Jimma University

Jimma Institute of Technology

School of Graduate Studies

Civil and Environmental Engineering

Hydraulic Engineering Master of science program

Socio-Economic Impact of Small-Scale Irrigation Development: (Case Study of Irrigation Schemes, Fogera, South Gonder, Amhara, Ethiopia)

A thesis submitted to the School of Graduate Studies of Jimma University Jimma Institute of Technology in Partial Fulfillment of the Requirements for the Degree of Master of Science in Hydraulic Engineering.

By: Kassahun Michael

January, 2017

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January, 2017

Jimma, Ethiopia

DECLARATION

I, the undersigned declare that this thesis entitled scocio-economic impact of small scale irrigation: A case study of Fogera irrigation scheme in Amhara region, Ethiopia is my original work, and it has not been presented for a degree in Jimma University or in any other University and that all source of materials and references used for the thesis have been fully acknowledged.

Name	Signature	Date
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This thesis has been submitted for examination with my approval as University supervisor

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List of Acronyms

ARDA	Agricultural and Rural Development Authority
AWWCO	Amehara Water Work Constriction Enterprise
CARE	Cooperative for Assistance and Relief Everywhere
CRS	Catholic Relief Service
CSA	Central Static Authority
DF	Degree of Freedom
E.C	Ethiopian Calendar
FAO	Food and Agricultural Organization (of UN)
FMIS	Farmer Managed Irrigation System
M	Meter
MOWR	Ministry of Water Resources
NGO, s	Non-Governmental Organization
NS	None Significant
P	Probability
SARAR	Sustainability and Rehabilitation of Amehara Region
SCFUK	Save the children Fund- United Kingdom
SPSS	Statistical package Social Science
UK	united Kingdom
UN	United nation
WWDSE	Water Works Design and Supervision Enterprise
WUA	Water User Association

Abstract

While the establishment of small scale irrigation was in an attempt to improve the welfare of the people it remains a pressing issue as economic and social problems continue to affect plot holders which results in the schemes being undermined. The intention of this research is to assess socio-economic and environmental impacts of small irrigation development. Both quantitative and qualitative methodologies were used in the investigation of the socio-economic impacts on the schemes.

The overall objective of this study is to assess the socio economic and environmental impact of small-scale irrigation development in the kuha rmikael irrigation scheme. The study was attempted to assess the annual crop productions, challenges faced by irrigation farming and environmental impacts of the irrigation scheme.

A survey of 40 irrigators and 40 non-irrigators was selected using randomly. The Data was composed both at household level and community level.

Analyses were done using SPSS. Tables, equation and graphs were in use in presentation and analysis. Results were that the two irrigation schemes have managed to create employment, income generation, but have some shortages like transport, market, capital and conflict between upstream and downstream and have it on environmental problems like sedimentation, erosion and dieses.

The study of kuhar 1ikael small-scale irrigation scheme has revealed some factors that are important for the successful implementation of small-scale irrigation schemes. It has come out clearly that irrigation can be moderately well designed and in sound technical state but other issues related to input supply, market situation, and health situation can affect the development of small-scale irrigation schemes.

***Key words**: irrigator, non-irrigator, kuhar & tannua irrigation.*

CHAPTER ONE

1. Introduction

1.1 Back ground

Agriculture is the mainstay of the Ethiopian economy as it accounts for about 46% of the gdp, 85% of the export and 80% of the employment opportunities (makombe et al., 2007).both industry and services depend strongly on the performance of agriculture, which provides raw materials, generates foreign currency for import of essential inputs and food for the fast growing population. Despite its importance for the national economy, agriculture is largely based on subsistence farming. The productivity of the agricultural sector is very low and lags behind the population growth rate resulting in food insecurity. To address this problem the Ethiopian government designed an agricultural development led industrialization (adli) strategy which aims to use agriculture as the base for the country's overall development (mowr, 2001)

This strategy aims to enhance the productivity of small-scale farmers and to improve food security both in the rural and urban areas. One of the policies within this strategy is stimulate and/or support the development of small-scale irrigation. Thanks to the enabling policies, irrigated agriculture is expanding rapidly in those areas where there is access to irrigation water

Despite Ethiopia has huge agriculture potential, it has been unable to provide adequate food for its rapidly growing population. A recent study made by Mutsvangawet 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 country has a national irrigation development strategy to use water and land potential to meet food self-sufficiency, generating export earnings, and provides raw materials for industry on a sustainable basis (MoWR, 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.

The main purpose of irrigation development in the 1960s was to provide industrial crops to the growing agro-industries in the country. The agro-industries were established by foreign investors and had the objective of increasing export earnings. During the 1960s, irrigation was seen as part of the modernization of the country's agricultural economy. It was considered as an important investment for improving rural income through the increased agricultural production. But, in 1975 the rural land proclamation was introduced in the country. Following the rural land proclamation, the irrigated private farms were nationalized and converted to state farms by the Derg regime.

By early 1985 in Ethiopia, some 7.7 million people were suffering from drought and food shortages. More than 300,000 died in 1984 alone, more than twice the number that died in the drought a decade before. Before the worst was over, 1 million Ethiopians had died from drought and famine in the 1980s. The recurring cycle of drought produce the need for small-scale-irrigation development expansion to other parts of the country to address drought and food shortages, and the need for more food for the internal market.

Agricultural growth is not produced by passive policies. There is no unique policy prescription that fits the diversity of the agricultural sector in the less developed countries. Enhancing productivity is a common essential requirement, the increase in productivity will determined by the appropriate policy mix. The major lesson that emerges from country experiences is that for agricultural growth to occur, a number of factors need to be addressed in the rural sector such as infrastructure, social services, technology, marketing infrastructure, and seasonal credit availability, along with the building of an appropriate institutional environment (UNDP 2007).

This study attempts to find out the socio-economic impact of small-scale irrigation schemes in Fogera woreda small irrigation projects.

1.2 Statement of the Problem

Agricultural production in Ethiopia is primarily rained, so it depends on erratic and often insufficient rainfall. As a result, there are frequent failures of agricultural production. Irrigation has the potential to stabilize agricultural production and mitigate the negative impacts of variable or insufficient rainfall. Irrigation development also can help offset some of the negative effects of rapid population growth 2.6% per year in Ethiopia (CSA 2007). Decisions to construct dams or upgrade traditional irrigation systems have often been made in the absence of sound objective assessments of their environmental and social implications (CRS, 1999).

The government upgraded several schemes without the consent of the communities concerned even though there were few occasions when stakeholders were involved in any aspect of water resources development. As a result, many of the small-scale irrigation projects have been operating below the required economic efficiency and affected the environment without any mitigation measures. This low level of efficiency and lack of sustainability may have been due to provision of input, lack of efficient utilization of water resource and lack of viable product market and marketing institutions (Girmay et.al, 2000)

Small-scale irrigation has the potential to meet the demand for food security, agricultural diversity and productivity. There is considerable experience with small-scale irrigation, but extent and potential has not been quantified and general documentation is sparse (CRS, 1999).

Information on water requirements of crops, the inputs and environmental effects are hardly available. Even if such data may be available they may not be accurate and reliable (CRS, 1999).

In most cases water users associations manage the irrigation schemes. However, un-economic plots and the inefficient use of water and conflict on equity basis of land allocation are observed (CRS, 1999).

Although the establishment of kuharmikael small scale irrigation schemes was in an attempt to improve the welfare of the people socially and economically, it remains a pressing issue as economic and social problems continue to affect plot holders to an extent that food shortages persisted in the area. This gave the schemes a negative impression. Thus the schemes remained undermined, resulting in its efforts unrealized. However, an assessment needs to be

done on how the schemes have contributed to people's livelihoods in two schemes. Similarly, the economy of the study area largely depends on subsistence agriculture, which is traditional type and rainfall dependent. The presence of erratic and variable nature of rainfall, poor soil fertility, soil erosion, sedimentation, stagnation of water at the canal and diseases and crop pests, and non-literacy of the farming community, poor infrastructure, limited knowledge of crop production, poor transport ,poor marketing, and limited farmers participation in the management of water, absence or low use of modern inputs are the major socio-economic and environmental problems in kuhar and tankua irrigation schemes that affect the development of the two small scale irrigation schemes. There is a need for research and capacity building to understand the complex issue of socio-economic and environmental problems, water and land management. Hence this research was assessed the socio-economic and environmental effects of small-scale irrigation development in Fogera.

Objectives

1.3.1. General Objectives

In general the objective of this study is to assess the socio economic and environmental impact of small-scale irrigation schemes in Fogera irrigation scheme.

1.3.2. Specific Objectives

- To assess the annul crop production and crop patterns grown using small-scale irrigation in the Kuharmikael irrigation scheme.
- To assess the potential positive and negative impacts of small-scale irrigations on the environment in the study area.
- To identify challenges faced by irrigation farming and major socio-economic impacts of small-scale irrigation development and propose alternative management options.

1.4 Research Questions

For a particular study of small-scale irrigation scheme linking with the issues of socio-economic and environmental impact, a number of questions have been raised and an attempt have made to address in the study. The major research questions are

- Which types of crops are cultivated in Kuhar 5ikael irrigation scheme?
- What are the major positive and negative impacts of irrigation on environment?
- What are the prevalent problems encountered in small scale irrigation development and what measurements is required?

1.5. Significance of the Study

The study is believed to contribute to the efforts working towards attaining technically feasible and socially desirable use of irrigation water; to the initiatives striving to identify better strategies for irrigated production; and to the local attempts in environmental protection.

The paper will give the government awareness to the hardships and the possible solutions to those which are currently faced by socio-economic and environmental impacts of irrigation farmers. Ignoring such hardships would lead to the continued failure and collapse of the irrigation project. Agricultural and Rural Development Authority (ARDA) would get an insight on the problems being faced by farmers. The farmers and researchers were also use the outcome of the study as well.

