farmers in the study area have good practice in use of improved crop and crop rotation agronomic management options as parts of agricultural land management practices.

However, related to the practice of crop rotation the respondents reported that most of the rotation system constitutes the cultivation of cereal crops alternated with the same cereal crops. The most common crop rotation pattern includes the cultivation *Teff* on *Wheat* cultivated land, the cultivation of wheat on *Niger seed* locally known as **Nug** cultivated land and the cultivation of *Niger seed (Nug)* on *Teff* cultivated lands. This indicates that, most of the rotation systems are not practiced in combined with leguminous crops.

Regarding to the use of hybrid crops, crop and seed improvement department in Woreda agriculture office and farmers during interview explained that the use of **Maize** and **Wheat** improved seeds are widely practiced in the study area. While in use of other hybrid crops, constraints were mentioned. Particularly the use of hybrid **Teff** seed was not adopted by farmers because of their perception that there is no any productivity difference between the hybrid **Teff** seed and the local one in their yearly yield comparison. Additionally, the distribution of some disease infected crop seeds also mentioned as a common challenge in the side of Woreda hybrid crop and seed development department office and farmers in the study area to adopt and use such hybrid crops.

During interview held with Woreda crop and seed development department officers, they reported that they were faced year after year resistance from farmers to accept and use hybrid seeds after they once received that infected seeds. This indicated that, due to inappropriate seed quality test, most framers in the study area lose their confidence on the quality of hybrid seeds and to use these crops. In addition to this, Woreda crop and seed development department officers also mentioned absence of soil fertility experts as a challenge to practice the use of hybrid crops effectively as a part of agricultural land management practice. To conclude, even if farmers have shown good management practice in use of hybrid crop, their practice could not be effective in ensuring agricultural productivity, unless quality hybrid seed crops are distributed and the use of such improved crops are practiced by considering soil fertility status in its nutrient proportion in particular and its agro-ecological variations in general.

On the other hand, farmers' practice of fallowing as a part of agronomic practice was found to be poor. Because the farm households' responses mean score value (2.35) was less than the pre-determined ideals mean score value (3.0) (see table 9). Respondents during group discussion are asked to explain the challenges to practice fallowing management technology. According to those respondents, small size of their farmland that is not enough to secure the increasing household members' annual food production was mentioned as a challenge to practice fallowing management technology in their agricultural lands. Because of this limited physical asset (land), farmers may encounter for a problem to continue crop production while resting part of their land. As a result farmers' in the study area were never gave rest for their plot of lands.

However, during discussion farm household respondents have explained that most of the farmers cultivated and used cover of local crop named **Gibto**. It was for only one year and when their plot of land is highly exhausted in its nutrient supply and unable to support the growth of any types of crops. This is due to farmers' finding from their prolonged experience that the local **Gibto** crop does not need any nutrient rich soil and any land preparation practice to grow. In addition to this, growing local **Gibto** crop has a wider range of benefits to the local farmers as a source of local food and to the soil under cultivation in retuning its exhausted nutrients through littering. Therefore, covering the degraded plot of land with **Gibto** crop used by farmers considered as fallowing management practice in the study area.



Figure 10: Agricultural land in Amanuel Zuria Kebele covered with local Gibto crop as fallowing management practice. (Photo by the researcher, 2014)

In addition to this, farmers in the study area were also found to be more concerned about their short-term benefits of their agricultural lands and they have some knowledge gap on the possibility of reversing the status of over cultivated land using fallowing management practices or other management options. For instance, during individual interview held with farmers, most farmers reflected the idea that when their plot of lands are depleted in its soil nutrients locally known as **(Yemeret Mentef)** and unable to grow and support any types of crops, farmers decided to plant eucalyptus tree over their farmlands due to its short term economic gain . However, in principle, planting of eucalyptus trees on degraded agricultural fields may lead to poor growth of eucalyptus tree due to lack of soil nutrients as compared to its excessively high requirement for its rapid growth. Additionally, the land covered with eucalyptus trees may also undergo to long run depletion of soil nutrients and in its soil moisture potential as a result of high uptake by eucalyptus trees.



Figure 11: Affected farmland in Amanuel Zuria kebele started to cover in Eucalyptus tree (photo by the researcher, 2014)

4.3.3 Management Practices Related to Water, Soil care and Crop Moisture Supply

As shown in (Table 12), farmers in the study area have different water and soil moisture management practices. From these management practices, contour plowing, diversion ditch locally known as **(Feses)** and soil bund locally known as **(Kibkab)** were the most widely used management options practiced by (95.1%) , (89.6%) and (62.0%) of the total sample farm household respondents respectively. Particularly diversion ditch and contour plowing soil care management mechanisms were commonly practiced by farmers as parts of their plowing activity. Soil bund constructed along the ditch also practiced to improve water availability with soil and crop moisture supply in agricultural fields of the study area. However, key informants reported that the constructed soil bunds stayed only for a short period of time. Because farmers have complained for its difficulty during plowing, mostly the constructed soil bunds were collapsed during plowing and due to repeated heavy rainfall. In the study area, most of the agricultural fields are dominated by sloped agricultural fields, however the researcher also observed that most of soil bunds were constructed across gentler slopes and its ridge also observed poorly compacted. Though farmers practiced soil bund management technology in their farm lands, they have explained that they were not much beneficial from their practice in maintaining soil loss from their farm fields. This is also directly related to the above mentioned problems related to soil bund construction and its maintenance.



Figure 12: Farmers in the practice of Diversion Ditch in the study area (Photo by the researcher, 2014)

In principle of soil and water resource management practices, in an area with gentler slopes and low rainfall intensity, contour farming and bund may be enough to control runoff and erosion. However, on agricultural lands with steep slope and high rainfall intensity needs to practice more management options. Because, adopting a single management practices particularly in such environments may not bring agricultural land productivity. However, this survey results indicates that about (10.3%) of respondents in Yewlla kebele, (4.9%) of respondents in Amanuel Zuria kebele and (1.8%) of the respondents in Debre Kelemu kebele or it was only (6.1%) of the total sample farm household respondents practiced water harvesting management technology. Additionally, (5.9%), (37.7%) and (20.0%) of the respondents in Yewlla, Amanuel Zuria and Debre Kelemu kebele respectively or (20.6%) of the total sample farm household respondents also confirmed that they protect water and soil and maintain crop moisture supply through the practice of terracing. This survey result indicated that water harvesting and terracing as parts of water, soil care and crop moisture supply management technologies were not widely practiced in the study area. In addition to this, the researcher's field observation confirmed that the physical soil and water conservation activities were not practiced in combination with biological treatment of soil and water conservation activities

Regarding to the practice of irrigation farming, farm households' response distribution shows that, about (57.2%) of respondents in Yewlla kebele, (19.6%) of the respondents in Amanuel Zuria kebele and (40.0%) of the respondents in Debre Kelemu kebele or totally about (40.1%) the total sample farm household respondents reported that they practice irrigation farming as a part of water and crop moisture supply management technology. As can be understand from the response distribution, irrigation farming was widely practiced relatively in Yewlla Kebele. However, it was noted from the discussion and interview held with farmers' and development agents that this due to the dominancy of large number of young age group population those who haven't their own land in the area. Thus, parts of communal grazing lands found adjacent to rivers and streams were given for the purpose of small-scale irrigation practice as a means of their livelihood.

4.3.4 Agro-forestry Management Practices

Agro forestry practices have been claimed to have the potential of improving agricultural land productivity status and alleviating adverse environmental effects in both at local and global level (Bifarin, *et,al*, 2013). In line with this, the study area had been assessed in the practice status of agro forestry as a means of agricultural land management mechanism.

The survey result indicated that about (31%) and (4.4%) of farm household respondents in *Amanuel Zuria* and *Yewlla Kebele* reported that they practiced crop cultivation on tree land areas Whereas farm household respondents in *Debre kelemu Kebele* reported that they were not totally adopted the practice of crop cultivation in tree land areas. As the indication of the response distribution, *Amanuel Zuria kebele* has relatively better adaptation and practice for agro forestry management mechanisms. As the survey result indicted that (63.3%) of Respondents from *Amanuel Zuria kebele*, reported as they planting trees around cropland areas and fruits like: *Papaya*, *Orange*, *Banana*, and *Sugarcane* plantations. This may be due to better accesses to information about the importance of agro forestry practices and accessibility of market opportunity following its geographical proximity to the town of *Woreda* administration named (*Amanuel*). As a result of this, the informants in *Amanuel Zuria Kebele* reported that they were beneficial from such agro forestry practices to earn extra cash income.

Generally out of the total sample farm household respondents, it was only (11.9%) and (33.1%) of the respondents responded that they practiced cultivation of crops in tree land areas and plantation of trees in crop land areas respectively (see Table 12). During discussion household respondents were perceived that plantation of trees along farmland areas reduces the plot of land under crop covers. This also directly related with increasing demand for land that used for only the cultivation of major crops to feed the increasing population pressure in the study area. During the interview held with farmers, most of the informants also perceived that, only the cultivation of major and common crops like: *Teff*, *wheat*, *barley* and *maize* are ensured the fulfillment of their annual food consumption. Whereas, agro forestry practices considered as simply the wastage of their cultivable farmlands used for these major crops.

