ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
INSTITUTE OF REGIONAL AND LOCAL DEVELOPMENT STUDIES

IRRIGATION WATER MANAGEMENT AND ITS IMPACTS ON CROP PRODUCTION AND AGRICULTURAL LAND: THE CASE OF METTI-WALGA IRRIGATION SCHEME IN SOUTH WEST SHOA ZONE

A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE MASTER OF ARTS IN REGIONAL AND LOCAL DEVELOPMENT STUDIES (RLDS)

By
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January, 2006
ADDIS ABABA

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REGIONAL AND LOCAL DEVELOPMENT STUDIES

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ACKNOWLEDGMENT

Above all, I want to praise GOD for HE gave me health and chance to undertake graduate study. Next I am thankful to the House of Peoples' Representatives for their financial support as well as access to essential documents.

Gracious thanks and appreciation are due to my principal academic advisor, Dr. Woldeab Teshome, whose guidance and invaluable comments have helped me in shaping my thesis. My deepest gratitude is also to my brother Ato Kebede Gebresellassie for his strong encouragement during writing my thesis.

I strongly express my deep appreciation to my colleagues' staff of Oromia People Mobilization, Labor and Social Affairs Bureau who helped me in editing, writing as well as shared their views with me.

Finally, I am deeply grateful to my wife and children who gave me loving support throughout the writing process.

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ADLI Agricultural Development Led Industrialization

DAs Development Agents

FAs Farmers Associations

FAO Food and Agriculture Organization of the United Nations

FGDs Focus Groups Discussions

HH(s) Household(s)

IDRC International Development Research Center

IGs Irrigation Groups

IWC Irrigation Water Committee

ISC Irrigators Semi Cooperative

IWMI International Water Management Institution

MoFED Ministry of Finance and Economic Development

MoI Ministry of Information

MoWR Ministry of Water Resource

MWIS Metti-Walga Irrigation Scheme

O&M Operation and Maintenance

OIDD Oromia Irrigation Development Department

SDPRP Sustainable Development of Poverty Reduction Program

USDA United State Department of Agricultural

WARDO Woreda Agriculture and Rural Development Office

WB World Bank

WID Woreda Irrigation Department

WUGs Water Users Groups

ABSTRACT

This study examines irrigation water management activities in Metti-Walga irrigation scheme and effects of this irrigation on crop production, income generation and employment creation with existing water control. To serve this objective, household survey, FGDs, interview and field observation were used to collect data at group and individual levels. The questionnaires were administered and filed by using locally recruited and trained enumerators. The analysis was undertaken using simple statistical methods. 105 respondents were selected by lottery method from the total population of 740 irrigators.

The findings of this study highlight the negative effects of irrigation on cultivated land and agricultural productions. Mismanagement of irrigation water resulted in rise of the water table, which causes water logging. About 20 hectares of the cultivated land at lower-lying and flat areas are converted to water logged and the production of irrigated crops declined. However, the irrigation scheme enables farmers to generate more income and able to create employment in the scheme. The Price and demand for irrigated crops increase due to facilities improved for marketing agricultural productions. But sustainability of the scheme is in a serious problem.

The study reveals that irrigation use activities such as control structure, water management activities and organizational structures are inadequate. Conveyance systems are inefficient because of water loss through canal seepage, percolation and leakage. Water use activities such as water allocation, distribution and field application are inappropriate.

Organizational structures that are responsible for managing the physical structures and water use activities lack coordination and integration. This resulted in inefficiency of the irrigation system.

Farmers were organized in the form of Irrigation Groups and Water Users Groups for activities of irrigation management but lack institutional arrangement and inadequate training of users made organizational control activities. Woreda Agricultural and Rural Development Office has shortage of skilled manpower and budget to train and assist the farmers in operation and maintenance of the control structures. Hence, lack of awareness, skilled manpower and coordination to manage irrigation system make the conveyance system and field application inefficient. These poor irrigation water management activities causes wastage of water that resulted in shortage of irrigation water in the scheme and conversion of cultivated land to water logging.

CHAPTER ONE

INTRODUCTION

1.1 Background

Seventeen percent of the world's agricultural land amounting to over 225 million hectares is under irrigation. Food grown on irrigated land accounts for 36 percent of the global harvest. Irrigation has been the cornerstone to global food production, providing water security to farmers, increasing crop yields, enhancing the extent of agricultural production and allowing multiple cropping (GWI, 2002:1).

Micheal (2001:1) noted that the need to increase the crop production to feed the increasing population results in the rapid expansion of irrigation throughout the world. In Africa, frequent drought conditions and ever increasing population in most countries have contributed to the increasing expansion of irrigation since 1960s. Woldeab (2003) also noted that between 1961/62 and 1995/96 the irrigated area in developing countries increased by annual rate of 1.9 percent to 197 million hectares. In Ethiopia, for example, irrigated land was 30,000 hectares in 1995 and this has increased to 197,250 hectares in 2004(Micheal, 2001 and MoI, 2004)

Irrigation has been given high priority in the development plans of Ethiopia with the primary objective of enhancing agricultural production. As it is cited in the SDPRP document, one of the objectives of the Ethiopian government is to enable the country to extricate itself from dependence on food aid and ensure food self-sufficiency through the strategy of ADLI by focusing on

increasing water resources utilization, agricultural research, water harvesting and small-scale irrigation.

In developing countries, only 25-30 Percent of the water diverted in to large canal systems become available to the crop. This means nearly 70 percent of the water diverted to agriculture has never benefited the crops (IDRC, 1999). The major factors that attributed to the low irrigation efficiency are leakage, percolation and evaporation, which are caused by inadequate maintenance of irrigation network (IDRC, 1999:13).On the contrary, good irrigation management can reduce seepage and increase irrigation efficiency. Provision of drainage, canal lining in highly permeable areas, and appropriate design for irrigation infrastructure alleviate the problem (GWI, 2001).

In developing water resources several factors are taken into consideration. These include the availability of water, quality of water, location, distribution, nature of soil and socio-economic conditions. In dealing with this, every effort must be made for the best use of water (Micheal, 2001).

Metti-Walga irrigation scheme is found in Wenchi woreda of South West Shoa Zone which is located in the central highland of Oromia Region. According to the Oromia Irrigation profile (2000), in West Shoa Zone, Wenchi woreda has better surface water potential for irrigation development and relatively its large area is under irrigation. Currently, about 73 irrigation schemes were developed in the woreda and from which about 29,000 families are benefited by growing a variety of irrigated crops like onion, tomato and potato. However, efficient water management has not yet received attention in developing irrigation schemes.

1.2. Statement of the Problem

Irrigation is defined as application of water to soil to provide a favorable environment for growth and development of crops (Aral, 1971). Irrigation helps farmers to increase their output and in the multiple cropping by providing supply of water in dry season to raise the commercial and cash crops as well as increase employment (Ellis, 1996:250). As a result of irrigation development, the living standard of the people gets improved.

On the other hand, irrigation development has an adverse effect on the productivity of the land by increasing salinity of the soil and water table (Salih, 2001). Irrigation has also adverse effect on health related issues (WHO, 1980).

Irrigation schemes, which have feasible irrigation water management systems, are dealing with, minimum water loss, fair allocation and distribution of scarce water for socio-economic development use and protection of the environment from degradation and loss of productive capacity of the cultivated land.

In most of the North and East African countries show that the regions with erratic rainfall patterns have developed or are in developing available water resources for irrigation. But, without efficient control and proper water management, these efforts to food self-sufficiency remain a mirage(IDRC, 1999 p.12). Woldeab (2003) also noted that in Africa, irrigation projects have been the obvious solution for modernizing production, minimizing food imports, removing food deficits and ameliorating the impact of drought. Although irrigated agriculture is promising option for tackling food shortage, the effort in Sub-Saharan Africa (SSA) is gloomy because of poor irrigation water management.

Salih (2001:9) stated that successful irrigation schemes play a major role in income generation, employment creation, improve nutrition and raise living standard of the farmers. Irrigation potentially increases agricultural output; but whether or not the individual farmer benefits from such irrigation development, it depends on the style of irrigation water management. Well-planned and administered irrigation scheme can improve the wellbeing of the local population in particular and overall economic development in general.

The availability of irrigation water and application of the right quantity is vital for boosting agricultural production. Otherwise, all efforts exerted to increase agricultural production through irrigation will fail. Therefore, proper water management is necessary for successful irrigation system (ibid).

According to Oromia Irrigation Profile (1999:137)stated that research works aimed at assessment of irrigation water management, effects of irrigation on crop yield, salinity as well as drainage of wet lands need to be conducted but in the Region, except giving attention to the expansion of irrigation development; the management of irrigation have not yet been studied.

Metti-Walga Irrigation Scheme was first developed traditionally in 1975 and then it was upgraded to modern irrigation in 1999 by Oromia Irrigation Development Department (OIDD). In the scheme, about 203 hectares of land has been irrigated and about 4000 people are benefited.

However, at the lower-lying level and flat areas, the cultivated land has been converted to water logging. As a result, about 20 hectares of irrigated land was totally abandoned and large areas of cultivated land are in the process of converting to water logging. Out of this total irrigated land that converted to water

logging, about half of it is not used both for cultivation and grazing. Cultivated land has been reduced from time to time in the scheme area and no one has given due attention to this land degradation.

Hence, the main concern of the study is to identify the major causes of converting the cultivated land to water logging as well as to search appropriate solutions for the problem. To achieve this objective, the study focuses on assessing irrigation water management activities of the scheme and its effects on crop yields, income generation and employment creation.

1.3. General and Specific Objectives of the Study

The main objective of the study was to examine irrigation water management activities of the Metti-Walga irrigation scheme and its effects on agricultural land, crop production, employment creation and income generation capacities.

Specific objectives of the Study

- To analyze how irrigators are organized for the irrigation water management activities in the scheme,
- To analyze the local institutions are integrated and coordinated with irrigators in irrigation water management activities in the scheme.
- To assess the efficiencies of water control and water use activities in the scheme.
- To assess the impact of irrigation on agricultural land, and
- To investigate the effects of irrigation on crop production, income generation and employment creation with the existing management activities of irrigation system in the study area.

1.4. Basic Questions of the Study

- What are the existing irrigation water management practices in the irrigation scheme?
- What are negative environmental effects of irrigation? and
- What is the effect of the irrigation scheme on income generation, employment creation and crop production?

1.5. Significance of the Study

- It helps to understand the main problems of irrigation management in the study area,
- It generates useful information for future development of irrigation schemes,
- It is important for initiating the local administrators and other stakeholders so that they could give attention to the problems, and
- It helps for further study.

1.6. Research Methodology

In order to meet the objective of this study, survey method, FGDS, interview and observation method were employed. Survey method was selected because it is more appropriate to involve sampling of various segments of the population at a time.

1.6.1. Sample Selection

1.6.1.1. Selection of Irrigation Scheme

Relatively, South West Shoa Zone is the place where a large number of irrigation schemes exist and at the same time it is high potential irrigation area. Out of nine woredas of the zone, Wenchi woreda has high irrigation water potential area which needs the consideration of government to develop irrigation. In the Woreda there are 2 modern irrigation schemes which are upgraded by government. Because of cultivated land of the Metti-walga irrigation scheme is in a serious problem the case of Metti-Walga irrigation scheme was intentionally selected from the two modern and 71 traditional irrigation schemes.

1.6.1.2. Sample Size and sampling Techniques

For the survey study, the list of all irrigator households (740) that were already grouped into 15 Water Users Groups (WUGs) was taken from water committee. From each cluster of Water Users Groups, 7 household heads were selected by lottery sampling method in order to incorporate all groups in the study. Therefore, a total of 105 HHs (14 percent of total population) were selected from the 15 WUGs.

For Focus Group Discussions (FGDs), 30 participants were selected by using purposive sampling method. In order to get detailed information about the irrigation scheme, irrigators who have rich experiences in irrigation were included in the FGDs. The selected irrigators were divided equally into three groups. Hence, three FGDs were held each at upper, middle and down stream.

Representative of Woreda Agriculture and Rural Development Office, Woreda Administrative and Kebele chairman, Water Committee members as well as WUGs leaders were also interviewed.

1.6.2 Methods of Data Collection and Data Analysis

1.6.2.1. Methods of Data Collection

This research work included both primary data or fist hand data that were obtained during field study as well as secondary data (a review of literature on irrigation water management). Hence, both primary and secondary data sources were used in this study.

Primary Data Collection

First hand data were collected from the survey of households, Focus Group Discussions (FGDs), interviewees and field observations.

Research instrument such as structured questionnaires were developed to collect primary data which were prepared in English language and then translated to Amharic in order to make communication easy. The questionnaires were administered and filled by three trained enumerators. These questionnaires were designed to address and reflect the issues that were raised in research questions.

Checklists for FGDs and interviews were prepared in advance and Qualitative data were collected from FGDs and interviewees by investigator himself.

Secondary Data Collection

Secondary data were collected from Oromia Irrigation Development Department, South West Shoa Irrigation Office, Wenchi Woreda Administrative Office and Oromia Agricultural Bureau. Literatures related to irrigation development and irrigation management activities were reviewed extensively

1.6.2.2. Data Analysis

Simple statistical methods such as ratio, average and percentage were used for quantitative data analysis. Qualitative information was aggregated with the results of quantitative analysis. Thus, both qualitative and quantitative analysis techniques were used for data analysis.

1.7. Limitation of the study

Some of the limiting factors during collection of the data were farmers' uncertainty to tell factual information on total amount of landholding, irrigated land, land converted to wetland and income earned from agricultural production for the fear of the rise of taxes and land redistribution.

The other limiting factor was difficulty of recalling past information about the amount of production and income. Further, farmers were not willing to spend long time for interview. However, by using different methods such as FGDs and informal interview, the problem was minimized.

1.8. Conceptual Framework

Irrigation as Socio-economic Phenomenon

According to Mollinga (2003), comprehensive understanding of irrigation requires a framework that integrates technical and social science perspective. Irrigation systems are socio-technical systems because it embraces both social and technical system components. The essential attribution of socio-technical systems include close interrelationship between structural, social and technological features (Huppert, 1989 and Mollinga, 2003). Social shaping or social constructing approach to irrigation technology investigates the social dimension of irrigation artifacts. Social dimension can be classified into

three points (Mollinga, 2003). They are social requirement for use, social construction and social effects.