1.5 Scope of the Study

The scope of this study is limited to investigative the socio-economic impact of small scale irrigation on social and economic aspect. The study was measured 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 and the like in general. As a starting point to give base line information for the existing or newly developed irrigation systems, the study focuses on undertaking socio-economic impact of small scale irrigation development; namely Kuhar and Tankua which is situated in south Gonder Fogera Woreda.

1.6 Limitation of the Study

Since keeping records at farm household level is not common in the study area, the data that the target groups of the study they supplied through recalling approach might not be accurate. Moreover, there were also limitations in the process of collecting secondary data from woreda level experts, kebele administrative offices and development agents mainly of keeping records for many successive years data without timely and regular updating. Planning and management of the two small scale irrigation schemes are very poor and also environmental protection and watershed management are not serious measure.

CHAPTER TWO

2. Literature Review

2.1 Water Resources and Irrigation Development of Ethiopia

It is believed that Ethiopia has a total volume of 123 billion cubic meters of surface water and about 2.6 billion cubic meters of groundwater (McCormicket al, 2003).

Turner (1994) points out that irrigation system can be classified according to size, source of water, management style, and degree of water control, source of innovation, landscape niche or type of technology.

According to Jorge (1993) irrigation system fall in two broad categories: those in which the principal management responsibility is exercised by government agencies with the farmers playing a subsidiary role, and those in which most management activities are carried out and decision made by the farmers themselves with the government providing periodic technical or logistical support. The latter category in which farmers assume the dominant role is referred to as Farmer-Managed Irrigation Systems (FMIS). FMIS are also known as traditional, indigenous, communal or people's systems. The precise set of activities and functions that the farmers and their organizations perform varies from country to country and from system to system.

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).

2.1.2 Perspectives and Objectives of Irrigation

A reliable and suitable irrigation water supply can result in vast improvements in agricultural production and assure the economic vitality of the region. Many civilizations have been dependent on irrigated agriculture to provide the basis of their society and enhance the security of their people. Some have estimated that as little as 15-20 percent of the worldwide total cultivated area is irrigated. Judging from irrigated and non-irrigated yields in some

areas, this relatively small fraction of agriculture may be contributing as much as 30-40% of gross agricultural output (FAO, 1989).

Irrigation is a system extending across many technical and non-technical disciplines. It only works efficiently and continually when all the components are integrated smoothly (FAO, 1989).

Irrigation in arid areas of the world provides two essential agricultural requirements: (1) a moisture supply for plant growth which also transports essential nutrients; and (2) a flow of water to leach or dilute salts in the soil. Irrigation also benefits croplands through cooling the soil and the atmosphere to create a more favorable environment for plant growth (FAO, 1989).

2.1.3 Purposes and Need for Small-Scale Irrigation in Ethiopia

Faced with a poverty driven depleted resource base, the risk averting strategy that has been followed by the rural community is increasing unsustainable pressure on natural resources leading to land and water depletion and degradation and/or 'forced' migrations to urban areas. In addition, the absence of off-farm income in rural areas has also contributed to the high population pressure on arable land, which leads to fast deterioration of natural resources. This situation will remain a challenge until a high rate of agricultural transformation coupled with maximum and sustainable agricultural productivity (per unit area of land-intensification) takes off from the present crisis. Realizing the present socio-economic situations, it is evident that Ethiopia cannot meet its food security and food self-sufficiency objectives using the prevailing land and water use systems (McCornick et al, 2003.

2.2 Socio-Economic Impacts of Irrigation Schemes

Irrigation development aims to bring about increased agricultural production and consequently to improve the economic and social wellbeing of the rural population. Properly implemented smallholder 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 etal. 2002).

FAO (1997c) further identified, poor resource base of farmers, lack of land tittle, poor transportation and marketing facilities are constraints to be affecting the capacity of farmers to invest and manage irrigation projects

A study conducted by SCF/UK/ (1999) on the North Wello East Plain Food Economy Zone reported that irrigators can plant three times per year and in most cases the production serves as a valuable source of income and the majority of the farms who have irrigation plot have been categorized under rich wealth group in the community.

2.3 Challenges Delaying Irrigation Farming

2.3.1 Water

Msingo (2007, Mujere, Chazovachiietal, (2010) postulated that unavailability of water affects crops. Kundlande (1994) showed that crop production in most areas is common in dark grey soils as well as brown thick soils which need large amounts of water to be saturated. In times of water crisis, the water table goes down forcing farmers to abandon their work. This possibly means that farmers will not be able to enjoy the fruits of irrigation farming and thus affecting their livelihoods at that time.

2.3.2 Capital

Irrigation farming like any other business requires financial capital. It is also needs chemicals, seeds, fertilizers and in certain instances irrigation pipes and sprinklers. It is unfortunate that farmers do not have money to purchase agricultural implements. Resultantly, they are forced to do away with such important inputs which negatively affect the quality of their crop. Makumire (1996) puts forward the idea that lack of inputs is a major setback. At the end these problems make irrigation farming a failure in uplifting rural people's livelihoods.

2.3.3 Labour

According to Hodder (2000) irrigation farming is extremely labour intensive. A plot needs to be maintained and thus tend to make considerable demand on the time of members. Given the demographic characteristics of rural areas, it follows that women and young children attend mostly to the plots. Watering the plots is particularly the best challenge especially in times of water crisis.

2.3.4 Markets

Makumbe (1996) showed that producers prefer selling to local markets in small quantities than in bulk.The reason being that, rural people could not meet commercial quantities and qualities. Markets are unreliable especially during the rainy seasons when people are self sufficient and reliant. In such times Makumbe (1996) argues that produce are bought at very low prices thus affecting producer's income.

2.3.5 Transport

Food crops from irrigation farms are a problem for many rural people since they lack the transport to ferry their produce to the market. This tends to disadvantage communal farmers to participate in the recent boom in horticulture. Jackson et al (1997) postulates that some small irrigation scheme faces problems of roads and transport facilities. Rural areas often have gravel roads which are long and winding, some poorly maintained and inaccessible. Transport operators are in most cases reluctant to reach such areas and some of the farmers fail to get their produce to the market in time. Given the perish ability of their products farmers face the risk of running a loss.

2.4 Environmental Consequences of Small-Scale Irrigation

The Catholic Relief Services conducted an environmental assessment of small-scale irrigation in Ethiopia in 1999 and revealed common and recurrent concerns and problems, considered typical of small-scale irrigation environmental issues, like Inefficient use of water, Soil Salinity Problems, Soil erosion, Water related disease hazards, and Soil fertility and quality maintenance problems (CRS, 1999).

2.4.1 Water Related Disease Hazards

The primary health risks associated with small-scale irrigation projects relate to water and vector borne diseases. Most of the reported impacts of irrigation development on health consist of water-related diseases. Generally, four groups of diseases are distinguished based on their way of transmission, such as Water-borne, Water-washed, Water-based diseases, Water-related (Cairn cross)

2.5 The National Irrigation Policy

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).

"To enhance and contribute its share in all national efforts towards the attainment of, 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 policy objectives are also expected to ensure that environmental protection measures are taken into account in the course of studies, planning and implementation and operation of water resources and water resources systems (MoWR, 1998)".

CHAPTER THREE

3. Materials and Methodology

3.1 Description of the Study Area

Fogera is one of the 113 woredas in the Amhara Region which is found in south Gonder zone Amhara , in northwest Ethiopia. It is 617 km to the north of the capital city, Addis Ababa. The woreda is divided into 32 kebeles (2 urban kebeles and 30 rural kebeles). The district is bordered on the south by Dera, on the west by Lake Tana, on the north by the Reb which separates it from Kemkem, on the northwest by Ebenat, and on the east by Fogera. The administrative center for this wereda is wereta town..

