INDIRA GANDHI NATIONAL OPEN UNIVERSITY

SCHOOL OF GRADUATE STUDIES

Evaluation of the performance of two selected Small Scale Pump Irrigation schemes in Dugda Woreda, East shoa Zone of Oromia Region, Ethiopia.

A Thesis submitted to the School of Graduate Studies of Indira Gandhi National Open University in Partial fulfillment of the requirement of the Degree of Master of Arts in Rural Development /MARD/.

By Deressa Tafa Gemeda

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INDIRA GANDHI NATIONAL OPEN UNIVERSITY

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DECLARATION

I hereby declare that the Dissertation entitled EVELUATION OF THE PERFORMANCE OF TWO SELECTED SMALL SCALE PUMP IRRIGATION SCHEMES IN DUGDA DISTRICT, EAST SHOA ZONE OF OROMIA REGION, ETHIOPIA submitted by me for the partial fulfillment of the M.A. in Rural Development to Indira Gandhi National Open University, (IGNOU) New Delhi is my own original work and has not been submitted earlier either to IGNOU or to any other institution for the fulfillment of the requirement for any course of study. I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated in this report from any earlier work done by me or others.

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CERTIFICATE

This is to certify Mr. DERESSA TAFA GEMEDA student of M.A (RD) from Indira Gandhi National Open University, New Delhi was working under my supervision and guidance for his project work for the course MRDP-001. His project work entitled 'Evaluation of the performance of two selected Small Scale Pump Irrigation schemes in Dugda Woreda, East shoa Zone of Oromia Region, Ethiopia' which he is submitting, is his genuine and original work.

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Above all glory is to the Almighty,

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List of Acronyms

ADLI:	Agricultural Development Led-Industrialization
Asl:	Above Sea Level
Br:	Birr
CCF:	Christian Children Fund
CRDA:	Christian Relief and Development Association
CSA:	Central Statistics Authority
DA:	Development Agent
FAO:	Food Agricultural Organization
Ha:	Hectare
IIMI:	International Irrigation Management Institution
IWUA:	Irrigation Water Users Association
JICA:	Japan International Cooperation Association
Kg:	Kilo gram
Km:	Kilometer
MARC:	Malkessa Agricultural Research Centre
MoA:	Ministry of Agriculture
NGO:	Non Governmental Organization
OADB:	Oromia Agricultural Development Bureau
OIDA:	Oromia Irrigation Development Authority
Qt:	Quintal
SSI:	Small Scale Irrigation
WHO:	World Health Organization

CHAPTER ONE: Background of the Study

1.1. Introduction

Agricultural production in Ethiopia is largely rain-fed, which mainly depends upon erratic and insufficient rainfall. To cope up feeding of an average 3% annual population growth and the problem of poor rain fed agricultural productivity in the country, expansion of small scale irrigation agriculture is taken as main strategy by the government of Ethiopia to address the problem of food security and rural alleviating poverty. Small scale irrigation schemes that involve effective management and institutional support from the local government are likely to be successful in contributing to poverty reduction and household food security (FAO, 1997).

According to FAO (1995), the population density has reached around 50 persons per square kilo meter in Ethiopia, against an average of 24 persons per square kilometer for the whole Africa. About 80% of the total population (that is about 50 million peoples) of the country is concentrated in the highlands of Ethiopia, which represents only 40% of the total land mass and 90% of all cultivated lands. The land over this area is severely degraded caused by erosion and over grazing.

Among the major factors behind the poor performance of subsistence farming of the Ethiopian Agriculture are diminishing farm size and severe degradation, inadequate and variable rainfall, weak agricultural research base and extension system, lack of financial services, imperfect agricultural markets and poor infrastructure (Mulat, 1998).

In Ethiopia, rapid population growth can be a significant factor in worsening the environmental, economic and social problem. Overgrazing and rapid depletion of the forest cover for fuel and housing have resulted in an alarming rate of soil erosion.

Sensitive areas has created a vicious cycle of declining soil fertility, erosion, low crop yields, feed shortages, progressive land degradation, and reduction of areas under fallow and greater exploitation of marginal areas. Declining productivity in rain fed agricultural and the need to double food production over the next two decades arise the needs for effective and efficient irrigation. However, there are important issues associated with land and water resources management like salinity, nutrient depletion, water pollution, loss of vegetation cover, soil erosion, over grazing, soil degradation and ground water depletion. These processes could lead long term deterioration and reduction of the potential and actual productivity of land, with adverse effects on agricultural productivity and serious food security implications at both the national and local levels (Kamara and Mc cornick, 2002).

According to Uphoff (1989), irrigation requires the integration of both dimensions that are social and technical. Without the incorporation of institutional and other social relations such as human interest, rational decision-making, power relations, conflict, etc. to the technical irrigation discourse, it limits the comprehensive understanding of irrigation. It can thus be seen that the proper development and management of irrigation is a complex and comprehensive undertaking, requiring attention too much more than hydraulics and agronomy.

According to FAO (2000), 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.

In line with the development objective of the country, the regional government of Oromia is promoting small scale irrigation development so as to increase and stabilize food production in the region. Since the establishment of the region, many river diversion, spring development and water harvested small scale irrigation have been built and upgraded in collaboration with non government organization and communities.

In Dugda Woreda small scale irrigation /SSI/ have been under development from the mid of 1980s for food security purposes. The area is endowed with lake, Ground water and river water recourses. On the water sources, Government, NGOs and farmers established small-scale motorized irrigation systems.

Based on the information obtained from woreda office, about 55,000 hectares of land is under agricultural production depends on rain fed. From the total agricultural area, the irrigation potential for the study area is estimated to be 13,300 ha in 17 kebels in rural area. Out of these, 82% (10,880 ha) have been developed under traditional and modern small-scale irrigation. Under those systems farmers grow field and horticultural crops production which allow up to three cropping per year, but low in terms of quantity and quality for market.

This study is therefore aims at assessing the contribution of irrigation in households income and the condition of irrigation management by emphasizing on two irrigation systems, namely; Bada Gosa and Oda Qallo Small Scale Irrigations (SSI) are purposively selected based on accessibility, age of the schemes, farmer's experiences and water source which found in east Shoa administrative zone of Oromia Region. It intends help to generate information and increase understanding to assist in future planning and development of smallholder irrigation.