(i) Social requirements for use- Irrigation technologies put demands on the management structure of irrigation system. The structural systems are devices by means of which water is drawn from intake of the river to the farmers' field. This conceptual framework reveal that irrigation technologies have social requirements for use. This means, in order to use technologies work effectively, management of irrigation structures have to be considered (Mollinga, 2003).

Woldaeb (2003) noted that differences in sources of water might require different forms of management. In river diversion, gravity irrigation is carried out using earth canals from the main source to the farmers' plot of lands. The transport of water from the source of water for irrigation to the farmers' field needs an efficient canal network to tackle problems such as water logging and soil salinity.

(ii) Social construction- Irrigation technologies are developed and designed with particular forms of cooperation and management in mind. In this theoretical framework, irrigation technologies are socially constructed. It implies that technology development and design are social processes in which different stakeholders interact, and that the nature of the process and different perceptions and interests of the technical characteristics of the technologies. Metti-walga irrigation scheme was developed by participation of peasant farmers and local administrators and later on, diversion of the river and the main canal of the Metti-walga irrigation scheme were constructed by the regional government. Water Committee has full responsibilities for operating and maintaining the irrigation infrastructure and for the distribution of irrigation water.

(iii) Social effects- The third way in which irrigation technologies are social objects is stating that irrigation technologies have social effects. These effects can be seen on crop production, peoples' health, and irrigation affects peoples' livelihoods. These effects are technology-dependents (Woldaeb 2003). Irrigation allows more diversified and intensive cropping. This lead to higher agricultural production and increased income, which may ,in turn, generate economic growth and employment (Mollinga, 2003).

Hence, irrigation can assist in agricultural diversification, enhance food self-sufficiency, increase rural incomes, generate foreign exchange (Ngigil, 1998:36)

Irrigation activities have a number of conditions of possibility. There are material and social conditions of possibility. The fertility of the soil is one of the material conditions of possibility. When irrigated land become saline or water logged , irrigation activities become difficulty. When the appropriate material conditions are not fulfilled, irrigation as usual can no longer take place. Labor market, land, technology, credit and inputs are conditions of possibility for irrigation activities.

Improper usage and application of water or faulty and careless irrigation can damage lands. excessive on-farm irrigation, deep-percolation and seepage of canal is occurred and the area below or around the irrigation scheme becomes water logging due to shallow water table. It diminishes productivity and can cause a number of indirect effects such as increasing and spreading water born diseases like bilharzias (GWI, 2001).

Good irrigation management, closing or matching irrigation demands and supplies, can reduce seepage and increase efficiency. The provision of drainage, lining canal in high permeable areas,

and good design for irrigation infrastructure reduce wastage of water. Water logging occurs when high water table affects agricultural land productivity or fertility. Therefore, with better water management systems, water could be saved and used to sustain fertility of irrigated land and increase production.

Irrigation Management Activities

Irrigation activities are not isolated activities, but they are part of wider activities. In relation to this, Woldeab (2003:4) noted that irrigation crop production process has a number of interrelated activities ranging from designing and constructing of the irrigation infrastructure to water acquisition and watering crops are carried out. Woldeab (2003) and Mollinga (2003) state the three categories of irrigation management activities, which are again sub-divided into four activities. These are: (1) **Control structure activities** which include design, construction, operation and maintenance activities; (2) **Water use activities** which include acquisition, allocation, distribution and drainage; and (3) **Organizational activities,** which are divided into decision making, resource mobilization, communication and conflict management.

According to Mollinga (2003), the concept of water control can be usefully employed to analyze the process of irrigation management in irrigation systems. The concept of water controls in the irrigation engineering literature is referred to as the physical control of water flows by means of irrigation technology. In irrigation management literature, water control refers to management of water distribution process. Organizational control is a group of farmers, which are in control of distribution and conflict resolution within their groups (ibid).

This study is concerned with irrigation water management activities such as water control activities, Water use activities and organizational controls.

In relation to assessment of socio-economic situations, the study focuses on contribution of irrigation scheme on employment creation, income generation and crop production.

1.9. Definitions of Terms

Drainage: - disposal of excess water from irrigation field due to precipitation and percolation of water(USDA 1994).

Field leveling: - grading and earthmoving to eliminate variation in field gradient or smoothing the field surface and often reducing field slope. Field leveling helps to control wastage of water and improve uniformity of soil saturation under gravity-flow systems (IDRC, 1999).

Furrow Irrigation systems: - the dominant gravity application system, are distinguished by small, shallow channels used to guide water down slope across the fields (IDRC, 1999).

Irrigation inefficiency: - poor irrigation management system, inefficiency of conveyance system and application, poor water distribution and inappropriate irrigation schedules.

Irrigation water management: - is the management of supplying, diverting, allocating, conveying, distributing, applying, and drainage of water to produce crop (EDR, 1999).

Irrigation: - The artificial application of water to soil for the purpose of crop production (Michael, 2001).

Multiple cropping: -the numbers of crops that can be grown sequentially on a given area of land during the annual cycle (Ellis, 1996).

Open-Canal conveyance system: - unlined traditional means to supplying gravity irrigation systems. Improved systems are typically lined with concrete or other less permeable materials to reduce seepage loss (AREI, 1999).

Organizational structures: - Institutional arrangements which facilitate collective action in the irrigation scheme (Mollinga, 2003). **Organizational structures** include: The users (Farmers organizations) and their bylaws and enforcement characteristics; and Stakeholders and relationship in irrigation management (concerned government bodies)

Shortened water runs: - reduce the length of furrow to increase uniformity of applied water across the field. Reduced water runs are most effective on coarse soils with high soil-water infiltration rates (AREI, 1999).

Water control structure: - is referred to as the physical control of water flow in irrigation system (Mollinga, 2003). Concerning this study, **Water control structures** refer to devices in which water is distributed to irrigated fields. That is, open canal network system and the level of canal system are canal (main canal), distributaries (secondary canal) and water course (tertiary canal)

Water Logging: - rise of water table due to percolation and leakage water that causes damage to agricultural land or makes unfit for cultivation (Punmia 2002).

1.10. Organization of the paper

This paper has seven chapters. Chapter one included background of the study, statement of the problem, research objective, significance of the study, research questions, method of data collection and data analysis, limitation of the study, conceptual framework and definition of terms.

Chapter two gives an overview of the literature on water resource and irrigation development, irrigation types, and technical design structure, socio-economic effects, environmental impacts irrigation water management and organizational structures. Chapter three describes the location, demographic and socio-economic of the study area.

Chapter four presents description of the irrigation scheme, background of the irrigator households and irrigation management activities of the scheme. Chapter five deals with agricultural land degradation, agricultural production, income generating, employment creation and finally, Chapter six presents summary, conclusion and recommendation.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Water Resource and Irrigation Development

2.1.1. Water Resource and Concepts of Irrigation

The absence of water results in the absence of life. Earth has water, but in limited quantity. The total quantity of water available remains constant (Arora, 1986). Water occupies about 71 percent of the earth, but nearly 97 percent is unfit for animal and plant use. Of the remaining 3 percent of fresh water, 90 percent of it is laying locked in ice caps, glaciers and inaccessible underground water. Therefore, only 3 percent of fresh water is accessible for plant and animal uses (Ramulu, 1998:3).

Water resource development, therefore, involves exploitation of surface as well as ground water. The most important use of water is for drinking purposes and for agriculture. Agriculture claims the lion share of water taken from rivers, lakes and wells which roughly accounts for 65 percent of global water use (Ibid).

Early agriculture involves mainly food production, which had been changed slowly to modern agriculture through continuous evolution of agricultural technologies. This transformation gave strong structural and economic base to human society for its existence and progress. Irrigation has dictated and decisive largely the pace and the process of agricultural development(Majumdar, 2002:7).

In many areas of the world the amount and timing of rainfall are not adequate to meet the moisture needs of the crops. Irrigation

is supplied available water in supplement to rainfall in contribution to soil moisture (Michael, 2001:1).

The success of irrigation depends mainly on how timely and adequately the water meets the needs of various crops to grow. This makes the water to conserve and economical use as a matter of great national importance (Aroa, 1986:58).

Irrigation work may be constructed at a place where more water is available and then to convey water to the area where there is deficiency of water and also to the areas where the rainfall may be sufficient to raise the crops, but more water may be necessary for raising commercial and cash crops in dry season (Panumia, 1998).

Availability of perennial irrigation encourages the farmer to adopt more scientific technologies as well as intensive cultivation. It enables the farmer to use the best quality of high-yielding varieties of seeds at right time and to be obtained bigger margins of profit (Arora, 1986:56). The availability of water and the application of the right quantity at a right time is also vital for profitable results from irrigation agriculture. Hence, Irrigation is the science of supplying water to meet crop-production needs, either by itself or together with rainfall.

2.1.2. Irrigation Development

250 million hectares of the world's agricultural land are irrigated and account for more than one-third of global food production (Said, 2002). Many studies indicated that large investments in irrigation have been an essential element in increasing food production to sustain the ever-growing population. To meet food requirements by 2020 when world population is estimated to reach 8 billion, food production from irrigated area will be increased from 35 percent in 1995 to 45

percent in 2020 (FOA, 1995). This indicates that the demand of water for irrigation is tremendously increased, but available water for use is in limited quantity. Thus, irrigation will become an issue of global concern and competition in the future. World Resource Institute (1999) stated that:

> *'Water scarcity will be the main problem of future generations and have effects in many parts of the world. Water scarcity is a great threat to the global sustainability of the water supply and potentially to world peace and development. The scarcity will affect mostly the poor and will undermine the economic, social and environmental foundations of many developing countries.'*

When we look at African situation, frequent drought conditions and ever-increasing population in most of the countries have contributed to the increase and expansion of irrigation farm since 1960s. It was also estimated that irrigation development in sub-Saharan Africa contributes to 10 percent of the regions cereal supplies (FAO, 1996).

In reviewing continued water scarcity and competition among users, it is necessary to seek measures that would foster sustainable increase in the productivity of water used for agriculture through better irrigation management. Being the biggest water use, irrigation requires special attention in better management of water and improved food production (Nigigi, 1998: 44).

2.1.3. Irrigation Development in Ethiopia

Ethiopia, often referred to as 'the water tower of East Africa' has the principal large water resource potential because of her high rainfall and big rivers which discharge large amount of water to neighboring countries. Although the total irrigation

potential area of the country is 3 million hectares, the total coverage of irrigation is estimated to only 197,250 hectares or only 6.5 percent (MOI, 2004). This indicates that the level of development of the irrigation sector was very low.

In previous time, the Imperial government of Ethiopia had the strategy of expanding large-scale irrigation with the mechanized agricultural activities. Later on in 1980s, during the Derg regime consideration was given to small-scale irrigation development under the Ministry of Agriculture by establishing Irrigation Development Department, while the Ministry of Water Resource (MOWR) has undertaken large-scale irrigation project development. The technological change is mainly because of 1984/85 drought and famine that affected millions of Ethiopia.

The present government has established water resource management policy through the MOWR in which a clear framework of irrigation development is stated and the policy has created conducive environment for the sectors (Nigussie, 2002:30). This water management policy includes the following objectives:

- The development and optimum allocation of the country's water resources for the benefit of the people on equitable, efficient and sustainable bases;
- Managing the effects of drought and other associated disasters through efficient allocation, redistribution and efficient use of water resources;
- Controlling and regulating floods through sustainable mitigation, prevention, and other practical means;
- Promoting small-scale, medium and large-scale irrigated agriculture to supply raw materials for industry, to achieve food security and earn foreign currency

- Developing techniques for water use efficiency, water wastage control, maintenance of irrigation infrastructures and drainage (Woldeab 2003, 43).

Currently, to give emphasis to development of small-scale irrigation, the irrigation development sector was established at the Regional level as well as Woreda level under the Office of Agricultural Development.

As it was put in Sustainable Development and Poverty Reduction Program (SDPRP), expansion of small-scale irrigation has been given emphasis to eradicate poverty and increase economy by mitigating the impact of variability, shortage and absence of rainfall.

2.2. Irrigation types and Technology choice

In the first instance, the irrigation methods are classified based on their usage of available water resources. The main technology for utilizing surface water is canal irrigation while the main technology for utilizing ground water is tube well irrigation (Ellis, 1998: 250).

Several factors may determine the selection of the best method to irrigate land. Among these are: the slope of the land, the crops to be irrigated, the water supply, the permeability of the soil and its water holding capacities.

Good production can be obtained from irrigated land only if the water is applied wisely and in such away that it would provide sufficient amount to satisfy the need of the plant.

Irrigation schemes are classified in to large, medium and small-scale schemes. The classification of the schemes depends on area of irrigated, scale of operation and type of management. However, the consideration of such criteria to draw the line between

'large' and 'small' scale irrigation schemes varies considerably from country to country. For instance, in India irrigation scheme of 10,000 hectares is small while in Ghana irrigation scheme of 3000 hectares is large scheme (Seid, 2002). In Ethiopia, irrigation schemes classification depends on the size and scale of operation. Small-scale schemes are those covering an irrigable area of less than 200 hectares, medium scale irrigations are those extending between 200 hectares and 3000 hectares and large-scale schemes are those above 3000 hectares (FOA, 1994, Seid, 2002:20 and Woldeab, 2003:38)

In relation to the specific water control technology used, small dam irrigation and shallow or deep tube well irrigation are termed as small-scale irrigation schemes (Seid, 2002). In most cases, large schemes are formally planned and managed by government departments delegated with the necessary authority for fair and comprehensive control. However in Africa, large-scale irrigation schemes have the following major weaknesses with regarding to operation and management according to FAO (1987).

- Lack of management and technical skills;
- Lack of consistent policy and failure to plan for the medium and long term;
- Political interference in technical and economic decision making; and
- Failure to give adequate return to farmers.

Due to such problems in large-scale schemes, small-scale irrigation has been increasingly recognized as attractive option in irrigation development both by government and donor agencies.

