Addis Ababa University
(Since 1950)

ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT STUDIES
DEPARTMENT OF WATER AND DEVELOPMENT

IMPACT OF SMALL SCALE IRRIGATION ON SOCIO-ECONOMIC DEVELOPMENT IN DEWA CHEFFA WOREDA,OROMIA ZONE OF THE AMHARA NATIONAL REGIONAL STATES

By: Tesfa Worku

A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY IN PARTIAL FULFILLMENT FOR THE DEGREE OF MASTER IN WATER AND DEVELOPMENT STUDIES (WATER RESOURCE PLANNING AND MANAGEMENT)

June 2011
Addis Ababa, Ethiopia

ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
INSTITUE OF DEVELOPMENT STUDIES (IDS)

Title

Impact of Small Scale Irrigation on Socio-Economic Development of the Society: Kemisse Zone, Dewa Cheffa Woreda.

By
Tesfa Worku

Water and Development

APPROVED BY THE BOARD OF EXAMINERS: SIGNATURE

Dr. Belay Simane
CENTER HEAD

Dr. Mebruk Mohammed
ADVISOR

Dr. Yohannes Aberra
INTERNAL EXAMINER

Acknowledgement

The many people to whom I have the pleasure of expressing my appreciation and gratitude. First and for most I would like to express my sincere and deepest gratefulness to my advisor Dr Mebruk Mohammed for his intellectual advice, guidance, encouragement and regular discussion were very valuable and inspiring in the processes of proposal writing, research undertaking and thesis writing.

I would like to express my deepest gratitude and appreciation to my friend Mulualem Yakob for providing me valuable comment.

I would like to take this opportunity to thank French government supported water and development program for providing me all the research funds to conduct this research. I would like to thank Dr. Mulugeta Fesha for facilitating the funding process and for his constructive comments.

As the saying goes 'behind every successful man is a strong support structure'. It would be unfair of me to pretend to be unexceptional to this popular belief by not admitting that I also had a strong support structure in the form of friend who was always there to support me all the way from Tina Bereded.

I am especially indebted to my best friends' Tadios, Abebe, Tsega (CDS secretary), Dejene, Aschalew, and Sisay and for all my department teachers for their advice and assistance they provide. Special tanks are also to my small brother Demissew Worku and Abinet Girma for their assistance they provide me while under taking the study.

Above all, I praise God the almighty and Saint Marry, for allowing me to make my dreams come true after a very difficult journey and a burdensome effort.

Dedicated

To My Beloved Parents.

Table of content

List of Table

List of Figure

List of Abbreviation

CSA	Central Statistics Agency
CARE	Cooperative for Assistance and Relief Everywhere.
E.C	Ethiopian Calendar
CRS	Catholic Relief Service
DA	Development Agent
EPA	Environmental Protection Authority
FAO	Food and Agriculture Organization
IDE	International Development Enterprise
IWMI	International Water Resource Management Institute
MoA	Ministry of Agriculture
MoWR	Ministry of Water Resource
MUS	Multi Use System
NGO	Non-Governmental Organization
SSI	Small Scale Irrigation
SPSS	Statistical Package for Social Science
USAID	United States Agency for International Development
US	Unite States
WSDP	Water Sector Development Program
WWDSE	Water Works Design and Supervision Enterprise

Abstract

The main objective of this study is to assess the impact of small scale irrigation on socio-economic development of the society in Kemisse Zone, Dewa Cheffa Woreda. The study employed survey method and personal observation to collect socio-economic data. Farming household and key informant were interviewed to collect primary data. In addition, relevant literature and essential documents that was useful for the study were reviewed. The analysis which was conducted amongst the same respondents before introduction of irrigation, allowed for the comparison in order to identify the impact after introduction of irrigation project. Also, the social and economic impact was assessed that used to assess the impact of small scale irrigation in the study area. The result reveals that small scale irrigation have an impact on social and economic well being of households. The skill of farmers after introduction of irrigation was better than that of before introduction of irrigation such as, plowing, threshing, harvesting, use of agronomic practice. All the farm households are worked in their farm on the daily basis, which is a big change as compared to before introduction the schemes. Land use intensity and crop diversification was improved due to irrigation. Land use intensity improved due to increases in acreage of main crop as well as cultivating at both seasons. Crop diversification was also observed as a result of irrigation development in the study area. Almost the entire farm household increased producing multi item and market oriented types of crop two cycles per a year. The study finding highlights that small-scale irrigation for food security enhancement, high yield obtained in irrigation and other benefit such as increased income, employment opportunity, crop diversification, land use intensity, and the like are indication that small-scale irrigation can bring sustainable agriculture and economic development in the study area. But issues related to small size of farm plot, input supply, market situation, reservoir capacity to enrich irrigation water for all user groups, crop water requirement, ways of water distribution for users and infrastructure can affect the sustainability of small-scale irrigation schemes.

Key words: *Small-scale irrigation, social and economic well being, crop diversification, household income, employment opportunity, market oriented crop pattern.*

1. CHAPTER ONE

1. Introduction

1.1 Back ground of the study

Ethiopia has considerable development potential: Its endowment of land and water resource is adequate relative to its population. Much of Ethiopia is suitable for crop and livestock production. However, Ethiopian agriculture has been characterized by small scale subsistence production system where crop and livestock yields are very low (Berhanu, 2006).It has renewable surface and ground fresh water amount to 123 and 2.66 billion cubic meters per annum respectively (CARE 1998). Special and temporal distribution of water and its contribution to the economy is not well documented. Flood, drought, and lack of means of storing water in terms of plenty place, Ethiopia at risk of chronic food shortage (CARE 1998). Rapid population growth and the consequent encroachment of food crop farming on environmentally sensitive areas has created a vicious cycle of declining soil fertility, erosion, low crop yields, feed shortage, progressive land degradation and reduction of areas under fallow and greater exploitation of marginal areas.

Agriculture in Ethiopia is heavily rely on rain fall, which is highly variable, both spatially and temporary. In many parts of Ethiopia, agricultural development is hampered by recurrent drought, which over the year has increased both in frequency and severity. According to Von Bran (1991) food production in Ethiopia is highly variable and unpredictable, due mainly to factors of erratic weather pattern .He noted that 10% decline in rainfall below the Ethiopian national long term average reduce national food by 4.4%. The declining productivity in rain fed agriculture and the need to double food production over the next two decades, call the need for efficient irrigation.

Issues associated with land and water resources management like salinity, nutrient depletion, water pollution, loses of vegetation cover, soil erosion, over grazing, soil degradation, and ground water depletion could lead to long term deterioration of productivity of land, with adverse effect on agricultural productivity and serious food security implication at both the national and local level (Kamara and Mc cornick, 2002). Despite Ethiopia has huge agriculture potential, it has been unable to provide adequate food for its rapidly growing population. A recent study made by Mulat et al. (2006) showed that, over the last 40 years the trend in per capita availability of food supply for the period 1961-2001 was declining. The study reported there is progressive decline in per capita food production from 128.08kmper

head in 1961-1974 to 125.41km per head in 1992 -2001.This had increased the deficit of food balance in Ethiopia from 0.75 million tons in 1979/80 to 1.4 million tons in 2000. One of the major factors that have contributed to low performance of agriculture sector is land degradation (Berhanu and Pender, 2002, FAO, 1986; Hurni, 1993; Shiferaw and Holden, 1999).

Ethiopia has an estimated irrigable land of about 1.5-3.5million hectares of which only about 5% developed to date, with about 55% of the developed area being traditional irrigation (MoWR, 2001a).At the ends of 1990s,the area under small scale irrigation scheme was estimated at 65,000 hectares while that of medium and large scale irrigation have 112,000 hectares coverage, of which 22,000 hectares were small scale irrigation schemes implemented since 1992(WWDSE, 2001).The country has a national irrigation development strategy to use water and land potential to meet food self sufficiency, generating export earnings, and provide raw materials for industry on a sustainable basis (MoWR, 2001).In Ethiopia different micro dams have been constructed to provide drinking and irrigation water supplies. However, many externalities are associated with irrigation in the basin. They include salinity of soil, sedimentation of dams, up slope erosion, water contaminations, and increased water born disease; incidence of water related disease such as malaria; schistosomiasis and diarrhea have been associated with the development of irrigation.

Most existing studies on irrigation in Ethiopia focus on technical aspects, and very little is known about the socio-economic implications of irrigation development (Haile et al., 2001). An exception is the recent study of Amacher et al. (2004), which shows that larger irrigation structures are associated not only with productivity increases but also With health costs: people living in villages close to dams spend more time ill and caring for ill relatives.

This study attempts to find out the socio-economic impact of small-scale irrigation schemes in Dewa Cheffa Woreda.

1.2 Statement of the problem

Irrigation is productivity enhancing, growth promoting, and poverty reducing. Instance of negative externality effect associated with large and medium scale irrigation system point to management issue, and thus, call for comprehensive response mechanisms from the planning and political community is necessary. However, the sustainability of irrigated agriculture is being questioned, both socio-economically and environmentally. The majority of existing traditional and modern irrigation schemes are micro level in size, usually serving households not more than 300 in number (Tahal, 1998). Many of these schemes use diverted stream or

river water and fewer schemes use small dams or perennial springs as their water source. This traditional and modern small scale irrigation system may be described as forms farms cooperatives. Each beneficiary has access to water on equal basis, and however, equity in the water distribution needs a strong attention.

In sub Saharan Africa more land is going out of irrigation each year than can be developed for irrigation because of the difficulty of planning and conducting sustainable schemes (http://www.cm.ksc.co.th/~burns/assess.html).

In Ethiopia, in adequate attention to factors other than engineering and projected economic implication of small scale irrigation schemes has led to difficulties on sustainable irrigation development (CRS, 1999).Decision to construct dam or upgrade traditional irrigation systems have often been made in the absence of sound objective assessment of their environmental and social implication (CRS,1999).

Small scale irrigation has a potential to meet the demand for food security, agricultural diversity and productivity. There is a considerable experience with small scale irrigation but the extent and potential has not been quantified and documentation is sparse (CRS, 1999). Information on water requirement of crops, the input, and the environmental effect are hardly available. Even if much data may be available they may not be accurate and reliable (CRS, 1999). Within agriculture, irrigation water is vital resource for many productive and livelihood activities. As a production input in agriculture, irrigation water is an important Scio-economic "good", with positive role in poverty alleviation. Irrigation water can also became a socio-economic "bad" when it lead to problem such as water borne disease (like malaria and schistosomiasis) and water related disease are commonly associated with the introduction of irrigation. Other irrigation related health risk includes those associated with increased use of agrochemicals and deterioration of land and water quality. The sustainability of small scale irrigation project depends on the maintenances of the implemented schemes and mitigation measure taken. The negative environmental impact of irrigation development occur offsite as well as onsite. These effect could occur upstream of the land to be developed where a river is used for supplying irrigation water. Negative environmental impact could also occur downstream of the irrigated area by the disposal of excess water that may contain harmful concentration of salt, organic waste, and agrochemicals. Usually full utilization of water creates water shortage to downstream ecosystem.

The development and utilization of water resource in agriculture through irrigation development creates an economic environment that has direct and indirect benefit at local and national level. However, many decisions of irrigation benefit have focused on direct

production effect such as increased crop yields and farm income. The debate often ignores a much wider array of benefit raging from increased labor demand and the creation of new opportunities for the non-irrigation water use. Furthermore the economic impact such as decrease in food price and other economic multiplier effect associated with the provision of irrigation are also significant (Hussin, 2007).

Despite the number of studies made so far, that assess the impact of irrigation on the economic and environmental aspect, there was less emphasis on its impact on social issue (Mekonnen, 1999, Abbi, 1997).

There is a need for research and capacity building to understand the complex issue of water and land management, so as to identify the impact of small scale irrigation on socio-economic development of the society. Hence this research will assess the impact small scale irrigation on socio-economic development of the society in Dewa Cheffa Woreda, so as to assess the sustainability of irrigation development in the area.

More specifically the study was address the following questions.

- Does irrigation project enables beneficiaries to diversify their production system?
- Does irrigation development narrow the income inequality?
- Does irrigation project change consumption pattern?
- Does irrigation project change employment pattern?
- Does irrigation project change crop production?

1.3 Objectives of the study

The overall objective of this study is to examine the impact of small scale irrigation on Socio-economic development of the society.

Specifically the studies were:

- Examining the effect of irrigation on income distribution.
- Explore the effect of irrigation on production capacity.
- To investigate the employment pattern.
- To investigate the consumption pattern of the society.

1.4 Significance of the study

- The intended thesis will furnish reliable and valid findings about different socio-economic factors to the relevant stakeholders. To this effect the research will have the following significance.

- It informs policy designers and implementers about the factors that determine the sustainability of irrigation development.
- The finding will serves as input in designing future irrigation development programs.
- It can be used as spring boards the other researchers who desire to assess the impact of small scale irrigation on socio-economic development at zonal or national level.

1.5 Scope and limitation of the study

The scope of this study is limited to examining the impact of small scale irrigation on social and economic aspect. The study were consider only those variables which determine economic aspect like production output, income level of the farmers, employment pattern, and those variables which determine social aspect such as skill of farmers, consumption pattern of the society, and the like in general. Since the study focus on impact of small scale irrigation on social and economic aspect in the intended area, other impact which exists by traditional, medium, and large scale irrigation is excluded from the study.

The research was conducted to assess the impact of small-scale irrigation on socio-economic development of the society in Kemisse Zone, Dewa Cheffa Woreda. However, this study is subject to the following limitations.

- Absence of secondary data needed to supplement primary data.
- Weak recording system of Woreda agricultural office about irrigation output.
- Due to resource and time limitation, the study had to focus only a few of respondents.
- Due to the absence of base line data, the study adopts personal enquiry and observations to compare the impact of small scale irrigation before and after its implementation.

1.6 Organization of the paper

The thesis is organized as follows: chapter one is an introduction of the study. This chapter contains background of the study, statement of the study, objective of the study, significance of the study, scope and limitation of the study. The next chapter represents research methodology. Chapter three present an overview of theoretical and empirical literature review on impact of small-scale irrigation on socio-economic development of the society. Chapter four present result and discussion. Chapter five present conclusion and recommendation.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Theoretical Literature Review

2.1.1 Irrigation

Irrigation is the supply of water to agricultural crops by artificial means, designed to permit farming in arid regions and to offset the effect of drought in semi-arid regions. Even in areas where total seasonal rainfall is adequate on average, it may be poorly distributed during the year and variable from year to year. Where traditional rain-fed farming is a high-risk enterprise, irrigation can help to ensure stable agricultural production (FAO, 1997).

Irrigated agriculture has expanded significantly over the past five decades. World irrigated areas have almost doubled from 139 million hectare in the 1961 to over 273 million hectare in 2001. Much of this expansion has taken place in developing Asia, with India, China and Pakistan accounting for around 48% of the total irrigated area (IWMI, 2002). While investment in large-scale canal irrigation systems have slowed down after peaking in the 1970s, private investment in groundwater increased significantly during the 1980s and 1990s.Much of the growth in groundwater development has taken place in areas of canal irrigation development, generally referred to as favored areas.

Past interventions in irrigated agriculture have yielded immense benefits to those societies. In Asia, cereal production has more than doubled, between 1970 and 1995, from 300 million tons to 650 million tons. This remarkable growth in food production was largely attributed to the growth in irrigated agriculture, coupled with the use of high-yielding varieties and fertilizers. At present, about 40% of the crop land in Asia is irrigated and accounts for about 70% of total cereal production. Irrigation is believed to have benefited the population by providing more food at reduced prices.

Despite this achievement, there are vast irrigated areas where agricultural productivity levels continue to remain low, notably in South Asia. Such low productivity areas are characterized by persistent rural poverty. There seems to be a general consensus that improving agriculture and enhancing agricultural productivity will remain a key strategy for rural poverty alleviation in most of the low income counties, where the majority of the rural poor depend directly or indirectly on agriculture. Improved access to food by the poor through their own increased production or enhanced purchasing power and economic ability to buy food would be the most effective way to move poor people out of poverty, particularly in low productivity areas.