As a result of this, during the researcher's observation agro-forestry practices were observed only along traditional land use systems. These were also for the purpose of demarking two adjacent farmlands that belong to different ownership and practiced near to the homestead of farm households' in the form of home garden as windbreak. This implies that farmers have some knowledge gap on the possibility of applying agro forestry practices in small-scale land users' level that helps these smallholder farmers to diversify crops and their income sources. Beyond this, agro forestry practices has wider range of importance to enhancing biological activity of soil and its fertility, increase rate of water infiltration and provide favorable microclimate for the agricultural practice, if it is widely practiced in the study area.

Table 12: Farm Households’ Response Distribution on Water, soil care and Crop Moisture Supply and Agro-Forestry Management Practices (Multiple Responses are Possible)

Items related to agricultural land management practices	Respondents of sample Kebeles						Total respondents n =184	
	Yewlla n =68		Amanuel Zuria n =61		D/Kelemu n=55			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Water, soil care and crop moisture supply management practices								
Water harvesting	7	10.3	3	4.9	1	1.8	11	6.1
Irrigation	39	57.2	12	19.6	22	40.0	73	40.1
Contour farming	64	94.1	58	44.3	53	96.3	175	95.1
Terracing	4	5.9	23	37.7	11	20.0	38	20.6
Diversion ditch	66	97.0	57	93.4	42	76.3	165	89.6
Bund	24	35.3	49	80.3	41	74.5	114	62.0
Agro forestry management practices								
Crops on tree land	3	4.4	19	31.1	0	0.0	22	11.9
Trees on crop land	16	23.5	39	63.9	6	10.9	61	33.1

Source: Field Survey, 2014 (percentage values are not added because of multiple responses)

4.3.5 Grazing Land Management Practices in the Study Area

In smallholder farmers, livestock and crop production are complementary. Grazing land management practice is also inseparable from cropland management practices. This also always leads to the productivity of both crop and livestock system. In line with this, the study area has been assessed related to the status of grazing land management practices as parts of agricultural land management practices.

The survey result shown in (Table 13) indicated that (76.4%) of respondents in *Yewlla*, (80.3%) of respondents in *Amanuel Zuria* and (78.2%) of respondents in *Debre Kelemu Kebele* or about (78.6%) of the total sample farm household respondents reported that they were commonly used fencing management option after continuous free grazing practice. Particularly temporarily fencing parts of communal grazing lands for hay harvest locally known as (***Dirkosh***) was widely adopted grazing land management practice in the study area. Fencing management option was

practiced widely almost in all parts of the study area. From this also one can understand that widely implementation of such fencing of fragile grazing lands management practice is the direct reflection for the expansion of over grazed areas in the study area.



Figure 13: Over grazed and degraded grazing lands in different parts of the study area (photo by the researcher, 2014)

To come up with a solution for grazing land degradation, community grazing land management need to be put in to practice (Berhanu. *et, al* 200). In line with this, interviewed development agents (DAs) confirmed that fencing of the severely degraded grazing lands was taken as a program implemented at community level in all parts of the study area. The implementation of the program used local community social organization called ***Idir*** as an enforcement strategy because communal grazing lands are belonging to the common properties of farm households. However, the informant (DAs) reported that farmers' complain on where their animals shall to stay was the major problem in the practice of fencing grazing lands. Because, most farmers have no private grazing lands due to shortage of land for crop cultivation and most of the time communal grazing lands were the only sources of animals' fodder particularly during the time of rainy season when crop residues are late to harvest. Additionally, development agents (DAs) also mentioned that too long time of rainfall duration and technical gaps in the side of farmers in

their late harvesting of fodder grasses were the major constraints that impede harvesting of fodder grasses on its appropriate time.

From the above discussion one can understand that fodder grasses produced through fencing of overgrazed lands were harvested after its maturation level which is not recommended from grazing land management perspective, since it loses its optimum moisture content. For example, fodder grasses that are more mature or have already seeded out will have lower moisture content than grasses that are still growing. During early growth of fodder grasses, there is also a rapid uptake of nutrients, and gradual weaken as the grasses become well enough mature (Hardt , *et al*, 1994). On the other hand, due to the continuity of rainfall beyond its normal duration, most of the time farmers decided to harvest fodder grasses too late. This was also resulted from inaccessibility of information related to short-term weather forecasting service.

On the other hand, (30.8%) of respondents in *Yewlla*, (45.9%) of respondents in *Amanuel Zuria* and (47.3%) of respondents in *Debre Kelemu Kebele* or only about (40.8%) of the total sample farm household respondents reported that they were practiced rotational grazing management practice. Rotational grazing management was mostly practiced when farmers use their own plot of land as a source of animals' fodder particularly more common during dry season when animals graze on crop field residues.

Regarding to the practice of production of fodder trees and grasses, about (20.6%) of respondents in *Yewlla*, (60.7%) respondents in *Amanuel Zuria* and (29.1%) of respondents in *Debre Kelemu Kebele* or about (36.4%) of the total sample farm household respondents responded that they practiced the production of animals fodder through planting fodder trees and grasses. As the response distribution shows that, the production of fodder trees and grasses was widely practiced relatively in *Amanuel Zuria Kebele*. This may be due to their better accessibility of information as a result of their geographical proximity to the *Woreda* administration town named (*Amanuel*) and the existence of farm households those who were dependent in animal raring agricultural practice. Among these fodder trees and grasses, ***Sasbania***, ***Veich*** locally known as (***Meno Guaya***) and ***Oat*** locally known as ***Sinar*** were mentioned as the most important sources of animals' fodder that were produced through plantation. In addition to this, in relation to the production of fodder grasses and tree species, *Machakel Woreda* agriculture office and department of animal resource development attempted to practice scientific identification of

different species of fodder grasses and trees for future plantation of these scientifically identified fodder grasses and trees as parts of grazing land management practices in the study area.



Figure 14: Scientifically identified fodder grasses and trees and ready to plant in the study area (Machakel Woreda animal resource development office. Photo by the researcher, 2014)

Regarding to the control of continuous grazing, it was only few respondents about (25.3%) of respondents in Yewlla, and (18.0%) of respondents in Amanuel Zuria kebele or only about (15.2%) of the total sample farm household respondents responded that they used control of continuous grazing management practice through controlling animals time to stay in grazing land area. However, all respondents in Debre Kelemu Kebele were not adopted control of continuous grazing management practice (See Table 13).

To reduce grazing pressure in the study area, mostly such controlling of continuous grazing was practiced at private grazing land level. Interviewed development agents (DAs) explained that, as a result of this mostly stocking rate was very high in communal grazing lands as it compared with the private grazing lands. Additionally, group discussion (GDs) participants and interviewed (DAs) in Yewlla Kebele reported that, following the availability of surface water

resources flowing in adjacent with communal grazing land in *Yewlla kebele*, parts of these communal grazing lands were taken for irrigation investment purposes in development projects. As a result of this the communal land used for grazing purpose become shrinking over time. From this one can conclude that the situation may lead to stocking problem in communal grazing lands and farmers also explained that they encountered for the shortage of grazing fields which is vital to continue their agricultural practice. The problem also may be worse, since farmers in the study area are smallholder agriculture practitioners those who are mostly the user of communal grazing lands.

Table: 13: Survey Households’ Response Distribution on Grazing land Management Practices (Multiple Responses are Possible)

Grazing land management practices	Respondents of sample Kebeles						Total responses n =184	
	Yewlla n =68		Amanuel Zuria n =61		D/Kelemu n=55			
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Fencing of fragile grazing land	52	76.4	49	80.3	43	78.2	144	78.6
Rotational grazing	21	30.8	28	45.9	26	47.3	75	40.8
Control continuous grazing	17	25.0	11	18.0	0	0.0	28	15.2
Production of grasses and fodder trees	14	20.6	37	60.7	16	29.1	67	36.4

Source: Field survey, 2014 (percentage values are not added because of multiple responses)

4.4 The Role of Development Agents (DAs) in Agricultural Land Management Practices

In the agricultural sector the role of development agents is helping farmers in the community in providing useful information related with their agricultural practices and play a supporting role in doing in collaborate with farmers during the practical implementation of appropriate agricultural land management technologies and works for the overall wellbeing of the rural poor society (John, 2000).

In line with the above principle, the student researcher assessed the supporting role of development agents' from farmers' perspective in the study area. The assessment gave emphasis on the issue related with development agents' cooperation and their advice, their ability and competency to select appropriate agricultural land management technologies, and related with their frequency to visit farmlands to provide technical support for farmers. Therefore, to ascertain the supporting role of development agents' in agricultural land management practices from farmers' perspective, the above mentioned expected contributions that enable (DAs) to accomplish their supporting role were provided to sample farm household respondents on five point Likert type scale with response options and assigned scores (very high =5; High =4; Medium =3; Low=2; and Very low =1). These values were added to obtain 15 and divided by 5 to obtain a mean score of 3.0 which serves as a benchmark for this five point Likert type scale.

Therefore, any response distributions with mean score values greater than or equal to 3.0 on a given variable implies that, (DAs) have full supporting role for their contribution related to their role in agricultural land management practices in the study area. Whereas, response distributions with mean score values less than the above-determined ideal mean score implies that, (DAs) have limited supporting role in relation to their contribution on the agricultural land management practices. In addition to this, to investigate in which contribution that (DAs) have more supporting role and in which of their contribution does less supporting role, the frequency values obtained for each contribution related items were weighted using the assigned score values and their contributions were also ranked according to their weighted scores.