1.2 Problem statement

Agricultural production in Ethiopia is largely rain-fed, which mainly depends upon erratic and insufficient rainfall. To cope up feeding of an average 3% annual population growth and the problem of poor rain fed agricultural productivity in the country, expansion of small scale irrigation agriculture is taken as main strategy by the government of Ethiopia to address the problem of food security and rural alleviating poverty. Small scale irrigation schemes that involve effective management and institutional support from the local government are likely to be successful in contributing to poverty reduction and household food security (FAO, 1997).

In 1980s as a result of the famine of 1984/85, small scale irrigation schemes were given emphasis in Ethiopia. However, the progress of irrigation development was slow; and did not also attempt to involve the farming population, who has a long tradition of water management for small scale irrigation use. The governments upgraded several schemes without the consent of the communities concerned even though there were few occasions when stake holders 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 by the following factors:-

- Economics of small scale irrigation are not well understood.
- Provision of inputs, services and technical advice is difficult because small scale irrigation system are often scattered widely.
- Inappropriate maintenance and operation irrigation schemes facility.
- Lack of efficient utilization of water resources.
- Lack of viable product markets and marketing institutions.

In most cases water users association manage the irrigation schemes. However, uneconomic plots and the inefficient use of water and conflict on equity bases of land allocation are observed (CRS, 1999). Irrigation plots are very valuable and there is tendencies to divide and sub divide them for lease to outsiders.

Water borne or water related diseases are commonly associated with the introduction of irrigation. Irrigation related health risks include those associated with increased use of agrochemicals and deterioration of water quality. Another set problem is generated from the irrigated area by the disposal of excess water that may contain harmful concentration of salts, organic wastes, pathogenic organism's, agrochemical residues and cause siltation, water logging and erosion.

There is a need for research and capacity building to understand the complex issues of water, crops, facility, organizational and land management, so as to enhance national and local capacity to deals with water, crops, facility, organizational and land management's issue to enhance food security, reducing poverty and speed up national and economic development. Hence this research will assess the social economic benefits of selected community based small

scale pump irrigation development schemes in Dugda Woreda, East Shoa Zone of Oromia Regional state and identify options to improve irrigation performance.

1.3. Objective of the study

1.3.1 General objective

The general objective of the study is to evaluate the performance of small scale pump irrigation schemes to improve the livelihoods of farm households in Bada Gosa and Oda Qallo irrigation schemes.

1.3.2 Specific objectives

The study also has the following specifics objectives:-

1. To assess the role of irrigation practices in improving livelihood of households,
2. To examine the organizational management of small scale irrigation schemes,
3. To assess the problems encountered in irrigated agriculture.

1.4. Significance and limitation of the study

This study is deemed useful to understand the socioeconomic, institutional and management constraining at the small scale irrigation/SSI/ users level and the opportunities of the farmers might utilize. The result of the investigation is believed to give useful information for researchers, development practitioners, policy makers, farmers, and government and non government development organization for better intervention in the area.

On the other hand, this study is with some limitations. These data collection from the questionnaire survey depend on the sole memory of the respondents. Households in the study area do not keep records of production and marketing such as yield, inputs used and income. As a result, the quantitative data may be short of accuracies.

CHAPTER TWO: Literature Review

2.1 Theoretical reviews on irrigation

Irrigation is defined as an artificial application of water to irrigated crop fields to supplement the natural sources of water to satisfy the crop water requirements and increase crop yields on sustainable basis without causing damage to the land and soils. The natural supply of water to the agricultural land for crop production purpose is usually received from natural sources such as precipitation/rain/, other atmospheric water, ground water and flood water. But the fact is that in many parts of the world including Ethiopia, the amount, frequency and distribution of rainfall, which is the principal source of water for crop production, is becoming more unpredictable and inadequate, Furthermore, the rainfall nature may be insufficient and untimely, and the ground water may be too deep in the soil profile beyond the active root zone, Which is Unavailable to the plant roots. This is common phenomenon in drought prone areas of the country and successful crop production in these areas is only possible with the support of irrigation (MOA, 2011)

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).

The history of irrigation water use for agriculture dates back to the early civilization of mankind. However, as noted by Peter Stern (1979), irrigation developed during the first half of the twentieth century was universally beneficial.

Irrigation is categorized as small, medium or large-scale depending on the area irrigated, scale of operation and type of control or management. But the criteria for this category may vary from country to country. For example, in India the irrigation scheme of 10000 ha is classified as small while in Ghana the largest irrigation is 300 ha. (Smith, 1998).

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. Most authors, however, agree that concepts of local management and simple technology should be combined with size, by the UK Working group on Small Scale Irrigation (SSI): 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'.

According to FAO (1986) large-scale irrigation is an irrigation area of at least 500ha and sometimes 10,000 ha or more, medium scheme roughly in the range of 50 to 500 ha and small scale development, comprising usually of 10 to 50 ha although sometimes a little larger. These are village level schemes usually of 10 to 50 ha and individual or family operated development of less than 10 hectares.

The three-scale classification of irrigation was established in Ethiopia during the *Derg* regime (Dessalegn, 1999). Accordingly, large-scale irrigation schemes are those, which hold over 3000 hectare of irrigation area while medium scale cover an area of 200-3000 ha. Small-scale irrigation schemes involve those with the total area of up to 200 ha.

Huppert (1989, in Mollinga 2002) explained that irrigation is not simply a technical task of delivering water to crops. It is also a human activity and social undertaking. Rural households operate within a larger historical, socio-cultural, economic and institutional and policy

environment that makes the need for the linkages very important. In the context of small farms, there are different kinds of theories of farm management derived from modern management theory.

Dillon (1992, in FAO 2003) asserts that farm system theory view a farm as a unique goal setting having a major aim of generating income (in cash or kind) for its stakeholders through agricultural production. Generally, a farm system is complex rather than simple. Its purposefulness is ensured by its human and social involvement, which enables the system to vary its goals under a given environment.

Any farm system is a mixture of abstract and concrete elements. The concrete elements involve technical resources such as technology, knowledge of cropping system or the irrigation system and opportunity that is useful for irrigation. The abstract elements relate to the entire farm system through the farm management activity of setting goals, developing long and short-term plans, specifying organizational structure, deciding on enterprises, choosing technology, allocating resources, seizing opportunities, establishing control processes, harmonizing relations between sub-systems relevant to the farm (ibid).