Consequently, attention is now being drawn to poverty-stricken agricultural areas, where productivity level is low but potential for increasing productivity is high. Recent analyses of returns to public investment in less favored areas in China and India suggest that attractive opportunities exist for reducing poverty through investment in these areas. These investments would offer win–win opportunities for achieving more production growth and greater poverty reduction (Fan et al., 2002; Fan et al., 2000a, b). Many of the low productivity areas may be classified as ''economically'' water-scarce areas (areas where water is not a limiting factor but they lack financial means to develop the available resources), and irrigation development is being suggested as a key strategy to enhance agricultural productivity. Examples of high potential areas include the Indo-Ganges basin, home to over 500 million people (many of whom are among the poorest in the world), and many areas in sub-Saharan Africa (Molden et al., 2001; Shah et al., 2000).While the debate on such investment is underway, fundamental questions are being raised over the role of irrigation development in poverty.

Massive irrigation infrastructure investment in Asia during the 1960s and 1970s have been successful in feeding growing populations, achieving rapid economic growth, and boosting employment (Barker and Molle, 2004). India and China, where famine was once a threat, have achieved agricultural growth through investment in irrigation infrastructure and by creating enabling institutional and economic environment that contribute to irrigation success. With sound management and careful planning, irrigation can improve the livelihoods of the rural poor by reducing the risks of expensive improved inputs being wasted as a result of crop failure due to lack of water (Food and Agriculture Organization (FAO), 1997). The FAO estimated that small-scale irrigation could increase agricultural production in Ethiopia by up to 5%.

2.1.2 Small scale irrigation

Small scale irrigation schemes: Small-scale irrigation systems are defined by the Food and Agriculture Organization as being controlled by single farmers or farmers' groups and are usually less than 200 hectares. Many development organizations believe small-scale irrigation methods are an effective way to increase food production.

According to FAO (2003), smallholder irrigation development has shown throughout the developing world that it can be used as a key drought mitigation measure and as a vehicle for the long-term agricultural and macroeconomic development of a country. Successful smallholder irrigation schemes can result in increased productivity, improved income and nutrition, employment creation and food security. However, socio-economic evaluation of smallholder irrigation systems is very essential in order to be able to derive lessons from the

past experiences and also to help policy makers in formulating sound policies for further irrigation development. Currently, the government of Ethiopia is developing master plans for various types of irrigation, including diversion/gravity schemes from major rivers, pumping from rivers, and small storage reservoirs by giving priority to low cost small-scale irrigation systems (OIDA, 2000).

Small scale irrigation is 'Irrigation, usually on small plots, in which farmers have the major controlling influence and using a level of technology which the farmers can effectively operate and maintain'.

Small irrigation schemes serve mainly to supplement rainfall and provide a greater degree of security to peasant farmers (McCornick et al, 2003). Because of increasing trend of population growth in the last six decades, (from 17 million in 1940 to 63 million in 2000) and increased exploitation of land resources, the balance of water resources has also been negatively affected. Although traditional small-scale irrigation practices existed in a few places, scaling-up activities must have started since the 1960s.

Irrigation is characterized by group interactions associated with human behavior. Accordingly, there are many versions of localized organizations that have developed in every country and society.

Small scale irrigation is frequently cited as an innovation that can bolster rural livelihoods through climate adaptation, food security, and poverty reduction (Lipton, Litchfield, and Faures 2003; Bennin and Mugarura 2006; Polak and Yoder 2006; World Development Report 2008).

Irrigation has the potential to increase agriculture production and improve the livelihoods of small scale farmers. Irrigation is linked to poverty reduction through its effect on crop production and increased farm income. Adequate water supply to crops increases the production available for household consumption and or sale. Irrigation can enable farmers to have a second and sometimes a third crop planting, increasing income for the farmer. In addition to increasing overall production, irrigation increases the reliability and consistency of production (Smith 2004). Irrigation enables the farmer to control the available water throughout the growing season, which boosts production and reduces exposure to water shortfalls or seasonal droughts.

2.1.3 Irrigation Development in Ethiopia

It is difficult to know exactly how much irrigated land exists in Ethiopia, however recent estimates put the total area of land at 160 000–198 000 hectares. This estimate includes traditional, communal, private, and public schemes. Many schemes are concentrated

(approximately 48%) in the Awash Valley, where 92% of all large schemes were built prior to 1990 (ACTS, 2002). Modern irrigation had started at the beginning of the 1960's by private investors and was concentrated in the middle of Awash valley. At the beginning of the 1970s, about 100, 000 hectares of land was estimated to be under modern irrigation, about 50% of which was located in the Awash basin (Wetterhall, 1972). With the 1975 rural land proclamation, the large irrigated farm were nationalized and placed under the responsibility of the Ministry of State Farms while small scale irrigation schemes were transformed into Producers' Cooperatives. After the major famines of 1984/85, the government began to focus on the potential of small scale irrigation as food security and started promoting farmer and community-oriented small scale irrigation by providing assistance and support to local communities for rehabilitating and upgrading traditional schemes, (Habtamu G.1990).

In Ethiopia, irrigation has long been in use; however, irrigated agriculture is far from satisfactory despite substantial investment, public interest, and strategic support through government policy. Irrigated agriculture comprises only 3% of the total national food production. Until recently, only 2% of cultivated lands were irrigated (Ministry of Water Resources (MoWR), 2001), and only 10% of the estimated potential irrigable land (3.5 million ha) is actually irrigated (Berhanu and Pedon, 2002). Per capita irrigation is also estimated at about 35 m2, compared with the world average of 450m2.

Since 1994, projects to expand small-scale irrigation schemes and to modernize or rehabilitate existing traditional irrigation schemes have been implemented, with a significant number of small-scale irrigation schemes being developed. However, it remains unclear whether investment in small-scale irrigation infrastructure development led to the desired goals of improving livelihoods and reducing rural poverty among the beneficiaries. Currently, literature on irrigation impact on rural poverty reduction is scant for Ethiopia, in particular, and sub- Saharan Africa in general. Thus, a detailed study to analyses and understand the impact of access to irrigation on household poverty is of paramount importance. This paper provides results of a study conducted to assess the poverty reduction impact of access to small-scale irrigation, taking the Indris small scale irrigation scheme located in Ethiopia as a case study. Understanding the poverty reduction impact of past irrigation development projects is important for charting sound policies for future irrigation development.

The Ethiopian government has committed itself to irrigation development several years ago. Before concentrating on the history and policies of irrigation development in Ethiopia a look on the African water resource development is taken. Since the 1960s many of Africa's river systems were dammed for irrigation, hydropower or flood control purposes. River basin

development planning and large-scale water projects dominated the water resource development. Authoritarian interventionist states, supported by international donors, adopted mainly technological top-down approaches in order to satisfy the food, energy and water needs of their populations (Dessalegn 1999). After the devastating droughts and famines in the Sahel zone in the 1960s, 1970s and 1980s, food insecurity and the dependence of millions of people on rainfed subsistence agriculture and environmental hazards became a central political and scientific issue. Irrigation development was discovered as one solution to cope with precipitation variability and its effects on rainfed agriculture systems. However, many water development and irrigation projects, often financed by international donors, failed in particular due to non-participative planning processes. In addition, they had various negative ecological, economic and social impacts including environmental damages, population displacement or the loss of traditional farming and grazing land. According to Dessalegn it is "commonly accepted that the African water development program [...] which was heavily financed by such donors as the World Bank and USAID, has by and large been a failure. [...] on balance, the troy of modern irrigation in the continent is one of failed promises, disappointments and large-scale ecological damage" (Dessalegn 1999). The Ethiopian irrigation development policy comprises various development key words such as participation or sustainability. However, it is uncertain if these theoretical commitments will materialize. Namely, irrigation development tends still to be decided and implemented top-down without involving the local people. In addition, irrigation trainings are provided and a trial plot is planned that will be cultivated by the development agent (DA) in order to teach peasants practically about cash crops, fertilizer or plant protection. Farmers who are motivated to irrigate are systematically favored by the Woreda as being role models for the other villagers. This strategy considers first of all the national development aims and not the people's needs and interests.

Irrigation and improved agricultural water management practice could provide opportunities to cope with impact of climatic variability enhance productivity per unit of land, increase the annual production volume significantly. Irrigated agriculture started in Ethiopia in the 1960 with the objective of producing industrial crops (sugar and cotton) on large-scale basis. Local farmers however, had already been practicing irrigation by diverting water from rivers in the dry season for the production of subsistence food crops as traditional irrigation. The experience in modern small scale irrigation (SSI) development and management started in the 1970s by the Ministry of Agriculture (MoA), in response to major droughts, which caused wide spread crop failures and consequent starvation. The sector could be used to reduce

family risks that are associated with crop failures resulting from droughts. Currently government gives emphasis to develop the sub-sector to fully tap its potentials by assisting and supporting farmers to improve irrigation management practices and the promotion of modern irrigation systems, Teshome A. (2006). Although irrigation potential in Ethiopia is estimated at 3.7 million hectares under conventional gravity irrigation, when rain water harvesting and supplementary irrigation, ground water use, and water lifting technologies are considered, it is believed that the potential could be significant. The current level of irrigation development is at about 250,000ha, with further planned for implementation. According to Teshome A. (2006), currently, irrigated agriculture produces less than 3 % of the total food production of the Country.

The government has revised its strategy for irrigation development. The previous development target was to put additional 274,612ha by 2016, Awulachew et al (2005), WSDP (2002). The ministry of water resources is currently undertaking a total of thirteen irrigation projects located in different parts of the Country. They constitute approximately a total area of 493,603 ha and envisaged to be completed before the end of the irrigation development program planning period in 2016, Teshome A. (2006). This revised target is mainly related to large and medium scale irrigation and it is expected that the small scale irrigation sub-sector which is under the Ministry of Agriculture and Rural Development will also strive similar targets.

Although the above are development targets mainly related to medium and large scale irrigation, the performance of the past investments are mixed. There quite successful schemes such as the Sugar States at Wonji, Methara and Fincha which are now expanding, there are also schemes which resulted in complete failures, and never put in to operation such as Omorate, Alwero scheme, etc. The new investment, therefore should carefully evaluate the causes of those failure and the strength of the successful ones. According to our observation, the successful schemes have a good infrastructure and market linkage; well to thought agro-enterprises that have established institutional set ups, processing, research and promotion. The failed one generally misses the above key aspects and are placed at remote places with poor infrastructure, inadequate labor, etc.

Based on the command area it serves irrigation in Ethiopia is classified in to three classes: small, medium, and large scale irrigation schemes. The small, medium and large scale possesses command area of below 200 hectares, between 200 and 3000, and above 3000 hectares, respectively (MoWR, 2001b). The present estimate of small scale irrigation

coverage in the country is about 65,000 has (MWR, 1998; CSA, 1998; AQUASTAT, 1998; IDD/MOA, 1993 as cited in CRS, 1999).

Small scale irrigation schemes serve mainly to supplement rainfall and provide a greater degree of security to peasant farmers (McCornick et al, 2003). Because of increasing trend of population growth in the last six decades, (from 17 million in 1940 to 63 million in 2000) and increased exploitation of land resources, the balance of water resources has also been negatively affected.

The present levels of total area estimated to be under small scale irrigation is currently less than one percent of the total area currently being farmed. A similar analysis could be carried out on the basis of population and small scale irrigation users.

The development of the country's irrigation potential is an important part of a major program for the intensification of agriculture launched by the new Federal Government (EPA, 1997). As part of this effort, Water Resources Management Policy to guide water sector development has now been operational. The stated goal of this policy is: "To enhance and contribute its share in all national efforts towards the attainment of prosperous, healthy and socio-economically developed society with all its human dignity by promoting sustainable management of water resources of the country, without endangering and compromising the capacity of water resources base for regeneration in the services of future generations (MoWR, 1998).

The environmental policy was approved by the council of Ministers in April 1997 (EPA, 1997). It was based on the policy and strategy findings and recommendations of the conservation Strategy for Ethiopia. The overall policy goal is "to improve and enhance the health and quality of life of all Ethiopians and to sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of the future generations to meet their own needs, (EPA, 1997)"

Irrigation development aims to bring about increased agricultural production and consequently to improve the economic and social well being of the rural population. Properly implemented small holder irrigation with appropriate technologies may have a considerable potential in improving rural livelihoods, although the viability of such systems becomes questionable when the financial responsibility rests entirely on the community in the absence of institutional support services that enhance market orientation (Kamara et al. 2002; Shah et al. 2002). Given the complex set of constraints facing small holder producers, providing

access to irrigation water by itself is not enough; smallholders also require a broad range of support services (access to inputs, credit, and output markets), knowledge of farming and secure land tenure.

2.1.4 Impact of small scale irrigation on socio-economic development

At present, small-scale irrigation schemes in Ethiopia take two forms. The first form is the traditional scheme, which are organized and managed by the community members themselves. The other form is recently upgraded (with permanent diversion weir and lined canals) which government and some NGOs have constructed since the 1980s. According to the 1988 inventory by MOA, there are 1309 traditional small-scale irrigation schemes covering about 60,000 hectares that scattered throughout the country. Such traditional schemes in most cases serve mainly to supplement and provide a greater degree of security to peasant farmers' rain fed agriculture.

When we look at the performance level of irrigation in Ethiopia, small-scale schemes (especially those operated privately and traditional irrigation systems) have had a better record of success than large-scale schemes. This was attributed to the distinct characteristics and advantages of small-scale irrigation that the management of village or community in the development process, there is a possibility to make use of local materials, local skills and labor which contribute to low cost of investment and operation. Due to such comparative advantages, irrigation development strategy in Ethiopia has mainly focused on the development of smallholders' schemes. In this regard, the statement of concern is clearly stated in the Ethiopian Food Security Strategy.

To increase food production, the strategy focuses on diffusion of improved agricultural technologies within smallholder agriculture in areas where there is ample rainfall. On the other hand, the strategy has envisaged implementation of cost-effective irrigation schemes in drought prone and densely populated areas in order to reduce the vulnerability of the sector to the vagaries of weather and to address food insecurity problem at the household level.

The available literature on the socio-economic impact of small-scale irrigation development in some African and Asian countries generally show that irrigators have been found in a better position in terms of income, nutritional status and standard of living than their non irrigation counterparts. For instance, in India Sing and Misra (1960) compared the Sarda canal irrigation and non-irrigating villages and made the following observation:

FAO (1997) also reported benefits from smallholder irrigation. In the socio-economic impact assessment of Hama Mavhaire, Hoyuyus and Nyaitenga irrigation schemes in Zimbabwe, it is reported that:

"Farmers' incomes from irrigated agriculture are significantly higher than incomes from dry land farmers. The report also indicated that levels of inputs in terms of quantity are higher in irrigation schemes than in dry land areas, suggesting that there is more intensive crop production in irrigation schemes than in dry land agriculture".

In many drought prone countries, including Ethiopia, there has been an optimistic view regarding irrigation development as a strategy to sustain agricultural production and ensure food security. The need for irrigation development in drought prone regions is also promoted by many international development organizations. For instance, FAO (1986) indicated that small-scale irrigation schemes would stabilize agricultural production system and assure food supply even in years with inadequate rainfall and increase the overall level of crop production in years with normal rainfall. Another advantage of irrigation is that the possibility of intensification of agricultural practices, especially in areas where arable land is a scarce resource. Irrigation provides the means of maximizing production with double or multiple cropping, taking full advantages of modern technologies and high yielding crop varieties. Moreover, irrigation provides farmers an opportunity to grow high value crops like vegetables and fruits that require year round and generous supply of water to grow. Such diversification of agricultural products will ensure reliable income source to the farming community.

Small scale irrigation needs to be expanded to increase food security in drought prone areas. It is not possible to address issues such as poverty, environmental protection of food security without putting in place mechanism for the exhaustive and efficient use of water which includes building irrigation schemes, expanding infrastructure, introducing modern irrigation equipment, strengthening agricultural extension, and training program.

Generally Small-scale irrigation is widespread and has a vital role to play in Ethiopia. The success of small-scale systems is due to the fact that they are self-managed and dedicated to the felt needs of local communities. Indeed, small-scale schemes are defined as schemes that are controlled and managed by the users themselves.