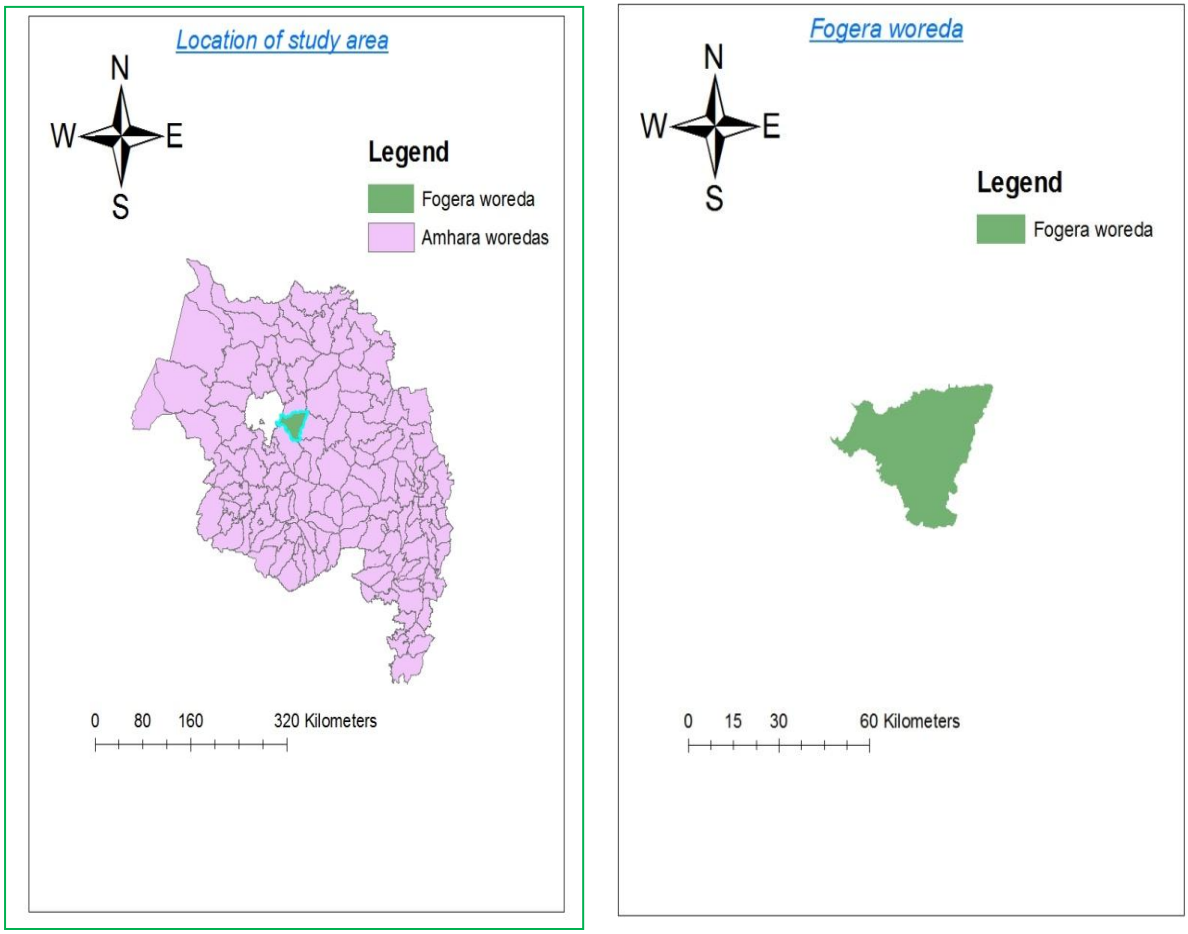

Fig.3.1 study area

3.1.1 Climate and Weather Condition

The altitude of this woreda ranges from 1774 to 2415 meter above sea level. Rivers in Fogera include Gumara and the Rib, both of which drain into Lake Tana. A survey of the land in Fogera shows that 44.2% is arable or cultivable and another 20% is irrigated, 22.9% is used for pasture, 1.8% has forest or shrub land, 3.7% is covered with water, and the remaining 7.4% is considered degraded or other

3.1.2. Economy

Teff, corn, sorghum, cotton and sesame are important cash crops. Fogera is also known for its breed of cattle, which has a large frame and is one of the best native milk cows in Ethiopia. There are 16 co-operatives, 9 of which are multi-purpose, 4 irrigation and 3 financial cooperatives

3.1.3 Population

The study area has a total population 228,449. This is an increase of 23.3% over the 1994 census showing of 185,280 inhabitants. By gender, the population has held steady in split of about 51% male to 49% female.

3.1.2 Water Resources

Fogera has an extensive resource potential in climate, land and water. Surface, ground and spring water are the main water sources in woreda. The main drinking water source for human and livestock are surface water as observed in the field survey.

3.1.3 Agriculture

The natural fertility of the soils of the Fogera wereda is generally high and satisfactory crop growth can be obtained with normal rates of fertilizer application. There are sporadic and income cases quite extensive, areas where the natural fertility is low and additional fertilizer input are required. The most important soil erosion processes, which occur in the Fogera,woreda are rain splash and sheet wash, gully erosion. Seasonal labor shortages in the woreda hinder efficient farm management. Theses shortages are particularly acute during the critical operation of weeding and harvesting. The effect of inadequate labor availability in preventing farm operations being completed on times reduced crop productivity, and this is reflected in the existing yield levels. This labor constraint can also seriously limit an improvement in cropping intensity.

It argued that without a coordinated water development program, there would be no prospects for agricultural development in the woreda. In an attempt to contribute a better understanding of the community based irrigation subsector in the Fogera woreda, a socio-economic performance and environmental impact evaluation was carried out on two selected smallholder irrigation schemes in two different kebeles called Kuhar and Abo. The selection criteria for the kebeles to be studied took in to account diversity and unique differences within the irrigation schemes. The type and age of schemes, access to irrigation related services; water sources market availability, access to farm inputs, climate variation, was key considerations. The selected schemes vary in size, crop production, and type of management and irrigation water gaining.

3.2 Description of Irrigation Schemes

3.2.1 Kuhar Irrigation Scheme

Kuhar irrigation scheme is located in Amehara Regional State, South Gonder Zone, Fogera Woreda at an altitude of 2612 m above sea level, latitude Easting: UTM390538.1 and Northing UTM1312044.3. It is about 9 km from Woreta city. The zonal classification of the scheme is Weyinadega. The mean annual rainfall is 900 mm. The cumulative mean monthly minimum temperature is 1 0C while the mean monthly maximum temperature is 28 0C. The water source for the irrigation scheme is Kuhar earth dams with storage capacity of 30 million m3 of water. The main source of water for the dams is the runoff of the surrounding catchments area supplying the Kuhar and Chan streams. SARAR constructed the dams for irrigation purposes in (2001Ec).The total population of the Kuhar peasant association is about 480 household heads out of which 64 are irrigation users.

Crop-livestock production system is dominant which is highly dependent on rain fed agriculture. The dominant rain fed crops grown in the area are wheat, teff, and barly while maize, garlic Onion, pepper, cabbage, and potato are irrigated crops. Land preparation for most crops is carried out with the traditional plough, using oxen as a source of power for traction assisted by hand tools. Water Users Committee of the peasant association in collaboration with Woreda Agriculture office does the operation of the scheme. The woreda Agriculture office organizes the committee and gives extension services. The maintenance of irrigation structures and other related works are to be performed by zonal irrigation development authority. A development agent is assigned to the peasant association to give technical assistance in agricultural activities to the farmers.

3.2.2 Tankua Irrigation Scheme

Tankua irrigation scheme is located in Amehara Regional State, South Gonder Zone, Fogera Kuhar at an altitude of 2419 m above sea level, Easting: UTM396464 and Northing UTM1315222. It is about 20 km from Worota city. The zonal classification of the scheme is Weyinadega. The rainfall in the scheme is bimodal. The average annual rainfall is 850 mm. The cumulative mean monthly maximum is to 30C and minimum temperature is 3 0C.

The total land area of the peasant association is 1425 ha out of which 322 ha are cultivated. The rest are used as homestead, grazing, forest, shrubs and wasteland. Out of the total cultivated land 64 ha is irrigated. The dominant soil type is vertisiols with red soil. Wheat, teff, Barley, and maize are grown by rain fed agriculture while potato, Onion, garlic, pepper, carrot and cabbage are grown using irrigation. The Gumara River was diverted using weir by AWWCE (2000Ec) financial contribution. The area developed at present is 64 ha with 264 households. Most of the irrigated farmers are around their homestead area. Water users committee elected by the farmers does the operation of the scheme. However it is not registered by the government and doesn't have legal entity. The committee performs the maintenance of irrigation structures and related works with technical support from Woreda Agriculture office. The irrigation canals and the main canals are maintained every year before the first irrigation season by the farmer's labor. There is also casual maintenance of their tertiary unit canals every irrigation time.

Figure: 3. 1 Features of the weir (tankua)

3.3. Methodology

The research used both qualitative and quantitative methods of collecting and presenting data. Qualitative methods were suitable to explore the benefits as well as the socio-economic impact of small irrigation development. The research used the quantitative method so as to know the inputs which were bought by farmers and the number of kilograms of crops produced. Therefore interviews and observations were employed. There was also need to triangulate this qualitative methodology with quantitative methodology so that important information which could have been left out by qualitative methodology would be presented using quantitative methodologies such as questionnaires. A population of (750) non-irrigator and (328) irrigator is near to Kuhar and tankua irrigation schemes respectively. However, the research used a sample of (80) farmers which near to Kuhar and tankua irrigation schemes. The researcher used (80) farmers as a sample because fewer farmers were easy to selection process (40) irrigators in both two schemes and (40) non irrigators near to two schemes were identified. Stratified random sampling method has used since it gives each irrigators and non-irrigators group equal chances of being chosen to take part in the research. This selection criterion reduces bias control and produce real representatives of the schemes.

The studies were used also both primary and secondary data sources. The planned study was used information gathered from those who directly involve in small scale irrigation development as a primary source of data. The primary data sources were included 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 socio-economic impact of small scale irrigation development all relevant and available document was reviewed and serve as a secondary source of data.

The data collected at the household level and community level using questionnaires and Focus groups of 10 farmers who know the village very well was elected from elders, religious leaders, water committee members, young people and women. The following data were collected at community level discussing with focusing groups.

- Details of farm size, land tenure and water rights for both men and women farmers
- Number of male and female headed households;
- Cropping pattern (for rain fed and irrigated crops) and technologies used
- Environmental impacts like flooding, erosion, water borne disease, vector borne and water contact diseases on irrigation, downstream effect etc.
- States of the organization and management structure of the irrigation scheme

3.2.1 Methods of Data Analysis

Comparative (coloration) data was analysis by using the statistical software package (SPSS). The purpose of this analysis was to show the flow of good services and cash in small farm system and to see the links between the farm and the household and between these two entities and the effect on the environment. Output per unit irrigated area, irrigation ratio and unit area per staff member was analyzed by equation (3.1) (3.2) and (3.3) respectively.

According to Molden et al. (1998) and Perry (1996), these indicators can be calculated as:

$$\text{Output per unit irrigated are} = \frac{\text{Total annual agricultural production (Birr)}}{Total\ annual\ irrigated\ crop\ area(ha)} \dots\dots (3.1)$$

$$\text{Irrigation rati} = \frac{\text{Irrigated area(ha)}}{commaned\ area(ha)} * 100 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.2)$$

$$\text{unit area per staff membe} = \frac{\text{Total irrigated area serviced by system(ha)}}{Total\ number\ of\ useres(person)} \dots\dots\dots (3.3)$$

CHAPTER FOUR

4. Results and Discussions

This chapter presents survey results of the two small-scale irrigation schemes, namely Kuhar and tankua. The findings are part of the study aimed at assessing the socio-economic and environmental impact of smallholder irrigation development in the Fogera woreda. The analysis was done between farms as well as among schemes. The schemes comparison was done to see the schemes performance since they have difference in irrigation ratio, crop type grown and irrigation experience.