2.3. Technical design Structure

Canal irrigation systems are commonly designed and used for supplying the full water requirements of the crops to be grown in the system. The first design principle maximizes the yield of the

crop per unit area. The second principle minimizes the construction costs per hectare (Mollinga, 2003:60). But in the case of traditional irrigation schemes neither of these principles applied to it. Water diverted directly from the river is distributed for irrigation through canal system. The canal network consists of main canals, distributaries and field canals. In India, the main canals and branches are lined to prevent excessive seepage. Especially in the sandy and sandy loam areas they are lined. Canal outlets are provided at suitable points. The main canals and major branches are constructed, operated, and maintained by the government while field canals mostly do not lined and the operation and maintenance are under the farmers (Michael, 2001: 29).

Small-scale irrigation schemes may be divided into traditional and modern irrigation schemes. Traditional small-scale schemes are the schemes that are run and constructed by peasant farmers' own initiation. Traditional irrigation has been initiated indigenously or informally under local responsibility and operated and controlled by the local people in response to their local needs.

As Debebe (1994) noted that the traditional schemes acquire their water via crudely constructed temporary diversions that have no any type of control facilities to regulate the flow of water. The location of the diversion and canals are determined by trial and error and the construction is taken place with local technologies and local materials available to farmers. The systems are supply oriented and are designed for continuous flow and distribution. The water supply into the system is not determined by actual and fluctuating demands in the field.

Water losses are comparatively high under gravity-flow systems. Improved technology may achieve higher field application efficiencies and conveyance efficiencies. Various irrigation

technologies are available to enhance efficiency of applied water in irrigated agriculture. Irrigation improvements are involved in upgrading the physical application of the system. The following table shows the existing and improved technology.

Table: 2.1. Conventional and Improved practices of Irrigation Technology

Systems	Conventional Technology	**Improved technology**
On-farm conveyance	Open earthen ditches	Concrete or ditch linings
Field run off	Water allowed to move off field	Application controlled by avoiding run off
Furrow management	Full furrow wetting, Furrow bottoms uneven	Alternative furrow wetting, Furrow bottoms smooth and consistent
Field gradient	Uneven field surface	Land leveled and smooth field surface gradient

Source: United State department of Agricultural, 1994

In most of the area, small-scale irrigation developments are concentrated on the upgrading of traditional irrigation. Traditional irrigation scheme which has the simple diversion structures constructed by communities with local means such as stone and brushwood have been replaced by small concrete or masonry weir, which divert water in a more effective and efficiency way.

In the promotion of small-scale irrigation, farmers' involvement in the planning, implementation, operation and management of irrigation systems have to be given consideration. The participation of farmers is essential as they are beneficiaries of the schemes and they are expected to discharge their

responsibilities in the operation and management activities. The participation of farmers could lower management costs and improves performance (Seid, 2002).

In developing countries, there are different reasons for preferring small-scale irrigation to medium and large -scale irrigation. A small-scale irrigation scheme has few costs compared with large-scale irrigation scheme. Also they provide irrigations in short time and in many places without displacing the people whereas the large-scale irrigation scheme has more cost and affects local people involving rehabilitation of the people that could be displaced and also results in submergence of the large areas of agricultural and forest lands (Ramulu, 1998:5).

Although small-scale irrigation schemes have such advantageous; they have faced the following problems in developing countries (Woldeab, 2003)

- Poor canal alignment, longitudinal slopes, and cross section;
- Complete blocking of the river by weirs constructed from stones, earth and timber;
- Lack of intake structures to control both the amount of water taken out and also prevent floods entering the system;
- Water abstractions were not related to the water needs of crops;
- Land leveling and cultivation practices under rainfall and irrigated conditions have remained the same;
- No control structures were provided to reduce erosion in field channels;
- No surface drainage or gully crossings were provided; and

- No control structures to measure and control water use.

In addition to the above factors, some studies showed that the common problems related to African irrigation practices are cost overruns, institutional factors, policy environments, and technical quality and related to environmental issues (Nugussie, 2002:30)

2.4. Social Effects of irrigation

Irrigation technologies have socio-economic effects. Irrigation can assist in agricultural diversification, enhance food self-sufficiency, increase rural incomes, generate foreign exchange and provide employment opportunities (Ngigil, 1998:36)

Developing countries like Ethiopia must seek ways to improve and stabilize agricultural production to cater for the needs of its increasing population. Raising agricultural productivity is crucial for rising income of agricultural workers who make up the large fraction of population, it may give other benefits to the economy of developing countries such as reduction of rural-urban migration and create strong bond between rural and urban communities (Tassew, 2004:3). The biggest potential for increasing agricultural production depends on the development of irrigation and water harvesting technologies. According to the Ellis (1996:257), the potential contributions of irrigation to farm output growth can be summarized as follows.

- Irrigation reduces risk by diminishing the adverse impact of rainfall variation on crop growth and yields.
- Irrigation increases crop yield directly by reducing the incidence of water stress in plants caused by uneven water supplies and by its complementary impact on raising the productivity as well as impacting on raising the productivity of other variable inputs;

- Irrigation results in the increase of farm output since the household can switch to higher value crop mix, or because of higher yielding varieties. This is more responsive to high levels of complementary inputs that can be cultivated;
- Irrigation permits a rise in the multiple cropping index for the average number of crops that can be grown sequentially on a given area of land during annual cycle-providing a supply of water in dry seasons and by permitting greater flexibility in the time of sowing; and
- Irrigation enables previously uncultivated land to become cultivated, by extending the margin of cultivation to semi-arid or arid regions provided that soils are capable of sustaining crop production in the presence of sufficient waters.

Irrigation is an important factor in agricultural development in areas where rainfall is inadequate and is unevenly distributed both in terms of time and space. It is also not limited to areas of water stress. It is equally important in areas where rainfall is adequate; although its temporal distribution is irregular it is vital for cultivation of high value cash crops in a dry season.

Hence, irrigation could offer on increased and stabilized agricultural production, reducing the adverse effects of drought and promoting rural development (FAO, 1987, Punamia, 2001) noted that the construction of irrigation provides the chance for increasing income through production increase as well as can increase income by creating more employment opportunities.

The availability of irrigation facilities result in the increase of the value of land and due to increases in yield of the crop and growing of cash crops, the farmers eventually become

prosperous along with the improvement of their living standard (Punamia, 2001).

2.5 Environmental effects of irrigation

Irrigation developments have impact on local environmental changes as well as economic and social changes. Local environmental changes are commonly attributed to proper management of the irrigation systems.

Improper usage and application of water or faulty and careless irrigation can damage lands and harm crops besides wasting valuable water. When water is available, farmers are tempted to over irrigate their lands without being conscious of their harmful actions.

When there is excessive on-farm irrigation, deep-percolation and seepage of canal is occurred and the area below or around the irrigation scheme becomes water logging and salt-loading due to the building-up of shallow water table.

Water logging occurs where irrigation system lacks adequate drainage system. It diminishes productivity and can cause a number of indirect effects such as increasing and spreading water born diseases like bilharzias (GWI, 2001).

Water logging and excessive salinity adversely affect large and increasing proportions of the world's irrigated land. Even if the exact affected area is not known, it is estimated that approximately 25 percent of the world's irrigated land is damaged by water logging and salt loading (FAO, 1989).

According to Gezmu's study (1990), in Ethiopia, 1640 hectares of land was totally abandoned and 2400 hectares of land reduced in

productivity only in the middle of Awash Farms as the result of the introduction of irrigation projects

The problems of water logging and salinity prevalent in most irrigated lands have been resulted from the excessive use of water for irrigation resulting from the application of inefficient irrigation systems, poor distribution systems, poor on-farm management practices, inadequate and inappropriate drainage management (1990, FAO 1998).

Drainage and seepage waters typically percolated through the underlying and flow to lower deviation lands frequently cause problems of water logging and salt-loading. Thus, the problems of water logging and salt-loading are related to inefficient irrigation and/or inadequate drainage system.

Therefore, majority of soil degradation (salinity and waster logging) problems related to irrigated agriculture occurring throughout the world are caused by inefficiencies in distribution and application of irrigated water (FOA, 1989)

Excessive irrigation and poor water management are the major causes of water logging and salt build-up and the land goes out of cultivation unless remedial measures are taken place (Michael, 2001: 686).

According to FOA (1989), the problems of soil degradation by water logging and salt accumulation and possible mitigation measures are brought in the following table.

Table: 2.2. Soil degradation problems and appropriate mitigation Measures

Problems	Mitigation measures
Degradation of irrigated land by salt accumulation and water logging	• Improve drainage system • Maintain canal to prevent seepage. • Reducing inefficiencies resulting from siltation and weeds, allow for canals maintenance • Provide water for leaching as specific operation • Adjust irrigation management infrastructure

Source: United State department of Agricultural, 1994

2.6. Irrigation water management

According to USDA (1994), irrigation water management involves the management of diverting, allocating, distributing and applying water to crop production. Conservation and allocation of limited water supplies is central to irrigation management decisions, whether at the field, or canal level. Although appropriate irrigation agriculture has greatly increased crop productivity, inappropriate and inefficient irrigation has resulted in wastage of water and damage land productivity.

Various management practices are available to enhance efficiency of applied water in irrigated agriculture; improved water management practices such as irrigation scheduling, water flow measurement as well as drainage system may be important concern in many irrigated areas. The following table shows the conventional management practices and improved management practices.

Table: 2.3. Irrigation water management in Conventional, and Improved practices

Systems	Conventional Management practices	Improved Management practices
• Assessing crop needs • Timing of applied water • Water measurement	• Judgment estimate • Fixed calendar schedule • Not metered	• Soil moisture monitoring • Water applied as needed by crop • Measured using canal flumes, weirs and meters

Source: *United State department of Agricultural*, 1994

Efficiency of irrigation must be increased by adoption of appropriate management strategies and practices, and through education and training (FOA, 1996).

2.6.1. Irrigation scheduling

Irrigation scheduling is one of the proper applications of water at the time of actual need to the crop with enough water to wet the effective root zone (Majimader, 2002:261).

It is important for both water saving and improved crop yields. The type of soil and climatic conditions has significant effects on the main practical aspect of irrigation, which are determination of how much water, should be applied and when it should be applied to a given crop. Other important elements to be considered are crop tolerance and sensitiveness to water deficit at various growth stage and optimum water use (FAO 2001).

The interval between two irrigations should be as wide as possible to save irrigation water without affecting adversely the growth and yield. The principal aim is to obtain maximum crop yield by making the most efficient and economic use of water.

2.6.2. Drainage system

Good drainage, both surface and internal, is essential to successful irrigation. The collection and disposal of drainage flows from irrigation and precipitation is an important management consideration in many irrigated areas. Interceptor drains may be necessary for the upper boundaries of the low-lying area to divert water logging. Integrated irrigation and drainage planning is often necessary for laying out farm area for efficient water use (Mikeal, 2002:398).

2.6.3. Operation and Maintenance

Poor operational and maintenance behavior that could depress irrigation crop production are: Overuse of water on the fields; inadequate maintenance of irrigation infrastructures which attributes to inefficient distribution of available water; inadequate repair of irrigation canals which result in excessive losses in conveyance; and insufficient cleaning of canals and water courses which bring about losses in conveyance to the fields (WB, 1997:28).

2.7. Organizational structure

In most case, the management of irrigation system is the responsibility of irrigator (water users') and Irrigation Development Department or Agencies. Irrigation Development Department generally looks after the system in giving instruction, applying rewards and giving training for farmers.

Irrigation system management depends on the organizational structures. Irrigators organization should be supported and encouraged by surrounding related official bodies such as local administrative and non-governmental organizations. Without supports by these bodies Water User Groups and the irrigation

system is unable to sustain in the long-term irrigation (IDRC 1999). International Irrigation Management Institute noted that without official stimulus to promote farmers association to protect scheme, the O&M of the schemes may be neglected (WB, 1997).

Farm water management deals with the hands of the individual farmer or small group irrigators who share irrigation turnout and agree on mutually beneficial allocation, conveyance and application of water to crops. Most of the organizations occurring at this level are informal and accomplished without written rules or an organization character. All the participants generally well understand the norms of water use and they make informal arrangements for periodic individual or group maintenance work for water sharing in times and for conflict management (FOA 1996).

According to the study of Huggins (2000:296) conducted in Kenya, the challenges of water management are: Limiting institutional capacity to collect information on irrigation activities; lack of state capacity to provide basic services in rural areas; the necessary supports such as training and encouragement have not been given to the communities to take over there role; lack of technical background in water management; and the difficulties of enforcing water theft by law.

CHAPTER THREE

3. THE STUDY AREA PROFILE

Metti-walga irrigation scheme is located in Metti-Walga Farmers Association (MWFA) which is found in Wenchi Woreda of South West Shoa Zone. The scheme is situated around the Wolliso-Ambo Road which is 5kms away from Wolliso Town. Wolliso, the capital of South West Shoa Zone is found on the main road of Addis Ababa to Jima at about 115 km distance from Addis Ababa.

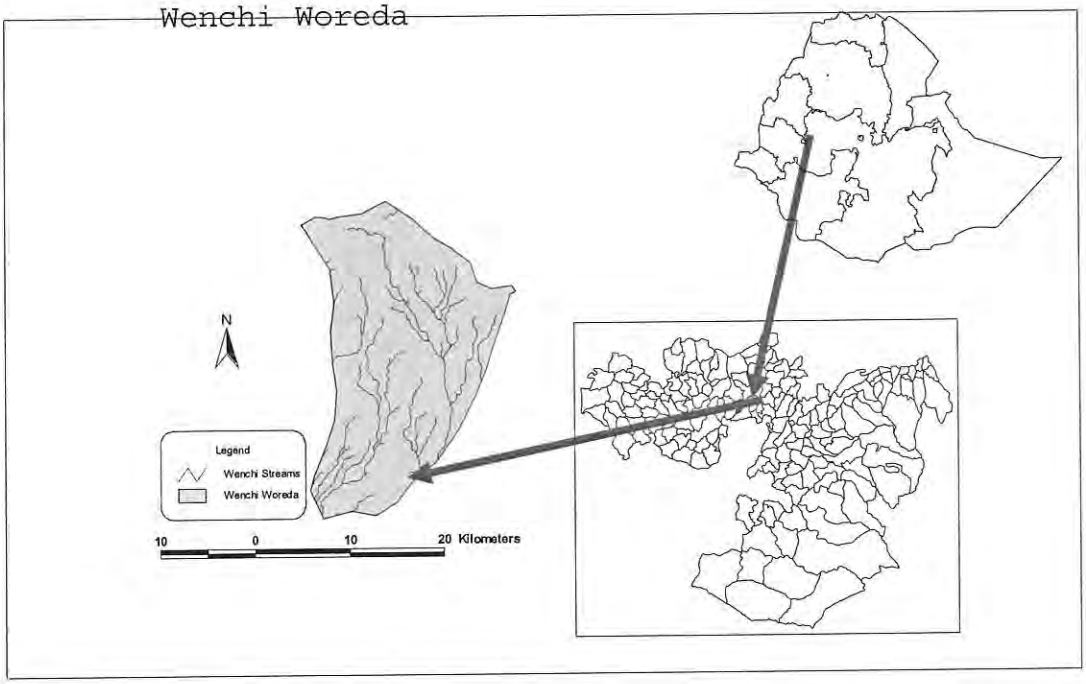

Figure 3.1: Maps that showing the study area

Wenchi Woreda is classified into three agro-ecological zones; namely, low land (Kola), mid-altitude (Weyina-Dega) and high land (Dega) which covers the percentage of 32, 53 and 15 respectively.