According to Freeman and Lower milk (1991), the integration process of subsystems (social and technical) should be recognized and managed as a purpose-driven system rather than as just a set of disjointed parts of farm system. For instance, exclusively social scientists, technical professionals or farmers operating independently of each other cannot solve the problem of water control at the local level.

FAO (2003) also summarized that the interaction and interdependence of these subsystems (concrete and abstract) are the building blocks to form a purposeful whole in farm activity i.e. for the farm system to function effectively, its management must pay close attention to these

integrating processes. These are leadership, decision-making, and information flow and control mechanism to guide and direct performance.

Uphoff (1986, in Mollinga 2002) noted the importance for the combination of social and technical aspects in irrigation. Both human and physical aspects interact continually and profoundly in irrigation agricultural activities. Enterprises, so a hyphenated construct of irrigation as a socio-technical process seems appropriate.

Huppert (1989, in Mollinga 2002) also supported the above argument by supplementing that agricultural activities including irrigation systems are socio-technical systems, i.e. they embrace both social and technical system components and subsystems. According to him the essential attributes of socio-technical systems include:-

- Close interrelationships between structural, social and technological features,
- Openness of the system to their system environments,
- An emphasis on conversion processes in which inputs imported from the system environment are transformed in a conversion process through input and exported to the system environment as outputs.

Mollinga (2002) concentrated on a perspective called the social shaping or social construction of technology to investigate the social dimensions of irrigation artifacts. The basic idea of Mollinga is that irrigation technologies not only mediate people's relationships with biophysical processes, but also shape the people-people relationships that are part of irrigation. He noted that the social dimension of irrigation could be specified in three points that includes;

- In order for the technologies to work properly, a particular social condition that fits to it should have to be fulfilled,

- The development of irrigation technology requires social construction in which different stakeholders interact (communicate, negotiate, take decisions, struggle, etc.),
- Irrigation technologies have social effects. i.e. through its effects on crop production, people's health, etc., irrigation can affect people's livelihoods,

According to FAO (1992), proper integration of sociological analysis is crucial that involves analysis of constraints and opportunities taking in to consideration both internal factors (goals, resource endowment) and external environments (physical, socio-cultural, policy, institutional) with the understanding the rationality behind farm practices.

Irrigation itself is a key input for successful and sustainable crop production. Irrigation water management is strictly combined with improved agronomic practices for increased yields of irrigated crops. In this context, irrigation agronomy simply defined as a branch of agriculture and biology that explores the principles and concepts of plants soils water relationships compiled with other improved crop management practices to optimize production on sustainable basis without causing damage to the environment. Therefore, maximum benefit of using improved crop production technologies such as high yielding varieties, optimum fertilizer use, Establishing multiple cropping systems, improved cultural practice an appropriate plant protection measures can only be achieved when adequate supply of water is assured. On the other hand, optimum benefit from irrigation can be obtained only when the required in puts are available on time and applied properly in a more integrated manner with other technologies (MOA, 2011).

2.2 Empirical review on irrigation

Proper irrigation water management aims at optimum and efficient use of water for best possible crop production keeping water losses to the minimum. Water is applied to the soil surface by a number of various irrigation methods. These irrigation methods are adopted to irrigate crops with the main objective to store water uniformly in the effective root zone soil with the maximum quantity required and ensured water losses to the minimum and sustain crop production with the desired quality of produce (MOA, 2011)

The principal methods being used for applying irrigation water to irrigated crops are broadly grouped under: 1) Surface irrigation (wild flooding, border, basin or ring, check basin and furrow: 2) Sprinkler irrigation (resembling artificial rain): 3) Drip irrigation (or trickle irrigation or sometimes called if localized irrigation (ibid).

In general, each irrigation method is adopted based on certain principles. Some methods may be adapted to a fairly wide range of conditions. In some areas, different methods can be profitably adopted and in other, only one specific method is applicable. However, the choice of the most appropriate method to be used should be based on a set of criteria that serve to minimize water losses and increase efficient water management and resulted in increased crop yields (ibid).

According to Wyss (1999, in Woldeab 2003), the practice of small scale irrigation schemes operated by traditional methods have been passed down from antiquity. However, the importance of small irrigation development as a means for socioeconomic transformation has been considered since the Second World War (Vincet1994 in Woldeab 2003).

Rosegrant, Cai and Coline (2002) pointed that there have been significant cutbacks in rain fed agricultural production due to frequent occurrences of drought and erratic rainfall especially in

the Sub-Sahara African countries. In order to tackle this problem, irrigation helps smallholder farmers to be free from dependence on rain fed agriculture by providing the capacity to produce crops twice or three times in a year.

FAO (2000:16) concluded that smallholder irrigation has brought many successes to farmers, among others are;

- It enabled farmers to grow high value crops and increase their income hence improve their livelihoods.
- The schemes helped in reducing the rural to urban migration by offering the rural population an alternative source of employment.
- In arid areas where drought is frequent phenomenon irrigation helped as strategy to cope with the problem.
- With a more integrated approach smallholder irrigation can be the basis for other rural infrastructure to be developed in areas, which could otherwise have remained without roads, telephones, schools and clinics.
- Smallholder irrigators have developed a commercial mentality
- Crop yields and farmer incomes have gone up manifold.

FAO (1997) also pointed out although many Sub-Saharan countries have realized the critical role of irrigation in food production there are also a number of constraints that have been responsible for a relatively slow rate of irrigation development in this region. These constraints are:

- Inadequate physical infrastructure and markets.
- Poor investments in irrigation.
- Lack of access to improved irrigation technologies.
- Lack of cheap and readily available water supplies.

- Poor resource base of farmers.
- Fragmented and small size of landholdings.
- High interest rates.
- Poor transportation and marketing facilities.

Rahmato (1999) explained that in response to severe droughts that hit Sub-Saharan Africa in the 1970s, many countries opted for irrigation development and made huge investments in government-driven irrigation projects with the support of international donors. Many drought prone countries of Africa, whose population is relatively high and can not be adequately supported by rain-fed agriculture alone, expanded irrigation schemes to stabilize agricultural production and promote food security. Many of these projects were performing poorly and unable to meet their objectives. For instance, in Ethiopia both in terms of choice of technology and scale of operation, the emphasis was on costly investments that required high management and maintenance costs.