4.1 Major Socio-Economic Problems in the Selected Schemes

Both during the field observation and discussion held with the community and representatives of the farm households, the following issues are considered as important challenges and problems of the community.

- For human being domestic and livestock uses, this small scale irrigation is important sources to the community. But the community is highly suffering from the water quality problem and usually during rainy seasons the majority of the farm lands affected by flood and sedimentation.
- During the previous years a number of farmers were benefited from the dam and the weir diversion for irrigated agricultural. Due to different reasons the volume of water flow into beneficiaries becomes significantly decreased. This causes the farmers to shift the production pattern from main grain crops and vegetable to grass pea and also a number of farmers have forced and start to cut and clear out their perennial crops to plant grass peas. The water shortage is not only limited in shifting the cropping pattern, but also there is high conflict among beneficiaries (up to canal distractions of the irrigation schemes).
- The community effort to use available water resource is appreciable. But there has not significant effort exerted to develop the watershed of the area.
- Cropping calendar and plan is not well practiced in the area and existing crop pattern changed to grass pea plantation and become invading the whole crop farm land. Unless remedial measures are taken into account in a short period of time the, whole crops farm land will be shifted into grass pea farm in the coming few years.

- The savings behavior of the community is very low and their extravagant behavior is become increasing particular when the farmers are celebrating blood relationship affiliated mahiber, which usually lost for a week at a household level.

4.1.1. Education

It is well understood that education is one of the most needed social services in any communities as whole and specifically in the study areas of the project. Accordingly, there are 5elementary schools at different level in the two kebele (near the two irrigation schemes; namely Kuhar and tankua).But there are a number of students drop out in the current academic year. Some of the major reasons mentioned as the cause and reasons of dropout were: significant number of students are engaging in chat plantation and trading; some students join daily labour works and migrate to other areas; lack prospect after education; parents badly needs the labour of students, particularly at the peak period of agricultural development practices. The data in figure 4.1 shows that there is a relationship between educational level and irrigation farming. Irrigation is considered a form of self-employment and income generating project in Kuhar and tankua. This is line with Chitsiko (1999) who asserted that small scale irrigation schemes augment government policy of reducing rural to urban migration. Instead of seeking employment in urban areas they are busy in the irrigation schemes.

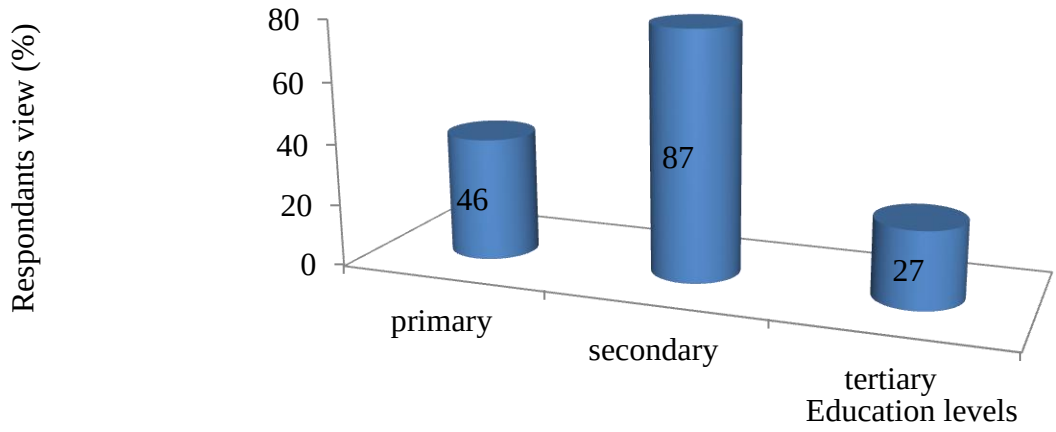

Figure: 4. 1 Education level of respondents

4.1.2. Health

The health post and health center are located at a reasonable distance to all residents. Particularly through the health post, diseases preventions and treatments service for some parasitic disease medication are being given by the health extension agents of the near to Kuhar and tankua irrigation schemes. As farm household heads of the study area confirmed, advises and consultation on disease prevention and control are being held as day to day activities in the study kebele administration. Surprisingly, all the respondent and focus group discussion participants have unanimously reflected that they are well aware and being taking care. In the study area, as the farm household head assured, health problems like Malaria are the most common problems of the community in the order of importance.

During the focus group discussion, farmers boldly expressed their complaints they have on the health post or health care services. Some of the complains they raised are: the medicine prescribed to the patient are not usually available at the health post or care level and they are referred to the private drug vender to buy; some of the health experts have lack skills and experiences; working hours are not properly practiced and the health center is not providing services in the weekend.

4.1.3 Overall Status of Downstream and Upstream Users and their Prospects

4.1.3.1 Upstream Users Attitude and their Perspective

As farmers confirmed, the upstream beneficiaries are relatively the new beneficiaries who have been increasing from year to year. The number of upstream beneficiaries who are going to use motor pumps are still expected to increase in the coming a few years. This is because farmers are being advised to produce crops using alternative irrigation means and there is extended land that is adjust to the bank of the river and near to the reservoir which could be developed through motor pumps. Unless the watershed development intervention around the river and dam and enhanced, as the agricultural development agent and beneficiary farmers explained, all the beneficiaries of the river and reservoir water users will be seriously affected in the coming few years.

4.1.3.2 Downstream Users Attitude and their Prospects

The downstream beneficiaries of Gumara river small scale irrigation project are estimated to be 200 farmers. The downstream beneficiaries are found in two different kebele administrations. The kebele administrations are called upper tebary and lower tebary. Downstream user farmers have more than 25 years of irrigated agriculture experiences. Mainly based on behary River, they have been practicing their irrigated farming through gravitational water flows. Data collected from the two kebele administrations showed that there are number of motors which are used to supplement and carried out the irrigated agriculture. Since the farmers have extensive irrigation practices, they have been cultivating crops like fruit, onion, garlic, cereals, grains, and vegetables for a number of years. But currently, farmers are seriously suffering from the shortage of irrigated water and forced to shift cropping pattern gradually to grass pea production using the residual moisture as supplementary to the irrigated water and they are cutting and clear out perennial crops from the farm land. So as to supplement the water deficit problem and to use the limited water supply, as observed at the field level, farmers have developed water harvesting ponds to prevent the river water loss to their farm land. In this process the greatest problem they have usually faced is that, the significant number of the ponds is collapsed every rainy season. Due to the decrement of water flow, as beneficiary famers, kebele administration committee and development agent explained, usually there are conflicts among lower tebary and upper tebary beneficiaries.

4.1.4 Others Services of the Community

Services to the community like marketing, transport service, and road services, are not available in the two schemes; namely Kuhar and tankua .The information obtained from kebele administration office and survey data has indicated that on average the rural community far from the service for 120 minutes walks. The community has been obtaining marketing services from Worota town only Saturdays due to lack of transportation.

4.1.5 Water Sources and Irrigation Ratio

Kuhar gets its water from Kuhar earth Dam while tankua gets from spring using modern diversion canals. The tankua scheme is traditional and has very long experience of irrigation and up-graded with partially cemented primary and secondary canals in (2000Ec) by AMELD.

The water source in the two schemes is not reliable during irrigation season and due to upstream and downstream unbalance use of water. This will restrict the crops they grow using irrigation. The water allocation system is very efficient except during shortage and have avoided dispute among farmers. However, there is water theft during water shortage.

The Kuhar irrigation scheme is silting up due to erosion from the surrounding sloppy agricultural fields. Its sustainability is at stake in the long run unless something is done to control the erosion up stream agricultural fields. The Kuhar Dam is found inside another Peasant Association. As a result, the up-stream farmers are always complaining and requesting compensation for their lost land and sedimentation problem near to their farm land. Similarly in tankua there is water shortage during dry season and conflict between upstream and downstream users. The farmers also mentioned that water borne and water related disease like malaria expanded in the area. The schemes studied vary in size. Households of Kuhar and tankua are 54 and 107 ha respectively. The rest are mentioned in the table below.

Table: 4. 1 Unit area per staff member and irrigation ratio

Schemes	**Sex**	**NHHPA**	**NHHS**		**PATA(ha)**	**CA(ha)**	**SS(ha)**	**UAPSM**	**IR**
			No	%					
Kuhar	male	323	43	34	1251	50	55		
	female	101	11	10					
	Total	424	54	44	1251	50	55	1.02	1.1
Tankua	male	430	86	45	1425	50	46		
	female	105	21	11					
	Total	535	107	56	1425	50	46	0.4299	0.92

*Source***:**FogeraWoreda Agriculture Office, 2008Ec.

NHHPA =Number of household in the peasant association, NHHS =Number of household in the schemes, PATA (ha) = Peasants association total area in hectares, CA (ha) = commanded area in hectares, SS (ha) = Scheme sizes in hectares, UAPSM =Unit area per staff member, IR =Irrigation ratio

According to equation (3.2) the higher and the lower values of irrigation ratio were observed in the Kuhar and tankua irrigation schemes (1.1%) and (0.92%) respectively. Also from

equation (3.3) unit area per staff member of Kuhar and tankua (1.02) and (0.4299) are respectively. The variability among unit area per staff member, irrigation ratio, and schemes size might be due to the variations in fallow land, number of household and shortage of water. In this study, the incomes were much higher in areas where fruits, vegetables and industrial crops are mostly cultivated. Where land is limiting relative to water, output per unit land may be more important. Where water is a limiting factor on production, output per unit water may be more important. Performance of an irrigation schemes are related to infrastructure (fixed, flexible), management (agency, joint, and farmer), allocation and distribution procedures (demand versus supply), climate and socioeconomic setting. In this study, the whole area cannot be irrigated for various reasons, such as water scarcity, fallow land, socioeconomic reasons and lack of irrigation infrastructure. There are considerable changes in irrigated area size and crop pattern in the same schemes on a year-to-year basis and efficient irrigation scheduling was not achieved in the pre-irrigation season.