2.2 Empirical Literature Review

There are some critical issues related to irrigation development and management, which are important to be highlighted here. Upstream developments and over abstraction of water supplies can affect the welfare of downstream users negatively. Taking the case of the Dalia barrage (Bangladesh), Higano and Islam (2002) show how the operation of the Gazoldoba barrage upstream (India) has affected the livelihoods of farmers in Bangladesh. Cross-boundary coordination failure is causing a reduction in agricultural production/land, loss of

fish, flash floods, and transportation problems in the short run. This situation is compounded by poor canal design and faulty structures, inequity in water distribution, untimely water deliveries, and insufficiency of irrigation water, with consequent loss of agricultural productivity and livelihood for the poor. The long-term impacts may include conversion of fertile land to wasteland, annual economic loss of over half a billion dollars in agricultural production, fisheries, and navigation and use of arsenic contaminated groundwater for irrigation which could create serious health hazards. Overall, an estimated 21 million people would be affected through economic and environmental ruin of this "man-made disaster". Some studies have highlighted negative environmental externality effects of irrigation. The main concerns are related to poor drainage, water logging and salinity in large irrigated systems, which have the potential to cause loss of soil fertility and productivity with consequent adverse impacts for the poor and regional economies. Taking the case of the Indira Gandhi canal command areas in Rajhastan, India, Jaglan and Qureshi (1996) document evidence of rising water tables and high incidence of irrigation-induced alkalinity. Soil salinity poses real constraints on agricultural productivity and economic livelihoods of Pakistani farmers. However, existing soil reclamation technologies are more traditional and costly, and during recent decades new technologies to combat soil salinity have not been widely disseminated.

Irrigation-induced green-revolution technology, due to its labor-saving and capital-intensive nature, is sometimes perceived to disfavor the poor. However, a more serious concern relates to inequity in irrigation water distribution and its impact on productivity and livelihoods for the tail-end farmers in large-scale canal irrigation systems. Using panel data from wheat farms in canal command areas of the Chaj sub-basin of the Indus basin, Pakistan, Hussain et al. (forthcoming) document the existence of large head–tail inequities in irrigation distribution. Less access to surface water and poor quality of groundwater at the tail-ends reduce productivity and consequently have negative welfare impacts for the wheat farmers. Reallocation of canal water to areas with a deficit water supply, and in particular to tail-end locations with poor quality groundwater, is considered a poverty-reducing intervention. In general, the distribution of benefits of irrigation among various socioeconomic groups is determined by the distribution of land resources. Where the distribution of land is skewed, as in India and Pakistan, large farmers benefit relatively more. On the other hand, if the distribution of land is relatively equal, for example irrigated land settlement schemes in Sri Lanka or the land distribution pattern in Chinese irrigation systems, the distribution of irrigation benefits tends to be more or less equal. The land poor also benefit, as the case

studies by IDE (2002) in Bangladesh, India, Nepal, and in African countries show, that micro-irrigation technologies such as sprinkler, drip, and trickle irrigation, self-target the poor, and empower them by enabling them to raise their incomes permanently. With modest investments of as little as US$15–25 per household, landless households can produce fruits and vegetables for family consumption or sale (Shah et al., 2000). Landless households benefit indirectly through increased employment opportunities, both on-farm and in agribusiness enterprises and nonfarm. These arguments serve to make the point that irrigation does offer opportunities for benefiting the landless and resource-poor households, although the incidence of these benefits may not always fall squarely on these households, due mainly to policy issues often unrelated to irrigation. This point out that pro-poor and antipoverty impact of irrigation infrastructure can be intensified through provision of complementary infrastructure and inputs and by adopting an all-inclusive approach in other policy areas.

The literature on the impacts of irrigation on poverty alleviation can be classified into three broad categories: (1) systematic empirical research measuring impact with rigorous methods using primary or secondary data and information, focusing on specific locations; (2) general articles and papers based on common perceptions and logic; and (3) appraisals, evaluations, and assessments of projects, mostly undertaken by the funding agencies. Our review focuses on the first category, i.e. empirical research studies. Impact studies differ in terms of geographic coverage, scale of analyses, and approach adopted in measuring impact. The scale of analyses varies in studies, ranging from household to village, region, national to international levels. The approaches adopted in various studies can be classified into three major categories: (1) "before and after" comparisons; (2) "with and without" comparisons; and (3) "more and less" comparisons with econometric methods applied in most studies in all three categories. It should be noted that studies documenting concrete linkages between irrigation and poverty are rare, and more so in case of studies documenting indirect linkages between irrigation and poverty. Simultaneity and the concurrent nature of interventions and multiplicity of linkages pose methodological problems in assessing and separating impacts of irrigation interventions. For brevity, we present here a synthesis of key findings and conclusions emerging from the review of the studies. For a more detailed review of empirical evidence on the impacts of irrigation on poverty reduction, based on (1) "with" and "without" comparisons of intermediate poverty-reducing indicators/variables cropping intensity, crop productivity, and employment generation; (2) "with" and "without" comparisons of poverty-related indicators—employment, incomes, income inequality, and

incidence of poverty; (3) econometric evidence on the nature, direction and magnitude of impacts of irrigation on poverty; and (4) evidence from earlier reviews and synthesis papers, see Hussain and Hanjra (2003). As mentioned earlier, micro-level impacts are realized at farm, household, and local level, and these affect intermediate variables of poverty including cropping intensity, land and water productivity of crops, labor employment, and household income. A number of studies conducted in various settings and countries show that cropping intensity, crop productivity (principally rice, as per these studies) and per hectare employment are higher in irrigated than in rainfed settings. A comparative review of the studies shows that: (a) cropping intensity, one of the intermediate indicators of poverty, is higher in the irrigated setting than the rainfed setting. Cropping intensity ranges between 111 and 242% in irrigated and 100 and 168% in the rainfed setting. The availability of irrigation facilities has therefore enabled farmers to raise nearly an extra crop a year, with consequent implications for household food security; (b) irrigation has contributed to increase land productivity of major crops, including rice and wheat, the main staple foods of Asian rich and poor alike. For example, rice yields fall in the vicinity of 3.0–5.5 t ha_1 in irrigated settings, while the upper bound corresponding figure in rainfed settings is around 4.0 t ha_1, implying that farmers can harvest an extra tonne per hectare of rice due to access to good irrigation water. Similarly, wheat yields are higher in the irrigated than the rainfed setting; (c) labor employment per hectare, and wage rates, are higher in irrigated than non-irrigated settings. Further, the former serves as an employer of surplus labor of adjoining non-irrigated areas. A number of studies have used econometric models to establish irrigation–poverty nexus. Although irrigation infrastructure variables are defined differently (for example, as the ratio of irrigated area to cultivated/command area, access to irrigation, and modern variety–irrigation interaction term), almost all of these micro- and econometric studies show that irrigation is a positive determinant of income, a negative determinant of poverty, and households having access to irrigation (and complementary inputs) are less likely to be poor. While irrigation is a negative determinant of poverty, magnitude of the anti-poverty impact of irrigation varies across locations.

Irrigation is a vital component of agricultural production in many developing countries. Besides Bruinsma (2003) found that developing countries are particularly dependent on irrigation. In order to see the impact of irrigation on socio-economic development of the society, some of the empirical findings are presented as follows.

Recently there has been a paradigm shift in policies and practices of irrigation management around the world. Admittedly, participatory irrigation management and its transfer to farmer's organization is now widely accepted and used as an effective tool for sustainable irrigated agriculture (Das 2005). Cumulative experience has shown that farmer managed irrigation can contribute usefully to food security through enhanced crop production and farmer income generation (chambers 1994).

Despite lack of available statistic, there is no doubt about the importance of small-scale irrigation (SSI) in many developing countries. For many farmers, irrigation is only part of their livelihood but often a very important part. Irrigated fields are usually valued very highly.

Turner (1994) gave the following reasons for the importance of such farmers managed irrigation system: it can be used to extend the length of the growing season; and as a form of insurance so that when rains start late and upland crops are at risk, crops planted in the valley bottoms or those which receive supplementary irrigation are often the only ones to reach maturity. Irrigation is thus a valuable insurance. Several crops, such as tomatoes and leafy vegetable, grow far better in the dry season when they do not suffer attacks of mildew or pests prevalent in the wet season, and other crops require the lower temperatures of the dry season. There is also a major advantage in combining dry season and wet season cultivation.

In general, according to McCornick et al (2003) all small-scale systems may have advantages over large-scale systems. These advantages include that small-scale technology can be based on farmers existing knowledge; local technical, managerial and entrepreneurial skills can be used; migration or resettlement of labor is not usually required; planning can be more flexible; social infrastructure requirements are reduced; and external input requirements are lower.

However, in Molden's (2007) studies, he pointed out that while "agriculture water management and development play an important part in poverty reduction, they cannot banish poverty alone. Also needed are complementary investments in education, health, rural infrastructure, capacity building, and supportive institutions, together with pro-poor, pro-gender research on low-cost and gender-suited technologies, crop research advances, and improved agronomic and water management practices and related dimensions of social exclusion, equity, and empowerment."

An empirical research made by Bruns (2000) showed that the introduction of irrigation in to farming systems created distinct socio-economic impact and wider demographic and

community changes, As Bruns (2000) examined that the most significant issue arising from large dam construction is resettlement of people displaced by the flooding of land and homes. As chambers (1994) pointed out irrigation creates social changes and it can transform the land, to be critical asset in the development of economies, Re-vitalize people, and stabilize communities. In Zimbabwe the assessment of the small holder irrigation sub-sector in found out that small holder irrigation has brought many successes to farmers (http://www.fao.org/docrep/X5594E/X5594e00.htm).

Salilih (2007) employed both qualitative and quantitative approach, to assess the contribution of irrigation on household food security and irrigation management and problems associated with it in the case of Zingni and Fetam small-scale irrigation schemes in Blue Nile basin of Amahara national regional state. The findings of the study revealed that irrigation contribution on minimizing household's socio-economic poverty significantly vary from one irrigation scheme to another. Its contribution also vary across irrigation systems depending on the physical structures of the scheme, amount of irrigation water, plot size, availability of agricultural inputs, management qualities and educational status of individual farmers to accept new ideas. For instance, 83.3 % and 42% respondents in Wonjella (Fetam) and Deninatquashta Kebeles (Zingni) respectively confirmed that improved irrigation system benefited them to minimize households' socioeconomic poverty. However, the degree of poverty is still high in Deninatquashta than in Wonejella Kebele and socio-economic and institutional problems are commonly much higher among female-headed households especially those households that have no close relatives and farmers who are disabled and aged. The two modern schemes are constrained by socio-cultural and technical problems. With the presence of these problems it is very different to generalize that irrigation system can reduce household socio-economic and institutional poverty. Finally, the author forwarded conclusion and recommendation based on the findings, farmers participation from inception to completion of irrigation projects should be a prerequisite for the sustainability of irrigation schemes, equitability and security in access and right to resource such as land, water and credit. In addition, training on irrigation water management contribute to break rural households' socio-economic poverty and help mainstreaming of gender in each irrigation management activities.

Gebremedhin and Pender (2002) analyzed the productivity of irrigation in the highlands of Tigray in 1998/99. The survey was based on 50 communities and 100 villages. The result

showed that irrigation was found to increase the intensity of input use, especially labor, oxen, improved seeds and fertilizer. Controlling for other factors, use of manure or compost was about 50% more likely on irrigated plots than on rain-fed plots. By increasing such inputs, irrigation contributed to increase crop production. The predicted impact of irrigation was 18% increase in crop production relative to rain-fed field plots. On the contrary, the impact of irrigation on the productivity of land management practices was statistically insignificant.
In the same way, another survey was done in Amhara highlands of Ethiopia. Irrigation was associated with improved technologies such as fertilizer and manure, and other inputs like improved seeds and pesticides, labor and draft power. However, the impact of irrigation on the productivity of farming practices was insignificant (after controlling other factors) (Benin et al. 2002).

Gebremedhin and Pender (2002) recommended that in both the highlands of Amhara and Tigray, the reason for failure of irrigation to improve productivity of farming practices needs further careful research on the technical, institutional, governance and managerial aspects of irrigation. In addition, they also suggested that such an investigation can give important guidance for policy and institution intervention to increase the impact of irrigation on productivity and income.

Gebremedhin B. and D Pedon (2000) stated that in Ethiopia, most problems of small scale irrigated agriculture that hinder its further development arise from the operational methods adopted rather than its construction and design. This study pointed out that in Ethiopia irrigation development planning gave emphasis to the agronomic, engineering, and technical aspects of water projects, with little consideration to issues of management, beneficiary participation, availability of institutional support services such as credit, extension and input supply, and marketing.

3 CHAPTER THREE

3.1 Research Methodology

3.1.1 Description of the Study Area

Kemissie zone is one of the zone of Amahara regional states. It is one of the largest zone in terms of area, population, contribution to the regional economy in particular, to the national economy in general. The zone consists of five Woredas and two city administration.

The capital city of the zone, Kemissie, is situated at a distance of 325 km north of Addis Ababa. The zone is divided in to three agro-ecological zones, namely low land, medium, and highland that cover the total area of the zone. With regard to location the zone is located 3200m above the sea level, the total area of the zone is 399432 hectares. The economy base of the zone is agriculture which is the majority of the population is depends on agriculture for their livelihood. The total population of the zone for the year 2008/2009 is estimated at about 485576 of which 241179 are males and 244397 are females. From the total population 426923 are rural dwellers where as the remaining 58653 are urban dwellers. The largest parts of the population of the zone engaged in agricultural activities other include those who participate in rearing of animals, trading, and unemployed population.

The selection of this project site for this study is based on the following reasons;

1. It is an area where a diversified economic activities being carried out. The irrigator's compositions are also have diversified activities.
2. The area was not much affected by abnormalities unlike for example the cost of cash crops area where irrigators are affected by frequent fluctuations not only in the national market but also in the international market and the general consumption pattern of the society.
3. The writer was born in this area hence has better observation about irrigators.
4. In this study area, there are a number of small scale irrigation projects.

This research is basically focused on two small-scale irrigation systems, namely Finchiftu and Worke SSI. The reason for the selection of these irrigation systems is that both are found in the semi-arid areas where insufficient and erratic rainfall is a recurrent phenomenon that causes crop failure. In this respect, water use for agriculture by smallholder farmers is an appropriate choice. Therefore, I became interested to see the implication of irrigation whether it helped to tackle the consequences of drought and its contribution to food security. Accessibility of both irrigation systems is also another factor for their selection.

3.1.2 Finchiftu and Worke irrigation project

Establishment: Prior to the development of Finchiftu and Worke irrigation project, the life of the farmers in the vicinity were relied on the production of rain fed crops and livestock. The agricultural production was not satisfactory due to the fact that the rainfall is too low for such arid environment. The farmers were forced to move and work in the neighboring state farms as daily laborers and the government, for their survival, had to feed some of the farmers. Considering the seriousness of the problem and to eradicate it from the area, the irrigation project was established by World Vision Ethiopia in 1992e.c and Japan Embassy in collaboration with Ethiopian Orthodox Thewahido church in 1998e.c respectively. Initially the project area was designed to cover gross command area of 25ha and 30ha and later the project can irrigate the total irrigable land of 24.75 and 20ha respectively. Up on the development of the project, each farmer was cultivating his/her own land separately (properly). This has created disputes among farmers. To settle the dispute, it was founded to set up the organizational rule. This organization rule was established by water user association they are called water committee.

***History and organizational setup of the project*:** Following the establishment of the project, Farmers' Water Users Association, which was lead by the selected administrative committee from the irrigation project run all over the project activity; out of the 25ha of land, 24.75 ha from Finchiftu irrigation project and 20ha from Worke irrigation project, had been cultivated. Even though the association had tried to produce crops (with the support of the World Vision and Bureau of Agriculture) due to the lack of experience and motivation, the project could not be successful as anticipated. The numbers of farmers get benefit (participating) are 80 in Finchiftu and 79 in Worke project activities were varying from year to year. From then onwards, the Ministry of Agriculture (MoA) has taken the responsibility and assigned one Development Agent (DA) for each to assist, organize the farmers and to create a link between the association and MoA, funding agency and other organizations.

3.1.3 Research Design

Due to the nature of the problem at hand, the intended thesis was designed based on qualitative and quantitative research approach. The subject of the study was those who permanently reside in Dewa Cheffa Woreda and use or involve in small scale irrigation. Additionally for triangulation purpose and enrich the study, qualitative and quantitative data were obtained via questionnaire, interview and direct observation.

3.1.4 Target Population

In the study area, the target population was those people having domicile in the target Woreda. The study target mainly focus on small scale irrigation system and their relations with irrigations development by taking in to consideration employment, output, income, and consumption pattern.