However, these attempts were also failed because the irrigation systems were guided by undemocratic guidelines, which were characterized by strong top-down approach. The Ministry of Agriculture put all irrigation systems under its responsibility and direct supervision. As a result, small-scale irrigation systems were denied operational autonomy and also the collectivization principle further destroyed the sense of ownership on the part of peasants. This in turn discouraged the participation of irrigation members on production activities (ibid).

Basically, irrigation water development needs to be analyzed from the perspective of costs, benefits and impacts to the community in relation to rural development, increased household

food security, increased social service utility, etc. In order to meet these objectives sustainable production increases must be achieved from irrigated agriculture (ibid).

As FAO (1997) pointed, in any agriculture based economy, the development is frustrated if the smallholders are not provided with the means of increasing their productivity, income and thereby their standard of living. Therefore, as one of the means of ensuring sustainable food self-sufficiency and poverty alleviation, irrigated agriculture continues to play significant role in the country.

In recognition of this fact, during the past few years of the country's agricultural development program (ADLI), establishment of small-scale irrigation was considered as one of agricultural development strategies to maintain sustainable growth of the sector.

However, as noted by Woldeab (2003) the performance of irrigation is far from satisfactory in the country. For instance, as Dejene and Yilma (2001) pointed in their study, in most cases problems arises from giving more emphasis to technical aspects and less emphasis to the managerial and institutional aspects that has led to inefficient and under utilization of available capacity of the irrigation project.

CHAPTER THREE: Research Methodology

3.1 Data type and source

This research is basically focused on two community-based small scale irrigation systems, namely Bada Gosa and Oda Qallo small scale irrigation. To achieve the objectives of this study, a combination of different methods of data collection will be used intensively through primary data collection, observation, focus group discussion, interview key informants and analysis of secondary data from different sources.

3.1.1 Depth interview

Depth interviews will be held by use of formal and informal survey methods with key formants such as the selected members of irrigation user's association to collect up to date and relevant data.

The informants will be selected purposely for their knowledge, experiences, and public and government responsibilities in the locality. The content of the questionnaire prepared to interview sample survey includes personal household data, household resources and means of livelihoods, issues related to irrigation practice, organization and management, available infrastructure, and institutional facilities.

Discussion has made with development agent/DA/, District agricultural official, village officials and service cooperative committees. The leading questions prepared to guide the discussion with the focus group emphasis on policy issues, external support for the schemes, institutional and managerial issues, major problems and future plans to further develop the irrigation systems

3.1.2 Focus group discussion

Focus group discussion will be held with development agent/DA/, District agricultural official, District cooperatives official, Meki-Batu union, village officials and committees members of water user's association to collect data about small holder's reaction about the schemes, the impacts of the project on their livelihood, productivity, change in cropping patters, the role of credit and market in the adoptions of technologies.

3.1.3 Observation

Visual observation with rapid walk through also is used to gather information about the nature of cropping patterns in the field, local production practices, agricultural implements and interaction of farmers with DA. The trip is important in that, it enable the researcher to make general observation and comprehend the geographical setting and the cropping patterns in the project area.

3.1.4 Secondary Data collection

Secondary data collection will be intensively collected from the development agents, service cooperatives and governments' officials as well as documents, studies and other useful written materials will be utilized in this study

3.2. Sampling and the universe

Among the number of community based small scale irrigation schemes in the Dugda district two irrigation schemes are purposively selected for the study based on accessibility, age of the

schemes, farmer's experiences, water source and types of schemes. Thise are Bada Gosa and Oda Qalo small scale irrigation schemes located in different villages of the same districtin East Shoa Zone of Oromia region are included in the study by using random sampling technique. The sample size is decided considering the homogeneity of the universe and size of the schemes.

3.3. Data analysis and presentation

In assessing irrigation development project the following welfare aims are more directly affected:-

1. To examine the organizational management of small scale irrigation scheme,
2. To assess the role of irrigation trends in improving the livelihood of households,
3. To assess the problems encountered in irrigated agriculture.

To measure the impact of the irrigation development on the household income, the observed environmental change, project evaluation method which is before and after project, will be used. Here the basic assumption is that household conditions are more or less similar in all socio-economic parameters that can make differences in welfare or food security in between the times.

To estimates the positive and negative impacts of two selected small scale pump irrigation schemes of farmers who are benefiting from the irrigation schemes will be interviewed. Quantitative and qualitative data will be analyzed by frequency count, simple calculation, any computer software was used for coding, compiling, and analyzing and it is presented by using descriptive statistics such as percentage, means, graphs, tables chart, etc.

3.4. Organization of the Paper

The paper is organized under six chapters. The first chapter includes background information statement of the problem, research question and significance of the study. The second chapter covers literature reviews which summarizing the irrigation development in Ethiopia, debates and related studies around community participation in irrigation development, outcomes which it brings about and factors influencing the success in management. The third chapter is research methodology to presenting the approach and methods used to collect and analysis data. The fourth chapter is the description of the study area. The fifth chapter is main finding and discussion around the impact of the project on livelihood and irrigation management related issues happening in the field. The sixth chapter will focus on conclusion and recommendation on which the researcher wants to do further research.

CHAPTER Four: Description of the Study Area

4.1 Description of the study area

4.1.1. Location

The district of Dugda is one of the 10 districts in the East Shoa Zone in regional state of Oromia. It is located in the central part of Rift valley (southern part of oromia region). According to Dugda district Agricultural Office the district lies between $7^{o}58'$ N and $38^{o}43'$ E and the altitude is ranges from 1600 to 2100masl in the great rift valley of Ethiopia. The district shares boundary line with: - Bora woreda in the North and North Weast, Arsi in the East, Adam Tullu Jiddu Kombolicha district in the south and Southern Nation Nationalities Peoples of Ethiopia (SNNP) in the west. The Capital town of the district is Meki which is located 134k from Addis (the capital of the country) and 88km west of Adama (the capital of East Shewa Zone) before reaching Ziway town, a long the same main asphalt road.

4.1.2 Population

Currently Dugda district has a total population of 164,394 about 84,585 (51.45 %) and 79,809 (48.55%) of the district's population are males and females respectively. About 73.8% of the total population (121,321) Male 62,172 and Female 59,149 are residing in the rural parts (Peasant Associations) of the district and while the remaining 26.2 % (43,072) male 22,413 and female 20,660) are living in the three urban Kebeles.