The relative water supply as an important water use efficiency parameter. Common practice in irrigation supply is to apply water to the root zone at the required time, amount and quality. For efficient irrigation management, all activities in the irrigation network should be monitored and checked, technical requirements should be meet, training and extension should be enhanced, evaluations should be performed on a daily and seasonal basis and the results should be delivered to the relevant individual and institutions with an efficient monitoring and evaluation system). WUAs, municipal organizations, village organizations and cooperatives that undertake the operation and management of irrigation schemes should be empowered as legal entities. The vitality of the monitoring and evaluation system should be well understood by all relevant individuals, from farmers to managers. When this is achieved, problems and solutions in project management can be easily and rapidly defined.

4.1.6 Planning and Management of the Irrigation Schemes

The nature of the project demands careful implementation of activities and strong integration of among stakeholders with real commitment for the achievement of the commonly shared goal. Unless all the concerned main stakeholders of the project are involved and properly executed the respective responsibility, it would be difficult to achieve the intended project objectives. Both the two selected schemes have a long experience in irrigation activities and farmers were farm workers when the schemes were under traditional farm. SARAR (2000Ec) and AWWCE (2001Ec) upgraded Kuhar and tankua irrigation schemes respectively. The

farmers didn't make any financial contributions towards the development of the projects. They only did the infield development in Kuhar scheme, the construction and maintenance of primary and secondary canals is done by the community finance and labor contribution without outside support. Due to approaches taken by the government and NGO's in schemes development, farmers consider their projects as government and NGO projects due to lack of awareness creation. This research believes that if they had participated in the planning process, they would strongly regard the projects as theirs. On the other hand tankua farmers don't contribute and participate in all activities of the scheme construction and have less of a sense of ownership and the canals filled by stone and children play game at the top of the canal like gebeta (Figure 4.2). Each of the two schemes has water users association (WUA) and groups for water management. They have a system of by laws' to manage the schemes. The water user association of Kuhar is registered by the government and has legal entity while tankua WUA are not registered. The registered WUA have the right to get inputs and market facilities, credit service etc. from government and NGO's while the nonregistered have legal entity problem. The registration is done by agriculture office at woreda level in collaboration with woreda Irrigation Desk. Woreda Agriculture Desk provides technical advice and inputs like fertilizer and improved seed but these offices are under stuffed and have little budget to give the required assistance even for the registered WUA.

Figure: 4. 2 Lack of management and ownership at the schemes (tankua)

4.1.7 Labor Supply and Allocation

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. To study the labor supply by the family, household composition by age, sex and educational status was analyzed. The sample household head farmer's composition by sex is tabulated in table 4. 2 and shown that there is significant difference (p-value 0.000) between farms types. This is assumed to be due to lack of participation or the labour-extensive nature of irrigation practices since women have additional responsibility in the house in providing food to the family, look after children and livestock their participation in irrigated practices as a household head is minimal.

Table: 4. 2 Mean comparisons of household by sex between farm types

Sex	**Farm type**		**Mean square**	**p-value**	**Remark**
	Irrigators	No irrigators			
Male	36	22	512	0.000	**
Female	4	18			

NS=non-significant, *=less significant; at p<0.05; **=strong significant at p<0.01,

The economically active population within the age group of 18 to 50 years shows any significant difference between scheme types (Table 4.3).

Table: 4. 3 Mean comparison of age between schemes

Ages	**Schemes**		**Mean square**	**p-value**	**Remark**
	Kuhar	Tankua			
Household age >50 years	20	7	50	0.000	**
Age between 18-50 years	10	23			**
Below18 years	10	10			Ns

NS=non-significant, *=less significant; at p<0.05; **= strong significant at p<0.01

From table 4.3 the majority of the respondents fell under the age group 18-50 years constituting the able bodied who could economically work in the plots. The high response in the age group has been attributed to their available in plots since they spend most of their

time working on the plots. Fewer children who constituted 25% of those respondents help parents in irrigating crops so that production can increase. More so the findings showed that these children worked in the absence of their parents who might be working in town or were at home busy with other commitments.

The family labor supply is not enough for irrigated farming in most cases while non-irrigated farms have almost enough aggregate labor needed for the farm operation. As a result non-irrigator family labor has to be used by irrigator farmers. Labor is both exchanged and hired to overcome labor bottlenecks. Hired labor is most used at transplanting seedlings, weeding and harvesting time. For other activities all physically able members of the household assist in farm work. The total labor required in man-days for irrigated crops is significantly higher than no irrigated crops in (Table 4. 4).

Table: 4. 4 Mean comparison of labour requirement between farms

Labours	**Farm types**		**Mean square**	**p-value**	**Remark**
	Irrigators	None irrigators			
Family (per ha)	26	38	72	0.000	**
Hired (per ha)	14	2			

NS=non-significant, *=less significant; at $p<0.05$; **=strong significant at $p<0.01$

4.1.8 Land Tenure and Size of Holdings

The data generated from the kebele revealed that the average land holding of the area is 1.72ha and the land holding per household head ranges from 0.5 to 3 hectares of farm land. As the manager of the kebele explained and the focus group discussion participants assured, there are many landless youths and newly married households that have been leading their live by renting in land from others and by doing works for others both in off and non-farm activities. The mean cultivated and holding of irrigated and non-irrigated farms are not significantly difference. However there is significant difference among the schemes (Table 4. 6). Land holdings are significantly fragmented between farm types in various practices, subdivided into different plots however; there is no significant difference between schemes. Fragmentation arises from the Peasant Association strategy of allocating different land classes equally among its member farmers after the abolition of producer's cooperatives in each scheme. In addition the redistribution of cultivate lands among the family members has also contributed to this phenomena. Fragmentation of cultivated plots has its own positive and negative impacts. It lowers production risks on the other side increases weed infestation

from adjacent plots, increases soil erosion and makes grazing difficult. Number of gully on plots was also counted and the comparison shows no difference between scheme types while among farm the difference is significant. This shows that irrigation has no effect on gully plots.

Table:4. 5 Mean comparison of cultivated landholding and other parameters between farm types

Land holdings	**Farm type**		**Remark**
	Irrigators	None irrigators	
Land holding (ha)	0.8085	0.86	Ns
Plot distance (m)	0.5	1.65	**
Gully formation on plot(m)	2	5	**

NS=non-significant, *=less significant; at $p<0.05$; **= strong significant at $p<0.01$

Table: 4. 6 Mean comparison of cultivated landholding and other parameters between schemes

Land holdings	Schemes		Remark
	Kuhar	Tankua	
Cultivated land (ha)	1.02	0.4299	**
Plot distance (m)	0.65	0.5	Ns
Gully formation on plots(m)	1.25	1	Ns

NS=non-significant, *=less significant; at $p<0.05$; **=strong significant at $p<0.01$

Plot distances is significant different between farm types. In most irrigated farms irrigation water is used for both human and livestock consumption. Since most farmers live near the irrigated plots and irrigation water passes through the villages they don't have to travel long distance like non-irrigators. In both the schemes, irrigated plots are near to their homestead with compared the non-irrigated plots. As observed during the study almost all of irrigated plots are permanently cropped. There is no any fallow land in all the schemes. The majority of farmers in the two schemes cultivate the land by the family inputs. Share cropping and rental systems (Table 4. 7) are present in both the two schemes. However, there is significant difference between schemes. Kuhar about 9.375% and 3.125% of the farmers give their land for share cropping and rented respectively.

Table: 4. 7 Mean comparison of tenure systems between schemes

Tenure status	Schemes		Mean Square	P-value	Remark
	Kuhar	Tankua			
Household	11	28	12.5	0.000	**
Share cropping	6	1			
Rented	3	1			

NS=non-significant, *=less significant; at p<0.05; **=strong significant at p<0.01

4.1.9 Crop Production Performance

In the study area crop production is the main activity, the major sources of income and the main means for the livelihood of the farm households. The benefit of Kuhar and Tankua kebele generated from crop production practices and the remaining balance is generated from livestock production. As tried to discuss in the previous section of this paper, the rainfall is uni-modal, and mostly characterized by uniform distribution. So, depending on the rainfall farmers have been growing diversified crops for a number of years. Crops like, pepper, and onion and garlic are the major crops grown in both schemes but the yields are minimal. According to the data generated from Fogera agriculture office, so as to increase and improve crops production and productivity farmers have been using and are using improved agricultural inputs such as fertilizer and improved seeds. But chemical utilization experience is minimal. As the respondent household farmers explained during interview there was shortage oversupply and qualities problems towards inputs, particularly improved seeds (more specifically maize). Also they complained on the cost of fertilizer, which the trend showed an increasing rate from year to year. Farmers have also been producing crops through using the two irrigation schemes as both traditional and small scale irrigation schemes. But the crop production pattern is very intermittent due to the shortage of water supply. In the previous year farmers were producing vegetables, cereals and grains in a continuous and planned manner, but nowadays the majorities of the farmers have shifted to grass pea production and others are producing intermittently, due to the inadequacy of the water supply of irrigation water in the area. As observed in the study, most farmers plant onion as cash crop. This is because of better price; gives relatively high yield and easily managed by farmers. It also resists water stress and pests. Generally the yield qt/ha, annual value of agriculture production birr and annual irrigated crop area ha of the two irrigation schemes is much diversified.