3.1.5 Data Source and Type

The studies were used both primary and secondary data sources. The planned study used information gathered from those who directly involve in small scale irrigation development as a primary source of data. The primary data sources were include both structure and semi-structured interview, personal observation as participatory manner, questionnaire and documents and statistical data from Kebele's and Woreda's that directly reflect the irrigation development in the Woreda. To compare the impact of small scale irrigation all relevant and available document were reviewed and serve as a secondary source of data.

3.1.6 Data Gathering Techniques

To assess the data from relevant sources, the researcher were utilized multiple data gathering techniques, vis., structured questionnaires, structured interview and direct personal observation. Key informant interviews were made with Woreda irrigation experts, development agents, scheme committee members, and experts from Woreda agricultural offices to improve understanding of the institutional functioning of the scheme.

3.1.7 Sampling Methods and Procedures

The selected study area, Dewa Cheffa Woreda, has four Kebeles. Based on purposive sampling methods two Kebeles were selected. Since the other two are partially irrigated because some of the populations are relied on rearing of animals, they are excluded from the study. The study is focused on selecting equal number of sample interviewee from each area. Out of 159 households from the two irrigation schemes 40 households were selected using the sample size determining formula. Mathematically the sample sizes were determined using the following formula :(http://www.surveysystem.com/sscalc.htm).

$$SS = \frac{Z^2 * (p) * (1-p)}{e^2} = \frac{1.96^2 * (0.4) * (1-0.4)}{0.13^2} = 54.55$$

Correction for finite Population

$$\text{New SS} = \frac{SS}{1+\frac{SS-1}{pop}} = \frac{54.55}{1+\frac{54.55-1}{159}} = 40.08 \approx 40$$

Where;

SS=Sample Size

Z = Z value (1.96 for 95% confidence level- tells you how sure you can be)

P = percentage picking the service improvement [the assumption is that 40% of the household's will have got access to increase their agricultural output which is expressed as decimal (0.4 used for sample size needed)]

e = confidence interval (also called margin of error) is the plus-or-minus figure usually, expressed as decimal (0.13 = ±13)

Pop=Population= 159, total house hold in the study area

Putting all these values into the above formula, yields a sample size of 40 and which is used for this study.

3.1.8 Methods of Data Analysis

The entire data and information gathered were categorized under major and sub-major of the study. A number of methods of analysis, relevant to each variable were used to analyze the data gathered through questionnaire. Appropriate statistical methods, in line with the research questions, frequency table, and average indicators were used to analyze various impact of irrigation on socio-economic development. On the other hand the qualitative data collected through interview and observation as participatory manner were analyzed as they are and they help to make conclusion for the study.

To study the socio-economic impact of irrigation various households socio-economic characteristics 'before and after' the implementation of irrigation schemes were compared. Data were collected on land holding size, actual irrigated land by the schemes, other source of income, skill of producing ability of farmers, distribution of irrigation water, productive capacity, number of farm hired and family labor and family food security conditions at household level 'before and after' the implementation of irrigation project.

The quantitative and qualitative data collected from the primary and secondary sources were analyzed using qualitative methods and descriptive statistics. Statistical Package for Social Sciences (SPSS) software was used for the analysis of quantitative data. Data collected from key informant interviews, and observations were qualitatively assessed. Finally, outputs of the statistical analysis were discussed using tabulation, cross-tabulation, means, frequencies and percentages.

Comparative data analysis was carried out using the SPSS statistical software package. The purpose of the analysis was to show the relationship between different variables.

The Chi-square test and paired t-test was used for testing the association between different variables. It uses different significance levels to test the strength of the relationship between variables. It used to compare between different variables.

3.2 Identifications of variables

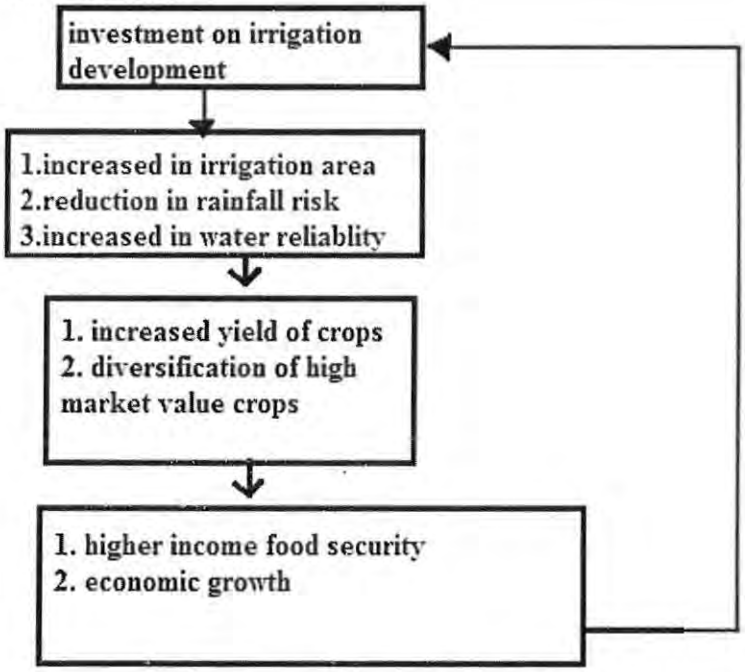
Economic variables or indicators assessed were;

- Production output.
- Income level.
- Productive capacity.

Social variables or indicators that were assessed include

- Consumption pattern.
- Farmers skill
- Employment pattern.

3.3 Analytical frame work



Own Source **Figure 1: Analytical frame work**

For analytical purpose the following intermediate indicators were considered: one of the direct impacts of irrigation development on socio-economic development is through increasing agricultural production by allowing the possibility of multiple cropping under dry land condition, increasing cropping intensity, crop diversification, and crop yield. This intern has a direct positive effect in boasting total farm output, raising farm incomes and increasing farmers' household consumption (Samad, 2002; Aliu and Pernia, 2003; and FAO, 1996).

Moreover, the increased income from higher yields is expected to help farmers to diversify in to productive assets holding like livestock, farm tools etc. Increased productive assets holdings also have an effect in increasing household income gains. Thus the magnitude of the direct impact of irrigation development is given by the difference in yield between dry land and irrigation production. Another direct linkage between irrigation and economic development through reducing crop losses from erratic, unreliable or insufficient rainfall, this also has an impact in increasing yields which leads an increase in households food self sufficiency and higher level of consumption expenditure (Lipton.etal.2003).

CHAPTER FOUR: RESULT AND DISCUSSION

3.4 Demographic characteristics

Of the total sampled farmers household about 80% were male headed and 20% were female headed at the two small scale irrigation. The survey summary shows that female to male proportion is too small.

According to the data obtained from the sampled household survey, the age distribution of household in both Finchiftu and Worke irrigation project shows that 3.3 %, 23.3%, 10 % and 63.3 % of the sample respondent were found to be in the age range between below 25years, 25-30year, 31-40year, and above 40year respectively (Table 1).However, 86.6% of the total samples are under active population category.

The level of education (years of schooling) of a rural household which plays an important role in improving the productivity (both at individual and organizational level) by equipping people with the skill and knowledge to actively participate in the economic endeavors of the society, and in promoting entrepreneurship. Therefore an attempt was made to assess the educational level of the respondents. As can see from Table 1 73.3% of the respondents were can read and write on the contrary 26.7% of the respondents were illiterate. Though 73.3% of the respondents could read and write but they did not pass through formal education.

Generally speaking, the survey data shows that the performance of primary education in the study area is not satisfactory (Table 1).

Table 1: Sample size and family number

Sex	Frequency	Percent
Female	6	20
Male	24	80
Total	**30**	**100**
Age		
Below 25	1	3.3
26-30	7	23.3
31-40	3	10
Above 40	19	63.3
Total	**30**	**100**
Education level		
Literate	22	73.3
Illiterate	8	26.7
Total	**30**	**100**

Source: **Survey Result 2011**

According to the data obtained from sample households' survey, the average family size of household in each family is 5.93(see Table 2).

Table 2: Number of family size in each household

Number of dependant in household	N	Minimum	Maximum	Mean
	30	1.00	13.00	5.9333

Source: **Survey Result 2011**

3.5 Source of income

Rowntree (1991), highlighted that a paired t-test result can only be said to show a significant relationship if its calculated value is smaller than its critical value. Applying this view by Rowntree (1991), Table 3 shows that the impact of irrigation on the household income level by comparing the situation before and after irrigation project introduced in the study area. The summary result depicts that there is a significant variation (difference) between the number of cattle after introduction of irrigation project and the number of cattle before introduction of irrigation project in the study area. This result was found to be significant at 5% level of significant were the t-calculated (0.4188) is less than the t-critical (1.7340). Furthermore, the survey result shows that the difference between the monetary value of asset in the form of cattle population just before and after introduction of irrigation (Table 3). Similarly it was found to be a significant difference between assets owned by household in the form of cattle population measured by their market value just before and after the irrigation schemes development.

Generally speaking not only increasing the number of cattle but also they have got accesses to increase the asset owned by selling their cattle after irrigation development. Table 3 reveals that other source of income other than agriculture using irrigation for those farmers reside in the study area is significantly increase the asset owned. This also shows introduction of irrigation project plays a pivotal role for farmers to increase their quality and quantity of cattle.

Table 3: Income from cattle before and after irrigation

	Mean Difference	Std. Deviation	Std. Error Mean	$t_{calculated}$	$t_{critical}$	Df (n-1)
Cattle number before and after irrigation	.105	2.208	.507	0.419*	1.734	18
Cattle in cash value before and after irrigation	4631.58	7109.70	1631.08	0.01*	1.734	18

Source: **Survey Result 2011** * **at 0.05 level of significant** ** **not significant at 0.05 level of significant**

3.6 Farming system, land holding size, irrigation water, awareness and time spend

Land holding size:

In the survey, farmers' land holding size was asked and summarized in Figure 2. These assets are a prerequisite in the productive activities for agricultural production. As participants noted that land size and distribution of irrigation water are the most important factors for improvement in agricultural production between households. The research then seeks to examine whether land holding per household vary among the sample study areas and household land holding size has relationship with type of irrigation system owned.

The average household land holding was found to be 0.7 hectares, which appears to be very small when compared to the national average land holding size (1.02 hectares) (CSA 1998).

The researcher found out that the distribution of land ownership owned with the majority of sample households (50%) having 0.5 hectare, and 20% of households owning 0.25 hectare. Only 30% of households were owned between 0.75 and 2.50 hectares in the study site. The land holding per household among the study group is almost similar.

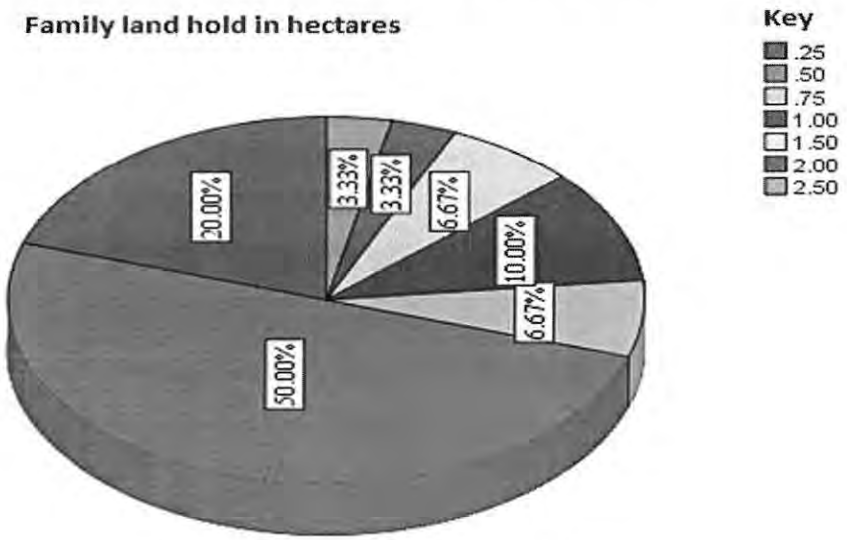


Figure 2: Family land holding in hectares

Table 4 depicts that 16.6% and 43.3% of the sample respondents who have 0.25 and 0.5 hectares of land respectively were able to fully utilize their land using the irrigation scheme. On the other hand, it was only 9.99% of the sample respondents who have more than 0.75 hectare was able to fully utilize their land using the irrigation schemes.

This implies partly that the irrigation project in the study area could not satisfy what the beneficiaries need to have. Furthermore, had the irrigation project been in such ways that satisfy the optimal need of the farmers there would have been more output than the existing

one. Generally speaking based on the cross tab result in table 4 there should be a further investment of irrigation project development.

Table 4: Comparison of household land and actual irrigable land hold per hectares

		Land holding of sample households							**Total**
		.25	.50	.75	1.00	1.50	2.00	2.50	
Irrigated land by the scheme	.25	5(16.6)	2(6.6)	1(3.33)	2(6.6)	2(6.6)	-	-	**12(39.73)**
	.50	1(3.33)	13(43.3)	-	1(3.33)	-	-	-	**15(50)**
	.75	-	-	1(3.33)	-	-	-	-	**1(3.33)**
	2.00	-	-	-	-	-	1(3.33)	-	**1(3.33)**
	2.50	-	-	-	-	-	-	1(3.33)	**1(3.33)**
Total		**6(19.9)**	**15(49.9)**	**1(6.66)**	**3(9.93)**	**2(6.6)**	**1(3.33)**	**1(3.33)**	**30(100)**

***Source*: Survey Result 2011** ( ) = percent, Outside ( ) number of farmers who irrigate their plot

Awareness:

The understanding of the project by beneficiaries as well as their active participation in the project is very important for the success of any project. As Table 5 shows that whether the respondents were aware about the introduction of irrigation before its implementation, 80% of the respondents indicated that they were aware of it. This implies that the concerned individual like World Vision Ethiopia and Regional Agriculture Bureau, Zonal Agricultural Bureau and Woreda Agriculture Bureau playing a pivotal role on the side of creating awareness about the benefit and role of small scale irrigation. The other 20% were found to be having no knowledge about the introduction irrigation project in their area. A possible explanation for this result could be the fact that the respondent in the study area in some households were persons other than the farmers or heads of households, they are migrant people who are residing in the study area for sake of searching land for transplanting onion. Some of them did not necessarily join the introduction of small scale irrigation project but after its implementation, hence the reason why they said they were not aware of the introduction of the irrigation project.

Box 1

According to interview guide from Woreda irrigation officer Mesfin Tingritu(38 years) before irrigation development those farmers in the study area have not willingness about the construction of the project because;

1. "All the population (farmers) are assuming as a result of introduction of irrigation, our farm area is becoming the settlement of other people who migrate from other,"

2. "On the other hand, the regional government declared the land which can be irrigable must be given (distributed) 0.25 hectares of land for each farmer. But world vision Ethiopia played a crucial role in convincing farmers in terms of supplying seed, fertilizer and market access"

Table 5: Awareness creation for household from the concerned individual

Respondents awareness about irrigation	Frequency	Percent
Yes	24	80
No	6	20
Total	30	100

Source: **Survey Result 2011**

Irrigation water:

The amount of water reserving (holding) capacity of both Finchiftu and Worke small scale irrigation project is estimated to be irrigating 24.75 and 20 hectares of land respectively. With regard to the opportunity of using irrigation water for the whole land 66.7% of the respondents indicated that they have the opportunity to use irrigation water for a purpose of irrigating their farm land because all of the respondents are owning the hectares of land smaller than that of the capacity of the schemes which accounts 18.25 hectare of land but Table 6 depicts that 33.3% of the respondents said that they do not have opportunity (access) to irrigate the whole land by the supplied water. This is due to the fact that;

1. The actual topographical location of the farm land which is far from the schemes
2. All the farmer households are did not consider crop water requirement but they only consider market oriented crop. These are the most aggravated factors leading to small irrigation water.