The total number of rural house hold is 18,386 of which 2,636 are female headed. In terms of age distribution 77,578 (47.19 %) belongs to under 15 age, 84,719 (51.53 %) of the population belongs to age 15-64 and the remaining 4232 (2.57 %) are above 64 years of years. This fact

implies that the large population of Dugda district belongs to young age population that is characterized by high fertility and abundance of labor force.

Table 1: Distribution of Urban and Rural Population

District	**Population**			
	Male	Female	Total	Percent/%/
Urban	22,413	20,660	**43,073**	**26.2**
Rural	62,172	59,149	**121,321**	**73.8**
Total	**84,585**	**78,809**	**164,394**	**100**
Percent/%/	**51.45**	**48.55**	**100**	

Source: - CSA**(1999 E.C)** Housing and Population Census Report

The population growth rate of the district is estimated to be 2.9 %. The crude population density of the Woreda is 173 persons per square Km and the average family size of the district is 4 per household. As we understood from the land available in the rural areas of the district and the number of rural population, one can find that the rural settlement pattern of the district is more scattered.

4.1.3. Climate

Based on the climatologically data of Ziway Center, the nearest weather station, the annual rainfall in the region can be estimated to vary between 700 mm to 800 mm. This is often preceded by secondary or small rainy season running from January to May. The average annually minimum and maximum temperature in the project area is 15^0c and 28^0c respectively. Generally the area is belongs to semi-arid (drought prone) region of the country.

4.1.4. Topography

The topography of the study area lies within sub tropical agro climatic zone. Its land escape is characterized by flat tapped plain, valley and mountain. The soils are fine-textured dominated by sandy, sandy loam and clay loam content that has good drainage capacity, which is suitable for irrigation and rain fed crop production.

4.1.5. Vegetation Covers

The major natural vegetation of the district includes acacia, woodlands and savannah of junipers and vanity of vegetation followed by sub-tropical grassland located at different pocket areas of the district. There is no closed woodland found in the plain area. Dense woodland and trees around the lake were found to support variety of wild life. Now, however they are degraded and the area is converted into different land uses. This time the areas around the lake have been left with only patches of ruminants' wood and bush lands.

The largest proportion (58.27 %) of district area is covered by cultivation land. The natural vegetation is highly distributed through human intervention. With the exception of pocket areas currently there is no land occupies by forest in the district. The only existing vegetation coverage of Dugda is grassland, which account for 15.7 % of the district area. The bush land and water body were respectively occupied 14.5% and 12.6 % of the district's area. The dominant tree species is Acacia.

4.2. Socio-Economic Environment

4.2.1. Land Use Pattern

The district has a total area of 95,945ha. Based on the general view the current land use pattern (58.27 %) of the district's land is under cultivation. While the rest 1.47 %, 10.33 %, 12.54 %,

and 0.12 % respectively occupied by forest land, grazing land, water bodies and Investment land. On the Other hand 16.97% and 0.3% respectively were occupied by Settlement and mountainous and Marsh Land.

Table 2: Existing land use pattern Classification in 2013

No.	Types of land use pattern	Area (KM^2)	Area(in Ha)	Percentage
1	Farm Land (Land under crops)	559.072	55,907.15	58.27
2	Grazing Land (pasture land)	99.08	9907.85	10.33
3	Green areas (Forest land)	14.11	1411	1.47
4	Investment Land	1.111	111,083	0.12
5	Water Bodies	120.32	12,032	12.54
6	Settlement/Residential/ Area	162.78	16,278	16.97
7	Mountainous and Marsh Land	2.98	298	0.30
Total		**959.45**	**95,945**	**100%**

Source: - Agricultural Office of Dugda

4.2.2. Agriculture

Agriculture is the main stay of the district's population and hence it provides almost the largest livelihood share of the population. Based on the information obtained from woreda office, about 55,000 hectares of land is under agricultural production is dependent on rain fed. From the total agricultural area, the irrigation potential for the Lake Ziway catchment is estimated to be 13,300 ha in 17 in rural area kebels. Out of these, 82% (10,880 ha) have been developed under traditional and modern small-scale irrigation. The water sources for small-scale irrigation schemes are River, Lake and Groundwater which allow up to three cropping per year, mainly high value crops.

Despite of this fact the district is potentially rich particularly for farming practice. Its agro-climatic condition is dominates by sub-tropical which is suitable for the production of cereal Crops. But meager and erratic rainfall distribution has been occurring in the district does impact

on agriculture. However, it is characterized by lack of access to modern technology, market, low productivity, dependency on rainfall and lack of irrigation practice, etc.

Mixed farming is a common practice prevailing in the district. As a result the livelihood of the rural people is dependent on crop farming, irrigated agriculture and livestock rearing. In addition to this, fishery is being practiced by the number of farmers who have access to the lake Ziway.

4.2.2.1 Rain fed Crop production

Rain fed Crop production of the district is limited to 'meher' season and the annual range of rain fall at Dugda and its surrounding is 700-800 mm which characterized by high variability and unpredictability. The rain fall pattern is bimodal. "Belg "rainy season begins in March and ends in May while the "meher" season begins in June and ends in September.

The major types of crops that are produced includes maize, wheat, teff, barley and sorghum from cereals, and haricot been, horse beans, chickpeas and field peas from pulses. From the cereals and all crops produced by farmers farming Maize, wheat and teff do accounts 22%, 31% and 24% respectively and occupied the largest cultivated area of the district land under crops and also they are used as the most staple crops of the district.

Pulses such as haricot been, horse beans, chickpeas, vetch and lentils are commonly produced and also share the larger area of land next to cereals. Haricot Bean is the leading from pulse crops in terms of area devoted to it.

There is enough market for agricultural out puts especially from around Dugda /Meki Town/ as it is retailed in close proximity to the major markets (Addis Ababa, Adama, Shashemene and Hawasa) connected with excellent asphalted road.