Wenchi is situated in the range of 1800 to 3280 meters above sea level.

The total area of the woreda is 47,486 Square Kilometers. The woreda's annual average maximum temperature is 26°c and its annual average minimum temperature is 17°c. Its average annual rainfall is 881 mm (WARDO, 2005).

In rainy season, the climate is suitable for agriculture. The period between the months of June to mid of September is the peak time of rainfall in the area. Autumn (Belg) rainfall occurs between March and May. The *Belg* rainfall is erratic in some years. Spring (Tseday) rainfall is from half of September to October and it is essential for crop development but most of the time the rainfall is not sufficient for crops maturity. Therefore, such erratic nature of rainfall might contribute to the declining of rain-fed agricultural production.

Wenchi Woreda has 23 kebele Farmers Associations with total population 103,119 (52,336 females and 50,783 Males). Of the total population, only 2 percent is urban population. Farmer Association is subdivided into small development team which is called *'Gare Misome'*. *'Gare misome'* has about 20-30 members of households. The development team *(Gare misome)*was organized according to the geographical settlement pattern of the households (sefer).

In the woreda about 20,824 students were attending both in the first cycle and in second cycle (Zone Capacity Building Office 2005). The enrolment ratio of the first cycle is higher than the second cycle. Totally, the education coverage for primary school is 64.81 percent.

Concerning health services, Wenchi Woreda has two clinics and five health centers and this made the woreda's health service coverage grow to 43 percent in 2005

In the woreda about 51.5 percent of the land is cultivated from the total land areas. This is because most of the high land areas are terrain and not suitable for cultivation. 30 percent of the area is irrigated out of the total 2,334 hectors of irrigable land (WID, 2000).

There are 75 irrigation schemes in the woreda, of which 2 schemes are modern irrigation schemes and 73 are traditional. About 29,000 families are directly benefiting from all schemes. In the woreda there are about 6 perennial rivers, many springs and ponds which are used for irrigation. Metti-Walga irrigation scheme is one of the modern irrigation schemes in the woreda.

The main types of soil in the woreda are red soil, blue soil, black soil and sandy loam soil that constitute 48.6%, 35.9%, 8.5% and 7% respectively (WADO, 2005).

Mountains like 'Tullu Bilacha, Goro Wenchi, Sonkolle, and Tullu Qorii' are found in the highland of the woreda. Lake Wenchi is also found in this high land.

According to Woreda Agriculture and Rural Development Office (WARDO, 2005), the main rain fed crops are teff, wheat, barley, sorghum, beans, maize and chickpeas.

Irrigated crops are onion, potato, tomato, maize, bean, sugarcane, carrot, pepper and other different vegetables. Irrigated crops like maize and potato are harvested during very critical period of July and August when the food stock from main rain production is fully used-up.

CHAPTER FOUR

4. RESULTS AND DISCUSSION

4.1. Metti-Walga Irrigation Scheme

Metti-Walga Irrigation Scheme is a small-scale irrigation scheme. The irrigation water for the scheme was diverted from the Walga River. The conveyance system is open-canal gravity flow system and the length of the canal from the upper stream to the down stream is about 7 km. The Irrigation scheme was upgraded to modern irrigation in 1999 by Oromia Irrigation Development Department (OIDD). Within the scheme, about 203 hectares of land have been irrigated and the number of irrigators is 740 households.

4.2. Background information of irrigator households

The total number of irrigators in the scheme was 740 and out of this population 105 heads of households were covered in this survey study. The general backgrounds of the respondents are described as follows.

4.2.1 Age, Education Background and Experience of irrigators

As it is presented in Table 4.1, 81 percent of the irrigators have more than 10 years experience in irrigation activities. Among the irrigators 11.4 percent are young educated farmers who have recently joined the Water Users Groups. The age of most of the irrigators (70.4%) ranges from 29 to 50 years.

Table: 4.1.Respondents' Age, Educational Background and Experience in Irrigation

Age Groups	Education Background				Experience in Irrigation (yrs) n = 105			%
	Illiterate	Reading and writing	1-8 grade	Above 8	1-10	11-20	Above 20	%
18-28	-	-	8	4	12	-	-	11.4
29-39	6	2	14	18	3	17	-	38.0
40-50	15	5	6	3	-	12	17	32.4
51-61	11	2	-	-	-	-	-	18.1
62-72	6	1	-	-	-	-	15	14.3
73-83	4	-	-	-	-	-	4	3.8
Total %	42(40%) 40%	10 9.5%	28 (26.7)	25 23.8%	15 14.3%	49 46.7&%	36 34.3%	100%

Source: Household Survey, 2005

Significant proportion of respondents (60 percent) is literate out of these, 26.7 percent of the irrigators are in between grade 1 to 8, and whereas 23.8 percent of irrigators are above grade 8. The remaining 40 percent of the irrigators are illiterate and yet they have long experience in irrigation.

4.2.2. Family size of the irrigator households

Table 4.2 indicates that most of the respondents (83.8 percent) are in the range of 3-8 family size. The average family size per household in the sample population is 5.5 people.

Table 4.2: Distribution of Family size per Household

Household size n=105	percent
1-3	6.7
3-5	45.7
6-8	38.1
9-11	9.5
Total	**100**

Source: Household Survey, 2005

The contribution of family labor to traditional agriculture is seen as the most important factor of production. Child labor is used for cattle rearing and harvesting irrigated crops during part-time such as before and after school attendance. Hence, 93.3 percent of the HHS has three and above children.

4.3. Agricultural Land in the Irrigation Scheme

4.3.1. Irrigated land and its productivities

Integrated farming system needs irrigation for efficient land use. The aim is for optimum use of every square meter of land with every cubic meter of water and full employment for the people on the land (Arora, 1986:45). Controlling and preventing soil deterioration and improvement of soil through water management is possible to maintain sustainability of irrigation, which is essential for increasing production.

Water application to the soil makes a favorable environment for the growth of crop plants; however, inappropriate and inefficient irrigation has adverse effects on proper utilization of water and

damage productivity of the land. This study showed that irrigation management activities are inefficient in Metti-Walga Irrigation Scheme due to poor canal conveyance and distribution system, poor field application system, and inadequate and absence of drainage system. Punmia (2002:688) noted that the percolation and seepage loss of water from canal is a dual loss in as much as water that could be utilized for irrigation is wasted; in addition, the same causes damage agricultural land or makes unfit for cultivation due to water logging.

In the scheme, farmers have both irrigated land and non irrigated land (dry land). Dry land is cultivated in summer of rainy season. Both dry land and irrigated land have not been redistributed since 1975. Thus, irrigators possess unevenly distributed irrigated plots of land. Some individuals have had large cultivated land in scheme area while others have had small cultivated land in the scheme since the irrigating scheme area was not considered when land was distributed. As a result, it may be one of the reasons why optimum use of irrigated plots of land with proper management has not been perceived by most of the irrigators.

Currently, Out of 660 hectares of irrigable land, only 34.8 percent is irrigated. The number of irrigators or head of household is 740 and the number of direct beneficiaries is about 4000 (Woreda Irrigation Department, 2005).

As indicated in Table 4.3 below, the number of irrigators has increased from time to time. This shows that the demand for irrigation water is increasing in the scheme.

Table 4.3: Irrigated land (ha), Number of Irrigators by Sex and irrigated land per Person from the year 2002/03 to 2004/05

Year	Irrigated land (ha)	Number of irrigators			Irrigated land per person in(ha)
		Male	Female	Total	
2002/03	247	605	25	630	0.39
2003/04	194	677	33	710	0.27
2004/05	203	700	40	740	0.27

Source: Woreda Irrigation Department, 2005

Irrigated land in the year 2002/03 was 247 hectares of land. This number was reduced to 203 hectares of land in the year 2004/05. Hence, the irrigated lands per person decrease from 0.39 hectare per person to 0.27 hectare per person the is not only for the causes of increasing the number irrigators but also by declining of cultivating land.

The other problem of the scheme is declining of the production. As presented in Table 4.4, the trends of irrigated crops Production particularly, for onion and potato were in the state of declining. One of the reasons for the decline of these productions is decline of land productivity.

Table 4.4: Production of Irrigated Crops in the Scheme from 2002/03-2004/05

Crop type	Quantity	Production 2002/03	Production 2003/04	Production 2004/05
Onion	Quintals	4,800	3,500	3150
Tomato	"	10,000	12,000	15,000
Potato	"	20,000	16,000	16,600

Source: Woreda Irrigation Department, 2005

The production of onion was reduced from 4,800 quintals to 3150 quintals in 2004/05 and that of potatoes decreased from 20,000 quintals to 16,600 between 2002/03 and 2004/05. But, the

production of tomato increased because farmers inclined to the production of tomato.

4.3.2. Size of Irrigated Land in the Scheme

To analyze the ratio of irrigated land to total irrigable land, the respondents were asked the size of irrigable plots of land they have and the size of plots of land irrigated in the year of 2005. As the result of the survey presented in Table 4.5, only 43.9 percent of land was irrigated of the total of 152.05 hectares of irrigable land.

Significant proportion of the irrigators (29 percent) have no irrigable land which was given to them . Most of these irrigators were not member of Farmers' Association during land distribution in 1975. They were not old enough to be a member of Farmer Association; hence, they did not get plots of land. They have got a plot of land from their parents or they may rent from other farmers or they may use both cases.

Table 4.5: Number of irrigators possessed irrigable versus Irrigated Land in hectares

Plots of land (ha)	Mean average (ha)	Number of irrigators possessed irrigable land (ha) n=105			Number of irrigators possessed irrigated land (ha) n=105		
		Frq.	Percent	Average irrigable land (ha)	Frq.	Percent	Average irrigated land (ha)
< 1	0.5	30	29	15.00	98	93	46.50
1.1-2.0	1.55	57	54	88.35	7	7	17.85
2.1-30	2.55	15	14	38.25	-	-	-
3.1-4.0	3.55	3	3	10.65	-	-	-
Total		**105**		**152.05**	**-**	**-**	**66.85 (43.96%)**

Source: Household Survey, 2005

The remaining farmers (71 percent) have more than one hectare of irrigable land. Out of these farmers, 93 percent are irrigating less than 0.5 hectare of land on average. It can be concluded that two third of irrigable land has not been irrigated.

To identify the main factors why they were irrigating only limited plots of land out of large potential of irrigable plots of land, the respondents were asked to state the reasons. As shown in Table 4.6, most of the irrigators (50.1 percent) indicated that the cause to irrigate limited plots of land is fear of decline in productivity of land due to water logging.

36.2 percent of the irrigators reported that shortage of water due to mismanagement of irrigation water resulted in irrigating limited plots of land. However, lack of finance to purchase inputs and lack of oxen are not serious problems in the scheme.

Table 4.6: Causes for Irrigating Limited plots of Lands

Causes for Irrigating Limited plots. No.=105	**Percent**
Fear of land degradation due to water logging	50.1
Lack of resources (Financial a materials)	14.3
Shortage of water	36.2

Source: Household Survey, 2005

Shortage of water increases at the beginning of the year when the demand for water is high. But from March to May the demand declines since harvesting of irrigated crops is completed. During these months, most of the farmers do not use water even if it is sufficiently available. That is, instead of using irrigation water, they wait for rain. As it was reported by the respondents,

that is fear of land degradation due to water logging. The productivity of irrigated land is declining more compared with non-irrigated land.

Some of the farmers who have large cultivated land in the scheme irrigate the lands for more than 3 interval years. Most of those irrigators (who have large irrigable land in the scheme) responded that the value of irrigable land is three fold higher than that of dry land. But they do not rent their land because of fear of declining productivity of land by irrigating every year.

4.4. Irrigation Management Activities in the scheme

Irrigation is an arena of struggle where social actors negotiate and decide on technological choice and management of water.

Irrigation water management activities have a number of interrelated activities such as organizational activities, control structure activities and water use activities. Irrigation management activities of Metti-Walga irrigation scheme review as follows.

4.4.1. Organizational Activities

Irrigation development and management is a social process in which different stakeholders interact to make irrigation system effective and efficient. Metti-Walga irrigation scheme was developed by the initiation of university students with farmers in 1975. During the Imperial regime, the river was diverted by one of the local landlords for the purpose of water mill operation. The local farmers could not use the water for irrigation because the landlord did not permit the water for irrigation. In 1974 when students of Addis Ababa University

raised the question of land for tenants, the students who were born in the area raised the question related to the necessity of giving irrigation water to local irrigators in addition to land.

They organized the local farmers and enforced their questions. After the collapse of Imperial regime, the questions of irrigation water and land were answered at the same time for local people.