Table 6: Opportunity to use the whole land by the schemes

HHs opportunity to use the whole land by the schemes	Frequency	percent	Total
Yes	20	66.7	66.7
No	10	33.3	33.3
Total	30	100	100

Source: **Survey Result 2011**

A representative farmer assigned by the association (irrigation users) throughout the year manipulates the schemes for a sake of equity distribution of irrigation water to users what we call it water committee. The representative of DA makes water allocation between farmers and it is basically governed by the water committee. The distribution can be allocated day and night rotation or for specific period (days interval) within a week. It implies that there is restriction how much water a farmer can divert for his/her field, without considering the size of farm rather based on time interval. From field observation and results of the questionnaire, due to unwise use of water by the upper users and siltation problems of the reservoir, the tail end user faced water shortages frequently.

Table 7 result shows that 66.7 % from the total respondents believe that water is fairly shared among the farmers and while 33.3 % the respondents are believe that it is unfairly distributed among users. The most important reason for these is aggravated due to the fact that since the distribution of irrigation water does not consider the plot of land and not only the upper users but also the lower users are diverting the wire after using their own share (looking for water theft, corruption, and water shortage).

The source of the difference among the schemes was resulted by the ability and capacity of the diversion and reservoir structures to convey sufficient irrigation water from the rivers and deliver to beneficiaries at different positions of farm area. According to interview guide due to the small amount of source of water in both the study area reservoir has the capacity to store water 26 m^3 and 22 m^3 (night storage) for Finchiftu and Worke irrigation schemes, respectively. Due to this factor irrigation water has not a capacity to reaching the intended beneficiaries that reside at far distances from the reservoir. Hence it aggravate for the inequality.

Table 7: Distribution of irrigation water

equity distribution of irrigation water	Frequency	Percent	**Total**
Yes	20	66.7	**66.7**
No	10	33.3	**33.3**
Total	**30**	**100.0**	**100.0**

***Source*: Survey Result 2011**

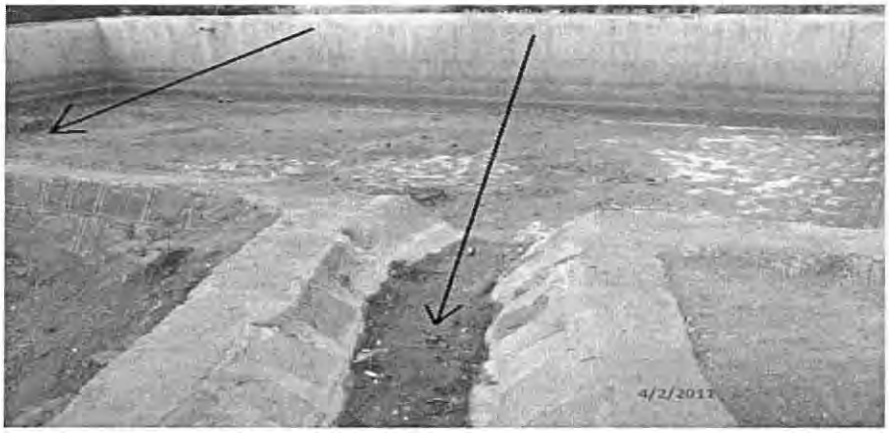


Figure 3: Siltation at Finchiftu irrigation project.

The term dispute (conflict) refers to controversy between different groups of people due to different factor like demarcation of farm land, unfair water distribution, water shortage and the amount of irrigation water that every one owned for their own.

The water distribution in the study area is based on scheduled distribution system. This distribution system is used when water is scarce. The scheme is owned by the groups, which need scheduled water distribution to avoid potential water conflicts.

With regard to conflict (dispute) between farmers in their farm area 83.3% from the respondents said that there is no dispute between farmers in their farm area. These is due to the fact that the absence of dispute among farmers is given to water user committee which is elected by the society in collaboration with DA expert take the responsibility to reduce or settle the dispute among farmers household. While Table 8 reveals that 16.7% from the respondents responds that there is dispute between farmers in their farm area. The dispute is mainly due to three factors;

1. Due to the absence of land demarcation between the farm plots.
2. Farmers did not consider crop water requirement in the farm area. Due to this factor the amount of irrigation water does not cover the whole intended beneficiaries.

3. The distribution of irrigation water does not consider the plot of land. These lead to the dispute between farmers.

Table 8: Conflict between farmers in the farm area

Conflict between farmers on the farm	Frequency	Percent	**Total**
Yes	5	16.7	**16.7**
No	25	83.3	**83.3**
Total	**30**	**100.0**	**100**

***Source*: Survey Result 2011**

Time spends:

As in the case of this study respondents identified themselves as full time farmers in day and night in the whole season. The survey result on Table 9 revealed that over 93.3% of heads of households worked daily in their fields compared to that of before introduction of irrigation project. On the contrary only a few of farmers are spending less time in their field which accounts 6.7% from the respondents. Each of these farmers spent an average more time during the cultivation season (Table 9). Several empirical studies in different countries done by Chambers (1988) also demonstrate that irrigation systems should directly raise employment by increasing both the number of days worked per hectare and days worked during a cropping season. Even though the labor hired is on temporary basis at times, there are some who are hired permanently. Those who are seasonal or temporary laborers also get hired by different farmers in each season depending on the need for extra labor and the availability of the means of payment. There is different reason contributing for those farmers spend more time on the field;

1. As a result of irrigation development, farmers are looking to produce market oriented items of crops such as onion, tomato, cabbage, tobacco, mango and the like. This item of crops needs treating the whole season for better implementation (production) because by its nature such types of crop easily infected by diseases like fungus (fungi) hence starting from reduction in amount of total output to total losing crop will occur. This and other factor looking for farmers to spend more time than before irrigation development.

2. Since the distribution of irrigation water is distributed for users based on fixed time, farmers' does not far apart from their farm area for waiting their time for effectively watering their crops. These and other factors has reversed the tendency of farmers putting more effort (and spending more time) in their farming fields than before.

Generally speaking the study conclude that almost all the farmers in the study area spend more time in their field than before irrigation development all over the season for better production.

Box 2

One respondent from DA expert in study area made the following remarks during interview. ***"Before the introduction of small scale irrigation, once they cropped cereal crop at march they had about seven months free time, all the farmers are idle to harvesting time. But following development of small scale irrigation the type of crop changed in to perishable and it required less time for its cultivation. Hence every member of the families including hired labor is engaged in working on the fields".***

Table 9: Time spending on the field

spending more time on the field	Frequency	Percent (%)	Total
Yes	28	93.3	**93.3**
No	2	6.7	**6.7**
Total	**30**	**100**	**100**

Source: **Survey Result 2011**

3.7 Impact of irrigation on crop intensity

Access to reliable irrigation has been regarded as a powerful factor which provides a greater opportunity for cropping intensity, multiple cropping and crop diversification (Saleth et al 2003). Hence, an attempt is made in this study to analyze the impact of irrigation, particularly on cropping intensity and crop diversification. Based on the information collected from the household survey the following descriptions were found in relation to the effect of development of irrigation in cropping pattern, multiple cropping and crop diversification.

Prior to the introduction of irrigation project, a majority of households in the study areas produced cereal crop as a main staple crops such as Teff, maize, and sorghum. Dry season vegetable and fruit cultivation were very limited only to households who had access to irrigation from river diversion and traditional irrigation and also they are limited to expect the main rainy season which is called summer season in Ethiopia. However, after the introduction of irrigation development, dry season horticultural crop production was found to have become common practice. The result show that many farmers are now producing high value horticultural crops such as potato, tomato, onion, banana, cabbage, as well as other crops like fruits such as papaya, mango, coffee, banana, 'Zeiton', and pineapple.

Following the development of irrigation project in the study area, new crops were introduced; changes were identified in the cropping pattern at the study site. One change was the decrease in the number of farmers producing cereal crops such as maize, sorghum, and Teff and the other increase in those producing marketable items of horticultural crops such as onion, tomato, and fruit. According to Table 10 report showed that 63.3% of the respondent because of irrigation development in their farm area they are looking for diversifying the items of crop being produced. While 36.7% of the respondent said no. Relied on the findings of this investigation, the capacity of the reservoir is not that much significant to diversify their product other than waiting for rainy season because during dry season the volume of irrigation water is become shrink. This big change is a result of two factors. First the adoption of the irrigation development by world vision Ethiopia and embassy of Japan in collaboration with government bodies. DA expert also encouraged the farmers to take farming as a business, and focus on those products that brought highest returns, which in the study area case are onion and tomato and other crops. The evidence proving that onion and tomato were the highest selling crops is presented in Table 13. The other contributing factor was the fact that farmers were not making much output from cereal crop production (the contribution of maize, sorghum and Teff) to household in terms of output is less than the output which is generated by producing horticultural crop. Most farmers therefore decided to reduce from cereal crop production.

The proportion of sample households which produced different horticultural crops after irrigation development is most profitable. As indicated in Table 13 the most common crops produced in the study area using irrigation were tomato, onion, and other fruit and vegetable like papaya, salad, cabbage, orange, pineapple, and tobacco are most profitable. As Table 12 reveals that 83.3% of the respondent responds that the product which is produced after irrigation is become profitable, in contrast 16.7% said that no because of the availability of market, fertilizer, pesticides, and herbicides is insignificant in availability and due to the absence of store near the farm area reduces the profitability of the product.

There seems to be a change in land use intensity as well. Almost more than half of the respondents indicated that they are produced mostly cereal crops in summer cropping seasons while horticultural crops are produced in both winter and summer season.

Due to irrigation development users were found to produce most common crops including tomato, onion, cabbage, salad, and fruit such as banana, papaya and mango.

Those types of crop which is mentioned above appeared to provide the most intensive production system where majority farmers were commonly able to produce two times per

year. According to Table 11 reveals that twenty samples from the user farmers can produce twice per a year. Only ten samples from the user farmers were reported to have harvested three times per year, by growing the seedlings much earlier and planting short cycle crop varieties. The greatest proportion of vegetable production in terms of the number of growers was found to be onion and tomato; which was predominant in all study areas. Onion was grown by 66.7% of sample farmers and 20% of sample farmers produce tomato while the remaining 13.3 %(4) from the sample produce other type of crop such as fruit and vegetable. Farmers reported the following reasons for them preference for growing onions and tomato in large quantities:

1. The seeds for onions and tomato are easily obtained from the market;
2. Irrigation water application and its field management is relatively easy;
3. Onions are less perishable and easy to harvest and transport when compared to other crops, it is not true for tomato;
4. In comparison to other vegetables, onion has a relatively long shelf-life;
5. For tomato product if much irrigation water available it can be possible to produce two or three times per one planted crop.

On the other hand farmers noted that they do not give more emphasis to grow perennial horticultural crops because requires long time for maturity and production and this is not tolerable for subsistence farmers whose livelihood is highly dependent on fast growing seasonal crops. That is why only very few farmers planted mango, coffee, and papaya to a lesser extent produce on the borders of their plots. The volume of production is also very low therefore it is mostly consumed in the household.

However, farmers realized that concentrating on a single crop (onion) has had a negative implication in that it causes competition for market among producers and the water consumption rate of onion is relatively higher than other type of crop. This is particularly difficult when they supply their product to the market at a similar time leading to a fall in market prices due to an oversupply of onions in the market place and it is also difficult when the amount of irrigation water is become smaller and smaller it is true for tomato production.

Generally speaking the study conclude that after irrigation development in terms of crop diversification, production rate per a year, the profitability of product which is produced using irrigation, items of product (crops) which give more profit using irrigation is showed a positive trend. Though most farmers are giving emphasis for one or two types of crop and exposed for price reduction and other environmental externality.

Table 10: Diversification in item of product using irrigation

Diversified crops	Frequency	Percent	Total
Yes	19	63.3	**63.3**
No	11	36.7	**36.7**
Total	**30**	**100.0**	**100.0**

Source: **Survey result 2011**

Figure 4: Diversification of agricultural crop

Table 11: Production rate of farmers per a year

Production per a year	Frequency	Percent	Total
Twice	20	66.7	**66.7**
Trice	10	33.3	**33.3**
Total	**30**	**100**	**100**

Source**: Survey Result 2011**

Figure 5: Fast onion crop which cultivate after four months

Table 12: Profitability of the products

Profitable product	Frequency	Percent	Total
Yes	25	83.3	**83.3**
No	5	16.7	**16.7**
Total	**30**	**100.0**	**100.0**

Source: **Survey result 2011**

Table 13: higher value of products

Higher value product	Frequency	Percent	Total
Onion	20	66.7	**66.7**
Tomato	6	20.0	**20.0**
Other(mango, cabbage, salad, coffee, papaya, tobacco, peanut, banana, 'zeyton', pineapple, carrot)	4	13.3	**13.3**
Total	**30**	**100.0**	**100.0**

Source: **Survey result 2011**

Average amount of production per hectare varies by crop type grown. High variation among mean crop yield per hectare (productivity of irrigated land) was observed among crops grown in the Woreda's agricultural office, which ranged (varied) up to maximum production of 103 to minimum production 8 quintal/ha of irrigated land. For instance, in the case of onion, the mean yield harvested per hectare was 86 quintal/ha with maximum amount of 120quintal/ha, whereas, 205 box/ha tomato produced minimally with a maximum amount of 250 box/ha in the study area (8 Boxes is approximately weights 1 quintal). On the other hand the minimum and maximum production of fruit in the area was harvested which accounts 190 and 250

quintal/ha, respectively. The fruit types include orange, papaya, mandarin, mango and avocado. This implies that 220 quintal/ha average production was harvested following irrigation development in the study area. In contrast tobacco was harvested with small amount of product per hectares which accounts 4quintal/ha with maximum amount of 12quintal/ha. Table 14 reveals that by comparing the average product of those different types of crop onion took the highest productivity per hectare i.e., 103quintal of onion averagely produced per hectares followed by fruit and tomato which accounts 220quintal/ha and 227.5(28.43) quintal/ha respectively.

Table 14: Comparison of average agricultural output per hectares

Types of crop	Production/ha		
	Minimum/quintal	Maximum/quintal	Average/quintal
Onion	86	120	103
Tomato *	205(23.75)	250(31.25)	227.5(28.43)
Orange, papaya, mandarin mango and avocado	190	250	220
Tobacco	4	12	8

Source: 2002 irrigation product evaluation * measured in terms of box 8 box =1quintal

( ) = quintal Outside ( ) measured in box

3.8 Settlement patterns of farm household

Regarding the settlement patterns of farm household with respect to their farm area, 66.7% of respondents are living away from their farm area. This is due to the smallness of farm plot. In contrast Table 15 depicts that 33.3% from the sample responds that they prefer for residence near their farm area. Since the item of crops which is produced after irrigation development is sensitive and perishable item, it needs treatment for better output. This and other factors contribute farmers' migration to the farm area.

Table 15: Pattern of farmer's settlement

Settlement near farm area	Frequency	Percent	Total
Yes	10	33.3	**33.3**
No	20	66.7	**66.7**
Total	**30**	**100.0**	**100.0**

Source: **Survey result 2011**

3.9 Impact of irrigation on household food sufficiency

FAO (2003) defined food security as a "situation that exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their

dietary needs and food preferences for an active and healthy life." For the purposes of this research, this definition was widened to include William's (2002) stance that food security should entail that households acquire acceptable foods in socially acceptable ways without resorting to emergency food supplies, scavenging, stealing, and/or other coping strategies.

Obviously high proportion of households food supply is generated from own agricultural production. However, there is also moderate level of dependence on other non agricultural sources as a means to fill the gap of food shortage such as raring of animal as Table 3 reports showed.

Though almost all the households depend directly or indirectly on agricultural production, they had experienced the problem in every harvest season. This shows that though the contribution of agricultural production is significantly high, it is not yet sufficient to cover households' food requirement.

Likewise, the study in Table 16 revealed that a significant proportion (83.3%) of farmers got sufficient amount of food requirements from their own farm plot harvest. In contrast, only 6.7% of the sample farmers got insufficient food after irrigation development and 3 (10%) from the respondent reveals that though there was irrigation development in the study area, there was no change in terms of sufficient food requirement. On the view of Table 16 generally speaking most of sampled households following irrigation development they did produce enough food to feed their families throughout the year.