Table 3: Cultivated area and produced yield by rain fed crops in past three years

Crop type	Land /ha/				Yield /Qt/				Coverage /%/	
	2011	2012	2013	Total	2011	2012	2013	Total	Area/ha	Yield/Qt/
Cereals crop	**44842**	**47,212**	**46,216**	**138,270**	**931,714**	**1,264,014**	**1,028,986**	**3,224,714**	**84**	**93**
Teff	11829	12139	15644	**39612**	135244	218,316	187,860	**541,420**	**24**	**15**
Wheat	13241	13982	22951	**50174**	215,783	510,008	694,080	**1,419,871**	**31**	**40**
Barley	2009	2987	2425	**7421**	24,108	71,675	36,376	**132,159**	**4**	**4**
Maize	16333	16,333	3,417	**36,083**	534814	433467	82602	**1050883**	**22**	**30**
Others	1430	1771	1779	**4980**	3	21765	30548	**28068**	**3**	**4**
Legumes crop	**7590**	**8,616**	**9612**	**25818**	**91,841**	**114,781**	**97427**	**304,049**	**16**	**7**
Bean	937	890	845	**2672**	14055	15696	8450	**38201**	**2**	**1**
Garden bean	427	443	456	**1326**	6405	6510	5472	**18387**	**1**	**1**
Chickpea	843	820	554	**2217**	14314	17061	9972	**41347**	**1**	**1**
Harcotbean	5155	5968	7381	**18504**	53,933	66746	69581	**190,260**	**11**	**4**
Others	258	492	376	**1099**	3234	8768	3952	**15854**	**1**	**0**
Total	**52,490**	**55,828**	**55,828**	**164,146**	**1,023,555**	**1,378,795**	**1,126,413**	**3,528,763**	**100**	**100**
Productivity/%					**19.5**	**24.7**	**20**	**21.5**		

Source: - Agricultural Office of Dugda

4.2.2.2. Irrigated crop and vegetable production

Dugda district has enough water resources potential and flat land escape which is available for irrigation activities**.** In the area modern and traditional irrigation systems have long been practiced in the catchment area of Meki River and around Lake Ziway by using furrow irrigation system.

Few land holders are engaged in irrigated agriculture using water from the lake Ziway, ground water and Meki River while the others rent out their holdings for private farmers who use their own diesel generators to pump out the water from the water sources and most of the farmers in the district are rain dependent. Major horticultural crops produced around Dugda area are Onions, Tomatoes, Cabbage, Maize, Papaya and pepper. From the irrigated crops produced by peasant farming Tomato and Onion do accounts 30% and 49% respectively in the past three year.

Table4: Cultivated area and produced yield by irrigated crops from 2011 to 2013 years

No	Crop type	Land /ha/				Yield/Qt/				Coverage /%/	
		2011	2012	2013	Total	2011	2012	2013	Total	Area/ha	Yield/Qt
I	**Cereal crop**										
	Maize	78	281	491	**850**	3081	11036	26615	40732	4	0
II	**Vegetables**	5622	5554.5	10694	**21870.5**	2259415	2508648	3676712	8444775	95	99
	Tomato	894	1647	4329	**6870**	1021253	1503861	1766320	4291434	30	50
	Onion	3276	2656	5356	**11288**	1074416	833413	1778070	3685899	49	43
	Pepper	115	174	218	**507**	6555	32046	25475	64076	2	1
	Cabbage	483	287	197	**967**	69231	47288	32760	149279	4	2
	Local cabbage	259	164	154	**577**	29163	11471	23012	63646	3	1
	Green bean	587	600	413	**1600**	56945	63697	45665	166307	7	2
	Others	8	26.5	27	**61.5**	1852	16872	5410	24134	0	1
III	Fruits	118	109		**227**	39091	36708	27930	103729	1	1
	Papaya	100	89		**189**	36470	34853	27930	99253	1	1
	Mango	4	6		**10**	126	113	0	239	0	0
	Others	14	14		**28**	2495	1742	0	4237	0	0
	Total	**5818**	**5944.5**	**11185**	**22947.5**	**2301587**	**2556392**	**3731257**	**8589236**	100	100

Source: - Agricultural Office of Dugda

Currently from the total potential area of land 11185 hectares were irrigated through modern and traditional system, 8589236 quintals of production obtained from 2011 to 2013years and more than resident of 15 Peasant Associations were benefited from this production.

4.2.2.3 Livestock

Dugda district rural populations has a great interdependence on livestock and make that livestock gives a substantial contribution to the rural economy. Most rural farming, transport and source of income do directly or indirectly link with them.

The district has diversified livestock population. In terms of livestock population cattle stands first and followed by Goat. Currently the district has a total livestock population of 274767 and 101611 poultry. There is also limited fishery practice on the lake Ziway.

Livestock extension package of dairy & beef farming development activity were not well adapted to the rural part. Only poultry development was disseminated to limited number of the district's farmers.

Table 5: Number of Livestock and poultry population in the district

Year	Sheep	Goat	Mule	Horse	Poultry	Oxen	Cow	Bull	Heifer	Calf	Donkey	Total
2013	41101	43515	1248	3243	101611	39952	54051	1676	37050	33036	17890	376378

Source: Agency of Livestock development, Health Protection and Livestock Market

The major livestock feeds in the district include pasture, bushes, shrubs, crop residues as well as industrial by- products. There is gradual declining of pastureland for various reasons. On the other hand the regular extension service did not devote for expansion of modern pasture.

The productivity of livestock in the district is affected by prevalence of diseases. Various diseases, shortage of feed, and water are the major reasons in diminishing the livestock population. Because of these cumulative effects the production obtained from livestock rearing activity is still remained low.

4.3 Social facility and Infrastructure

4.3.1 Water Supply:

The district is endowed with surface and ground water resources. It has many water source named such as Meki River, lake basins (Some part of Lake Ziway) and ground water though its moisture is affected by high temperature. The main reason for this endowment is its geographical location for it is situated in middle of two high lands. The Gurage and Arsi highlands from where a large amount of surface water drains into the district. The ground water development of the district is affected by high concentration of fluoride content. As result people have been suffering from the effect.

In Dugda district most of pipe water is limited to certain urban Kebeles and a few rural communities. Water supply development schemes were constructed in different parts of the district was boreholes, shallow wells and windmills. In the district there are 45 Deep wells, 76 Shallow Wells, 3540 Hand Dug Wells, 26 Wind Mills, and 108 Hand Pumps and 45 Water Points for the year ended 2013.

Table 6: Distribution of Water wells in the District

Years	Types of Water Wells				
	Deep Wells	Shallow	Hand Dug	Wind Mills	Hand Pump
2013	45	76	3540	26	108

Source: - Water Resource Development Office of Dugda

The present potable water supply coverage for the rural population is 74 % and town is 75 %. Therefore Potable water supply coverage of the district is increasing from time to time for the last consecutive years.