Table: 4. 8 Output unit irrigated area and crop pattern

Crops	TAAP (birr)	Yqt/ha	TAICA(ha)		crops	TAAP(birr)	Yqt/ha
			kuhar	Tankua			
Year			2006/07				
Potato	4000	10	88	64	Potato	4400	11
Cabbage	1600	8			Cabbage	1400	7
Garlic	45000	15			Garlic	6000	20
Carrot	4800	6			Carrot	5600	7
Onion	36000	18			Onion	400000	20
Tomato	4000	5			Tomato	4000	5
Barley	2700	3			Barley	2700	2
Wheat	4000	4			Wheat	6000	6
Maize	1400	2			maize	1400	2
Pepper	220000	20			pepper	242000	22
total	323500	91	88	64	total	673500	102

Source: South Gonder and Fogeraworeda agriculture office (2006/07Ec)

TAAP (ha) =Total annual agriculture production in hectares, Yqt/ha= Yields quintal per hectares, TAICA (ha) =Total annual irrigated crops area in hectares,

The output per unit cropped area for the 2 irrigation schemes is presented in Table 4.8. According to equation (3.1) Output per unit irrigated area in tankua irrigation is the higher with 10523.43 birr/ha however Kuhar irrigation is the lower with 3676.13birr/ha. Total annual agriculture production per hectares varied between 323500and 673500 birr/ha-1 for the period of 2006/07 respectively. The higher and lower values of the output per unit cropped area were observed at the tankua and Kuhar irrigation schemes 673500 birr/ha-1 and 323500 birr/ha-1respectively. The output per unit cropped area varied from one project to another due to fluctuations in the crop pattern and national (local) prices of the base crop.

4.1.10 Agricultural Income of the Schemes

Analysis of farm resource productivity involves not only details of the farms, but also external factors, such as markets and prices of inputs and output, asset base and infrastructure. Productivity is related to the proper choice of technology among those alternatives at the farm. The mean asset value included livestock, farm tools and fixed assets specifically buildings as discussed from the community level there is significant difference between farm types is observed in fixed asset ownership. The difference in net farm income between farm types was calculated (Table 4.9).The cost of inputs like fertilizer, pesticide, herbicides and seed were deducted from the gross farm income. The result revealed that the average net farm incomes of irrigation farms in general are higher per ha than the non-irrigated farms. The mean income comparison among schemes also shows a significant difference in the two schemes (table 4. 10).

Table: 4. 9 Mean comparison of net farm income between farms type in 2006/07

Irrigation incomes	**Farm type**		**Remark**
	Irrigators	None irrigators	
Input cost (Birr/ha)	14199.49	5262.35	**
Gross farm income birr/ha)	997000	350000	**
Net farm income (birr/ha)	982801	297376.35	**
Fixed asset	999800	365000	**

NS=non-significant, *=less significant; at p<0.05; **=strong significant at p<0.01

Table: 4. 10 Mean comparison of net income between schemes type in 2006/07

Irrigation incomes	**Schemes**		**Remark**
	Kuhar	Tankua	
Input cost (Birr/ha)	3676.13	10523.43	**
Gross farm income (birr/ha)	323500	673500	**
Net farm income (birr/ha)	319823.87	662976.57	**
Fixed asset	451352.12	721236.35	**

NS=non-significant, *=significant; at p<0.05; **=significant at p<0.01

At Kuhar the net farm income is small. This is assumed to be due to the type of crop grown and the price offered for the produce. Garlic and onion, which have lower production, is

grown in Kuhar while in tankua relatively higher production is grown. In addition it is assumed that the crop type grown, the land fertility, temperature and price of the produce have influenced the yield production. As we have seen from the previous discussions, Kuhar is at high altitude, where the soil is depleted from long years of cultivation, and where the two crops grown as a major crop, which is affected, by diseases and low price offers. This show that irrigation in higher altitude where the annual rainfall is more than 900 mm and with limited crop type and low temperature is not attractive venture among smallholder farmers.

4.1.11 Commercial Aspects

In both the schemes, there is no organized marketing system for agricultural product. Yields are sold individually at the prevailing market price at the farm. Buyers come to the field and determine the price. The price variability is high for some crops like onion, pepper, and garlic which sometimes bankrupt of the farmers. In some season, prices shoot up and lucky farmers benefit a lot. For example the price of pepper in 2007Ec crop season varied from 20 birr to 200.00 Birr per kilo (Table 4. 11**)**. The same is true for onion and garlic. The no irrigated crops price is usually uniform throughout the year with low rate of variability. Due to lack of storage and transport facilities, perishable vegetables are highly sensitive for marketing situation. Vegetables produced are sold at the farm with prices fixed by the buyer in both the schemes. The marketing situation is very critical for perishable products, which are at present grown by most farmers .The farmers also produce similar crops at one time creating market competition among them. Therefore, any future intervention in the promotion of cash crop production should consider the issue of marketing and other necessary facilities like price, information, storage, marketplace, production diversity, consumer preference etc.

Table: 4. 11 the mean crop prices of the study area in 2007 Ec.

Crop type	Maximum(Birr/kg)	Minimum(Birr/kg)	Mean(Birr/kg)
Potato	10	4	7
Cabbage(vegetable)	2.5	1.5	2
Garlic	30	10.5	15.25
Carrot	8	2	5
Onion	20	4.5	12.25
Tomato	12	4	8
Barley	9	8.5	8.75
Wheat	12	10	11
Faba bean	6	5.5	5.75
Teff	10	8.5	9.25
Maize	7	5.5	6.25
Pepper	200	20	110

Source: survey data (2007Ec)

4.1.12 Input Supply and Credit System

So as to improve and increase agricultural production and productivity of the study area, services like appropriate inputs provision and organized marketing system are primary important. The data of the survey revealed that in the study area improved agricultural inputs (fertilizer, improved seed, and improved farm tools, etc.) are being supplied by private company either in cash or credit. Sometimes farmers buy inputs in cash as if they perceive no alternatives. Irrigation farmers use more inputs like fertilizer, improved seed and chemicals (pesticides, herbicides, fungicides) than non-irrigators as discussed from wereda agriculture office. This is because nothing is returned to the soil again in general while in particular in irrigated farming the vegetable production and cropping intensity is believed to deplete the soil nutrient requiring more than the non-irrigated plot. However, a farther study is needed to verify the nutrient balance in the system. In addition income from cash crops and increased production enables irrigator farmers to meet the high price of inputs.

Credit facilities are non-existent in both schemes namely in Kuhar and tankua schemes. As an alternative savings and credits services providers, nowadays rural savings and credit cooperative are being established and expanded throughout the region, but this opportunity has not been practiced so far in the study area. The loan is provided in-group not more than 8 farmers. The group gives guaranty to cover the loan taken by defaulters. In both schemes

merchants provide seed and fertilizer on credit and collect it back in any kind. The agreement is that the farmer will sell his produce to the merchant at time of harvest with price fixed by the merchant. This has implication on the income of the farmer since the merchant fixes the price. Totally Some Challenges hindering in irrigation farming socio-economically summarized as follows in my study area (Figure 4.3).

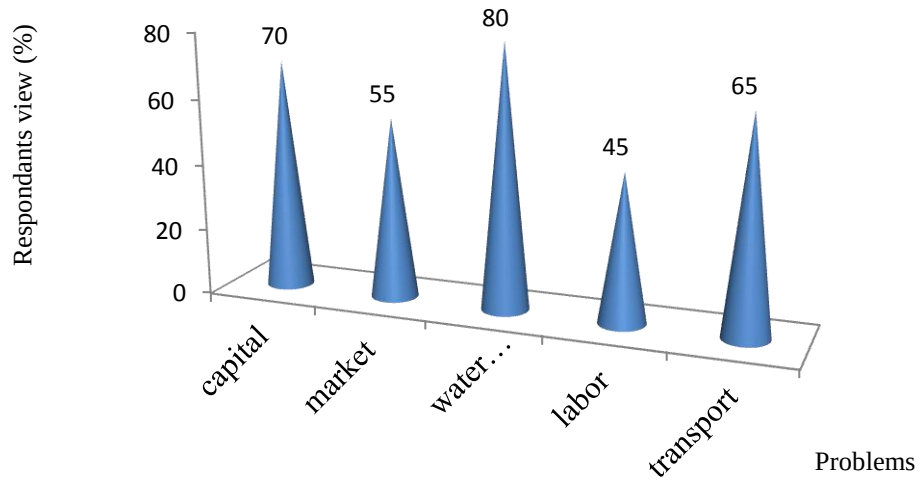

Figure: 4.3Challenges faced by farmers

From figure 4.3, the majority of the respondents indicated that they had problems in securing capital to buy inputs such as seeds, fertilizers and chemicals. Due to such problems plot holders (irrigation users) end up using unspecified organic fertilizers or just plant without. The results are that yields obtained fall below standard and this threatens (looms) the scheme objectives of maximizing production through irrigation. The unavailability of reliable markets to sell their produce is one of the major challenges facing farmers. Farmers who constituted 80% of the respondents complained that imbalance use of water by the upper stream and downstream users. This compelled some plot holders (irrigation users) to temporarily abandon cultivation and made conflict between them. According to the respondents highlighted that it is true that irrigation land is more expensive to rent or buy and the water pricing leaves the beneficiaries with little profits which means that farmers are usually disadvantaged. Some farmers also complained about the nature (accessibility) of the road which forces bus operators and private vehicles to look for other routes. This affects their products which need a ready market. More so some of the challenges faced by farmers were also linked to the availability of laborers to water crops, distribution of water given the number of farmers in the scheme, it is too involving. As Hodder (2000) puts it, "irrigation farming is labour intensive."

4.2 Anticipated Impacts of the Selected Schemes on the Environment

As it is intended when the project is appraised and implemented at the specific site of the project some positive and negative socio-economic impacts are inevitable. By taking into account the existing socio-economic variables of the project area and the nature of the project itself, have its own positive and negative effect on the environment.