Box 3

Mesfin Tingritu (38 years) is Woreda irrigation officer. ***"He said due to drought prone area of land all the farmers are produce sorghum product that are existed (stayed) on the farm land for a long period of time starting from April to November. This product (output) is not sufficient not only for other society (market) but also for farmers and farmer's family. From 0.25hectares of land almost all of the farmers are getting not more than 2000 birr per a year, which implies that they have not satisfied their food consumption throughout the year. However, after development of irrigation they become from the same plot of land that he mentioned above they have the power to get 15 to 16 thousands of birr per a year. Due to these most farmers are satisfying their food consumption".***

Table 16: food security status of the society after the development of irrigation

Food self-sufficiency status	Frequency	Percent	Total
Sufficient	25	83.3	**83.3**
Insufficient	2	6.7	**6.7**
No change	3	10.0	**10.0**
Total	**30**	**100.0**	**100**

Source: **Survey result 2011**

3.10 Impact of irrigation development on economic wellbeing

When researcher asked whether there had been any improvements in economic wellbeing after the development of irrigation, 93.3% of respondents said "yes". The response to this question is presented in (Table 17). While 6.7 % whose response was before the development of irrigation. They mentioned that they did not have sufficient plot of land to plant a number of crop per crop season time and also the amount of irrigation water distribute to the end user insignificant in amount.

Still on the issue of income, it was necessary to understand how the introduction of irrigation development had affected the economic well-being of the respondents especially since literature from Hasnip, et al. (2001) presented economic well-being as one of the measures of poverty levels. Economic growth is usually seen as a critical factor in reducing poverty and thereby increasing food self-sufficiency. Since the study area is one part of the Woreda, the structure and performance of the Woreda economy in particular and its components can affect the food security situation of an entire Woreda through the performance of food markets in general. As used in this context, economic well-being was generalized to refer to the state of households being healthy, happy, or prosperous (Mishra, et al., 2002). All these states depend on a number of various factors such as family characteristics, the resources of these farm households, production and employment levels, and the ability of income to meet consumption, savings and other household needs because those are the most and sole measure of economic well being of the society in general. However, economic wellbeing does not mean that societies wealth. As Mishra, *et al.* (2002) pointed out, Cantó (2000) and Ravallion (1992) agreed with Mishra, *et al.* (2002), that expenditures are typically a better guide to longer term well-being as household's consumption. Development of small scale irrigation in the study area was expected to act as the source of such economic well-being by improving the farmer's level of saving, level of consumption, level of employment and etc. So far, 93.3% of the farmers who are members of the small scale irrigation project had experienced improvements in their economic well-being as the project had allowed them to get more from

their fields than before its implementation. Table 17 shows how the respondents perceived the project to have positively affected their economic well being since irrigation development.

Table 17: Comparison of economic well being of the society before and after irrigation

Economic wellbeing status before and after irrigation	Frequency	Percent	Total
Better before	2	6.7	**6.7**
Better after	28	93.3	**93.3**
Total	**30**	**100**	**100**

Source: **Survey Result 2011**

3.11 Impact of training on irrigation user

Many scholars agreed that smallholder irrigation is important to agricultural development and food security not only to individual household but also for the countries in general. To be successful, the smallholder irrigation system should be based on the wide participation of the farmers using the bottom-up approach to planning. Gender mainstreaming is important at all levels of the development process; women should be able to own land, participate at the leadership level, share in the economic benefits, etc.

Government and NGOs should assist farmers in providing extension services in water saving technologies, better agronomic practices, and environmental conservation. Policy and regulations in irrigation water abstractions, land tenure and land lease issues should be favorable for irrigation development as well as promoting environmental conservation.

Irrigation project with the general objective of enhancing food security need to be planned, developed and managed within the context of a clearer program of capacity building, and with a longer timeframe given to farmers to attain financial sustainability, compared with irrigation program for commercial purposes targeted at farmers with some asset base. According to Table 18, 66.7% of the respondents said that training is given by the government in collaboration with world vision Ethiopia. Only 10 persons from the sampled farm household did not have the training which is given by the concerned individual. There are a number of factors contributing for those farmers they did not have the training, such as some of the farmers are come and settle as a result of irrigation development in the study area.

Generally speaking the government plays a pivotal role through strengthen irrigation extension capacity by increasing the number of capable DA and strengthen extension service training programs (build capacities of extension agents).

In a country such as Ethiopia in general and in study area in particular, where the majority of farmers are illiterate, agricultural extension would play a significant role in assisting them by

identifying and analyzing their production problems and by making them aware of opportunities for improvement.

Hence, the effectiveness of the other inputs in production partly relies upon the availability of sound agricultural extension services at community levels. The survey result revealed that 70% of the sample households identified themselves to be beneficiaries of extension services from DA expert. The percentage of farmers using extension services is high at study area. The researcher asked about the impact of training, respondents witnessed that all beneficial changes in farming practice can be attributed directly to the training services provided. Development agents are frontline workers in day-to- day contact with farmers. The survey finding revealed that development agents at the kebelle level are playing a pivotal role in changing agricultural practices by transferring agricultural technologies to farmers through demonstration plots and trainings.

The DA has a critical role to play in supporting farmers to realize their potential in the study area. According to Table 19 reports 70% the samples got support from the DA expert about the way how to perform irrigation. Such support includes the following components;

Extension service delivery to participating households needs to be improved and strengthened through:

1. Training in irrigation water applications;
2. Promoting organic farming and use of compost manures;
3. Improving access to better farming techniques and post-harvest techniques.
4. Creating model farmer system and should be adopted to provide extension directly to farmers in the study area motivating farmers to produce more.
5. Creating awareness for farmers to plant short duration, high-value crops and the way how to plough the farm land, how to use pesticides, and herbicides.
6. Monitor all small-scale irrigation development programs to ensure that the intended support reaches the targeted beneficiaries.
7. Provide support to NGO-operated programs to facilitate efficient attainment of intended sustainable food security targets.
8. Encourage and strengthen women in agricultural programs
9. Creating awareness for farmers to reduce planting single crop throughout the year. This is because it has risk when price competition arises in the market.

Box 4

Girma (34 years), DA expert in the study area, reveals the following remark during interview. The author asked his about the involvement irrigated plot, he responded *"as result of irrigation development in the study area, yes I definitely help the irrigation user's in terms of traveling up to their farm area and giving training for the users one times per a month on the other hand I contact with water committee two times per a month and I am discussed in very moment with Woreda officials about the facilities, shortage and problem around farm area"*

Table 18: Training related to irrigation

Training related to irrigation	Frequency	Percent	**Total**
Yes	20	66.7	**66.7**
No	10	33.3	**33.3**
Total	**30**	**100.0**	**100.0**

Source: **Survey result 2011**

Table 19: DA support for all the irrigation users

DA support	Frequency	Percent	**Total**
Yes	21	70	**70**
No	9	30	**30**
Total	**30**	**100**	**100**

Source: **Survey result 2011**

3.12 Impact of irrigation on farmer's activity

Beside irrigation development help to increase agricultural output, it also used for farmers to develop their ability (skill) in different activity. As Table 18 and Table 19 showed that there was different training given for farmers from the concerned individual which accounts 67.7% and 70% respectively. Such activities are include which is given by the concerned individual include how to prepare the land, how to transplant onion, irrigating crop, harvesting, threshing crop, how to use pesticide and herbicides and the like. As Table 20 showed that following irrigation development, the experience of farmers in different farm activity is become improved. This implies that as a result of irrigation development the skill for farmers in different irrigated farm activity showed radical change. Generally speaking it has a direct influence on farm activity.

The analysis as shown in Table 20, the significant difference between farm types is observed in plowing, seeding and good quality seed selection which implies that knowledge improvement after irrigation development was at 0.05 level of statistical significance. Though

farmers are improving their activity, farm activity like harvesting, weeding, threshing, seed reserve capacity, and use of pesticides didn't show any significance difference at 0.05 significant levels. This implies that there is no significant improvement among farmers.

Table 20: Comparison of farmers ability (skill) in different activity (N=30)

Knowledge(skill) of farmers on different activity before and after irrigation	$\chi 2$	Df(n-1)	Probability(p-value)
plowing After Irrigation **Vs** plowing Before Irrigation	9.544	4	.049*
seeding after **Vs** seeding before	9.734	4	.049*
Harvesting Products After Irrigation **Vs** Harvesting Products Before Irrigation	7.994	4	.092**
Weeding After Irrigation **Vs** Weeding Before Irrigation	11.940	6	.063**
Threshing After Irrigation **Vs** Threshing Before Irrigation	2.381	4	.666**
Good Quality Seed Selection After Irrigation **Vs** Good Quality Seed Selection Before Irrigation	4.523	4	.340*
Seed Reserve Capacity After Irrigation **Vs** Seed Reserve Capacity Before Irrigation	3.031	4	.553**
Use of Pesticide After Irrigation **Vs** Use of Pesticide Before Irrigation	3.261	6	.775**

Source: **Survey result 2011**** Not significant at 0.05 level of significant =p>0.05 * Significant at 0.05 level of significant = p< 0.05

3.13 Impact of Irrigation on Farm Labor Employment

It is expected that irrigation will result in higher employment rate due to the fact that small scale irrigation projects are labor intensive (Hussain and Hanjra, 2003). Thus, an attempt was made to compare the number of labor force for different irrigation activity used for crop production by irrigation users with that of households who did not use irrigation farming.

The labor needed to operate family farms is characterized by seasonality and the family's work schedule, which is dictated by the agricultural calendar. The availability and type of family labor has also direct relationship to agricultural practices of the smallholder farmer.

The sole source of labor for each and every agricultural activity in the study areas is family labor; in peak agricultural season hired labor use is also common. Household header has at least one or two active members including his/her child or wife/husband. Those are involved in agricultural activity.

Moving on to labor patterns in the scheme, Roder (1965) indicated that most irrigation projects have been successful in reducing the rural to urban migration by offering the rural population an alternative source of employment and income. The survey data on Table 21 shows the number of labor used by each irrigator during one farm season.

The minimum number of labor force used per household for sowing, weeding, harvesting, and threshing is 2, 6, 2, and 5 with the maximum number of labor force 30, 40, 20, 20, respectively during one cultivation season. For those labor force hired in farming activity, each irrigator are expected to pay 50 birr per a day per single labor force. Hiring fee was not based on the type of crop to be planted but the area of land to be cultivated. These implies that introduction of irrigation project has its own positive impact for the non user group in terms of labor force. This is due to the fact that as a result of irrigation farm household using intensive farming like horticultural cultivation activity such as for sawing (onion transplanting), tomato, cabbage, mango. Such types of farming practice absorb large number of labor force.

Respondents were also asked about their observations on farm labor demand after the introduction of irrigation schemes. The majority of respondents said that starting from introduction of irrigation project and onward that they are engaged in their own farming activities during the day and night season. Prior to the use of irrigated farm ,during the dry season most farm households had surplus labor but now irrigated agriculture has provided additional dry season employment to household family members. This clearly showed that introduction of irrigation schemes contributed to employment opportunities for a considerable number of household family members.

Hired labor is most used at transplanting seedlings, weeding, harvesting and threshing time.

For other activities all physically able members of the household family assist in farm work.

Overall, this study confirmed that farm labor employment, which is one of the intermediate indicators of poverty, was higher in irrigated farm area. Therefore, this suggests that the reliable water access for irrigation cultivation enables better motivation to irrigate their farm which also has immense contribution in terms of providing more labor employment to family members for none user group, with consequent positive impact for household income and food security.

Box 5

Gebiru Negash (34 years), Dewa Cheffa Woreda Agriculture officer. When the researcher asked about the contribution of irrigation development not only for farmers who resides in the study area but also for the non user group, he responded *"following irrigation development it has enormous employment contribution for the non user group starting from transplanting of onion, weeding, harvesting, and threshing activity for these activity each farmers are expected to pay 50 birr per a day per labor. Apart from employment contribution, the non user group also benefited on the said of getting their food consumption from irrigators like salad, cabbage, onion, papaya, and mango in the market".*

Table 21: comparison of hired labor being employed in irrigation activity

	Hired labor requirement				
Type of activity	N	Minimum number of labor	Maximum number of labor	Mean	Std. Deviation
Sowing(transplanting)	24	2.00	30.00	10.9167	6.28260
Weeding	23	6.00	40.00	21.8261	8.62687
Harvesting	22	2.00	20.00	7.9091	4.48181
Threshing	22	5.00	20.00	10.3636	3.59292
Total	**91**	15	110		

Source: **Survey Result 2011** N=number of total hired labor force in each activity.

Figure 6: Hired labor on onion transplanting activity at the study area

Labor is one of the major inputs used in small-scale irrigation schemes. Trained and experienced labor is an essential production factor. Family labor is the major source of labor for both irrigation schemes except during peak production period, i.e. transplanting, weeding,

threshing and harvesting when farmers hire additional labor as showed in Table 21. For other activities all physically able members of the household assist in farm work especially for land preparation and watering (irrigating). Both male and female laborers are involved in the production activities.

The average number of family labor used per household during one crop cultivation season was found to be 4, 5, 5, 4, 4 and 5 for land preparation, sawing (transplanting), weeding, watering, harvesting and threshing respectively as Table 22 showed. The total average number of family labor used in land preparation however is greater than that of other types of activity. In most cases, the family labor is limited to one household member, the head of household or the farmer himself/herself. It was illustrated earlier on Table 10 depicts that 93.3% of the respondent farmers have been spending more time in their fields after irrigation development. This intern increased land use intensity.

Generally speaking irrigated farms are more labor intensive after irrigation development as can see be in Table 21and Table 22.

Table 22: Mean comparison of family labor requirement between different farm activities on irrigated farm

	Family labor requirements			
Types of Activity	Mean	Maximum	Minimum	Range
Plowing	2.4667	5.00	1.00	1-4.00
Sowing	2.4333	5.00	.00	1-5.00
Weeding	2.4667	5.00	.00	1-5.00
Watering	2.3333	4.00	.00	1-4.00
Harvesting	2.0667	4.00	.00	1-4.00
Threshing`	2.1667	5.00	.00	1-5.00

Source: **survey result** 2011

Figure 7: participation of women on onion transplanting activity.

3.14 Impact of small scale irrigation on cereal crop production

T-test highlighted that the result can only be said to show a significant relationship if its calculated value is smaller than its critical value. As observed during the study almost all of irrigated plots are permanently cropped. There is no any fallow land in the schemes. The calculated value of sorghum output is greater than that of its critical value which implies there is no significant difference. But by comparing the mean difference, it shows significant variation before and after irrigation development. Based on this the test result confirmed this difference was statistically not significant at 0.05 level of significance in terms of sorghum output which shows after the development of irrigation the amount of sorghum output become decline at increasing rate. This indicates that following irrigation development almost all the farm households are changing the type of product in to other horticultural crop like onion, tomato, cabbage, mango and salad. In contrast, the monetary value of sorghum output as Table 23 reveals that statistically significant at 0.05 level of significant. Even though the amount of total sorghum production after the development of irrigation project showed a declining trend, the amount of income which is generated by selling sorghum production is become increasing trend. These attributed towards for different external factors. One of the most important determinants factors that looking for increment in price of sorghum production;

1. Due to market situation and price of input and output of the commodities, which implies that the market price of output is, become increase.

Generally speaking even if the price of sorghum become increase, the quantity which is produced after irrigation development is shows a declined trend which reveals that those farmers in the study area become changing the items of product produced using irrigation.

Table 23: Comparison of sorghum production before and after irrigation

	Obs.	Mean Difference	Std. Deviation	Std. Error Mean	$t_{calculated}$	$t_{critical}$	Df [n-1]
Sorghum after irrigation in quantity **Vs** Sorghum before irrigation in quantity	30(18)	-.33333	10.63844	2.50751	1.7396**	0.4479	17
Sorghum after irrigation in birr **Vs** Sorghum before irrigation in birr	30(18)	2171.389	1033.802	4386.05	0.0254*	1.7396	17

***Source*: survey result 2011** **Not significant at 0.05 level of significant level * significant at 0.05 level of significant
( ) total sample number of cereal crop producers, outsides ( ) total number of sample

According to the result of paired t- test value (Table 24) showed that the critical value of Teff product is greater than that of its calculated value which refers statistically significant ($p<0.05$). However, by referring the mean difference of Teff output before and after development of irrigation it showed that the output of Teff production after irrigation development slightly decline but regard to the monetary value of Teff product it is statistically significant. This attributes due to market factors. It is true for maize production. As Table 25 showed though maize output statistically significant, but by comparing the mean output of maize product after irrigation development become decline but it is not true for monetary value of maize which implies after irrigation development showed increasing trend (Table 24 and Table 25) showed that the total cereal crop become decline. This showed that farmers through time there is a shift in farm households' crop choice decision towards highly priced and marketable agricultural products. The farmers themselves witnessed, it has a positive impact on their income as well as on the living standard of their families. However, one thing to note in this case is, the level of magnitude of benefit accrued to the beneficiary farmers significantly depends on market.