Before the irrigation scheme was developed to modern irrigation scheme, management of the scheme had taken place by the farmers through traditional line under social leaders (Shanachaa) for about 21 years. *Shanachaa* is the social coordinators and responsible for the operation and maintenance of the irrigation activities. At that time even though there were no clear written bylaws, every farmer participates in canal cleaning and maintenance. Currently, the organizations that are responsible for irrigation management activities in the Metti-Walga Irrigation Scheme are irrigators and Government Institutions

4.4.1.1. Irrigators

Irrigators were organized in the form of Water Committee (WC), Water Users Groups (WUGs), and Irrigation Groups (IG). The structures of irrigators' organizations are as follows

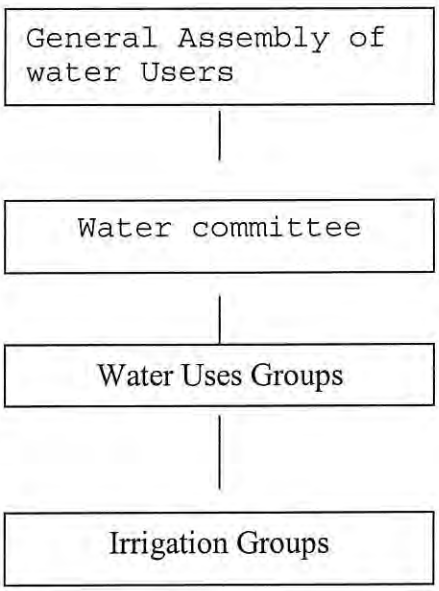

Fig. 4.1. The irrigators' organization

After the irrigation scheme had developed to modern system, the irrigation scheme management was transferred to the Woreda Agriculture and Rural Development Office (WARDO). Again, WARDO transferred direct management of the scheme to the Water Committee. Water Committee members were elected by irrigators with initiation of Woreda Administrative Officials and Woreda Agriculture and Rural Development Office. Water committee members were elected based on their ability and respect to the community. Water Committee has a chairman, a secretary, a treasurer, an auditor and other three-committee members. The committee members are from irrigator households. The committee chairman, secretary and auditor have completed their secondary school education while the other members learned above grade 8.

Under Water Committee (WC), Water Users Groups (*Abbaa shantamaa*) were organized. In the scheme there are 15 Water Users Groups. Each group has 50 members of irrigator households. Again each Water Users Group is sub-divided into 5 Irrigation Groups (*Abbaa*

kudhaanii). Each Irrigation Group (IG) has 10 members of irrigator households. This sub-division is for the purpose of simplifying the irrigation management activities and for smooth operation of the scheme.

Normally, the committee holds a meeting once in a month if there is no special case. Water committee is accountable for the General Assembly and it serves as executive committee. The responsibilities of the water committee are:

- Mobilizing resources (human and financial) for reconstruction and maintenance of the canal network;
- Link between farmers and government institution;
- Controlling water distribution, allocation and resolve water dispute, and
- Collecting annual fees from irrigators and other related activities.

Canal Cleaning

Since mobilizing irrigators for maintaining and cleaning diversion weir and canal are water committees' task, the Committee plans for main canal cleaning and maintenance. As the committee chairman responded, the canal cleaning is at the beginning of the year after the flood is over and at the middle of the year. But the irrigators responded that the main canal is cleaned once a year and secondary canal is cleaned twice a year. However, as it was observed during the field, the main and secondary canals were cleaned only at the beginning of the year.

Canal cleaning and maintenance works are the responsibilities of all irrigators. A person who fails to participate in the work of canal cleaning is fined 5 birr. If a person does not pay the amount he is fined, he will be dismissed from the member of WUG.

Participation in the canal cleaning and maintenance works are not based on the size of the plots or water utilization of individual farmers. Financial source for different activities such as salary for guards and for simple maintenance is collected from irrigators irrespective to the size of the plots or water utilization of individuals. Hence, some of irrigators participate in the canal cleaning and maintenance works may be due to fear of punishments. The consequence of this may affect the quality of cleaning and maintenance works of the canal.

Conflict resolution

The other responsibility of the WC is conflict resolution. Most of the time conflict arises between irrigators when irrigation water is cut out of one's turn. A water dispute is committed when one person cuts irrigation water before other irrigator finishes irrigating his field. When water disputes, first it reported to the Water Users Group Leader. Then, after verifying the case, the committee fines illegal person.

Conflict resolution is one of the management activities in smoothing the operations of the scheme. The conflict is resolved according to the groups' bylaws, which were set by WC and ratified by all irrigators. When dispute cannot be resolved by disputants, it will be taken to water user group leader and the person found guilty will be punished. If the conflict can not be resolved at the level of water group leader, the case will be passed to the Water Committee and it is resolved at WC level. Again, if it is not resolved at WC level, it will be passed to *Kebele Shengo* where the case is finally ended. *Kebele Shengo is a group of people formed in the community to resolve conflicts in the community.*

4.4.1.2 Institutional Authorities in Irrigation Management

The institutions that are involved in irrigation management of the scheme are Woreda and Kebele Administration, Woreda Agriculture and Rural Development Office and Woreda Irrigation Development Desk.

Kebele and woreda administrators are responsible for organizing and consolidating development team which has direct impact on water using activities; checking whether the farmers are provided with inputs or not, and other related activities.

Although the local administrators have direct and indirect responsibilities for managing irrigation activities, as the key informants responded, the Kebele Officials do not support the work of the committee and there is no line of communication between water committee and local administrators.

Woreda Agricultural and Rural Development Office (WARDO)

The responsibilities of the Woreda Agricultural and Rural Development Office are:

- Delivering extension services;
- Giving training to farmers;
- Organizing Irrigators into Semi Cooperatives (ISC);and
- Supplying inputs like selected seeds and fertilizers.

Under WARDO, Woreda Irrigation Department has responsibility of training irrigators on irrigation water management such as field leveling and application of water, using and maintaining different irrigation technologies. But irrigators were not trained and they have not known about improved irrigation technology system.

Regarding to this issue, the head of Woreda Irrigation Department (WID) responded that there are shortage of skilled manpower, budget and materials. For instance, the structure requires 6 experts in WID but including the head of the desk, only two experts exist in the office. shortage of skilled manpower, budget and materials hinder giving training to the farmers.

The other important task of the Woreda Irrigation Department is organizing irrigators into irrigators' semi cooperatives. Farmers are organized into a form of legally registered irrigators' semi cooperative. But in Metti-Walga irrigation scheme only one irrigators' semi cooperative was established in 2004.

The Office of Agriculture and Rural Development provides services through the Development Agent (DA). DA workers give advices to farmers on agricultural agronomy. They serve as two ways communication channel both to convey government directions to farmers and inform farmers' needs or problems to Woreda Agriculture and Rural Development Office. However, in the scheme, there is one DA worker and as the head of WID reported, DA workers have inadequate skill about irrigation. Besides this, DA worker did not motivate to the work due to lack of incentives.

4.4.2. Water Control Activities

Water control structure in irrigation is referred to as the physical control of water flows. In this study, the means of conveyance structure is the canal network. Water flows from diversion to farmers' fields through canal system. Controlling structural activities are including activities like design, construction, and operation and maintenance of the canal network structures.

In Metti-Wlga Irrigation scheme, the diversion weir was constructed by cement and it is diverted in more efficient way and it is possible to control flow of water. Water is diverted into canal network system which consists of main canal, secondary canals called distributaries and field canal. The diversion, the main canal and distributaries are operated and maintained by the farmers.

The length of the canal from the intake to the end of farmers' field is about 7 km. After 2 km. from the intake, the main canal is divided into the right and the left side. The one diverted to the left is again sub-divided into two distributaries and they distribute water to the villages called *Mishig, Jigo* and *Doyyu* from which about 300 irrigators have used.

The canal diverted to the right is again sub-divided into three distributaries. They distribute water to the *Dullele, Yayya, Wandimitu, Qanno,* Gurra and Cabo, Gabatu, Abibi and Galeyyi sefer. The distributaries have no division boxes. Irrigators in each sefer are organized in one water users group and each Water User Group has about fifty irrigators.

As far as the construction nature of the canal network is concerned, the main canal is lined at the upper stream for only 30 meters. About four drop structures, five outlets and two division boxes are also constructed on the main canal. All distributaries and the large parts of the main canal are unlined. According to the experts of the Woreda Irrigation Department, the construction structures were below standard and as a result within few years all structures became out of use. During field study, it was also observed that control structures were destroyed. As it can be seen on the photograph, the dropping structures did not match with the slope of the canal level, thus, water could be diverted from the dropping structure.

Photo 4.1: Dropping Structure of the Main Canal

Photo 4.2: division Structure of Channel to Wandimtu Sefer

Lack of division boxes of distributaries also causes water leakage.

Weed and silt of the distributaries were cleaned at least once in a year but the maintenance of structures has not been done by government since the development of the irrigation since 1999. At present time, the canal structures get damaged. As it was described by the Water Committee and responded by irrigator HHs, maintenance of the canal especially, canal stretched to "Mishg sefer" is beyond the capacity of the farmers. This was confirmed by the investigator during field observation. This canal passes through black and sandy soil so that the canal embankment became breached (see on the photo 4.3).

Photo 4.3: Channel to Mishg sefer

Generally, as it was observed in the field and reported by key informants, the structural design of the network system has the following problems:

- Lack of drainage system;
- Absence of cut-off drain floods;
- Lack of division boxes at distributaries; and
- Faulty design structure.

4.4.3 Water Use Activities

Water is allocated to the Water Users Groups of each 'sefer' depending on the number of irrigators. Each group has 50 irrigators; for one group, water is allocated for 48 hours. This allocation criterion neither considers the location of the 'sefer' (whether they are at head or tail end) nor does the pattern of the crops, the crops' stage of growth and canal conditions.

The distribution of irrigation water is on the bases of rotational schedules. Irrigators receive a regular supply of water through gravity distribution system.

Irrigators can get water at a fixed schedule. If an individual misses to irrigate his field because of shortage of water or other factors, he will irrigate his field during his next turn. Depending on these issues, the respondents were asked whether they face water shortage on water distribution and whether the water reaches their field on time. Subsequently, the results of the study survey are summarized in Table 4.3 and Table 4.4 as follows:

As it indicated in Table 4.7, most of the respondents (81 percent) have faced shortage of water for irrigation, particularly those farmers found at the tail end and those whose canal is in bad condition (for example channel to Mishig Sefer).Though the respondents answered multi reasons for the causes of the problem, 58.1 percent of the respondents responded

that the main cause for water loss is seepage and percolation. The main reason for shortage of water in the study area is canal loss.

Table 4.7: Availability of irrigation water

Do you face water shortage?			**causes for shortage of water**			
Yes/No	No.	%	Reduction in source	Canal loss	Water theft	Design fault
Yes	85	81%	42.3%	58.1%	21.9%	27.6%
No	20	19%	-	-	-	-
Total	*105*	*100*	-	-	-	-

Source: Household Survey, 2005

It is reported that seepage, percolation and leakage are the problems of irrigation system of the scheme. Thus, inadequate maintenance as well as faulty design of controlling structure would result in canal loss. Inadequate maintenance of the canal is the indication of poor management of the controlling structures.

Generally, factors for water loss are design faults of structures, nature of the construction, inappropriate operation and maintenance of the irrigation network system.

The other problem for shortage of water is the reduction of source of water level. 42.3 percent of irrigators reported that decline in the source of water level causes shortage of water. There are many factors for declining source of water level (the river flow). One of the factors for declining of river flow in the study area is the ever increasing demand of the irrigation development. For example, when Metti-Walga irrigation Scheme was developed, there was no irrigation scheme on upper and lower

streams. But currently, about seven schemes were traditionally developed in upper stream while three schemes were developed in lower stream. Hence, competition for water supply is other factor for shortage of water in the study area.

Design fault and water theft also contributed to shortage of water that aggravated the scarcity of water in the scheme.

The other problem is a delay of water to reach the fields of the farmers on the allocated time. Water does not reach most of the farmers within the time allocated to them. As it is shown in Table 4.8, most of the respondents (59.0 percent) reported that water does not reach their fields on the allocated time whereas 41 percent of the respondents (irrigators of the upper stream) reported that they have no such problem.

Table 4.8: Availability of Water on time and Reasons for Delay of Water to reach the fields

Availability of water on time			**Reason for delay of water to reach farmers field in allocated time**			
Does water reach your field in allocated time? No.105			**Design fault**	**Distance of the field**	**Canal loss**	**Water theft**
Yes/No	Percentage	No.	-	-	-	-
yes	41	43	-	-	-	-
No	*59*	*62*	*26.6%*	*20.9%*	*52.4%*	*14.3%*
total	*100*	*105*	-	-	-	-

Source: Household Survey, 2005

As indicated in Table 4.8, canal loss is the main cause for delay of water to reach fields of the farmers. 52.4 percent of the respondents reported that the reason for delay of irrigation

water to reach the irrigated field is seepage and percolation of the canal.

26.6 percent of the irrigators reported that design fault of the canal is a cause for delay of water to reach their fields on time. For instance, the slope of the canal stretched to '*Qannoo*' and '*Gurraa*' sefer reduces the speedy flow of water. As a result, it created a delay of water to reach farmers' field on time.

The problem of water delay is more serious at the tail end and at places where canal design is faulted and destroyed. Where canal design is faulted and destroyed, the irrigators wait for a longer time until the water reaches their fields.

14.3 percent of the irrigators reported that water theft is another cause for delay of water to reach the fields. When water distribution is interrupted because of water theft, the water supply disappears in the canal. Water theft is one of the causes, which create conflict among the irrigators. It has been attempted to manage this dispute using bylaws. However, the problem still exists.

The other cause for the wastage of water in the scheme is the distance that water flows to the irrigated fields. As it was indicated in table 4.8, some of the irrigators (20.9 percent) reported that the distance of the irrigation fields is the cause for delay of water. As was observed in the field study, distance of irrigators' field in the same irrigation group or even irrigation fields of individual irrigator are far from each other. Within one group, irrigators' plots of land are far from one another. Irrigating the fields of one farmer, and passing to other farmer's field takes longer time. Therefore, the water is lost across the fields.

Hence, canal loss (due to seepage and percolation), water theft, design fault, distance of the farmers' field are the factors that contributed to the delay of water and wastage of irrigated water.

The efficiency of the delivery of water from diversion weir to the field depends on the efficiency of conveyance of the main canal and distributaries. To analyze the main cause of canal loss, the perception of respondents were asked a question 'what factors contributed to canal loss?' The responses to this question are presented as follows in Table 4.9.