As the survey results shown in (Table 14) indicated that, the advice and cooperation of development agents revealed that the calculated mean score value was 2.67 which was less than the pre determined ideal mean score value 3.0. There by implying majority of sample farm household respondents rated their response as the advice and cooperation of (DAs) was low. Thus, one could conclude that, from farm households' perspective, development agents' (DAs) supporting role in advising and doing tasks cooperatively was found to be limited. In the same way, farm households also viewed the frequency of development agents (DAs) to visit farmers' farm fields to provide technical support and advice on how to implement agricultural land management technologies was also found to be limited. Because, the calculated mean score value of responses 2.25 was less than the pre determined ideal mean score value 3.0. In addition

to this, from this survey results perspective, the weighted frequency values shows that, the supporting role of development agents in providing technical support for farmers through their frequent visit of farm fields was ranked third (see Table 14).

On the other hand, development agents' (DAs) supporting role in their competency and their ability to select the appropriate agricultural land management technologies based on the characteristics of farmers' farm fields was found to be high and showed that development agents have full supporting role in their competency as it viewed by farm households. Because the calculated mean score value of the farm households' responses 3.28 was greater than an ideal mean score value of 3.0. Additionally, from this survey result perspective, the farm households' response weighted frequency shows that development agents competency and their ability to select appropriate agricultural land management technologies was ranked first (see Table14).

Generally, from the above farm households' response distribution one can understand that the supporting role of development agents' was appreciable in their competency and ability to select appropriate agricultural land management technologies. However, their cooperation and frequency of visiting farm fields to provide advice for famers was not as such appreciable. This also indicated that development agents in the study area could not support the majority academically illiterate and technically poor farmers as per their potential. This might be the reflection of absence of incentives and trainings that needs to be given for development agents. Because, development agents may be discourage to be inspired to accomplish their tasks and to take full supporting role throughout their contribution.

Table14: Distribution of Farm Household Respondents' Opinion and Response on the Role and Contribution of Development Agents (DAs)

Contributions related to the role of (DAs)	Frequency alternatives n= 184					Statistics		Total weighted frequency
	V.high	High	Medium	Low	V. low	Mean	Std. D	
The advice and Cooperation of (DAs) with farmers	18 (90)	36 (144)	44 (132)	39 (78)	47 (47)	2.67	1.31	491
Competency and ability of (DAs) to select appropriate management technologies for farm fields	26 (130)	69 (276)	40 (120)	29 (56)	20 (20)	3.28	1.20	602
The frequency of (DAs) visit to give technical support for farmers'	5 (25)	19 (76)	46 (138)	62 (124)	52 (52)	2.25	1.06	415

Source: Field survey, 2014

CHAPTER FIVE

CHALLENGES AND PROSPECTIVE GROUNDS FOR AGRICULTURAL LAND MANGEMENT PRACTICES

5.1 Major Challenges for Effective Agricultural Land Management Practices

The majority of farm household respondents and agricultural experts have mentioned major challenges in the current practices of agricultural land management technologies. These include unsuitable agricultural landscapes for management options, shortage of management inputs, inappropriate implementation of policy related strategies and technical gaps related with the practice of appropriate agricultural land management options. All the above-mentioned challenges might contribute their own share for poor practice of agricultural land management technologies in the study area which also ultimately might have also a negative impact to achieve agricultural productivity. It was also possible to learn from the fieldwork that the agricultural land management in Machakel Woreda was observed with many challenges. These constraints were also attributed to a number of indicators including inability of the Woreda agriculture office to reverse the severely degraded areas particularly gully areas developed over the agricultural fields of the study area.

5.1.1 Challenges Related to Institutional Capacities

Agricultural land management practices can be influenced by the capacity of institutions that work with the agriculture sector. It is only any policies, strategies and programs related to agricultural land use are effective, when adequate and strong institutional capacities can be realized. This situation was assessed in Machakel Woreda. Findings of the study on human resource capacities that works in agricultural extension particularly agricultural extension experts' to farmer ratio were discussed. Additionally, the capacity of the agriculture office to provide the necessary incentives for effective extension work in agriculture, provision of trainings, credit services and its capacity to implement the appropriate land use policy strategies that are relevant for effective agricultural land management practices were also investigated under this study.

5.1.1.1 The Number of Experts and DAs in Agricultural Extension

The practices of good agricultural land management and the implementation of appropriate land use policy have to be supported by qualified and well skilled agricultural extension man power. Agricultural extension is critical to introduce better agricultural practices and land management technologies particularly to smallholder farmers in the country like Ethiopia where traditional agricultural practice is extensively practiced (Addisu, 2011).

In line with this, the survey result on the agriculture office of *Machakel Woreda* indicated that, the *Woreda* agriculture office has a total number of 34 experts and development agents (DAs) that works at *Woreda* and *Kebele* level. These numbers of experts and DAs were also engaged in all agricultural departments mentioned as: natural resource management, crop development and seed improvement, animal resource and grazing land management and irrigation agricultural practice departments. However, the information obtained from agriculture office indicated that, currently the *Woreda* agriculture office need about 73 total required numbers of experts and DAs in all the above listed agricultural departments. This indicated that, there was a disparity in the existing and required number of agricultural extension workers. Particularly the case was observed in the disparity of number of extension experts to farmer ratio. In this aspect, the general gap between the existing and the required number of agricultural extension workers in all agricultural departments was found to be considerable, about 39 (53.5%).

Table 15: Distribution of the Number of Agricultural Extension Experts under Each Departments of the Agricultural Sector in Machakel Woreda

Departments in the agriculture sector	The number of agricultural extension experts			
	Required	Existing	Gap	(%) of Gap
Natural resource management	18	6	12	66.5
Crop and improved seed development	7	5	2	29.0
Irrigation agricultural practice	24	5	19	79.1
Animal resource and grazing land management	24	18	6	25.0

Source: MWAQ, 2014

As the survey results shown in (Table 15) indicated that, out of the total 18 experts required in natural resource management department only 6 experts exist with a gap of 66.5%. Furthermore department of irrigation agricultural practice was shown 79.1% gap in the number of experts. On the other hand, departments of crop and improved seed development and animal resource and grazing land management have shown a gap of 29.0% and 25.0% in the number of agricultural experts respectively. This implies that the agricultural sector in *Machakel Woreda* in general agricultural land management related to natural resource conservation and irrigation practices in particular were challenged by shortage of experts those who can assist the rural poor society in transferring the necessary knowledge to adopt and practice appropriate agricultural land management technologies.

As the information obtained from interview held with the agriculture office officer indicated that shortage of experts was a challenge to practice knowledge based agricultural land management options are some of the constraints for natural resource management practices. It was due to high rate of agricultural experts' emigration in the study area. As a result, surprisingly during the study conducted the agriculture office officer reported that there were three *Kebeles* named *Insilala*, *Minch* and *Angot*, left without any experts working with natural resource management which is critical to insure agricultural productivity through effective environmental protection in such areas.

Farm household respondents were also asked to put their level of level of agreement on that shortage of assistant development agents was challenge in their agricultural land management activities to implement more effective agricultural land management practices. As the survey results shown below in the figure, totally about (84.6 %) of the total sample farm household respondents were agreed that the shortage of number of assistant development agents (DAs) and disparity in farmer to extension workers ratio was one of the constraint to practice more effective agricultural land management technologies. On the other hand, only few numbers of the total sample farm household respondents, totally about (15.4%) were disagreed and responded that the shortage of number of assistant development agents (DAs was not a constraint to practice more effective agricultural land management technologies in their farm lands.

Generally, from the response distributions one can understand that agricultural land management practices were challenged by inadequate access to information and knowledge on the practice of

agricultural land management technologies in the study area. This was also due to imbalance ratio between limited numbers of development agents and the increasing number of farm households. For example, informant (DAs) in *Amanuel Zuria Kebele* reported that about 2000ha plot of agricultural fields were found under sever degradation indicated by soil erosion gully formations. Obviously, this is the direct result of inappropriate use of resources in general and inappropriate agricultural practice in particular. This also might be rooted from inaccessibility for adequate support in information and necessary knowledge for farmers on how to manage their agricultural lands.

Regarding to this problem, one development agent (DA) in *D/Kelemu kebele* has also explained his view as follows:

“Farmer to extension workers ratio is extremely far below the standard, reach up to 1:800 farm households. Therefore, since I am a human being, I will tire and it is impossible to access and work with all farm households.”