Table 24: Comparison of Teff production before and after irrigation

	Obs.	Mean Difference	Std. Deviation	Std. Error Mean	$t_{calculated}$	$t_{critical}$	Df [n-1]
Teff after irrigation in quantity **Vs** Teff before irrigation in quantity	30(16)	-1.3125	1.35247	.33812	0.00073*	1.753	15
Teff after irrigation in birr **V** Teff before irrigation in birr	30(16)	834.3750	952.31626	238.07906	0.00159*	1.753	15

Source: **survey result 2011** * Significant at 0.05 level of significant level ** not significant at 0.05 level of significant. ( ) total sample number of cereal crop producers, outsides ( ) total number of sample

Table 25: Comparison of maize production before and after irrigation

	Obs.	Mean Difference	Std. Deviation	Std. Error Mean	$t_{calculated}$	$t_{critical}$	Df(n-1)
Maize after irrigation in quantity **Vs** Maize before irrigation in quantity	30(10)	-3.45000	6.0205	1.9038	0.0516952*	1.8331	9
Maize after irrigation In birr **Vs** Maize before irrigation in birr	30(10)	360.00000	442.71887	140.00000	0.0150585*	1.833112923	9

***Source*: survey result 2011** * Significant at 0.05 level of significant level ** not significant at 0.05 level of significant ( ) total sample number of cereal crop producers, outsides ( ) total number of sample.

As indicated earlier, because of irrigation development farmers have shown interest in planting horticultural crops like onion, tomato, and fruits than cereal crop production. As indicated in table 10 farmers are looking for diversification of crop produced in their plot. According to table 26 reports 83.3% of the respondents said that following irrigation development they were reduced the amount of cereal crop production only 16.7% of the respondents are produced using irrigation. In contrast almost all of the total farmers are produced horticultural crops using irrigation which accounts 93.3%.

On the other hand farmers noted that they do not give more emphasis to grow perennial horticultural crops because it requires long time for maturity and production and this is not tolerable for subsistence farmers whose livelihood is highly dependent on fast growing seasonal crops. As Table 26 reveals that only 10(33.3%) from the respondents said that they were produced cash crop production using irrigation such as coffee and chat. It is lower than that of horticultural crop production in general in the study area case. That is why only very few farmers planted mango, coffee, chat, and papaya to a lesser extent produce on the borders of their plots. The volume of production is also very low therefore it is mostly consumed in the household. In overall the study conclude that from those of different types of crops which are listed on Table 26 horticultural crops were produced by many farmers using irrigation in better condition than that of the other type of crops.

Table 26: Comparison of different crop produced using irrigation

Types of product	Frequency	Percent	Valid Percent	**Total**
Cereal Crops(sorghum, Teff and maize)				
Yes	5	16.7	16.7	**16.7**
No	25	83.3	83.3	**83.3**
Total	**30**	**100.0**	**100.0**	**100.0**
Horticultural crops(Fruits and Vegetables)				
Yes	28	93.3	93.3	**93.3**
No	2	6.7	6.7	**6.7**
Total	**30**	**100.0**	**100.0**	**100.0**
Cash crop production(Chat and Coffee)				
Yes	10	33.3	33.3	**33.3**
No	20	66.7	66.7	**66.7**
Total	**30**	**100.0**	**100.0**	**100.0**

Source: survey result 2011

3.15 Farmer's income generated from fruit and vegetable

In all the study area, there is no organized marketing system for agricultural product. Yields are sold individually at the usual market price at the farm. Buyers come to the field and set the

price of agricultural product and also farmers are selling by near market by transporting through camel, donkey, and vehicles and sometimes human portage was used mainly to transport light weight. The price fluctuation is high for some crops like onion, tomato, and potato which sometimes bankrupt the farmers. In some season, prices shoot up and lucky farmers benefit a lot. For instance the price of onion not only in the study area but also throughout Ethiopia in recent year showed fluctuation in general such as the price of onion in the study area during field observation was 300 to 550 birr per quintal, the price of tomato is varying from 300 to 500 birr per box. According to (Table 27) the income which is generated from fruit and vegetable before and after irrigation development showed significant difference. This implies after irrigation development the income is become increase. The increase in income from fruit and vegetable is due to that of irrigation development farmers are reducing the amount of cereal crop production such as sorghum, maize, and Teff because those cereal crops is more available for home consumption not for market purpose. As survey result on (Table 23, Table 24, and Table 25) showed that the amount of cereal crop after irrigation development slightly decreases. However, due to lack of storage and transport facilities, perishable vegetables are highly sensitive for marketing situation. Fruit and Vegetables output are sold at the farm with prices fixed by the buyer in all the study area. Only small number of farmers tried sells their product at Kombolcha, Dessie, Addis and Mekelle markets.

Generally speaking the amount of income generated by fruit and vegetable after irrigation development is greater than that of the income generated by fruit and vegetable before irrigation development.

Table 27: Comparison of income generated from fruit and vegetable before and after irrigation

Fruit and Vegetables before irrigation(M)			Fruit and Vegetables after irrigation(M)		
Minimum	Maximum	Mean	Minimum	Maximum	Mean
75.00	3000.00	766.2500	1070.00	255000.00	19594.0000

Source: **survey result 2011** **M=income**

3.16 Transport situation in the study area

The means of transportation for commodities farmers' product in the study area are camel, donkey, vehicle and human portage.

As can be seen from Table 28 only 9 (30%) of the respondents have faced transportation problem. On the other hand 70% of the respondent said that there is no transportation

problem. Generally speaking in the study site all the farmers have not serious transportation problem. Though there is no much more transportation problem in the study area, 30% of the respondents are exposed to transportation problem. The survey result on Table 29 showed that there are different causes of transportation problem;

1. High cost of transportation is the first cause of transportation problem which aggravated (20% from the respondents) farmers are enforced to pay 10 - 20 birr per quintal to nearby market to 30-60 birr per quintal to distant market for transportation(to rent camel, vehicle, and donkey) purpose to sell their product in the market.
2. Beside high transportation cost of agricultural output, 10% from the respondents also exposed to the absence of transportation problem (see Table 29). This implies that since most farm area are far apart from road infrastructures, most of farmers are enforced carry their agricultural output to sell in the market. Due to this the perishable item of agricultural output are losing its quality in particular total damaging of output in general.

Table 28: Transportation Problem

Transportation Problem	Frequency	Percent	Total
Yes	9	30.0	**30.0**
No	21	70.0	**70.0**
Total	**30**	**100.0**	**100.0**

Source: **Survey result 2011**

Table 29: Cause of transport Problems

Cause of Transportation Problems	Frequency	Percent	Total
high cost of transportation	6	20.0	**20.0**
lack of transportation	3	10.0	**10.0**
Total	**9**	**30.0**	**30.0**

Source: **Survey result 2011**

4 CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

4.1 CONCLUSION

Irrigation can bring about increased agricultural production thereby improve the economic and social wellbeing of the farmers. For meeting the growing demand for food in the short run and long run food security, small scale irrigation has immense contribution in achieving the objective. It is one of the options which increase yield, facilitate diversification, reduce rainfall risk, and create employment opportunities. Thus it is an important indicator of economic development and brings sustainable agriculture development.

The study of two small scale irrigation schemes in the study area has revealed some factors that are important for the successful implementation of small scale irrigation schemes. But issue which is related to the capacity of reservoir to store sufficient amount of water, way of irrigation water distribution system to users, type of crop planted (crop) frequently on the farm land, market situation (distance from farm land) can affect the sustainability of irrigation.

The study revealed that farmers have started to grow crops which were not previously grown in the area. Following these it also found that it has a positive impact on their income as well as on living standards of their families. Hence, farm household depend more on the production from their irrigated field, which enabled them to harvest more than once pre a year round. As Table 11 indicates that all the sampled respondents responds that following irrigation development all the farm households produce more than once per a year.

The finding of the study also related with the assumption that irrigation agriculture demand more labor person- day than before irrigation development agriculture. As Table 20 indicates that the average hired labor person days used per one cropping season specially for sowing (transplanting), weeding, harvesting, threshing in the study area was around 91 persons. It indicates that each sampled household was used at list 2 hired labors for each activity in one crop season.

Though the participation of men in the study area was significantly higher (80%), women also involved in irrigated agriculture in male and female headed household. 20% of female headed household in the study area was practice irrigation due to irrigation agriculture needs more labor, financial problem and unsafe timing of irrigation water.

The study has ensured that the role of irrigation development was increasing food sufficiency level of household after irrigation development 83.3% of sampled household produce sufficient amount of food consumption, increasing income level, asset building such as house construction for rent, saving account and creation of employment opportunity. Reduction of food insufficient level of household was resulted by irrigation affirms that economic well being of the society in the study area was significantly better than that of after irrigation development. As Table 16 portrays that 93.3% of the farm households experienced improving in their economic well being after it implementation.

Prior to the development of irrigation dry season cultivation was not common, as most farm households are remain idle up to the main rain season in Ethiopia, but after the introduction of irrigation, farmers started to produce high value horticultural and profitable crop such as onion, tomato, tobacco, which account 300-350 birr per quintal, 300-500 birr per box, and 1000 birr per one bundle respectively both dry and wet season, which enabled them to create employment opportunity for a considerable number household family member and additional labor employment for the non user group.

This study confirmed that access to irrigation development in the study area have major impact. This are not only an increase in household farm production, income, farm labor employment opportunity and hired labor employment, but also have significant impact on the overall rural economy as absolved from analytical frame work. Therefore, the finding of this study concluded that introduction and expansion of irrigation is economically valuable and an important mechanism in fulfilling food self sufficiency in the study area particularly and development process in Ethiopia in general and support for further expansion of irrigation development.

In addition, this study also concludes that irrigation development has positive role in diversification crop intensity. It confirms that the proportion of farm household extremely diversify significantly higher in comparison to the pre irrigation status. Furthermore, crop diversification has leading to some additional income gained from the sale of dry season horticultural production (like onion, tomato tobacco, salad, banana, and mango) that increased beneficiary consumption levels. However, for the sustainability of maintaining this benefit in the future, supplying of fertilizer, herbicides, pesticides, modern technology, store and strong extension support from DA is playing a crucial role.

The studies also conclude that from the output perspective an investment on irrigation development is become profitable. As can be seen an analytical frame work and 83.3% from respondents produced after irrigation development was significantly better compared to pre irrigation development. However, the majority of farmers didn't produce three times per a year. These due to different factors;

First, due to the less amount of irrigation water, it didn't reach the intended beneficiaries,

Secondly, majority of farm household didn't consider crop water requirement,

Thirdly, due to improper design and site selection, the reservoir was silted by soil,

Fourthly, week extension support and irrigation water management in collaboration with coordination among stakeholder were contributing factors for the poor performance of irrigation in the study area.

4.2 RECOMENDATION

Generally the introduction of irrigation scheme impact in the economic progress of the area is undeniable. However the attained economic progress is not the ultimate one. To attain the maximum economic benefit from the introduced scheme this study gives the following general recommendations:

Problem such as lack of market information and the absence of market intermediaries will need to be addressed. Supplying input, improved seed, pesticides, herbicides, will need to be strengthened, establishing market link between input suppliers and farmers. Government should give special attention for agribusiness and agro-industrial enterprise and giving emphasis on small-scale industries that used for diversifying food and agricultural product, supplying agricultural input, and providing transport and marketing service. In over all, the development of effective market information system should be promoted.

Although mainly irrigated farmers fulfill their food security condition better than compared to the situation before implementation of irrigation schemes. However, for the sustainable food self sufficiency of farm household, there should be given special attention for further expansion of small scale irrigation schemes not for the study area but also throughout the country.

Almost all the farm household perform the farm activity by their own, these reduce the amount of better output. Therefore, improved and well organized advice and training should be given for farmers by DA and Woreda agricultural and irrigation expert. These lead to better skill of farmers to apply input for better yield performance.

Water user committees in coordination with DA expert are in charge of coordinating and managing in irrigation schemes but the user groups are not transparent to use their share of water. Therefore, the concerned individual should creating trust between farmers committee member for actively participating in management of their schemes for equity distribution irrigation water for all user group.

Better training of farmers an improved agronomic practice, crop rotation and irrigation practice will need to increase or diversify crop productivity and for sustainability and profitability of small scale irrigation schemes. In addition to these training, capacity building and motivating DA and committee member will essential to increase the farmers understanding and capabilities to effectively assist farmers.

To make irrigation investment more achievable, special attention should be given to strengthen the capacity of the existing extension system by assigning additional extension agents as well as equipping them with necessary technology. In addition, knowledge and skill in selecting agronomic practice, pest and disease management and post harvest management should be enhanced.

Effective and efficient use of irrigation water system should be promoted to avoid irrigation water inequality among user farmers and also involvement of communities should be given because they are playing a crucial role in irrigation development. In addition involvement of NGO in irrigation development should be enhanced.

Establishing water use fee should be promoted for wise use, conservation and better community responsiveness.

Labor intensity and agricultural productivity was significantly high on irrigated field, hence the benefit of irrigation can spread to the non irrigated household through market for labor, food and other benefit. Therefore, attention should be made in improvement of infrastructure as well as creating market linkage.

Different type of crop has different amount of water consumption rate. Therefore, the concerned body should be design rule and regulation that enforce crop rotation.

Generally speaking more effort exerted by both governmental and NGO to provide training more frequently to enhance the understanding of beneficiary farm household on how to use irrigation water, effectively and efficiently and raise the awareness of farmers about the benefit and contribution of small scale irrigation in general.

5 References

African Centre for Technology Studies (ACTS). 2002. Scarcity and Surfeit: The Ecology of Africa's Conflicts Institute for Security Studies (ISS), Chapter 6, and Nairobi, Kenya.

Amacher, G. S., Ersado, L., Grebner, D. L. and Hyde, W. F. (2004) Disease, microdams and natural resources in Tigray, Ethiopia: impacts on productivity and labor supplies,Journal of Development Studies, 40(6), pp. 122–45.

Ascher, William and Robert Healy. 1990. Natural Resource Policymaking in Developing Countries: Environment, Economic Growth, and Income Distribution. Durham, NC: Duke University Press.

Awulachew, S. B., D. J. Merrey, A. B. Kamara, B. Van Koppen, F. Penning de Vries and E. Boelee with editorial assistance from G. Makombe (2005). Experiences and Opportunities for Promoting Small-Scale/Micro Irrigation and Rainwater Harvesting for Food Security in Ethiopia. IWMI Working Paper 98. Colombo: IWMI.

Barker R, Molle F. 2004. Evolution of Irrigation in South and Southeast Asia. Comprehensive Assessment Research Report 5. Comprehensive Assessment Secretariat, Colombo, SriLanka.

Benin, Samuel, and Samuel Mugarura. 2006. Determinants of change in Household-level consumption and poverty in Uganda, 1992/93-1999/00. International Food Policy Research Institute (IFPRI), Discussion Paper No. 27.

Berhanu, A. (2006). Effective Aid for Small Farmers in Sub-Saharan Africa: Southern Civil Society Perspectives Ethiopia Case Study, Addis Ababa, Ethiopia.

Berhanu, G., and Peder, J. (2002). Policies and institutions to enhance the impact of irrigatiodevelopment in crop-livestock mixed systems. Paper presented at International Workshop on Integrated Water and Land Management Research and Capacity Building, Dec. 2-4, 2002, ILRI, and Addis Ababa, Ethiopia.

Bucks, D. A., and S. Davis. 1986. Historical development. In Trickle irrigation for crop production design, operation, and management, eds. F. S. Nakayama, D. A. Bucks, 1-26. Amsterdam: Elsevier.

Bruns, Bryan and Ruths.Meinzen-Drck (2000) negotiating water Rights: Introduction in Bryan Randolph Burns and Ruths. Meinzen-Dick (eds) Negotiating water right. New Delhi: international food policy Research Institute intermediate technology publications.

CARE. (1998). Initial Environmental Examination – CARE Ethiopia DAP Food and Livestock Security Program. Addis Ababa: CARE-Ethiopia, March 1998.CRS

(Catholic Relief Services). (1999). Programmatic Environmental Assessment of small scale irrigation in Ethiopia. Cooperating Sponsors. Baltimore, Maryland, USA.