Table 4.9: Perception of irrigators about water loss

Reasons for water loss N =105	**Percentage**
Over flows of water	9.4
Seepage and percolation of water	37.2
Leakage of water	20.9
Fault design structure	32.4

Source: Household Survey study

As indicated in the above Table, 37.2 percent of the respondents reported that water loss through canal is the main cause for irrigation inefficiency. Water loss due to seepage is found to be most serious. In relation to this, the study conducted by Punmia (2002:693) indicated that seepage loss depends mainly upon position of subsoil water table; probity of soil and subsoil; extent of absorbing medium; and design of canal cross section: that include depth of water in canal (the greater the depth, the greater will be the loss) and velocity of water (the lower the velocity, the greater will be the canal loss).

32.4 percent of the respondents reported that design fault of the structures result in low efficiency in irrigation. Design fault structures are related to slope of the canal that slow the

velocity of water thereby increasing water seepage and percolation.

The other cause for low efficiency of the irrigation is leakage of water due to lack of division box structures. 20.9 percent of irrigators reported that water leakage reduces efficiency of irrigation.

The other problem of irrigation inefficiency is the method of field application. As observed in the field, the irrigators rarely practiced land leveling before irrigation. The farmers use furrow irrigation method with uneven bottom irrigation system that causes water loss during surface irrigation.

The other problem with water management activity is irrigation scheduling. Time of the irrigation scheduling is fixed in which each irrigator gets water within 15 days. But proper management demands the application of water at a time of actual need of crop with enough water to wet the effective root. Thus, watering all crops on a fixed frequency has a problem because success in irrigation depends on watering of actual requirements that various crops need. That is, different crops have different critical stages or flowering stages in which care must be taken in watering the crops. Hence, in the scheme, irrigation scheduling has problem because water application is not based on the types of crops, stage growth of the crops and soil conditions.

CHAPTER FIVE

5. IMPACTS OF IRRIGATION ON AGRICULTURAL LAND, CROP PRODUCTION, INCOME GENERATION AND EMPLOYMENT CREATION

5.1. Effects of Irrigation on Agricultural Land

Controlling and preventing soil deterioration and improvement of soil through water management is possible to maintain sustainability of irrigation. In the scheme, irrigation land is in the process of converting to other uses or to water shallow and abandoned areas. The utility of irrigation system have been in the state of diminishing. Poor water controlling structures particularly at high permeability of soil texture in the scheme resulted in high seepage and percolation

Water percolated from the canal through the underlying and flows to lower lying land and causes water logging. In other case, the absence of drainage management system in the field aggravates the problem.

Photo 5.1: Water Logging in Jila Area

The above photo 5.1 is the photograph of "Jila" area. As it is seen on the photograph, more than half of the cultivated land below the main canal is converted into water logging

As irrigators responded, before 5 years all the land bellow this main canal was used for cultivation but gradually, more than half of the cultivated land was converted into wetland at the bottom of the field. The irrigated land below the main canal has been converted to water logging because water percolation, seepage and surface runoff during field application.

One of the guards of the diversion weir noted that the irrigated land was not converted to water logging overnight but it gradually increased its coverage. Therefore, if the remedial action is not taken within a short period of time, all the cultivated land below the canal jila area will be changed to water logging.

The absence of field drainage system at the bottom-irrigated land aggravated the problem. The irrigators responded that they have not known about the use of the drainage system because they were not trained about the use of drainage system.

Photo 5.2 Ambacho land area in the process of converting to wetland

The above photograph shows that the land is on the way of being converted to water logging in Amabacho areas. Ambacho is situated below the Jila area. The land has not been used for cultivation since it was converted to wetland but it is used for grazing especially during dry season. The other area that converted to water logged is Gayo area.

Photo 5.3 Gayo Area Land converted to water Logging

Gayyo area is lower lying land. The area is between the canals extended to the Gabatu and 'Yayya sefer'. Seepages from these canals are percolating from higher elevations to the lower lying area (Gayyo area). As it is seen on the photo 5.6, the cultivated land is changed to water logging.

The other areas that were converted to water logged like Gayoo are Obe, Walga, Garrami, and Galeyyi areas.

Photo 5.4: Garrami land converted to Water Logging

When the irrigated land is converted to water logged, it may be used for grazing. But Garrami area is completely changed to wetland. It is not used for grazing even during dry season.

5.2. Effects Of Irrigation on crop production, Income generation, Employment creation

This section deals with effects of irrigation on agricultural production, income generation and employment creation. Irrigation technology has socio-economic effects since it affects people's livelihood through crop production, employment creation and income generation. Irrigation has a means of attaining greater food production through increasing production and productivity not only for subsistence crops but also for commercial crops. It means irrigation may secure subsistence and support limited commercial elements.

5.2.1. Crop Production

In the irrigation scheme, most of the farmers are able to produce more than two times a year by using irrigation.

Rain-fed production is largely cultivated during main season (June to September). Most of the time rainfall during the main season is adequate but it temporal distribution is irregular in the 'Belg' season. The main rain-fed crops cultivated in the area are teff, maize, wheat, barley, bean and sorghum.

The irrigated crops grown in the scheme area are onions, tomatoes, potatoes, sugarcane, pepper, carrots and other vegetables. The dominant irrigated crops are onions, tomatoes and potatoes. The farmers prefer such dominant crops in order to get better price in the market. Crops like maize and bean are also grown for the commercial purposes. In the recent year, the farmers have increased varieties of irrigated crops.

On the other hand, irrigated lands particularly in lower-lying areas are in the way of being converted into water logging, which have adverse effects on the yields of the crop.

To identify the types of crop failed and to examine the main factor for crop failure, the respondents were asked whether they have faced the problem and they specified those crops frequently lost as well as the causes for the failure of the crops. As a result, most of the respondents (89 percent) reported that they have faced problem of crop failures in partial and /or in total.

Table 5.1: Crops frequently lost in partial and/or total

Crops frequently lost				**Partial lost**	**Total lost**
Yes/No	%	Irrigated crop	Rain fed crop	%	%
Yes	89	-	Beans	45.7	33
		Onion	-	68.6	-
		Potato	-	34.3	-
No	11	-	-	-	-
Total	100	-	-	-	-

Source: Household Survey

The production of irrigated crops like onion and potato are lost in partial. 68.6 percent of the respondents responded that the production of onion declined. As presented in Table 6.1, some of the irrigators (33.3 percent) reported that the production of beans was totally lost and they did not grow beans. 45.7 percent of the irrigators reported that they have grown beans but the production is declining because of the rise of water table.

As it was discussed in FGDs, irrigated crops like onion and potato production have been declining from time to time. As most of the farmers responded that before 10 years, 10-15 quintals of onion were produced from 0.25 hectare of land. Before five years, the production was reduced from 10-15 quintals to 7-12 quintals. Currently, the production reduced to 4-7 quintals from the same amount of plots of land. Though the production of potato also reduced, its reduction is not as much as the onion. From their

experiences, the farmers attributed to the land degradation, which is a result of water logging. As a result of water logging, 20 hectares of cultivated land was totally abandoned and large area of cultivated land reduced its productivity.

Table 5.2: Causes for Failure of Crops

Causes for Failure of Crops No.105	Percent
Shortage of water	25.8
Water logging	52.0
Crop disease	22.2

Source: Household Survey

As indicated in table 5.2, the main reason for crop failure is land degradation due to water logging. The other causes for crop failure are crop disease and insufficient crop watering. Most of the farmers (52.0 percent) responded that irrigation land declines in productivity of irrigated crops.

25.8 percent of the respondents reported that the other cause for decline of crop production is shortage of water for irrigation. Therefore, land degradation due to water logging and inadequate frequency of watering the crops due to shortage of water resulted in decline of irrigated crops.

5.2.2.Income Generating

There are many facilities like transport, proximity of the scheme to Walliso and Ambo towns that made better condition for farmers to supply their products for the market. The farmers transport their products on Donkey, Cartage and by Car to deliver their products to market. To deliver their products to market by Car, it takes only about 10 minutes, by Cartage it takes 40-50 minutes, and on Donkey, it takes an hour. Most of the farmers

prefer cartage to transport their products to market. In other ways, some the farmers sell their products like tomatoes on the field. Many retailers go to the scheme from Addis Ababa and Wolliso to purchase the crop on the field. In general, the construction of road from Wolliso to Ambo town along the scheme and the proximity of the area to these towns created market accessibility.

Most of the production of the irrigated crops are supplied for market. Farmers produce irrigated crops like potatoes and onions and take to Walliso town for sale. As presented in table 5.3, 23.8 percent of irrigators have got more than 2,800 birr from irrigated crops annually. Irrigators who diversify their irrigated crops are compensated if one crop decrease in production or price from one crop.

Table 5.3: Sale of Irrigated crops and rain fed crops for the year 2005

Sale in birr	Irrigated Crops n=105	Rain-fed cops n=105
	Percent	Percent
No sale	-	51.4
< 200	6.7	19
200-800	9.5	24.8
801-1400	25.7	2.9
1401-2000	19.7	1.9
2001-2800	14.3	-
> 2800	23.8	-
Total	**100%**	**100%**

Source: Household Survey, 2005

In the scheme, most of the rain-fed crops are used for subsistence. 51.4 percent of the irrigators have not produced surplus production for sale. However, 48.6 percent of the irrigators supply their grains for sale. The most rain-fed crops supplied for sale are teff and wheat.

In the scheme, the price of irrigated crops increases from time to time. As presented in table 5.4, the price of irrigated crops has increased two fold within five years. For instance, the price of onion before 5 years was 60 birr; tomato 80 birr and potato about 30 birr per quintal. But now, it has increased to 130, 180 and 80 birr respectively.

Table 5.4: Trends of Price for Irrigated-crops

Crops	Unit	Price of crops in different years (birr)	
		1992	1997
Onion	Quintal	60	130
Tomato	"	80	180
Potato	"	30	80

Source: Survey study

The road from Wolliso to Ambo town created favorable market for the farmers' production. It makes favorable condition for the retailers to go to the field and buy farmers' products with good price. Moreover, the farmers easily transport their products to the market.

In the scheme one Irrigators Semi Cooperative (ISC) was established. This cooperative has been searching for market to get a good price for the irrigated crops. The ISC communicate with Oromia Saving and Credit Association in order to get credit from this organization. With this credit fund, the ISC purchases tomatoes and other irrigated crops from farmers to send to Addis Ababa and Djibouti market. As key informants responded, the farmers got good price from tomatoes in 2004/5. Private dealers purchased one Box of tomatoes for 20 -25 birr but the Cooperative purchases the same amount of tomatoes for 30-40 birr and also

share the dividend to the farmers. ISC do not purchase only for the purpose of profiting but for stabilizing the price.

Respondents were asked whether they have got good price from their products or not. As the result of survey study, most of the irrigators (72.9 percent) responded that they have got good price for their products. The rest of the irrigators responded that they could not get good price for their products.

The reason why they could not obtain good price is lack of adequate farmers' cooperatives that stabilize the price of irrigated crops and for the increases price of inputs. The price of onion, potato and tomato fluctuate depending upon the size of supply. It increases when the supply is at minimum and decreases when supply of the products increases. The other problem is related to the nature of the product. That means, it is difficult to store vegetables for a long time to sell when the price increases.

The respondents were asked whether their income increased or not due to irrigation scheme. 65.2 percent of them reported that their income increased while 34.8 percent reported that their income had not increased.

Table: 5.5: The status of irrigators income in the Scheme

Does your income increase due to irrigation? n = 105			
Yes/No	Yes	No	Total
Number	79	26	105
Percent	65.2	34.8	100

Source: Household Survey, 2005

The income of most irrigators increased because of good price of the products and diversification of crops. During FGDs farmers reported that their income did not increase due to the low production and low demand of crops in harvesting time. The other

problem raised was, the price of inputs like fertilizers and selected seeds were the causes for low income of farmers. The cost of these inputs increased more than the price of their production.

Most of the irrigators reported that more income is generated from the irrigated crops compared to income from rain fed crops. In relation to this, what was mentioned during Focus Group Discussion was that if there is no irrigation, they could neither pay their expenditures nor could feed themselves properly.

The respondents were asked about the source of finance to purchase inputs like selected seed, fertilizes and pesticide for irrigation.

As indicated in the following table, 90.5 percent of the irrigators purchase inputs on their own whereas 9.5 percent of the irrigators purchase the inputs by borrowing money from private creditors.

Table 5.6: Source of Finance to Purchase Inputs

Source of finance	**Percent n= 105**
Borrowing money	9.5
Saving	42.8
Sale of livestock	30.5
Sale of rain fed crops	17.2
Total	**100**

Source: Household Survey, 2005

42.8 percent of irrigators purchased the inputs from their savings in the form of cash and assets. Hence, starting saving is one of the indicators of increasing income of the irrigators in the scheme.

5.2.3. Employment creation

This study indicated that the family members of the irrigators involved in different types of irrigation activities such as plowing, planting, weeding, watering and harvesting. In addition, most of the young children have their own irrigated land and work on wage bases for other person.

Table 5.7: Daily laborers hired by irrigators

Have you hired daily laborers n=05				**Number of daily laborers hired**
Yes/No	%	No. of Laborers	%	
Yes	81	1-3	71.4	2x70=140
		4-7	9.6	6x10= 60
No	19	-	-	-
Total	**100**	-	81	200

Source: Household Survey, 2005

As presented in Table 5.7 in average 200 number of laborers have been required in addition to the labor of family members during harvesting, weeding and planting irrigated crops. The data obtained from Wenchi woreda Irrigation Desk also support the findings of this study in that irrigation scheme create job opportunity for 396 laborers per irrigated hectare (WID, 2005).

In other case, women informants said that the development of the irrigation benefited them in reducing the time spent for fetching water from distant areas besides irrigating their fields and income creations. Most of the time, fetching water for domestic use and drinking is the responsibility of women. To discharge this responsibility, women seek assistance from children (particularly girls). Since irrigation has been introduced, the

time spent on fetching water is reduced. Problems related to shortage of time that affect them to complete other tasks have been solved. Hence, the participations of women on production activities increased. Subsequently, problems related to wastage of time for school girls who are traditionally expected to assist their mothers in fetching water instead of devoting their spare time for study is also solved.