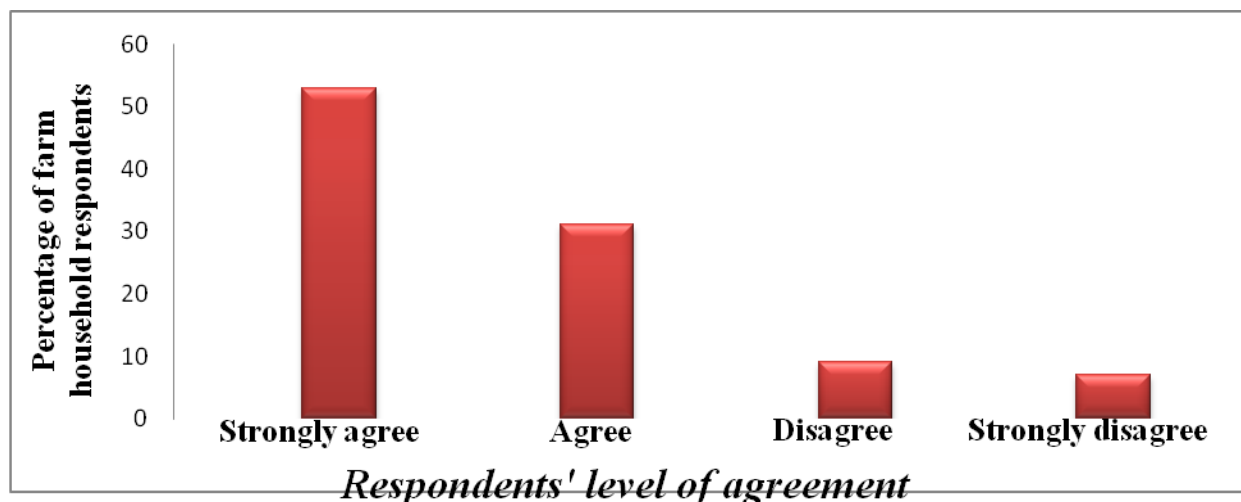


Figure 15: Percentage of farm households' level of agreement on shortage of assistant experts as a challenge for effective agricultural land management practices (Field survey, 20 14)

5.1.1.2 Challenges Related to Access for Training

Regarding to farm households' accessibility for training, (37.0%) of the total sample farm household respondents responded that there was no any training given for farmers on how to manage the agricultural lands. Even though there were trainings given on how to implement

agricultural land management practices in the study area, about (28.0%) of the total sample farm household the respondents' also reported that trainings were given focused on theoretical aspects rather than practical based on the ground. On the other hand, it was only (19.4%) and (15.6%) of the total sample farm household respondents gave their response that trainings were delivered more emphasizing practically and both theoretical and practical trainings were given equally respectively (See Table 16).

As informant development agents reported that farmer-training centers (FTC) were established at all *Kebele* level in the study area. It is obvious that the objective of establishing these farmer training centers (FTC) is to access information and provide comprehensive trainings for farmers in introducing new farming practice on improved crop cultivation and animal raring , on how to implement new agricultural land management practices and how to reverse degraded agricultural fields. Even though farmer-training centers (FTC) were established in the study area the distribution of farm households' response underpin by the researcher's observation indicated that training centers established in sample Kebeles were observed without complete and proper function in relation to its pre defined objectives.

Regarding to the training of development agents (DAs), all participants of interview held with development agents reported that the provision of necessary trainings given to development agents were limited. Particularly practical based trainings on the practice of new agricultural land management technologies were not adequately provided for development agents. Regarding to this problem one participant development agent in *D/Kelemu Kebele* had explained his view as follows:

*“Following sloped characteristics of the agricultural fields, in some cases there is need of constructing **bench terracing** management technology. However, I have some knowledge and technical skill gap on how to this bench terracing management technology would be constructed and practiced.”*

Always development agents are needed to respond to technological need of farmers in transferring the appropriate knowledge and technology significantly through practical demonstration (EUUDP, 2005). In line with the above principle and as per the above explanation given by development agents the adoption of agricultural land management practices particularly

that needs ones knowledge and technical skill were challenged by the absence of practical based trainings that need to be given for development agents in the study area.

5.1.1.3 Challenges Related to Access to Credit Services

Access to credit service is also very important particularly for poor smallholder farmers those who practice subsistence farming. Because credit services can secure accessibility of resources related to inputs for agricultural practice in general and for agricultural land management practices in particular for poor rural farmers.

In relation to access to credit services the survey result indicated that about 79.4% of the total sample farm household respondents responded that there was no accessibility related constraints that impede farmers to use credit services. However, few farm household respondents 23.4% and 9.8% reported that credit service term of agreement and credit center distance were constraints to use credit service for their agricultural field management respectively. Whereas about 39.6% of the total sample farm household respondents also responded that they were not the user of credit services (See Table 16).

As the information obtained from group discussions indicated that, most of the time any volunteer farmers can easily access credit services in particular for use of inorganic fertilizer and improved seed with 25% pre-payment. Farmers also mentioned the provision of chemical fertilizer and improved seed in the form of credit as a good opportunity. However, farmers during interview and discussion reported that most of the farmers were not apply for credit services because of their fear to paying back their credit. This also indicates that limited credit use does not always imply the limitation of credit accessibility, rather sometimes it may relate with demand side constraint.

Table 16: Household Respondents' Response Distribution on Challenges Related to Access to Training and Credit Services

Variables	Respondents	
	Frequency	%
How is the training on how to manage your farmland?		
It focused on practical aspect	36	19.4
It focused on theoretical aspect	51	28.0
Both practical an theoretical aspect are given equally	29	15.6
There is no training at all	68	37.0
Total	184	100.0
What problems do you identified that matters you to use credit service used for farmland management? (multiple responses are possible)		
No matter at all	146	79.4
Term of agreement	43	23.4
Interest rate	0	0.0
Credit center distance	18	9.8
No comment since I am not the user credit service.	73	39.6

Source: Field survey, 2014 (percentage values are not added because of multiple responses)

5.1.1.4 Challenges Related to the Provision of Incentives for DAs

As all interviewed development agents that works in all rural sample *kebeles* with smallholder rural farmers explained that there was no any special incentives given except their own monthly salary. Because of this all informants explained that they were not satisfied in their job career. Agricultural experts especially who work in deprived environment with very tiresome activity needs special incentives and supports to be effective in their career. However, according to development agents' response during interview, this was not seen in practice and failing to do so. Regarding to this issue, one development agent in *Yewlla kebele* has explained his view as follows:

“I love my job since am lucky to see the direct reflection of the work done when the environment is protected and the land is productive, but it does not mean that I am currently satisfied in my job”

From the above explanation one can understand that development agents in the study area were not satisfied in their job career. This also might be challenge in the motivation of these experts to transfer the necessary knowledge for the majority academically illiterate farm households.

5.1.2 Challenges Related to the Natural Resources in the Agricultural Fields

One of the challenges impeding the practice of more effective agricultural land management practices is the natural capital and cost needed for the management of the existing natural capitals over the agricultural fields. Regarding these challenges, agricultural field slope steepness and its stony characteristics were identified as the major challenges that impede the practice of more effective agricultural land management technologies in the study area. Particularly all participants in the study explained repeatedly slope steepness of the agricultural fields and the cost needed for the management of such fields was the most challenging problem. It is obvious that the management of sloppy agricultural lands needs special management technologies as an input and the management practices need to be always cost effective.

Interview was held with development agents (DAs) in the respective sample *Kebeles*, to investigate the challenges related to the natural capitals of the agricultural fields to implement agricultural land management technologies in the study area. All the informants of development agents (DAs) in sample *Kebeles* reported that the implementation of agricultural land management technologies had been encountered by sloppy and stony characteristics agricultural fields.

5.1.2.1 Slope Steepness of Agricultural Lands in the Study Area

As all informants in *Amanuel zuria* and *Debere Kelemu Kebele* explained that the sloped characteristics of the agricultural lands were the most challenging problem to construct and maintain structural management practices. Related to this, one development agent working in *Amanuel Zuria Kebele* had explained the pre-defined problem as follows:

*“Almost all agricultural land in Amanuel Zuria kebele is dominated by sloped landscape. Following this characteristic, most of the time the constructed management practices along this elevated agricultural fields could not be stable during rainy season and difficult to maintain it. For example, when **bund** is constructed, it is destroyed by heavy runoff flow over the sloppy farm fields”.*

In the agricultural land dominated by elevated landscapes, management practices needs to be supported by appropriate management tools. For example using Gabion or wire boxes filled with stones is the most important management tools used to eliminate flood damage and over flow hazard. However, as experts reported that accessibility of such important management tools in the study area was limited and mentioned as a problem to manage elevated agricultural landscapes.

From the above explanation, one could understand that structural agricultural land management technologies were not effective due to its sloppy characteristics and inaccessibility of the required management inputs. Additionally, the discussion also indicated that there was limited adoption in supporting such agricultural landscape using biological management practices. It was also confirmed during the researcher’s observation that majority of elevated agricultural fields were bare and observed without any biological management measures.

5.1.2.2 Stony Characteristics of Agricultural Lands in the Study Area

On the other hand, agricultural land management practices were also challenged by stony characteristics of the agricultural landscapes in different parts of the study area. For example, in order to implement modern agricultural land management technologies like row planting and other field preparation related management options, farmers’ agricultural practice is challenged by shallow soil depth and stony characteristics of the agricultural landscapes.

One interviewed farmer also explained his view on the effect of the above challenge on agricultural land management practices as follows:

“I could not be beneficial from row planting technology because, when I used row-planting technology repeatedly, the seed was left only for birds feed”.

This implied that as parts of agricultural land management technologies, seed bed preparation for row planting and field preparation management practices were challenged by the stony characteristics of the agricultural fields in the study area.