Das, D.K (2005)'participatory irrigation management-A perspective from. Panipanchayat program in orissa' proceedings of world water day 2005 Central Water commission, Bhuboneswar, Government, oOf India, and Pp126-149.

DESSALEGN RAHMATO 1999: Water Resource Development in Ethiopia: Issues of Sustainability and Participation. Forum for Social Studies, Addis Ababa, June 1999: http://www.ethiopians.com/Main_FSS_Paper1.htm [21.02.2011].

Environmental Protection Authority. (EPA). (1997. Environmental Policy In: Environmental Protection Authority in collaboration with the Ministry of Economic Development and Cooperation. Addis Ababa.

FAO, 2003. The State of Food Insecurity in the World 2003: Monitoring progress towards the World Food Summit and Millennium Development Goals. FAO, Rome.

FAO (Food and Agriculture Organization). 1997. Small-Scale Irrigation For Arid Zones: Principles And Options. FAO, Rome.

FAO. 2009. The state of food insecurity in the world 2009: Economic crises Impacts and lessons learned. Rome, Italy: Food and Agriculture Organization of the United Nations.2008. The state of food insecurity in the world 2008: High food Prices and food security—threats and opportunities. Rome, Italy: Food and Agriculture Organizations of the United Nations.

FAO (1986). Highlands Reclamation Study – Ethiopia', Final Report, Vol. I, Food and Agricultural Organization of the United Nations, Rome.

(FAO) Sub-Regional Office for East and Southern Africa (SAFR). Harare. (On line). (Accessed 5th May 2004) available from the World Wide Web:http://www.fao.org/docrep/X5594E/X5594e00.htm

Gebremedhin B. and D. Pedon (2000). Policies and institutions to enhance the impact of irrigation development in mixed crop–livestock systems In: Policies for sustainable land management in the highlands of Ethiopia: Summary of papers and proceeding of a seminar held at ILRI, Addis Ababa, Ethiopia, and 22–23 May 2000 Socioeconomics and Policy Research Working Paper 30. ILRI (International Livestock Research Institute), Nairobi, Kenya. 68 pp.

Gebremedhin B. and Pedon (2002), Policies and Institutions to Enhance the Impact of Irrigation Development in Mixed Crop- Livestock , Workshop Held at ILRI.

Gebremedhin B., J. Pender, S.K. Elui and Mitiku Haile,(2002), Policies for Sustainable Land Management in the Highlands of Tigray, Northern Ethiopia, Working paper no.54

Habtamu Gessese. (1990) Problems and Constraints in the Study, Construction and Management of Small scale Irrigation Projects, Paper No. S2-6. Presented at the National Irrigation Policy and Strategy Workshop, Addis Ababa.

Haile, M., Tesfay, G. and Yazew, E. (2001) Land Tenure and Plot Size Determination Issues in Small-Scall Irrigation Development Intigray, Northern Ethiopia. Proceedings of the Workshop on Current Issues on Land Tenure in Ethiopia, Addis Ababa.

HASNIP, S, MANDAL, N, MORRISON, J, PRADHAN, P & SMITH, L, 2001. Contribution of irrigation to sustaining rural livelihoods. Department for International Development. Report OD/TN109.

Held, I. M., T. L. Delworth, J. Lu, K. L. Findell, and T. R. Knutson. 2006. Simulation of Sahel drought in the 20th and 21st centuries. Proceedings of the National Academy of Sciences of the United States of America 102 (50): 17891-6.

Hurni, H. (1993). Land degradation, Famines, and Resource scenarios in Ethiopia, in D. Pimentel (eds.), World Soil Erosion, and Conservation, pp. 27-62. Cambridge: Cambridge University Press.

Hussain, I., and Hanjra, MA. (2003). Does irrigation water matter for rural poverty alleviation: Evidence from South and South-East Asia. Water Policy, 5 (5/6).

IDE. 2002. Summary of research documents available with IDE (India). International Development Enterprises, India. http://www.ide-india.org/ document.htm accessed 14 December 2002.

Jaglan MS, Qureshi MH. 1996. Irrigation development and its environmental consequences in arid regions of India. Environmental Management 20(3): 323–336.

Kamara A.B., van Koppen B. and Magingxa L. 2002. Economic viability of small scale Irrigation systems in the context of state withdrawal: The Arabia Scheme in the Northern Province of South Africa. Elsevier Science, Physics, and Chemistry of the Earth 27:815–823.

Kamara A. and McCcornick. (2002). Synthesis of research issues and Capacity building in water and land resources management in Ethiopia .In: Integrated water and l management research and Capacity building priorities for Ethiopia, Proceedings MoWR/EARO/IMWI/ILRI international workshop held at ILRI, Addis Ababa, Ethiopia.2-4 December.

MoWR (Ministry of Water Resources). (2001a). Data collected from different river basin development master plan studies. Planning and Projects Department, Ministry of Water Resources, Addis Ababa, Ethiopian MoWR (Ministry of Water Resources). (2001b). Water Sector Development Program Methodological Framework. MoWR, Addis Ababa, Ethiopia.

Ministry of Water Resources (MoWR). 2001. Irrigation Development Strategy (Component of the Water Sector Development Strategy). Draft Report. Addis Ababa, Ethiopia.

MISHRA, A.K, EL-OSTA, H.S, MOREHART, M.J, JOHNSON, J.D & HOPKINS, J.W, 2002. Farm Sector Performance and Well-Being Branch, Resource Economics Division, Economic Research Service, U.S. Department of Agriculture. Agricultural Economic Report No. 812.

Molden D. J., Sakthivadivel R., Perry C. J., and Charlotte de Fraiture. 1998. Indicators for Comparing Performance of Irrigated Agricultural Systems. Research Report 20. International Water Management institute. Colombo, Sri Lanka.

RAVALLION, M, 1992. Poverty comparisons: a guide to concepts and methods. Living Standards Measurement Study. Working Paper 88. Washington DC World Bank.

RODER, W, 1965. The Sabi valley irrigation projects. Department of Geography Research No. 99. Chicago, Illinois.

ROWNTREE, D, 1991. Statistics Without Tears: A Primer for Non mathematicians. London, England: Penguin Books. Sing the number of hours spent on the fields each day.

Saleth, R. M., Samad, M., Molden, D. and Hussain, I. (2003). Water, poverty andgender an overview of issues and policies, Water policy, Volume 5 Number 5/6.

Salilih Keralem, 2007, Irrigation Management and its Contribution in Reducing Households' Socio-Economic Poverty: The Case of Two Small Irrigation Schemes in Blue Nile Basin of Amhara National Regional State., MS. c. Thesis

Shah T, Alam M, Kumar D, Nagar RKN, Singh M. 2000. Pedaling out of Poverty: Social Impact of a Manual Irrigation Technology in South Asia. IWMI Research No. 45. International Water Management Institute: Colombo, Sri Lanka.

Shivered, B. and Holden, S., (1999). "Soil Erosion and Smallholders' Conservation Decisions in the Highlands of Ethiopia," World Development, Elsevier, vol. 27(4), pages 739-752, April.

Smith, Laurence E. D. 2004. Assessment of the contribution of irrigation to poverty reduction and sustainable livelihoods. International Journal of Water Resources Development 20 (2): 243- 57.

Smith, Lisa C., Harold Alderman, and Dede Aduayom. 2006. Food insecurity in sub-SaharanAfrica- - new estimates from household expenditure surveys. International Food Policy Research institution Washington, D.C., Research Report No. 146.

Tahal Consulting Engineers. (1988). Traditional organizational forms in Small scale irrigation schemes in Ethiopia (prepared for Ministry of Agriculture, Addis Ababa, Ethiopia).

Tahal Consulting Engineers, Tel Aviv, Israel.Polak, Paul, and Robert Yoder. 2006. Creating wealth from groundwater for dollar-a-day farmers: Where the silent revolution and the four revolutions to end rural poverty meet. Hydrogeology Journal

Teshome Atnafie (2006). Irrigation Policies, Strategies and Institutional Support Conditions in Ethiopia. Proceedings of Symposium on Best Practices and Technologies for Agricultural Water Management in Ethiopia, March 7-9, 2006, Addis Ababa Ethiopia

Turner, B.(1994) Small-scale irrigation in developing-countries, Land Use Policy,11(4), pp. 251–61.

Wetter hall H. (1972). Government and land in Ethiopia. Ministry of Land Reform and Administration, Addis Ababa, Ethiopia (UN published report).WILLIAMS, D.M, 2002. Food security and access in Akron, Ohio. Unpublished Master's Thesis. The University of Akron, Ohio.

WWDSE (Water Works Design and Supervision Enterprise). 2001. Water Sector Development Program (Project ETH/98/001). Ministry of Water Resources, Addis Ababa, Ethiopia. EPA (Environmental Protection Authority). (1997a). Environmental Impact Assessment Guideline, Volume I–Procedural Guideline. Addis Ababa:

http://www.surveysystem.com/sscalc.htm. Accessed 10 December 2010

6 Annex I

Questionnaire

Dear respondents

This questionnaire is formulated to collect factual and relevant data that will help to identify the impacts of small scale irrigation on social as well as economic development of the society. The information you offer will be kept confidential. Therefore, you are kindly requested to answer the questions below carefully and responsibly.

Thank you

1. Personal information.

I. Sex female ☐ male ☐

II. Age below 25 years ☐ 25-30 years ☐ 30-40 years☐ above 40 years

III. Education level: literate ☐illiterate ☐

IV. Family status

Family Member	Age	Participation In irrigation
Father		
Mother		
Son		
Daughter		

V. other income source (before and after irrigation schemes)

Income source	Before irrigation		After irrigation		Difference	
	Quantity	Value in birr	Quantity	Value in birr	In quantity	In birr value
Salary						
Cattle						
Beehive						
Wood work						
Other						

I. VI Family land holds in hectares.

A.0.25h. B. 0.5h. C. >1h. D. < 0.25h.

VII. How many hectares of land actually irrigated by the schemes?

2. Are you aware of irrigation project in your area?

Yes ☐ No ☐ yes=0 no=1

3. Are you, as a family capable of irrigating the whole land you own in the command area?

Yes ☐ No ☐ yes= 0 no=1

4. How could you compare your economic well being before and after the introduction of irrigation?

A. before irrigation = 1 B. after irrigation =2

Why?

5. How many times did you produce from your farm land at present?

A. twice a year =1 B. once a year=2 C. trice a year =3 D. other=4

6. Is there equal distribution of water in the schemes?

Yes ☐ No ☐ yes=0 no=1

7. If not, what do you think is the reason for the inequality?

8.If there is inequality, which group of people get more and which group of people get less?

- Who get more
- Who get less

9. Would you say you spend more time now in the field compared to that of before the introduction of irrigation schemes?

Yes ☐ No ☐ yes =0 no=1

10. If yes, why?

If not, why not?

11. Participation of family member on different irrigation activities? Put a tick mark as appropriate.

No	Types of activity	Husband	Wife	Children	Relatives	labor
1	Land preparation					
2	Sowing					
3	Weeding					
4	Watering					
5	Harvesting					
6	Threshing					
7	Crop residue piling					
8	Others					

Husband=1, wife= 2, children=3, relatives=4, labour=5

12. How would you evaluate the amount of production of your land per year before and after the introduction of the irrigation schemes?

No	Type of crops	Before irrigation		After irrigation		Differenc e	
		Quantit y	Value in birr	quantit y	Value in birr	In quantity	Value in birr
1							
2							
3							
4							
5							
6							
7							
8							

13. Is there variation in item of the product after irrigation?
Yes ☐ No ☐ yes =0 no=1
14. What are the impacts of irrigation project on your household food security?
A. more food secured = 1
B. less food secured =2
C. no changes =3
15. What positive and negative effects does the irrigation scheme have on you as farmer?
Positive ----------
Negative----------
16. What crops are you growing using irrigation?
17. Do you think that what you producing at present are the most profitable?
Yes ☐ No ☐ yes =0 no=1
18. If yes, what crops do you think are profitable?
19. Do you sell or consume your irrigation product? If you sell, are you selling at the nearby market and/or to a city/town nearby?
Why you sell?
20. Have you faced transportation problem while selling your product?
Yes ☐ No ☐ yes =0 no=1
21. If yes, how? (Costly transportation cost and/or lack of transportation)
A. costly of transportation=1 B. lack of transportation=2 C. lack of infrastructure=3
22. Did you have any conflict with any concerning land use?
Yes ☐ No ☐ yes =0 no=1
23. If yes, what is the reason for conflict?
24. Do you know, what crops have been recommended for production for your schemes by designer?
Yes ☐ No ☐ yes =0 no=1
25. If yes, do you use the recommendation?
26. Are you settle for long period of time near your farm area?
Yes ☐ No ☐ yes =0 no=1
27. If yes, what is the reason?
28. How do you sell your irrigation crop production?
29. Have you ever taken training and/or technical support related to irrigation?
Yes ☐ No ☐ yes =0 no=1
30. How do you see the knowledge and skill on crop farming after and before irrigation? Put a tick mark as appropriate.
1. Excellent 2. Very good 3.Good 4.poor

No	Description	Before irrigation				After irrigation			
		1	2	3	4	1	2	3	4
1	Plowing								
2	Seeding								
3	Weeding								
4	Threshing								
5	Good quality seed selection								
6	Seed reserve capacity								

Please, put your justification for your choices as "reasons for 30"

Interview guide for woreda and zonal agriculture office

Date_____

This interview guide is prepared to get elicit information from Zonal and Woreda agricultural and water resource bureau, Zonal and Woreda health office.

1. Personal data

I. Sex female ☐ =0 male☐ =1

II. Age below 25 years 25-30 years ☐ 31-40 years ☐ Above 40 years

III Education level: Certificate ☐ College diploma ☐ First degree ☐ MA/Msc ☐

iv. Year of service: below 6 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ above 20 ☐

2. Are the farmers aware of the irrigation project in their area?

Yes ☐ No ☐ yes =0 no=1

3. What are the main objectives of irrigation project?

4. Do you think that the project is in the right direction meeting its objective?

Yes ☐ No ☐ yes =0 no=1

5. If yes, what are your indicators?

If not, why?

6. Do farmers in the irrigation area plant crops as per the recommendation given by the feasibility study report of the project?

7. Do you quantify the productivity of the irrigation scheme?

Yes ☐ No ☐ yes =0 no=1

8. If yes, can you give me some information of crop production per hectare?

Crop type	Production		
	Minimum	Average	Maximum

9. Can you describe the kinds of relationship your farmers have with the irrigation project?

10. Is irrigation project gender specific?

11. Have you noticed any employment opportunity because of the irrigation scheme?

Yes ☐ No ☐ yes =0 no=1

12. If yes, can you give me some information on employment pattern?

	Employment		
	Minimum	Average	Maximum
Before irrigation scheme			
During construction of the irrigation scheme			
After Irrigation scheme construction			

13. Do you think, apart from employment, do the non-user groups benefited from the irrigation Project?
If any, please explain.
14. How could you rate the economic wellbeing of the farmers after implementation of the irrigation project?
A. it was insignificant
B. it was better.

Part II. Interview check list for health office.

Date_____

1. What negative and positive effects have the project on farmers?
2. Do you think irrigation could be the source of any water related and/or water borne diseases?
3. If say yes, have you ever experience any water related and/or water borne diseases in this area? Please list them.
4. Were these water related and/or water borne diseases seen in the area before the introduction of the irrigation scheme?
5. If yes, how do you rate their incidence and intensity of occurrence before and after the introduction of the irrigation scheme?
6. Have the dwellers of this area lost some of their income in these health related diseases?
6. If yes, list the amount of money (birr) per year?

Part III. Interview checklist for DA Expert

Date_____

1. How do you help the irrigation users?
2. Have there been any conflict pertaining to irrigation in the schemes?
3. Do you make decisions pertaining to irrigation on your discretion or have to wait for guideline to come down from Woreda office?
4. What is the relation between the Woreda agriculture office and the irrigation schemes?
5. What have people gained because of irrigation introduction?
6. How water allocation and distribution to users?
7. How is land distributed to irrigation users?

Thank you!!!

Declaration

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

Declared by: confirmed by:

Candidate Advisor