CHAPTER SIX

7. SUMMARY, CONCLUSION AND RECOMMENDATION

7.1. Summary and Conclusions

7.1.1. The objective of this study is to examine water management activities of Metti-Walga irrigation scheme and effects of irrigation on income, employment generation and crop production. To achieve the objective of this study, the first hand information was collected using different techniques. The techniques employed to collect primary data were questionnaire, FGDs, interviews and observation. Qualitative data were collected using FGDs, interviews and observation. In FGDs, deliberately selected households were participated. WARDO heads, experts, WC members, kebele and woreda officials were interviewed. Out of 740 total populations, 105 sample respondents were contacted for this study purpose.

7.1.2. The transport of water from the source of water to the farmers' field is through canal network. In order to make these technologies efficient, proper controlling structures of the irrigation system is required. However, in the scheme, inappropriate control structures convey water from the source of water to the farmers' field. The structures of the canal network system have the following problems.

- Canal structures are unlined and old,
- Distributaries have no division boxes,
- Dropping structures are damaged and the canal embankment is breached,
- The scheme lacks drainage structures,

- Absence of cut-off flood,
- Design faults, and
- Lack of adequate maintenance and operation.

Controlling activities such as maintenance, operation and reconstruction of the main canal and distributors are inadequate. Generally, controlling structures are in poor management. 90.5 percent of the respondents responded that the controlling structures are not efficient to convey water from intake to the irrigated fields.

7.1.3.Water use activities are also inappropriate. Water allocation to each village (sefer) of WUGs does not consider distance of the 'sefer' and conditions of the canal structures. At the same time, water is not fairly distributed in the scheme. 38 percent of the irrigators reported that they have faced shortage of water for irrigating their crops. It was identified that the factors for shortage of water are canal loss, design faults and water theft. A canal loss due to seepage and percolation is the main factor for shortage of water. Hence, low irrigation efficiency in the scheme was caused by conveyance loss and field-level loss

7.1.4. Unavailability of water on allocated time is another problem of the scheme. Water does not reach the farmers' field on time it allocated. 59 percent of the irrigators responded that they are affected by this problem. The factors for delay of water on the way to reach farmers' field are seepage of water, design fault, water theft and distance of the irrigated fields from one another.

7.1.5. Irrigation schedule practices of the scheme are poorly managed. That is, fixed schedule is applied without considering the amount of water needed by various crops. Apart from this, irrigation fields are not leveled and it resulted Poor field application. These factors cause irrigation inefficiency in the scheme.

7.1.6. Irrigation system consists of institutional and physical structures. Irrigators were organized in the form of IG, WUG and WC in order to make the operation of the scheme smooth. Framers and different stakeholders interact with one another to make decisions regarding the contribution of labor, local materials, and finance for O&M of the irrigation system. However, in the scheme lack of integration of the organizational structures make the irrigation system mismanaged. The interaction and coordination among the organizational structures have not been adequate.

Shortage of skilled manpower, lack of budget, lack of coordination and integration among organizations, and lack of awareness about improved technologies are some of the constraints in managing irrigation water properly. Irrigators have strong interest to contribute local materials and labor to the work of irrigation canal system but lining and reconstructing the canal structures are beyond the capacity of the farmers in terms of finance and knowledge about designing and canal construction.

WC has the responsibilities of allocating and distributing water to the irrigators, organizing and mobilizing the irrigators to the work of irrigation system; yet, the committee members are not skilled and trained to realize their responsibilities. As a result, the main canal and distributaries are in poor condition. Generally, in the scheme, there are the following problems:

- Lack of adequate training to irrigators;
- Lack of fund for maintenance and operation;
- Due to lack of awareness about the drainage system, the farmers do not use the drainage system;
- Farmers are not trained on crop calendar and irrigation technology system;
- Lack of organizational coordination and integration; and
- Lack of adequate skilled manpower and material in WARDO

Therefore, poor controlling activities and inefficient use of irrigation water in the scheme have resulted in conversion of cultivated land to non-cultivated land and reduction of productivity of land in the scheme. Conveyance loss and field-level loss cause shortage of water and land degradation, which in turn result in decreasing agricultural production

7.1.7. In the scheme, limited plots of land are irrigated. The main causes for irrigating limited plots of land are fear of land degradation emanating from rise of water table and shortage of water for irrigation. About 20 hectares of cultivated land are converted to water logging. Out of this total irrigable land that converted to water logging, about half of it is not used both for cultivation and grazing. Agricultural production has been reduced from time to time in the scheme area and yet no one has given due attention to land degradation.

7.1.8. The production of irrigated crops such as onion and potato as well as rain fed crops like beans and teff are reduced while some of them are totally lost. The factors for decline of the yields of irrigated corps are increasing water logging, crop disease and shortage of water for irrigation. Water logging is the main causes for the problem. Even though agricultural production is decreasing from time-to-time, market for production

increased because of the creation of favorable conditions such as the construction of road from Walliso to Ambo, availability of transportation and proximity of the scheme to Wolliso town.

7.1.9. The income of most household (65.2 percent) increased due to good price as well as diversification of crop production. Income earned from irrigated crops is better than income from the rain fed crops.

7.1.10. The scheme also creates employment opportunities. Most of the irrigators (81 percent) hired daily laborers in addition to their families' labor.

In addition to irrigating the fields, the development of irrigation was used for domestic and drinking water supply. It saves the time women could expend in fetching water for drinking and domestic use. As a result, it increased the participation of women in agricultural production and non-farming activities. It also increases girls' school participation in the scheme.

7.2. Recommendations

In order to achieve the objective of irrigation development, the transportation of water from the source to the farmers' field needs efficient canal network to avail sufficient water for irrigation in the scheme. The availability of irrigation water and application of the right quantity at the right time is vital for boosting agricultural production. But as the findings of this study indicated, irrigation scheme has adverse effects on productivity of the irrigated land due to mismanagement of irrigation water.

Therefore, to reduce these adverse effects, possible solutions must be taken to sustain the irrigation services. The following are some of the recommendations to tackle the problems.

7.2.1. To decrease conveyance loss and on-field application loss, control structures must be improved. Provision of division boxes and canal lining particularly at the highly permeable areas are important to improve controlling structures. The canal also needs design improvement to facilitate the gravity flow of water. Improving these controlling systems is beyond the capacity of irrigators. Hence, the Regional government and non-government organization have to give due attention to assist the irrigators in the reconstruction and design of the structures.

7.2.2.The farmers should be trained on how to use better irrigation practices in field application by avoiding run-off water, shortening water runs and land leveling or smooth field surface gradient that help to distribute water uniformly and reduce deep percolation. In addition to the indigenous knowledge, training farmers helps to the efficient use of irrigation water, which also has direct consequences on crop yields. Hence, attention should be given to on-field training of farmers as well as to the rehabilitation of the control structures so as to increase agricultural production and sustain the scheme.

Training of the farmers is the responsibility of WARDO and DA workers. As it was revealed in survey of this study, WARDO has inadequate budget, materials and skilled manpower. Hence, to achieve the objective of the irrigation development, a proper attention must be given by the regional government to capacitate local government.

7.2.3. To reduce the rise of water table, provision of drainage wetland system is important. Lack of drainage system causes water

logging. Currently, the problem becomes serious and getting beyond the capacity of the irrigators to drain wetland. Hence, the government and non-government Organizations in collaboration with the irrigators must take strong measures to drain the wetland.

7.2.4 Success in irrigation depends on watering of actual requirements that various crops need. Water distribution and allocation should depend on the time of actual need of the crop. That is, different crops have different critical stages or flowering stages in which care must be taken in watering the crops. Therefore, the farmers have to be trained on how and when to irrigate their crops.

Generally, it is indispensable to reduce seepage and percolation, which are the main problems in the scheme and which cause water loss and land degradation as well as that result in the decline of the agricultural production. With better water management system, irrigation water could be saved and sustain fertility of irrigated land and increase production. To ensure better management in the scheme, the following activities have to be undertaken.

- Improving and operating drainage system;
- Lining and maintaining canal to prevent seepage;
- Reducing inefficiencies resulting from silt and weed;
- Improving controlling structures of the irrigation scheme;
- Scheduling irrigation with appropriate amount and frequency as well as applying water uniformly by leveling and grading the fields;
- Training farmers about improved irrigation technology system;

- Consolidating the coordination and integration of the organizational structures; and
- Allocating adequate budget for the WID so that it would build the capacity of farmers.

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Addis Ababa University School of Graduate Studies
Regional and Local Development studies

Survey Questionnaire for Assessing Irrigation Water Management System of Walga Irrigation Schemes in South West Shoa Zone. The objective of this questionnaire is to collect information from irrigator households for the purpose of academic study.

Identification

- Name of the scheme _____
- Village _____
- Name of Enumerators _____
- Date of Enumeration _____

1. Personal and Household data

1.1. Sex of the respondent (HH head)
1) Male 2) Female

1.2. Age of respondent
1. 15-30 3. 46-60
2. 31-45 4. 61-85

1.3. Household size
1. Less than 3 3. 6-8
2. 3-5 4. More than 8

1.4. Level of education
1. Illiterate 2. Read and write 3. 1-4
4. 5-6 5. More than 8

1.5. Do you send all your school age children to school?
1. Yes 2. No

1.6. If the answer for question # 1.5 is 'No', what is/ are the reason/s?
1 Lack of finance for educational cost
2. Need of his/her labor
3. Thought unnecessary
4. School distance is too far
5. If any, specify _____

1.7. For how many years have you harvested from this irrigation scheme?
1. More than 15 years 2. 10-15 years
3. 5-9 years 4. 1-4 years

2. Irrigation Management Activities

2.1 Water Use Activities

2.1.1 Where do you get water for your irrigations field?
1. River 3. Pond 5. If any, specify_____
2. Dam 4. Well

2.1.2 Do you use irrigation water throughout the year?
1. Yes 2. No

2.1.3. If the answer to Q # 2.1.2 is "No", When do you return water from the river for irrigation?
1. Always at the end of September
2. Always at the end of October
3. Always in December
4. Depending on the length of "Tseday" rainfall

2.14. When does the irrigation water return back to the river?
1. Always in May 3. Always in July
2. Always in June 4. As soon as cash crop harvesting has finished.

2.1.5. In what device water is distributed to the irrigated fields?
1.Through open earthen ditches 2. Through lined ditches system
3.If any, specify _____

2.1.6 From what level of canal system, do you apply water to the fields?
1. From main canal
2. From distributaries canal

3. At the end of watercourse
4. If any, specify _____

2.1.7 Do you face shortage of water?
1. Yes 2. No

2.1.8. If the answer for Q. # 2.1.7 is " Yes", What is/are the reason/s do you think?
1. Reduction of water from the source
2. Losses of water in canal network
3. Because of the water theft
4. Because of design constraint
5. If any, specify _____

2.1.9. When do you irrigate your fields?
1. During daytime
2. During nighttime
3. Depend on the type of crop convenience.

2.1.10. Who allocate water to the irrigators
1. Development Worker
2. Water Committee
3. Water users Group leaders
4. Local Administrators

2.1.11. How is water allocated among the irrigators?
1. Depends on the size of irrigated land of the specific area
2. Depends on the number of households
3. Depends on the patters of crops
4. If any, specify _____

2.1.12. In your opinion, Does the water fairly allocated among the irrigators?
1. Yes 2. No

2.1.13. If 'not' what is/are the reason/s?
1. There is unfair allocation among the upper and lower stream
2. If any, specify _____

2.1.14 . Does the water reach on the time it is allocated to you?
1. Yes 2. No

2.1.15 If the answer to Q # 2.1.14 is 'No', What is/are the problem(s)?
1. The design constraint of the canal
2. The distance of the canal
3. Due to leakage of the water
4. Due to theft of the water
5. If any, specify _____

2.1.16. How the distribution of water to the irritators field is decided?
1. Depends on irrigators' round
2. Depends on irrigators' field Preparation
3. If any, specify _____

2.1.17. Do you have drainage system in your irrigation field?
1.Yes 2. No

2.1.18. If the answer is ' No' what is/are the reason/s/
1. Thought that unwanted
2. Thought that negligible system
3. Lack of knowledge about it
4. If any specify

2.1.19. If the answer to Q #2.1.18 is 'Yes', does the system efficiently collects and disposes the drainage flow?
1. Yes 2. No

2.1.20 . If 'No' what are the related problem?
1. Design constraints in drainage system
2. The system is not being full able to drain the water
3. If any specify _____

2.1.21 Which of the following technique/s of irrigation do you use in irrigation water management?
1. Appropriate schedule irrigation intervals

2. Apply water uniformly to the field during irrigation
3. Improve land leveling and grading before irrigation
4. I do not use any of these techniques
5. If you use any other techniques specify_____

2.1.22. What type of irrigation technology do you use during application of water to the field?

1. Flooding irrigation system
2. Furrow irrigation system
3. By sub irrigation
4. By localization system

2.2. Control Structural Activities

2.2.1. What is the structural construction of the canal system?

1. The main canal lined but the distributaries were not lined
2. Both the main canal and distributaries were not lined
3. Both the main canal and distributaries were lined

1. Water leakages from regulatory out let
2. If any, specify _____

2.2.2. Does the canals convey water from the diversion to the field efficiently?

1. Yes 2. No

2.2.3. If the answer for question # 2.2.2.is 'No', which problems are causes for reducing irrigation efficiency?

3. Over flows of water
4. Seepage of the canal
5. Water flows to the un irrigated areas

2.4. What are the problems related to the canal design?

1. Absence of internal drainage system
2. Absence of cut-off drains
3. Inappropriate positioning of outlet
4. Canal level is below the level of adjacent field
5. If any, specify

2.2.5. What cause for the problem mentioned above question # 2.2.4

1. The outlet or division structure have not operated properly
2. The canal system has not been maintained properly
3. The canal system has not been cleaned properly
4. If any specify _____

2.2.6. From your the experience how many times canal maintenance is done in a year?

1. More than three 3. Once a year
2. Not at all 4. Twice a year

2.2.7.What are the consequences for inefficiency of the canal?