4.2.1 Potential Positive Impacts of the Selected Schemes on the Environment

With reference to the objective of the project, increasing production and productivity, then improving living standards of the target population is the most expected social and economic positive impacts. The implementation of the proposed irrigation project is expected to bring about several economic and social benefits particularly to the local population. Some of the major potential positive impacts of the project are summarized as follows:

- Although famers have had the experience of irrigation practices in the area, due to water shortage and lack of proper management of the water resource, in the process of crop production through irrigation there are conflicts, water wastage and farmers unable to produce crops that important to the community. Since the project is designed to supply adequate amount of water to the direct beneficiaries of the project that enable them to produce selected crops and vegetables with proper utilization of water. So due the project adequate amount of water would be supplied to the direct beneficiaries, the loss of water significantly increased and farmers able to produce crops that are useful and important to the community.
- Along with efficient utilization of the irrigation water, farmers would be encouraged to use important inputs and technologies; participated in training programs; properly implemented cropping calendar and technical supports and follow up of the service provider could be enhanced. So, due to the project valuable crops production and productivity of the farmers would be boosted (better) than non-irrigators in the two irrigation schemes.
- As far as farmers' crop production and productivity per unit area of land increased, products supply to the market relatively increased and farmers per household income become improved. These lead to livelihood improvement of the community and proper utilization of the natural resources.
- Farmers are free from the risk of crop failure that could be happed due to hail damage and unexpected interruption of rainfall. And it serves as a buffer for the farmers for the

risk and uncertainty that are associated with rain fed agriculture through land renting in and demanding of more labour for the irrigation agriculture, significant number manpower could be absorbed.

4.2.2 Potential Negative Impacts of Selected Schemes on Environment

It is true that from the nature of the project limited potential negative impacts are expected. Some of the negative impacts of the project are presented below:

- Nearly 64 farmers have been using the Kuhar irrigation and 264 farmers have been using the tankua diversion schemes where the two projects are going to be established. So far the irrigation farmers have made their own agreement among the beneficiaries to use minimal flow water for limited crop production and for human being and livestock uses and watershed management near to the dam in the tankua and Kuhar irrigation projects respectively. While the projects are going to be constructed and used, it will serves like sedimentation on the dam in Kuhar and significant number of downstream user farmers would not be directly addressed for the irrigation purpose in tankua. So, unless downstream users are going to be treated separately with any alternative modalities and watershed management practice with not made at the dam conflict of interest is inevitable.

4.2.2.1 Soil Fertility

Irrigation gives farmers the option for second and third season production. As a result of this intensification of agricultural production the quality and fertility of the soils of irrigated plots have been affected. This was observed in both irrigation schemes namely tankua and Kuhar where the land has-been cropped for more than 50 and more years. Farmers stated that without any fertilizer application their land would not give any yield. Nutrients are removed more rapidly than they are replaced. All crop residue and green byproducts from vegetable production are removed from the field for livestock feed, fuel, and house construction. The only source of nutrient is use of fertilizer. Few farmers who have livestock apply manure. It is believed that irrigated plots are more exposed to nutrient depletion than the non-irrigated plots given the other factors are similar in both cases. The indication for these phenomena is gradual yield decreases. The farmers in both the schemes witnessed this phenomenon. Farmers were asked the field management and care practices by farm type. Their experience and perception are most irrigators practice drainage ditch, stone terrace are more than the non-irrigators. However, income activities like tree planting, stone clearing from the field, no significant difference was observed between irrigators and non-irrigators (figure 4.).

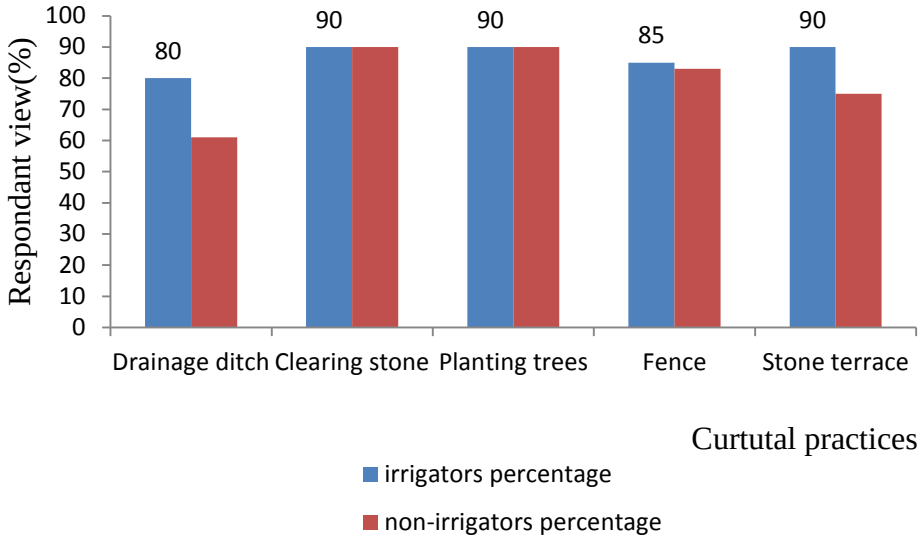

Figure: 4.4 cultural practices between farm types

4.2.2.2 Soil Erosion Problem

Due to shortage of rainfall dry condition is observed in both irrigation schemes. Wind velocity is very high. The heavy grazing from the pastoralists animals which migrate in the dry season to the area and the livestock owned by no- irrigator farmers causes considerable damage to the natural protective vegetation cover of the soil. Thus the soil is exposed to the action of strong wind, causing wind erosion forming rills and gullies. In the two irrigation schemes another, erosion caused by flood irrigation and furrow irrigation along the slope is common problem as observed during the study. Most of the slope of irrigation plots in kuhar and tankua are excessive and flood irrigation is practiced specially for supplemental water. Sheet and gully erosion are eating the fields **(**Figure. 4.5 and 4.6) respectively.

Figure: 4. 5Problems of erosion at the dam (Kuhar)

Figure: 4. 6Problems of erosion at the canal (tankua)

4.2.2.3 Canal Sedimentation Problem

Canals without the right elevation, size and slope are exposed to erosion, sedimentation, and stagnation of water and can convey water with over flowing.

Figure: 4.7Sedimentation problem at the canal (tankua)

4.2.2.4 Irrigation Water and Related Dieses

Water-borne diseases account for a substantial part of the total incidence of diseases in the rural population. It is directly related to the water use system adapted by the farming community. It is believed that the problem is more sever in irrigated agricultural system where irrigation water is used for human as well animal consumption directly without any treatment. The greatest danger associated with drinking water is contamination by human and animal excrement. Fecal of human as well as animal are left in the open system in the field and around homestead area. Rainfall and direct excretes on the irrigation water and inefficient utilization of irrigation water takes coli form bacteria into water. The Coli form is a family of bacteria common in soils, plants and animals. It was also found out in the study that the design of irrigation systems, which was supposed to avoid stagnant water to prevent negative health impacts of irrigation, was not properly working in my study area (Figure 4.8).

Figure: 4.8 Stagnation of water at the canal (tankua)

This has created favorable condition for vector and water borne diseases like Malaria, Parasites, Diarrhea, Anemia, Rheumatic pain Gastritis and Eye diseases. According to the data collected from Worota hospital, Malaria, Diarrhea, Gastritis, Eye diseases and parasite were most frequent diseases (Table 4. 12).

Table: 4. 12 Number of treated patients affected by different dieses in 2007Ec

No	Disease type	Number of Treated patients	Treated patients (%)
1	Malaria	1000	55
2	Parasites	620	62.2
3	Diarrhea	1457	65
4	Anemia	500	80
5	Rheumatic pain	406	75.3
6	Gastritis	1235	53.4
7	Eye diseases	740	67

*Source*Worota Hospital (2007Ec)

The farmers are using the two irrigation water for human consumption and animal watering without any treatment. This has increased the incidence of diseases in irrigated areas. Good construction practices are crucial in the implementation of a new irrigation system. Apart from avoiding favorable situation for development of vectors and intermediate hosts, the

location of villages and drinking water supply are important factors. When farmers are working in the field, especially children drink the irrigation water from the nearby furrows and ditches. In tankua the canal pass through the villages and people and animal drink and clean them from the some irrigation water (Figure4.9). For several mosquito and fly species, the flight range is known and when houses are located at a larger distance from the breeding sites, people will be less exposed to possibly dieses bites.

Figure: 4.9 Canals water pass through between community houses (tankua)

Generally some challenges of irrigation on environment in my study area are (Figure 4.8) according to percentage of respondent and field observation. From Figure, 4.9 the majority of the respondents indicated that they had problems in securing stagnation of water at the irrigation canal. Due to such problems plot holders (irrigation users) affected by different water born dieses. The results are during irrigation season there had been shortage of labour requirement and yields product decrease which is not harvest and weeding with its specific time and this threatens the scheme objectives of maximizing production through irrigation. The unavailability of reliable clinic is one of the major challenges facing farmers. Farmers who constituted 75% of the respondents complained that different dieses affected their children and family. This compelled some plot holders (irrigation users) completely un-productive. Some farmers also complained about sedimentation problem on upstream of the dam and canals as you can see in figure 4.5 and 4.7 respectively. This affects their land

completely damages and leads to conflict. More so some of the challenges faced by farmers were also linked to dieses, erosion and soil fertility are shown (Figure 4.10).