Figure 16: Sloppy agricultural field in Debre Kelemu Kebele with stony characteristic and difficult for the practice of field preparation and row planting technology (Photo by the researcher, 2014)

5.1.3 Challenges Related to Technical Gaps

As the information obtained from informal group discussions, interviews and as it ensured throughout the process of the researcher's field observation, agricultural land management practices in the study area were challenged by technical problems. Particularly, the technical gaps identified during the practice of agricultural land management were observed at farm field level. For example, technical gaps related to crop watering system in irrigation farmlands, irrigation canal management practices and technical gaps on the selection of appropriate sites for the practice of management technologies were found to be the major technical challenges investigated under this study.

5.1.3.1 Technical Gaps on Crop Watering System and Canal Management

practice in Irrigation Farmlands

Small-scale surface irrigation was the type of irrigation practiced in the study area using a water pump motor which used to harvest water from the surrounding river named **Gedeb.** . However, as participant farmers reported and the researcher also observed that in order to save their fuel gas consumption, most of the time farmers practiced uncontrolled flooding crop watering system by flooding the entire farm field surface. Obviously, such crop watering system is not advisable from irrigation management perspective. Because it is impossible to access watering of all crop root zones particularly in an elevated farm fields. Additionally, when a farm field is become water logged, planted crop seed germination will be badly affected and crop stand will be poor, because of poor soil aeration. It might also affect soils under cultivation to undergo in the process of leaching of important easily soluble nutrients and that causes acidification.

Since such crop watering systems in the study area were practiced without having water quality test, through a long run after excess evaporation from that excess water application, soil salinity may occur. The case is true particularly when ground water table has salinity characteristics. Foremost such technical gap on crop watering system caused unnecessary water wastage and shortage for irrigation practice of the study area. In relation to this also one (DAs) participant said that:

“The volume of water in a river is decreasing from time to time, then we design a short-term alternative solution for farmers to practice scheduled based crop watering system (alternately one after the other) at this time farmers were challenged by shortage of water for crops in waiting their turn”.

As informants said that, during such scheduled crop watering system a farmer may wait until his turn for about more than a month. This scheduled crop watering system also highly affected timely crop moisture supply in irrigation farming of the study area. Because of late watering system, the normal and healthy growth of some crops was also limited as a result some dry out plantations were observed in the study area.

In relation to technical related problems observed in irrigation practice, absence of technical experts and spare parts work with technical problems of water pump motors were additional challenges mentioned by farmers' and development agents in Machakel Woreda. One interviewed farmer in Yewlla Kebele explained the above problem as follows:

“In every two week, I am exposed to cost for about 300-400 Ethiopian birr for the maintenance of my water pump motor in traveling a distance of 35km up to Debre Markos”.

As the above discussion indicates that, since water pump motors are a means to harvest surface water for the existing surface irrigation system in the study area, sometimes crop-watering practice is interrupted due to absence of technical experts for motor pump failures. Thus timely crop watering practice goes to under difficulty condition.



Figure 17: Farmers in overflow crop watering system of maize planted farmland in the left, and partially dried up Coffee plantation due to shortage of water in the right side (photo by the researcher, 2014)

In addition to this, a technical gap also observed on irrigation canal management system. During the implementation of irrigated agricultural land management practices in general and in its water management in particular, the most important problem reported by development agents (DAs) was landslide problem occurred near to the constructed canal. The irrigation constructed in *Yewlla kebele* was observed filled by sediments transported from the surrounding crop farm lands and grazing fields in the form of erosion and by debris sediment fragmented and slide from the wall of the water canal system. As experts explained and the researcher's field observation confirmed that famers and experts tried to use *Gabion* management tools particularly for protecting debris that slide from the wall of the canal system. However, landslide along the canal system could not be effectively controlled due to such short term and inappropriate management tools as it compared with the observable debris pressure in the canal system. Additionally, since the canal had been poorly constructed, most of the time flow of water over the canal was also observed. According to FAO (1997), use of canal with a large of sediment load may result canal clogging. It is obvious that unless the appropriate construction and canal management practice is effectively carried out, the canal may gradually lead to a problem of total loss of water from the canal system. In addition to this, grasses were observed grown near to the constructed canal. This also highly affects water holding capacity of the canal, further reduces the amount of water needs to be used by crops.



Figure 18: Poorly constructed irrigation canal in Yewla Kebele with landslide problem (Photo by the researcher, 2014

5.1.3.2 Technical Related challenges during the Implementation of Management Technologies

It is obvious that, currently Ethiopia implements soil and water conservation program through mass mobilization strategy at national level. Such program is effective and fruitful with the required social economical and environmental results only when technically appropriate management technologies are implemented along the appropriate sites. Such costly investments also needs to be long lasting in its benefit through the involvement of the direct actors related with the program needs to be implemented.

In the study area participant farmers and development agents (DAs) have mentioned that technical problem in the selection of appropriate sites was a challenge for effective agricultural land management practices. Participant farmers during group discussion complained that most of

the implementation of the national soil water conservation program was not implemented based on the selection of appropriate conservation site. As participant farmers in group discussions explained, mass mobilization soil and water conservation activities were implemented through top-down approach and carried out including in an area where erosion hazard is not a problem. However the lands under severe erosion hazard were left without any management practices. Most development agents in the study area also confirmed that land management practices are not water shade focused and the existing soil conservation practices are not carried out along the hill sides. As the informants justified that, this was because of lack of commitment of the concerned bodies to give emphasis for biological management conservation mechanisms and to construct technical standard and appropriate structural management practices on hilly agricultural fields.

Such technical problem also caused farmers' complain on their farm lands fragmentation and its difficulty during plowing. As the above discussion and the researcher's field observation confirmed that such technical problems manifested by inappropriate site selection during the practice of land management technologies was found to be a challenge for the practice of more effective agricultural land management technologies in the study area.

In addition to this, informants also reported there that there was a technical problem related with the practice of row planting technology. Particularly during *Teff* crop planting, farmers in the study area have been practiced their own indigenous soil particles compacting activity locally known as **Beray** for the purpose of seedbed preparation. However, after the introduction of the newly raw planting technology for *Teff* crop, informant farmers and development agents reported that the newly introduced raw planting technology was not productive.

Particularly Development agents (DAs) in *Yewlla Kebele* confirmed that during the implementation of raw planting technology particularly in the case of *Teff*, many farmers were not much more beneficial in yield productivity as it compared to the production produced before the introduction of the new raw planting technology. As their justification, it was due to technical gaps on the technology implementation that recommended by the top-level experts to plant *Teff* crop in raw pattern without seedbed preparation of compacting the soil particles. In relation to this problem, one interviewed farmer in *Yewlla Keele* has explained the following occasion what happened on his farmland as follows :-

“In the last cultivation season, when I am preparing my plot of land to make ready for Teff planting, experts were visited my plot of land and meet with me and they gave me an advice to implement Teff raw planting in my plot of land. Their advice was to plant Teff crop simply by raw without any seedbed preparation known as Beray. However, I refused the advice from experts and I was not willing to practice it. Again experts tried to convince me as they will take the incoming risk related with the normal growth of crop. Finally, I agreed to implement the technology by their own decision and isolated myself by providing the seed and the required fertilizer input. Then after, experts were directly implemented the technology what they want to be implemented. After a time, the raw planted Teff is seen to germinate and grow above its root zone. Surprisingly, the experts those who advice and implement this technology respond to me as “God help you”

From the above discussion, important ideas can be drawn that technical gaps had been observed on how to implement new technologies in productive manner than ever before. The introduction of new technologies always needs ones rigorous experiment and ones skill before implementation. Because such situations may lead to crop failure and farmers future suspicion on newly introduced agricultural practices and they will perceive as every new agricultural land management technologies are always wrong and are not productive.

5.1.4 Challenges Related to Local Farmers’ Attitude

Regarding to the attitude of farmers’ towards the acceptance and implementation of agricultural land management technologies and strategies need to be adopted and implemented on their farmlands, the researcher tried to understand their perceptions during group discussions conducted with farmers’ of the study area. Furthermore, the researcher wanted to know development agents’ understanding on farmers’ attitude towards agricultural land management technologies. To this end, interview questions are prepared and forwarded to (DAs). Thus one participant in *Amanuel Zuria Kebele* was asked to explain his view on the local farmers’ attitude towards their acceptance of agricultural land management technologies. He has explained his view as follows:

“I have been working as a development agent in Machakel Woreda for more than four years. But still in my stay here, the attitude of farmers is really a challenge impeding the implementation of appropriate agricultural land management practices; particularly Amanuel Zuria Kebele that I am working now is dominated by sloped agricultural landscapes. However the implementation of terracing management technology is not accepted by farmers. Because farmers perceived that, constructing terracing does not insure productivity rather it causes wastage in fragmenting our plot of lands and our time to construct it”

As informant development agents in the respective sample *Kebeles* explained that, because of farmers’ attitudinal problem to practice appropriate agricultural land management technologies on their farm fields, most of the time DAs use a convincing strategy of peer teaching. This implies that if there is one model farmer in adopting management technologies within a village model farmers assigned to share his or her experience to farmers those who are not practiced agricultural land management technologies.