1. Water logging 2. Salinisation
3. Soil erosion 4.Shortage of water
5. If any, specify _____

2.3. Organizational Activities

2.3.1. Who initiated to develop the irrigation scheme?

1. Farmers
2. Local Administrators
3. Woreda Irrigation Department
4. If any, specify _____

2.3.2. Have the all irrigators participated in construction and maintenance of irrigation system during they are called by the coordinators?

1. Yes 2. No

2.3.3. If the answer is 'No' what do you think the reasons?

1. The farms prefer to work on their own field.
2. All irrigators do not equally need for water at the begging of the year
3. If any, specify _____

2.3.4. How do the water committee established

1. Composition of different Organizations
2. Elected from the farmers
3. The composition of different social leaders.
4. If any, specify _____

2.3.5. How does the committee find financial resource for its activities?

1. Through contribution from water users
2. From the support of different organizations
3. If any specify _____

2.3.6. Which organization are responsible for irrigation management activities in the area?

1. Water User Group
2. Water Committee
3. Local Administrators
4. Woreda Irrigation Department
5. If any, specify _____

2.3.7. What are the responsibilities of Irrigation Management Committee?

1. Mobilizing the resources for construction and maintenance of the scheme
2. Controlling water distribution, allocation, conflict resolution
3. Link between farmers and government institutions
4. If any, specify _____

2.3.8. What are the responsibilities of Local Administrators in water management activities?

1. Give support for water committee
2. Conflict resolution
3. Organizing the farmers in Water Users Group
4. Provided inputs
5. If any specify _____

2.3.9. What are the responsibilities of Woreda Irrigation department?

- Give training for farmers
- Organizing water user associations
- Supply inputs
- Link the farmers with other institutions

2.3.10 Towhat extent do the responsible organizations undertake their tasks in irrigation management activities?

No	Organizations	Condition in which they are			
		Very strong	Strong	Weak	Very week
1	Water Committee				
2	Local Administrators				
3	Woreda Irrigator Department				
4	If any, specify				

2.3.11. Is there any restriction in irrigation water activates?

1. Yes 2. No

2.3.12. If' Yes' What is/are the restriction/s ?

1. Farmers who do not participate on canal construction and maintenance do not use water for irrigation.
2. Farmers from other residences do not you the water for irrigation
3. If any, specify_____

2.3.13. Who put restriction and control the irrigation activities?

1. Water Committee
2. Development Worker
3. Local government
4. If any, specify

2.3.14. What is the line of communication between the farmers and other institutions?

1. Through Water Committee
2. Through Farmer Association
3. Through Development Agent Workers
4. If any, specify

2.3.15. Which tasks of irrigation activities are in serious problem? Fairly distribution of water
1. Mobilization of farmers for cleaning and maintenance of the canals system
2. Conflict resolution
3. If any, specify _____

2.3.16. Which conflict happen most of the time among water users?
1. Conflict because theft
2. Conflict because upper stream and down stream of water dispute
3. If any, specify_____

2.4. Property Right and Governance

2.4.1 In what ways the farmers are involved in the construction of scheme?
1. Labor provision
2. In financial contribution
3. Provision of construction material
4. All activities accomplished by farmers
5. If any, specify _____

2.4.2. Who decided on the water using activities?
1. The farmer himself
2. The government bodies
3. Irrigation expert
4. Development workers

2.4.3. Who sets the rule for the water using activities?
1. The ruling bodies 3.Water committee
2. All the water users 4. Irrigation experts

2.4.4. Whom do you think in governance of the irrigation system?
1. Local government
2. Farmers
3. Jointly by the government and farmers
4. I don't know

3. Questions Related to Irrigation Land

3.1. How many irrigable plots (in timed) of land do you have?
1. 1-4 3. 9-12 5. More than 15
2. 5-8 4. 13-15

3.2. How many plots of land do you irrigate currently?
1. 1-4 3. 9-12 5. More than 15
2. 5-8 4. 13-15

3.3. If the answer to question # 3.2 is "Choice No 1", what is/are the reason/s for irritating minimum plots of land?
1. Fear of land degradation
2. Used to fallow farming system in irrigation
3. Lack of finance to purchase the seeds and other in-puts.
4. Shortage of water
5. Decline productivity of land
6. If any, specify_____

3.4. What is the productivity of irrigated land when you compare to non- irrigated land for crop production?
1. No difference
2. Irrigated land is less productive than non-irrigated land
3. Irrigated land is more productive than non-irrigated land
4. It is not comparable.

3.5. Have you ever faced problems associated with the use of irrigation?
1. Yes 2. No

3.6 .If the answer for the question of 3.6 "yes", what are the main problems. (Circle the possible)?
1. Decline in productivity of land
2. Conversion of cultivated land to wet land
3. Shortage of water
4. Conflict with water users
5. Disappearance of certain crops

3.7. If your answer for question # 3.6 is "Conversion of cultivated land to wet land", what do you think about the reason? (Circle the possible answer)

1. Over flow of irrigation water and changed cultivated land to wet land
2. Because of canal seepage cases the cultivated land at low level converted to wet land.
3. Because of the diversion box does not properly regulate the water flow from the field.
4. Because of design that causes the cultivated land change to wet land
5. Because of run-off water during application of water to irrigate the field.
6. Specify, if any others

_____

_____

3.8. What do you think the causes of the problem for the question #3.8? (Circle the passable respondent)

1. Lack of maintenance and operation of the canal system.
2. Water use administrative problem
3. Lack of organization system to solve the problem.
4. If any, specify _____

4. Socio-economic Effects

4.1 Agriculture

4.1.1. Which irrigation crops do you often grow?

1. Onion
2. Potatoes
3. Tomato
4. Vegetables
5. It any, specify

4.1.2. Why do you prefer to grow such crops?

1. Better price
2. Good production
3. Easy to cultivate and manage
4. Good production seed available.

4.1.3. What is the trend of your growing crop from year to year?

1. Decreased in general 2. Increased in general 3. Did not show any change

4.1.4. If your answer for question # 4.1.3 is "Decreased in general", what is/are the reason/s? (Circle possible reasons)

1. Reducing in productivity of land
2. Increasing cost of the inputs
3. Decrease the price of products
4. Lack of interest
5. Decreasing in farm land per person

4.1.5. According to your experience, what is your opinion regarding the adequacy of rainfall you get during the rainy season for the crops you grow?

1. Always adequate
2. Mostly adequate
3. Rarely adequate
4. Usually inadequate

4.1.6. If the answer is 'Rarely adequate', Do you irrigate rain fed crops?

1. Yes
2. No

4.1.7. If the answer for question, # 4.1.7 is 'No', what is/are the reason/s? (Circle the possible answer).

1. Availability of sufficient production by rainfall agriculture
2. Scarcity of water
3. Scarcity of inputs
4. Productivity of land decrease form time to time.
5. Restriction of water use
6. If any, specify _____

_____

_____

4.1.8. How many times did you produce crops annually?

1. Once a year
2. Twice a year
3. Three times in a year
4. If any, specify_____

4.1.9 If your answer is" more than once", specify how you could able to produce?

1. Using normal rainy seasons _____
2. Irrigation
3. If any, specify _____

4.1.10. In what time interval do you irrigate the crop?

1. On a fixed time
2. Depends on the types of crop and maturity of crops
3. Depends on the climatic condition
4. When the water is available
5. If any, specify

4.1.11. Do you us inputs other than water for crop production?

1. Yes 2. No

4.1.12. If yes, which inputs did you use?

1. Fertilizer
2. Pesticide
3. Herbicide
4. Improved seeds
5 If any, specify _____

4.1.13. Have you faced any other problem of crop failure when using irrigation?

1. Yes 2. No

4.1.14. If the answer is "Yes", Specify the condition of crop failure in following in the table

No	Which crop frequently lost	For how many times lost	Standard of crops failures	
			Partial lost	Total lost

4.1.15. If the answer to the question # 4.1.13 is "yes", which of the followings are the major causes?

1. Water shortage
2. Production decline
3. Salinity problem
4. Water logging problem
5. Over flooding of the farm
6. Crop diseases
7. If any, specify_____

4.2. Income generation

4.2.1. How much you have earned (in birr) from the sale of your irrigated crop in the year of 1996?

1. Less than 200
2. 201-600
3. 601-1000
4. 1001-1400
5. 1401-1800
6. More than 1800

4.2.2. How much you have earned from the sale of rain fed grain production in the year of 1997?

1. Less than 200
2. 201-600
3. 601-1000
4. 1001-1400
5. 1401-1800
6. More than 1800

4.2.3. What is the source of your income other than crop production?

1. Non-farming activities
2. Livestock
3. Remittance
4. If any, specify _____

4.2.4. What are the main sources of your annual incomes to cover your cost?

Source of income	Put in its order of hierarchy
1. Cash crop	
2. Food crop surplus sale	
3. Live stock and livestock product	
4. Remittance	
5. Non-farming activities	
6. If any, specify	

4.2.5. Has your annual income increased due to irrigation?
1. Yes 2. No

4.2.6. If the answer to Q # 4.2.5 is 'yes' s what is/are the reason/s ?
1. High production
2. High selling
3. Diversification of the crop
4. If any specify_____

4.2.7. If 'No' what is /are the reason/s?
1. Low demand
2. Low productivity
3. If any, specify _____

4.2.8. Did the household involve in any off-farm activities?
1. Yes 2. No

4.2.9. If in what type of off-farm activity?
1. Other farms (poultry and beekeeping)
2. Petty trade
3. Handicraft
4. Others /Specify_____

4.2.10. Did you rent your plot of land for other persons for irrigation?
1) Yes 2) No

4.2.11. If your answer for the question # 4.2.10 is 'Yes', what is/are the reason/s for do so? (Circle the possible answer)
1. Lack of finance to purchase inputs
2. Lack of labor to irrigate
3. Lack of oxen
5. If any, specify _____

4.2.12. How much have you got from the land rent?
1. Less than 100 4. 301-400
2. 100-200 5. 401-500
3. 201-300 6. More than 600

4.2.13. Where have you got the cash for purchasing the seeds of irrigation crop?
1. By borrowing
2. From saving in the form of asset
3. From saving in the form of cash
4. By selling live stock

4.3. Employment Generation

4.3.1 Do you hire labor during the production time?
1. Yes 2.No

4.3.2. If yes, how many daily laborers do you hire?
1. 1-3 2. 4-7
3. 8-11 4. 12-14 5. More than 15

4.3.3. Are your family members involved in irrigation?
1.Yes 2. No

4.3.4. If your answer is "yes", how many of them involved in irrigation?
1. Mother/Father 2. All children who are able to farm
3. Some children who are able to farm

4.4. Marketing

4.4.1 Do you produce irrigation crop for sale?
1. Yes 2. No

4.4.2 If' 'Yes', What are you using to transport the production
1. Motor trucks
2. Donkey
3. Human porter age
4. Cartage
5. If any, specify

4.4.3. How many hours you need to travel (on foot) to get market

1.0.30 -1 h
2. 1-2 h
3. 2-3 h
4. more than 3 hours

4.4.4. Did you see any seasonal change with the demand of the irrigation product?

1. Yes 2. No

4.4.5. Do you get appropriate price for your production?

1.Yes 2. No

4.4.3. If your answer for question #4.4.5 is "No" what are the problems?

1. Lack of cooperation
2. Lack of demand for production at harvesting time
3. If any specify_____

5. General questions

5.1. What institutional support do you need in relation to scheme?

1. Rehabilitation of the canal system
2. Training on operation and maintenance of the irrigation system
3. Training on the pattern of cropping
4. Ruled and regulation of water using activities
5. Market for the productions
6. If any, specify

5.2. Do you think that development irrigation has changed the life of beneficiaries in the scheme?

1. Yes 2. No 3. Undecided

5.3. If the answer for question # 5.1 is 'No' what do you think the reason/s is/are?

_____
_____
_____

5.4. How do you think the management of water system in the area be improved?

_____
_____
_____

Check list for Focus Group Discussion

These check list will be prepared for the FGs of Water Committees, Water User Group leaders, women and popular irrigators who have long experience in areas.

- Does the canal convey water from diversion to the field efficiently?
- What are the problems related to the canal design?
- How have management and operation of the schemes been under taken?
- How are construction and maintenance activities performed on the scheme?
- Does productivity of land decreases more than non-irrigated land?
- What is the trend of crop production from year to year?
- Do the irrigators get the appropriate price for their production?
- Does the water available sufficiently for irrigators?
- Do the irrigators get training on the management of irrigation system?
- Do the irrigators get the support from the government (in supplying of fertilizers, pesticide, and improved seed credit etc)?
- Does the irrigation scheme generate employment for local people especially for the youth?
- What is the change on the environment since irrigation scheme has been developed?
- What are the main problems in connection with the irrigation?
- What do you think about the cause of the problem?
- What are the possible solutions do you think for the problems?

Check list for key Informants

The following checklist will be used to guide in the informal interviews for woreda and kebele officials and woreda irrigation department

- What is the role of your institution in developing and rehabilitation irrigation schemes?
- How would you support irrigator households of the scheme?
- How the management and operation of the schemes have been undertaken?
- What incentive would you give for the irrigators? (Supplying fertilizers, seed, etc)
- Does the beneficiaries' income increase from time to time?
- Does the scheme effectively benefit the households?
- How would you control and support water committee?
- How construction and maintenance activities to be performed on the scheme?
- How do you evaluate the production level of the schemes?
- What major change did you observe in the consumption level of irrigators?
- What major change did you observe in the income of the irrigators?
- What do you think of the present organizational structure of small-scale irrigation schemes?
- Would you give training for the irrigators?
- What are the effects of the scheme on household income?
- To what extent the schemes generate employment for the local people?
- What are the major problems encountered by farmers on the scheme?
- What are the possible solutions you think?
- What do comment on the market and produce of small-scale irrigation?

DECLARATIONS

I declare that this thesis is my original work and has not been presented for a degree in any other University, and that all sources of materials used for the thesis have been duly acknowledged.

Name Tenaye G/selassie Signature _____ Date 28/12/06

Addis Ababa University

This thesis has been submitted for examination with my approval as a University advisor.

W/Gebreal Teshome

Date 28/12/06