4.3.2 Health:

The Regional health policy emphases on the provision of a comprehensive primary health care centre by integrating the decentralized health facilities, health personnel and provision of equitable resources.

The number of major health institutions administered under office of Health that directly provide services to all people of the district in 2013 was 7 health center, 13 clinics, 9 Drug Stores, 6 Drug Vendor, 4 laboratory diagnosis and 36 health posts.

Table 7: Distribution of health facilities in Dugda district

year	Type of Health Institutions						
	Health center	Clinics	Health posts	Drug Store	Drug Vendor	Lab. diagnosis	Total
2013	7	13	36	9	6	4	75

Source: Dugda District Health Office,

The ratios of both medical personnel and health facilities to the district population were far below as recommended by the World Health Organization (WHO). In addition to these, a large proportion of the district population has neither access to safe water nor to sanitation facilities that causes for widespread of water borne diseases.

4.3.3 Education:

Education plays a crucial role in the process of social and economic transformation. It stands as a key factor for social and economic development. But it requires higher rate of investment that causes a great challenges for developing countries. Provision of primary education and improving quality of secondary education is the focal area of educational goal of Oromia Region.

This can be achieved through expansion of schools and reducing local disparities among schools as a key strategy.

4.3.3.1. School Distribution:

The concentration and spatial distribution of schools in the district during the 2013 have medium disparities among kebeles of the district. In this mentioned year there were only 29 (1- 4) grade-level of schools, 47 (5-8) grade-level of schools, 76 (1-8) grade-level of schools and It has three (5) senior secondary schools. In terms of localities the vast majority of schools were concentrated in rural (75.3%) of the district whereas, the remaining 24.7 % is concentrated in urban area of the district.

4.3.3.2. Students' Enrollment:

In 2013 E.C. the students' enrollment (excluding kindergartens) have reached 34326 at which 16265(47.38 %) are males and 18061 (52.62 %) are females. In all levels males outnumbered from females students. The highest and lowest number of student's enrollment was recorded in primary schools (1-4) & senior secondary schools (11-12) respectively.

Although significance progress has been made in expanding basic education and the level of primary participation still remains low. Student's participation rate was about 87.38% in 2013. The major factor accounting for low primary school participation includes lack of awareness by the parents, low of standardized (Attractive) schools at nearby, less effort on the part of the non government organization /NGOs/ in mobilizing the society toward education.

Table 8: Distribution of schools and Students enrollment in Dugda district by levels of schools

No	Types of schools	Years 2013							
		School distribution				Students population			
		Urban	Rural	Both	**Percent /%/**	Male	Female	Total	**Percent/%/**
1	Primary (1-4)	8	21	29	**35.8**	10336	11249	21585	**62.88**
2	Primary (5-8)	7	40	47	**58**	4029	4793	8822	**25.7**
3	Primary (1-8)	15	61	76	**93.8**	14365	16042	30407	**88.58**
4	Secondary School (9-10)	3		3	**3.7**	1478	1649	3127	**9.12**
5	Secondary School (11-12)	2		2	**2.5**	422	370	792	**2.3**
6	Secondary School (9-12)	5		5	**6.2**	1900	2019	3919	**11.42**
7	Secondary School (1-12)	20	61	81	**100**	16265	18061	34326	**100**
	Percent /%/	**24.7**	**75.3**	**100**		**47.38**	**52.62**	**100**	

Source: Dugda Woreda Education Office.

4.3.4. Road Transport:

The total lengths of all roads in district until the end of 2013 were 301.5kms with regard to the road type 23km, 96.5km, 89 and 93 km were respectively categorized to asphalted, gravel, all weather road and rural road (dry roads).

Table 9: Road Transport Distribution of the District

Dugda District	Road Type (Condition)				
	Asphalt Road	Gravel Road	All weather Road	Dry Roads	Total
Distance/km/	**23**	**96.5**	**89**	**93**	**301.5**

Source: Dugda Authority of Roads.

4.4. Establishment of small scale irrigation/SSI/

4.4.1. Oda Qallo SSI

Oda Qallo SSI Project is located in the Giraba Qorke Adi Peasent association, around 3km on the right side of the road from Meki town to Ziway in Dugda district Administrative office of East Shoa adiminstratve zone, Oromia Regional State.

Oda Qallo small-scale irrigation scheme has been initiated for fact that the area was a drought affected dry land where both human and animal population suffered from severe food shortage, to intervene and do something for the improvement of the livelihood of farmers in the area attract NGOs.

The development intervention intended to change the difficult condition of the farmers in the area was not an easy task at the start. This was due to the fact that peasants lack trust in suspicion of appropriation of their land as they learnt it from their past experience. Therefore, the realization of the scheme demanded strong and continuous efforts by all stakeholders to build trust and confidence on the part of the peasants in the area.

Finally, having settled the problems by changing the attitude of the peasants, Oda Qallo SSI developed by a non-governmental organization; Christian children fund /CCF/ in 2005 with partially material, financial and technical supports. Farmers also participated in the development of the irrigation scheme by giving their land and labor to the project.

When the irrigation project started operation in 2005 having irrigation capacity of 6 hectares, the beneficiaries were to be 24 family heads of 177 household members enabling them to cultivate vegetables, fruits and cereal crops.

The irrigation water supply for Oda Qallo farm was made available by pumping from the Meki River by installations of pumps, main supply pipeline and construction of pump house. The

IWUA of Oda Qallo was registered as a legal entity by the District Cooperative office of the regional government in 2005 having by-laws being an official document of the association.

Before handing over the project to irrigation users in 2005, technical training and practical demonstration have been conducted by the project staff with supports from the staff of line departments and other relevant organizations.

4.3.5.2. Bada Gosa SSI

Bada Gosa SSI project is located in the Tuchi Denbal peasent association on the road to Ziway town on the west bank of the Lake ziway, which is 16 kilometers far from Meki town, capital of Dugda district Administrative office of East Shoa adiminstratve zone, Oromia Regional State.

Bada Gosa area is insufficient rainfall and food shortage is a common feature in area. On the other hand, there is abundant water resource and suitable agricultural land that is conducive for crop and vegetable production. This circumstance makes the use of irrigation technology more appropriate to overcome the long standing problem of drought and food insecurity in the area.

Initially, The commend area of Bada Gosa irrigation project was developed by a private investor during the 1980s using lake ziway, the investor install irrigation pump to pump the lake artificially. The length of the leading canal was about 1.4 kilometers long from the source to pump station.