Additionally, during group discussion farmers reported that they are not allowed to involve directly in the practice of soil and water conservation activity on their plot of lands. Following absence of their direct involvement on their farm fields, farmers perceived that absence of their direct involvement on their farm fields mean that there is incorrect implementation of the management technology over their agricultural fields by farmers those who are not as wise as the owner of the farm fields. Thus, as the information obtained from group discussion, farmers were not interested to participate in this mass mobilization soil conservation program unless the strategy is obligatory.

One interviewed farmer in *Debre Kelemu Kebele* has explained his view as follows:

“Now I am participating in soil and water conservation program in farmlands where its ownership is belongs to the other. However in reality I am not interested to participate unless it is an obligatory. Because farmers those who participate in the conservation practice that carried out over my plot of land are not careful in putting the pattern of the ditch in a sense of belongingness, even I may do the same thing on farm fields belongs to the other. However I will happy on the introduction of such soil and water conservation program and can be effectively implemented, if the enforcement strategy is land owner based even up to taking away of my plot of land, unless I practiced such farmland management technologies in my own farmlands.”

Informant development agents also reported that they faced a resistance from farmers those who develop and reflect such perceptions particularly during the implementation of the national soil and water conservation program. To conclude, it is obvious that farmer-training centers (FTC) can play important roles in changing farmers' attitude and to implement new technologies even by proofing its effectiveness. However, the above discussion indicates that, such attitudinal challenge on the side of farmers was the direct reflection of the absence of such strong functional farmer-training centers.

5.2 Prospective Grounds to practice Effective Agricultural Land

Management Technologies in the Study Area

This part focused on the prospective grounds or opportunities suggested by respondents to implement more effective agricultural land management practices. The prospective grounds are opportunities to implement more management technologies in the future. To these end respondent participants of this study were asked about the prospects of agricultural land management practices. Despite the major challenges discussed above, findings of the study obtained through interview and group discussions indicated that, the study area has some opportunities that enable to bring improvement in implementing more effective agricultural land management practices in the study area.

As respondents reported that the main prospects of the study area include, the availability of abundant water resources like springs and rivers. According to the figure obtained from *Woreda* administration office, the study area has about 128 rivers and 161 springs. Therefore, if appropriate resource management would be practiced, this potential can seize farmers' use of irrigation practices that used to rise up and diversified their productivity and level of income.

Respondents also mentioned the establishment of farmers' training centers as a prospective ground to transfer the necessary knowledge and technology for farmers'. According to the respondents report and confirmed by the researcher's observation, farmer training centers (FTC) were established at each *Kebele* level in the study area. If it is well organized with trained manpower and material with a system along the aim of its establishment, really it can be a future corner stone to transfer and implement knowledge based appropriate agricultural land management practices through transforming farmers' attitude towards resource conservation.

Lastly, the national soil and water conservation plan implementing through mass mobilization was also mentioned as an opportunity to conserve soil and water resource in the future. However such resource conservation plan and program is more effective only when it incorporated social, economic and environmental considerations that makes its result sustainable.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Summary

Nowadays, adopting and practicing agricultural land management technology has become a critical issue due to its result in ensuring agricultural productivity and its value in maintaining environmental stability. Particularly, in agrarian societies such practices play indispensable role in ensuring agricultural productivity and bringing better life of rural poor societies. Therefore, this study attempted to investigate the different types of agricultural land management practices that are currently adopted and practiced, challenges impeding the practice of more effective agricultural land management technologies and the prospective grounds for future improvement of agricultural land management practices in Machakel Woreda, East Gojjam Zone, Amhara National Regional State of Ethiopia.

To this end, quantitative and qualitative research approaches are employed. Data were collected from both primary and secondary sources like sample households, development agents at *Kebele* level, agricultural office officers and agricultural experts in *Machakel Woreda*. The collected data were analyzed by using descriptive statistical tools in the case of household survey questionnaires whereas data collected through interview and discussion were analyzed qualitatively.

Analysis of the data revealed that farmers in the study area have shown limited adoption in the practice of management technologies. Farmers showed good practices only for agricultural land management practices that are more tied with their agricultural activities. The practice of more effective agricultural land management technologies were also challenged by technical related problems, difficult agricultural land slope, stony characteristics of agricultural lands, farmers' attitudinal problems and weak institutional capacities. Based on these, developing the capacity of institutions related with credit service, trainings and narrowing the gap in human resource along with other relevant suggestions were forwarded in this study.

6.2. Conclusion

This study attempted to assess practices, challenges and prospects of agricultural land management in *Machakel Woreda*. Thus, the analysis of the study leads to the following major findings. Regarding to the status and problems of agricultural lands in the study area, the finding of the study revealed that slop steepness and soil erosion hazard were the major problems. As a result, the agricultural land in the study area was found to be under serious degradation problem indicted by the development of rill and gully areas.

Farmers' application of inorganic fertilizer found to be increasing over time. However, almost all sampled farm households (about 98.9%) in the study area are not applied inorganic fertilizer, as per the recommendation of experts. On the other hand, farmers' use of organic sources fertilizer and their indigenous soil fertility management practices were found to be limited. However, farmers have good adoption for technologies that are more associated with their agricultural practices. For example, crop rotation and use of hybrid crops from agronomic management practices, and contour plowing and diversion ditch from soil and water conservation were the major agricultural land management practices widely adopted in the study area. The supporting role of development agents in agricultural land management practices particularly in their competency and ability to select appropriate management technologies was found to be full. However as compared with their competency, sampled farm household respondents confirmed that development agent's cooperation and their frequency to visit farmlands was not appreciable.

Generally the survey results of this study indicated that the practice of more effective agricultural land management in the study area was challenged by different constraints. Among these constraints, challenge related to weak institutional capacities, challenge related to unsuitable agricultural fields, challenge related to technical gaps observed at field level, and challenge related to the local farmers' attitude towards the acceptance of agricultural land management technologies were the major challenges that impede the practice of more effective agricultural land management in the study area. Despite the above mentioned challenges, the availability of abundant water resources, the establishment of farmers' training center and the introduction of mass mobilization in soil and water conservation were identified as prospective grounds to practice more effective agricultural land management in the study area.

6.3. Recommendations

Based on the study results, the following recommendations were suggested:

- The implementation strategy of the existing soil and water conservation program should be revised by conducting discussions with the local farmers and keep in focus their constraints and opportunities to get their full support and participation.
- The implementation of agricultural land management practices need to be adopted and the existing farming practice should be supported by the practical implementation of appropriate land use policy.
- To improve farmers' farming practice and their acceptance to practice agricultural land management technologies the established farmer-training centers should be strong enough and should work for the intended objective in increasing farmers' confidence on the new agricultural land management technologies. If the farmers' training centers are strong enough in their role, these centers can be an opportunity in changing farmers' perception towards new management technologies.
- The Supporting roles of development agents in frequent visiting of farmers' farmlands and in their cooperation role with farmers have shown that it is not full. To come up with full supporting role of the agricultural development agents the agriculture office of Machakel Woreda should rearrange continues trainings, supervisions and giving a chance to update their educational status with different incentives.
- To narrow the gap in the ratio between the numbers of development agents (DAs) and the number of farmers in general, to fill the gap between the number of required experts and existing experts in particular an effort needs to be done in both at national level and *Woreda* agriculture office respectively.
- Farmers in the study area were found to be more dependent on inorganic fertilizer as a sole source of soil nutrient supply. To improve soil fertility status through a long run and come up with a solution for farmers' complain about the cost of inorganic fertilizer, wider range of support, awareness creation and encouragement are needed to combine farmer's traditional soil fertility practices that have organic sources with that of the modern inorganic fertilizer.

- The technical gaps on the practice of agricultural land management technologies should continuously be supported through practical and theoretical based trainings particularly for development agents (DAs). Uncontrolled surface flow watering system should be improved and controlled through introducing different irrigation water use efficiency mechanisms like furrow and drip irrigation watering systems. The practice of these irrigation water use efficiency mechanisms can be a solution for farmers complains in minimizing the cost of oil fuel consumption in motor pump during water harvesting. Because crop productivity can be ensured through accessing water throughout the farmlands uniformly under each crop root zone. The constructed canal for irrigation practices in the study area should be constructed to its technical standards in quality civil works to control any threat on the flow of water. Additionally to control the entrance of sediments to the water in the canal system, agricultural fields near to the irrigation canal needs to be conserved from soil erosion hazard.
- Agricultural fields slope steepness with no vegetation cover was found to be one of a challenge for effective agricultural land management practices. Since the area belongs to the high land relief of Ethiopia, urgent intervention on the biological management practices will have wider range of benefit in insuring sustainability of all land resources primarily soil and water resources.
- The development of gully areas on the agricultural fields that could not be reversed by the capacity of resource poor farmers found to be the challenge for farmers in the study area. Therefore, to minimize further damage and to restore its status, such agricultural fields in the study area needed an urgent intervention in diverting run off away from the gully area and putting sediment trapping check dams to raise the level of gully floor using different equipments. To control further similar degradation, gully re-vegetation also mandatory.
- Finally, the researcher also recommends conducting further study in the area to examine the issue in depth and particularly in the status of soil fertility and its agricultural potential aspect.