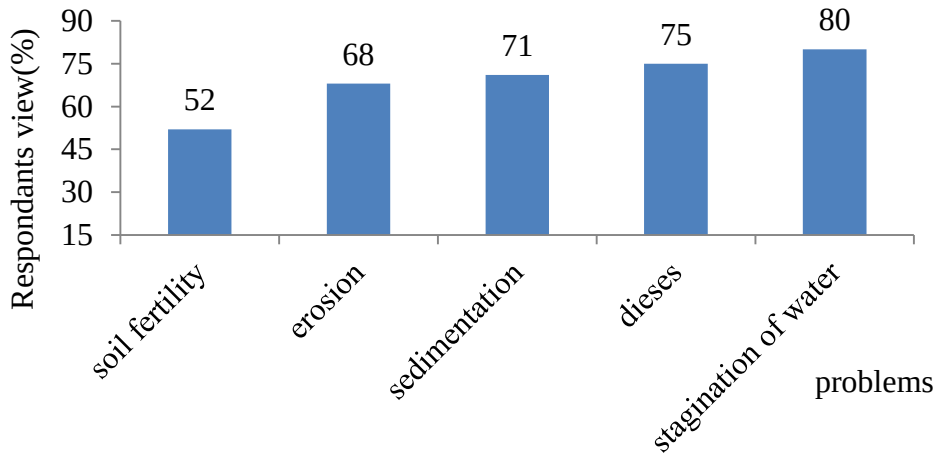

Figure: 4.10 Challenges of irrigation on environment in % (both in Kuhar and tankua)

CHAPTER FIVE

5. Conclusion and Recommendations

5.1 Conclusions

In this study, labor requirement, input supply, commercial aspect, transport and crop production performance were determined for Kuhar and tankua irrigation Schemes. The study of the two small-scale irrigation schemes in Fogera woreda has revealed some factors that are important for the successful implementation of small-scale irrigation scheme. It has come out clearly that irrigation can be comparatively well designed and in a sound technical state but other issues related to input supply, market situation, capital, labor, transport, erosion, sedimentation, fertility and health situation can affect the development of irrigation schemes. The most important factor that came out as affecting the viability of the irrigation schemes are capital, transport, water shortage, soil erosion, sedimentation, dieses and nutrient depletion.

Irrigation ratios ranged from 1.02% to 0.4299%for Kuhar and tankua respectively. All irrigation area cannot be irrigated due to fallow area, deficiency of irrigation facilities, topographic structure and socio-economic factors in the irrigation scheme. If it can be irrigated completely, production performance indicators will be arisen to the current level.

In Fogera, the peasant association where the Kuhar irrigation scheme is located near to their farm land and house at the upstream, so complaining and asking for compensation and this was a point of conflict between upstream and downstream users. In the analysis of the two schemes it has come out clearly that NGO's and government upgraded or new small-scale irrigation projects are handed over to the farmers without proper completion of construction and technical training and without proper management establishment. This creates problems at such schemes as farmers remain with the understanding that the government and the NGO are still responsible. It is also important to be transparent and not to threaten people as a way of making them accept a project. These problems were made at tankua scheme especially and farmers always refer to such events.

The results of the study showed a significant improvement especially in irrigation ratios, transport, market, input supply, and labor and watershed management as the state has transferred the irrigation schemes to the user organizations.

5.2 Recommendations

Based on the facts found during the socio-economic and environmental survey the following recommendations are made:

- The community found in the project area has low savings behavior and high extravagant experiences, particularly through blood relationship affiliated mahiber So, increasing awareness creation forums; conducting experience sharing visits at nearby kebele administrations where locally established saving and credit cooperatives are being operating and facilitating and undertaking consultative meetings are quite important means to alleviate the problems.
- As the farmers repeatedly stated that, the volume of water flowing in the Gumara River has-been decreasing from year to year and Kuhar irrigation cannal increase sedimentation year to year. Among others, the major cause for the decrement of the water flow and increase sedimentation is associated with the poor watershed development experiences of the community. Both to ensure the water supply of the direct and indirect beneficiaries of the two projects in a sustainable manner and to maintain the ecosystem in the area, giving attention is expected from the respected organizations so as to implement and speed up watershed development intervention near to the two schemes.
- Once the project has been appraised and recommended for action/implementation, the ultimate owner and beneficiaries of the project should be engaged in the activities from the very start of the project by forming legally recognized body.
- Sedimentation ,erosion ,stagnation of water and dieses are common in the study area due to improper design of canals and drainage system so, as much as they can NGO's and governmental institution rehabilitate the canal with proper elevation, size and slop to convey water with minimum velocity without over flowing
- Sustainable irrigation is at risk due to excessive flooding of lands with inappropriate irrigation methods. Therefore, cultivation plans and patterns should be followed and water must be supplied to the root zone.
- For an efficient and reasonable irrigation management, an information system for monitoring and evaluation, which encompasses all stakeholders, should be set up and irrigation scheduling should be properly designed. In addition, irrigation scheduling and predicted cropping patterns should be followed by farmers and irrigation.

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Annexes

Annex III

Household Level Questionnaire

Questionnaire Number: ___Date of interview: Day: _____ Month: _____Year: _____Interviewed by _____Date checked: Day: _____ Month: _____Year: _____Checked by: _____Date entered: Day: _____ Month: _____Year: _____Entered by: _____Woreda: ___ Code: _____PA: _____Code: _____Scheme: code: _____ Household No: _____Farmer's Name _____Age _____Farmer's sex ____

1. How long has the farmer practiced irrigation (years) _____

2. What are the main objectives of using irrigation? (Rank according to importance) 1=to generate cash income 2= to produce food for the household 3=other (specify)

3. Did you participate in irrigation association activities? 1=yes, 0=no

4. If yes, what are the activities?

1=_____

2= _____

3= _____

4.1. If yes, who participate from the household_____? 1=men, 2=women, 3=children

5. Have you ever faced any human health problem due to using irrigation? 1=yes 0=no

5.1. If yes, rank the problems according to importance

1= _____

2= _____

6. Rank the most important inhibiting factors on your irrigated crops?

Factors	Rank
Water	
Land	
Labor	
Inputs	
Credit	
Marketing	
Transport	
Capital	

7. Have you ever faced any conflict with neighboring farmers because of using irrigation?
0=no 1=Yes

7.1. If yes, what were the problems or sources of the conflict? Rank

1st=_____

2nd=_____

3rd=_____

7.2. If yes, what measures were taken to resolve the conflict?

1=_____

2=_____

3=_____

7.3. If no measure was taken so far, what solutions do you suggest to resolve such conflicts?

1=_____

2=_____

3=_____

8. What is your irrigation water source? _____1=stream/river 2=dam 3=other (please specify):

9. What is the water conveyance method from source to field?

1= _____

2=_____

10. Does your access to water, limit the area that you cultivate in any part of the year? 0=no, 1=yes

10.1 If yes, indicate the reasons

1=_____,

2=_____

3= _____

11. Do you think your yield is reduced because you cannot apply enough water to your crop? 1=Yes 0=No

11.1. If yes, by how much (specify proportion in percentage) _____

11.2. Do you use irrigation water for drinking as well? 1=Yes 0=No

12. Do you have irrigation water users association? 0=No 1=Yes

12.1 If yes, how was the association formed? ----------

13. What is your most important source of prices information for your agricultural products? during 2006/07 production year?

1= Radio, 2= Newspaper, 3= Traders at the market, 4=Traders who came to the farm, 5= Fellow farmers, 6=Extension officers, 7=other sources

14. Did you use credit when you first started irrigated agriculture? 1= Yes, 0 =No

15. 1If yes, where did you obtain the credit? 1=bank 2= money lender 3=NGO 4=middleman 5=friend

16. What problems have been associated with obtaining credit?

1=_____

2=_____

3=_____

17. What was the purpose of the loan(s)?

1=Purchase of agricultural inputs, 2=Purchase of livestock, 3=Purchase of equipment, 4=Purchase house construction materials,

THANK YOU VERY MUCH FOR YOUR COLABORATION

Annex IV

Peasant Association Questioner

Questionnaire Number: ___Date of interview: Day: _____ Month: _____Year: _____Interviewed by _____Date checked: Day: _____ Month: _____Year: _____Checked by: _____Date entered: Day: _____ Month: _____Year: _____Entered by: _____Woreda: ___ Code: _____PA: _____Code: _____Scheme: code: _____ Household No: _____Farmer's Name _____Age _____Farmer's sex ____

1. PA level survey

Description	P PA	PWUA	NHHU	AHHS
Male				
female				
total				

PPA=Population of the peasant association, PWUA= Population of the water users association NHHU =Number of household Units, AHHS =Average household size

2. Land use: Please give estimated size of area coverage in ha

Land use	Irrigated area	Homestead	Grazing area	Forest	Area enclosure
Code					
Estimated size (ha)					

3. Crop Budgets (Birr)

Crop Type	Irrigated (ha)	Rain fed (ha)	Total size (ha)
Potato			
Cabbage			
Garlic			
Carrot			
Onion			
Tomato			
Barley			
Wheat			
Faba bean			
Teff			
Maize			
Graspea			
Pepper			

4. What are the prevalent problems encountered in irrigation development?

1=_____

2=_____

3=_____

5. What are health problems previously unknown in the community?

1=_____

2=_____

3=_____

6. Is there water lose during transport? 1=Yes, 2=no

7. What are the human diseases that are caused because of irrigation? (Rank)
1=malaria, 2= schistosomiasis 3= diarrhea 4=typhoid 5=worms

8. What is the impact of using water for irrigation on the downstream?

1=_____

2=_____

3=_____

9. Do you think the upstream people will be affected by dam construction? 1=yes, 0=no

9.1. If yes, how are they affected?

1=_____

2=_____

3=_____

10. Do you have communal grazing lands? 1=yes, 0= no

11. What are the problems encountered in marketing products?

1=_____

2=_____

3=_____

12. How is the management and operation of the scheme undertaken?

_____

13. Who is responsible for the diversion weir and ditches maintenance?

_____

14. Which institutes are involved in the irrigation schemes?

1=_____

2=_____

3=_____

15. What are the major problems of the upstream farmers?

1=_____

2=_____

3=_____

16. What are the major problems of the downstream farmers?

1=_____

2=_____

3=_____

17. What are the major benefits of irrigation for your community?

1=_____

2=_____

3=_____