REFERENCES

- Addisu, D. (2011). Benefits and challenges of adopting soil conservation techniques: in the case of Goromti Watershed. Central Ethiopia. MA.Thesis. Addis Ababa University, Ethiopia.
- Aklilu, A. (2006), Best practices: in soil and water conservation: in the case of Beressa water shade. Highlands of Ethiopia. PhD dissertation. Wageningen University, Netherlands.
- Alberta Agriculture, Food and Rural Development, (2004). Manure management. A Book. CABI Publishing. Canada.
- Anteneh, D. (2003). Integrated Natural Resources Management to Enhance Food Security. FAO working paper. Rome, Italy.
- Belayhun, H. (2010). Present and Future Trends of Natural Resources (Land and Water) Management in Ethiopian Agriculture. Report paper on Workshop by MoWR and ILRI, Addis Ababa, Ethiopia.
- Benson, T. Cunguara, B. and Mogues, T. (2013). The Supply of Inorganic Fertilizer to Smallholder Farmers, IFPRI discussion paper No. 01229. Mozambique.
- Benson Agriculture and Food Institute Corporation (2004). Land Preparation. Manual paper available from <http://www.bensoninstitute.org>. Benson, USA.
- Berry, L. (2003). Land Degradation in Ethiopia its Extent and Impact. Global Mechanism, WB. Report paper on environment.
- Bifarin, J. O. Folayan, A. J. and Omoniyi, L. O. (2013). Agro forestry Practice as Land Use Option for Sustainable Agricultural Production. A. Book. Vol. 2, pp. 069-074, Ondo State, Nigeria.
- Bryan, E. (2011). Adoption of Smallholder Agriculture to Climate Change Insights from Kenya. IFPRI Discussion Paper Nairobi, Kenya.
- Chamala, S. and Shingi, P.M (1997). Establishing and Strengthening Farmers' Organization. FAO Corporate Document Reference Manual.

- Christina, M. Foreman, J. Baylis, K. and Lipper, L.(2012). Land Degradations and Implications on Agricultural Value of Production in Ethiopia. Report paper. IAAE (International Association of Agricultural Economists). University of Illinois, USA.
- Demese, C. (2010): Ethiopia's Agricultural Sector Policy and Investment. Framework paper. Addis Ababa, Ethiopia.
- Dennis, J. (1994). Soil Management for Sustainable Agriculture and Environmental Protection. A Book. Oxford publication. United Kingdom.
- Dillaha T. (2008). Global Water Management. More Crops per Drop. Journal of Soil and Water Conservation Society (SWCS).Virginia, USA.
- Enemark, S. (2005). The Emerging Land Management Paradigm and a Major Challenge for Global Surveying Community. Discussion paper to International Federation of Surveyors' conference. FIG Publication. Aalborg University, Denmark. .
www.fig.net/pub/figpub/pubindex.htm.
- European Union Upland Development Program (2005). Agricultural Extension and Land Management. European Union manual paper. South Mindanao, Philippines.
- FAO. (2011). World's Land and Water Resource for Food and Agriculture. Report paper Rome, Italy.
- Fikru, A. (2009). Assessment of Adoption Behavior of Soil and Water Conservation Practices in Koga Watershed, Highlands of Ethiopia. MA Thesis. Cornell University.
- Gara, A. (2011). Assessment of Soil Conservation Impact on Rural Development in Central Ethiopia, PhD dissertation Tokyo University, Japan.
- Gebremedhin B, Gebremedhin W, Yigzaw,D. Tilahun, G. and Worku,T. (2010). Sustainable Land Management through Market Oriented Commodity Development. Working paper No. 21. for IPMS (Improving Productivity and Market Success). International Livestock Research Institute. Addis Ababa, Ethiopia.
- Hooda, N. and Tennigkeit, T. (2012). Introduction on Adoption of Sustainable Agricultural Land Management, World Bank Report paper on environment. Kenya.

- Hurni, H. (2000). Assessing Sustainable Land Management (SLM). Journal of Development and Environment. Bern, Switzerland.
- International Organization of Supreme Audit Institutions and Working Group on Environment Auditing, (2013). Climate Smart Agriculture. WGEA Working Paper.
- John, B. (200). Agricultural Extension. A Book. Volume 38 // Number 3 Ohio State University, USA.
- KalimQamar, M. (2005). Modernizing National Agricultural Extension System. A practical Guide for Policy Makers of Developing Countries. FAO. Rome, Italy.
- Kimaru, G. and Jama, B. (2005). Improving Land Management in Eastern and Southern Africa a Review of Policies and Practices. World Agro Forestry Center. Nairobi, Kenya.
- Kothari, C.R. (2006). Research Methodology: Methods and Techniques. A Book. New age international Pr.Ltd. publisher. New Delhi, India.
- Meli, A. (1993). Overview of Agricultural land Use in Malta. Article. Ministry of Food, Agriculture, Fisheries and the environment. Valletta. Malta. <http://www.ciheam.org/>.
- Miller, R. (2003). A-Z Social Research. A Book. SAGE Publication Limited. London, UK.
- Minale, K. (2009). The Contribution of Sustainable Agriculture and Land Management to Sustainable Development. Journal of sustainable development innovation briefs. United Nation Department of economics and Social Affairs publishing. University of Gothenburg, Sweden.
- Mitiku, H. Herweg, K. and Stillhardt, B. (2006). Sustainable Land Management – A New Approach to Soil and Water Conservation in Ethiopia, North-South University of Bern, Switzerland.
- MoARD, (2010). Sustainable Land Management Technologies and Approaches in Ethiopia. Report paper by SLMP and natural resource management sector, Addis Ababa, Ethiopia.

- Mugesha, J. and Aloba, S. (2010). Determinants of Land Management Practices in the High land of Uganda. Journal of Sustainable Development in Africa. Makerere University, Uganda.
- Mutunga, K. (2009). Water Conservation, Harvesting and Management, Kenyan Experience. Report paper Selected for International Soil Conservation Organization meeting. Purdue University, USA.
- Muzari, W. Gatsi, W. and Muvhunzi, S. (2012). The Impacts of Technology Adoption on Smallholder Agricultural Productivity. Journal of Sustainable Development Vol. 5 No. 8 Canadian Center of Science and Education. Canada.
- Namara, R. (2007). Agricultural Water Management Technologies and Practices. Research Project Ministry of Agriculture and Rural Development. Ethiopia.
- Nkonya, E. Pender, J. Kaizzi, .K Kato, E. Mugarura, S. Sali, H. and Muwonge, J. (2008). Linkages between Land Management, Land Degradation, and Poverty in Sub-Saharan Africa, the case of Uganda. Research Report for IFPRI NO.159. Washington DC. USA.
- Pender, J. (2006). Strategies for Sustainable Land Management in East African Highlands. Research project. International Food Policy Research Institute. Washington DC, USA.
- Pender, J. Nkonya, E. Jagger, P. Serunkuuma, D. and Sali, H. (2003). Strategies to Increase Agricultural Productivity and Reduce Land Degradation. Discussion paper to International Conference of Agricultural Economists, Durban, South Africa.
- Rahman, S. Wiederholt, R. and Chen, Y. (2009). Land Application of Manure and Environmental Concerns. North Dakota State University press. www.ag.ndsu.edu.
- Recha, J. kinyangi, J. and Omondi, H. (2012). Climate Related Risk and Opportunities for Agricultural Adaptation Mitigation in Semi Arid Eastern Kenya. Research report. AIRC (Agricultural Information Resource Centre). Nairobi, Kenya.

- Rozanov, B.G. (1998). Strategies for Sustainable Food Security. Journal of Environment and Development. World Commission for Environment.
- Rroling ,N.and Pretty, J N. (1997). Extensions' Role in Sustainable Agricultural Development. FAO Corporate Document Reference Manual.
- Samuel, G. (2006): Land, Land Policy and Small Holder Agriculture in Ethiopia. Discussion paper No. 008. www.future-agricultures.org.
- Scherr, S.J. and Yadav, S. (1996). Land Degradation in Developing World Implications for Food, Agriculture and the Environment to 2020. Report paper. FAO. Washington DC, USA.
- Simon, B. P. Garba, A. and Bunu, G.M. (2013). Determinants of Sustainable Agricultural Land Management Practices. Journal of Environmental Management. Admawa State, Nigeria.
- Singh, S. (2008). Land Resource and Agriculture. A Book. Capital publishing company. New Delhi, India.
- South Africa Agricultural Department, Scientific Research and Development. (2005). Norms and Standards and for Extension and Advisory Service in Agriculture. SAAD Guideline paper. Pretoria, South Africa. <http://www.nda.agric.za>.
- Stein, B. Michael, K. Colin, L. Susan, O. and Brett, U. (2009). Sustainable Land Management Practices for Grazers. A Book published by Industry and Investment State of New South Wales. Sydney, Australia.
- USDA, (2011). Environment and Natural Resource. United States Department of Agriculture blueprint paper. USA.
- Waskom, R. (1992). Best management practices for phosphorus fertilization. Guideline paper for agricultural extension. USDA Natural Resources Conservation Service. Colorado State University, USA.
- Weihrich, H. (1993). Management Science, Theory and Practice. A Book. University of Sanfrancisco, California. USA.

Woodfine, A. (2009). Using Sustainable Land Management Practices to Adopt and Mitigate Climate Change in Sub-Saharan Africa. Journal of Regional Sustainable Land Management. Kenya.

Yan, J. (2012). Assessing the Health of Agricultural Land. Article. Capital University, China.
www.elsevier.com/locate/catena.

APPENDIX A

Addis Ababa University

College of Social Science and Humanities

Department of Geography and Environmental Studies

Research Questionnaire for Farm Households

Confidentiality and Consent: The purpose of this questionnaire is to gather pertinent data that will be used for an input for the research work on Practices, Challenges and Prospects of Agricultural Land Management. The questionnaire is designed to obtain information about farmers' experiences and opinions on agricultural land management practices and challenges for the practice of more effective agricultural land management technologies. Your name is not written on the questionnaires and the information you are going to provide will be kept secret and will only be used for the academic purpose. You do not have to answer any question that you do not want. However, your genuine response to these questions will help to the better outcome of the study. Therefore you are kindly requested to give your genuine response.

Part I: General Information of the Respondents'

Questionnaire code: _____

Date _____

1.1 Address Kebele: _____

1.2 Sex 1. Male ☐ 2. Female ☐

1.3 Age 1. 20-29 ☐ 2. 30-39 ☐ 3. 40-49 ☐ 4. >50 ☐

1.4 Educational status:

1. Illiterate ☐ 2. Only writing and reading ☐ 3. Primary education ☐

4. High school education ☐

1.5 The number of household members

1. <3 ☐ 2. 3-4 ☐ 3. 5-7 ☐ 4. 8-9 ☐ 5. >10 ☐

1.5 The size of your farm land

1. I have no farmland ☐

2. < 0.5 hectare ☐

3. 0.5-1 hectare ☐

4. 1-2 hectare ☐

5. > 2 hectare ☐

1.6 What type of agricultural practice do you have?

1. Only Rain fed based agriculture ☐

2. Only Irrigation agriculture ☐

3. Both Reified and Irrigation based agriculture ☐

4. Only animal raring ☐

Part 2: The Current Status and Problems of Agricultural Lands

2.1 Do you think that currently your agricultural lands are found under soil erosion hazard?

1. Yes ☐ 2. No ☐

2.2 How do you see the severity level of soil erosion hazard on your crop yield productivity?

1. Severe ☐

2. Moderate ☐

3. Minor ☐

4. It has no effect ☐

2.3 How is yearly crop yield productivity of your agricultural land?

- 1. Increasing ☐
- 2. Declining ☐
- 3. No change ☐

2.4 Which one of the following problems observed in your farmlands (multiple responses are possible)

- 1. Poor soil fertility ☐
- 2. Its susceptibility for erosion hazard ☐
- 3. Water logging problem ☐
- 4. Difficulty to plow ☐

Part 3: Farmers' Agricultural Land Management Practices

3.1 From the following soil fertility management technologies and agronomic practices select your level of practice in front of the represented numbers using a thick mark (✓) on the table provided below:

Key:

- 1. = Never at all**
- 2. =Rarely**
- 3. =Sometimes**
- 4. =Often**
- 5. =Always**

3.1.1	Soil Fertility Management Practices	Always	Often	Sometimes	Rarely	Not at all
	Inorganic fertilizer					
	Animal manure					
	Compost					
	Green manuring					
3.1.2	Agronomic Practices					
	Use of improved seed					
	Fallowing					
	Crop rotation					

3.2. Farmers' Fertilizer application trend on farm lands

3.2.1 How is your fertilizer application trend in your farmlands over time?

1. Increasing ☐

2. Decreasing ☐

3. No change ☐

3.2.2. Do you think that fertilizer application is applied as per the recommendation of experts?

1. Yes ☐ 2. No ☐

3.2.3 If your answer for question 3.2.2 is "**No**" please explain your reason on the space provided. _____

3.2.4 What constraints that you identified related to your inorganic fertilizer application on your farm lands? (**Multiple Responses are Possible**)

1. Removal of the fertilizer with the top soil ☐

2. Economic constraint to sue inorganic fertilizers ☐

3. Increase of soil acidity ☐

4. Lack of technical support ☐

5. Removal of fertilizer through volatilization and leaching ☐

If any others, please specify it. _____

3.2.5 How is animal manure application pattern on your agricultural lands?

1. before crop planting ☐

2. during crop planting ☐

3. after crop planting ☐

4. Sometimes before planting sometimes after crop planting ☐

5. I don't have any adoption of animal manure application ☐

3.3 From the following soil care, water and crop moisture management technologies, which of these do you practice **(Multiple Responses are Possible)**

1. Irrigation ☐

2. Diversion ditch ☐

3. Soil bound ☐

4. Terracing ☐

6. Water harvesting ☐

If any others, please specify it _____

3.4 Which of the following agro forestry practices do you practice? **(Multiple Responses are Possible)**

1. Planting trees on crop land areas ☐

2. Cultivating crops on tree land areas ☐

If any others, please specify it _____

3.5 Which one of the following Grazing land management practices do you practice **(Multiple Responses are Possible)**

1. Fencing of degraded grazing lands ☐

2. Rotational grazing ☐

3. Control of continuous grazing ☐

4. Production of fodder grasses and trees ☐

Part 4: The Role of Development Agents', the provision of Trainings and Credit Services for Agricultural land Management Practices.

4.1 Put your own view on the level of development agents supporting role in their contribution for agricultural land management practices in front of the represented numbers given in the table below:

Key:

1. = Very low

2. = Low

3. = Medium

4. = High

5. = very high

No	Contributions of development agents related to their supporting role.	5	4	3	2	1
4.1.1	How is the cooperation of development agents and their advice for you?					
4.1.2	How is the competency and ability of development agents to select appropriate agricultural land management technologies?					
4.1.3	How is the frequency of development agents to visit your farmlands?					

4.2 How is your level of agreement on that shortage in the number of development agents has its own influence on your agricultural land management practices?

1. Strongly agreed ☐

2. Agreed ☐

3. Disagreed ☐

4. Strongly disagreed ☐

4.3 How is the training that you are given for the purpose of your agricultural land management practices?

1. It is only focused on practical ☐

2. It is only focused on theoretical ☐

3. Both practical and theoretical are given equally ☐

4. There is no any training at all ☐

4.4 Which of the following constraints do you face to use credit service that used to agricultural land management practices?

1. Credit agreement with credit centers ☐
2. Credit interest rate ☐
3. Distance of credit centers ☐
4. There is no any problem ☐
5. No comment because I am not credit beneficial ☐

APPENDIX B

I. Professional Interview Guide for Agricultural Extension Development Agents (DAs)

Interview Code_____

Date _____

1. When did you start your job in this area?
2. What problems have you identified on the practice of agricultural land management technologies and strategies in each farm level?
3. What challenges do farmers share with you in agricultural land management practices?
4. How do you judge the motivation of farmers towards the practice agricultural land management technologies?
5. How do you see the attitude of farmers towards their acceptance and practice of agricultural land management technologies?
6. How do you convince farmers to practice agricultural land management technologies on their farm lands?
7. Do you get enough training on agricultural land management practices?

8. Do you have any incentives that you have given from the government?
9. Do you think that you are currently satisfying in your job career?
10. If you say no, what reasons do you have behind your dissatisfaction?
11. What possible solutions do you recommend to improve practices of agricultural land management in your Kebele?

II. Interview Guide Questions for the Agricultural Office Officers

1. What are the required and the existing number of employees of development agent and agricultural experts in your Woreda?
2. Please explain for me the processes that your organization has used for promoting agricultural land management practices?
3. What management technologies and strategies are now applied in agricultural lands in your Woreda?
4. Does your office conduct suitability assessment before implementing management practices and strategies?
5. What problems face the agriculture office to implement more effective agricultural land management strategies?
6. What opportunities are there that used to implement more effective agricultural land management practices in the future?

III. Interview Guide Questions for Individual Farmers

1. Do you practice agricultural land management options in your farmlands?
2. Do you think that agricultural land management practices are ensuring the productivity of your farmlands?
3. What challenges that you identified impeding the practice of effective agricultural land management in both grazing fields and your crop farm land level?
4. Are these challenges human induced or naturally occurring?
5. Is there any measure taken to solve these problems?
6. Is there any improvement as a result of the measurements?

APPENDIX C

Questionnaires for Group Discussion with Famers

1. What concerns do you have about adopting and implementing agricultural management options in your agricultural land? Identify any challenges.
2. How do you compare the agricultural land management technologies that you are told to practice from experts and your own agricultural land management options?
3. How do you see strategies of mass mobilization in soil and water conservation practice? And how about your participation?
4. What factors influence you to make changes in your farming practice?
5. What facts would most convince you to practice agricultural land management options?
6. What measures and conditions do you identified in your area that would create opportunities for your agricultural land management practices?

APPENDIX D

Observational Checklists

1. Widely Adopted Agricultural Land Management Practices in the Study Area

- 1.2 The presence of agro forestry practices in the farm plot areas
- 1.3 The presence of grazing lands management practices
- 1.4 The presence of irrigation practices its managements

2. Agricultural lands and its degradation and conservation status

- 2.1 The presence of environmental indicators of land degradations such as
Gullies on farm plot and bare lands in the area
- 2.2 Patterns of water flow in irrigation activities and its management practices
- 2.3 Sloping nature of the agricultural land in relation to vulnerability for
Erosion
- 2.4 crops growing in the area