As a result, they requested the assistance of OIDA District for organization and further development of the schemes capacity. The request accepted by OIDA in 2004 and Construction irrigation facility, pump installation and development of the irrigation was completed in 2004

which sponsored by the NGO known as JICA. The irrigation project started operation in 2005 having irrigation capacity of 4.75 hectares; the beneficiaries were to be 19 family heads of 133 household members.

Before the introduction of the scheme, the peasants in the area cultivated cereal crops such as maize, haricot bean and wheat. But they have changed their pattern of cropping as a result of the schemes development which enabling them to cultivate cash crops such as onion, cabbage, pepper and tomato that enabled them to supplement their income. Few farmers also adopted producing food grain crops such as Maize and Green bean by using irrigation.

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Chapter Five: Main finding and Discussion

5.1. Social and Economic Profile of the Study SSI

5.1.1. Family Composition

The participation of female in the small scale irrigation activity is too less. This less number of women's access to rural economic resources mostly emanates from their exclusion, which is deep rooted in the socio-economic, religious and cultural relations.

Of the total sample farmers about 92 percent were male headed and 8 percent female headed at Oda Qallo and 68 percent male headed and 32 percent female headed at Bada Gosa study site. In this case the female to male proportion is too small to be representative (Table 10). This shows that women's access to productive asset or land is very limited.

Table 10: Household number and Age Distribution

No	**Household characteristic**	**Oda Qallo**		**Bada Gosa**		**Total**	
	•	No	Percent	No	Percent	No	Percent
	• Male Household	22	91.66	13	68.4	35	81.39
	• Female Household	2	8.12	6	31.6	8	18.61
	• **Total household**	**24**	**100**	**19**	**100**	**43**	**100**
	Husehold in age						
	• <15	0	0	0	0	0	0
	• 15-60	14	58.3	14	73.68	28	65
	• >60	10	41.7	5	26.32	15	35
	• **Total**	**24**	**100**	**19**	**100**	**43**	**100**

Source: Survey Results

As per the practice in the area economically active populations are those within the age group 15-60 years and this account 58% and 74% in Oda Qallo and Bada Gosa respectively (Table 10). This figure indicates that the household labour source in Bada Gosa SSI is much better than Oda Qallo. Due to this, irrigators' use more hired labour to supplement scarce labour in Oda Qallo SSI. Their hired labour source is mostly from the surrounding peasant association.

Definitely, such marked difference of age group between the two irrigation systems needs further investigation. All members of the household that are found between the age group from 15-60 including male and female participate in the agricultural activities though the skill and efficiency could actually be different.

Table 11: Households Family Size

No	**House characteristic**	**Oda Qallo**		**Bada Gosa**		**Total**	
		No	Percent	No	Percent	No	Percent
	Households family size						
	▪ Male	90	51.7	62	46.6	152	49.5
	▪ Female	84	48.3	71	53.4	155	50.5
	▪ Total	174	100	133	100	307	100
	▪ Average	7.25		7		7.14	
	▪ Percent	56.67		43.33		100	

Source: Survey Results

According to the data obtained from sample households' survey, the average family size of household at both Oda Qallo and Bada Gosa is 7.25 and 7 respectively (Table 11).

Obviously family labour is very important resource on small farms. All family members except the very young and very old can supply productive labour. The actual available lobour supply is not easy to measure because family labour contributed in terms of quantity, quality, time and

custom dimensions. Difficulty in measurement arises due to different family classes generate different amount of labour service and irrigation farm operations/tasks are labour-type specific while others can use any class of labour.

5.1.2. Education

Majority of people are illiterate who did not get the opportunity of primary education because the access to the primary education in both study area is not satisfactory. There are two government owned elementary schools (1- 8 grades) at both study sites. It serves all pupils that come from both schemes and the surrounding peasant associations. As compared to the size of population, the number of schools and the grades level is very low to meet the demand in the area. Generally, the performance of formal and non formal education is not satisfactory.

Table 12: Educational Status of Family size in the Study Area

No	Educational status	Oda Qallo		Bada Gosa	
		Number	Percent	Number	Percent
	Grade				
	▪ 1 – 4	39	37.87	21	27.64
	▪ 5 – 8	25	24.27	29	38.16
	▪ 9 -10	22	21.36	13	17.1
	▪ 11 – 12	5	4.85	7	9.21
	▪ >12	12	11.65	6	7.89
	Total	**103**	**100**	**76**	**100**

Source: Survey Results

5.1.3. Household Farm Resources

Land is typically the most important resource that usually provides service agriculture definitely. As it is generally observed in both studies area land is neither abundant nor scarce. There is of course uneven or skewed land holding among the farming community. This is due to the fact that land was redistributed only in 1975 following the overthrow of the imperial government.

However, with regard to irrigation land exchange is rarely an exceptional practice is observed in both irrigation schemes, which is not the case yet in any schemes found in the district. Those farmers who lost their extra land within the new irrigation boundary have been compensated with the same land size from other place in the peasant association. Such effective solution was born and implemented by the concerned farmers themselves with slight technical support from external bodies.

Table 13: Household land status

No	Types land holding	Oda Qallo			Bada Gosa			Total		
		Area/ha/	Mean	%	Area/ha	Mean	%	Area/ha	Mean	%
1	Irrigation	8.75	0.375	12.68	5.25	0.276	8.64	14	0.33	10.79
2	Rain fed	60.25	2.5	87.32	55.5	2.9	91.36	115.75	2.69	89.21
	Total	**69**		**100**	**60.75**		**100**	**129.75**		**100**
	Mean	**2.88**			**3.2**			**3**		

Source: Survey Results

Generally, the average farmland holding that equals 2.88 hectares in Oda Qallo and 3.2 hectares in Bada Gosa SSI is higher than the national average land size that equals 0.95 ha. The figure for national average land size is based on the statistical abstract explained by the Central Statistics Authority (CSA, 1999). But the existing difference between the maximum and minimum plot holding can be good reason for production and income variation among farmers.

5.1.4. Household Source of Income

Access to productive resources such as capital, land and family labour is the determining factor for the households' income. There are different sources of household income in the study area although there is variation in the number and amount of their contribution. As far as this study is concerned, sources of household income in both schemes can be classified into three main groups that includes; income from cereals crop production, income from cash crop production and income from sales of livestock.

5.1.4.1. Cash Crop Production

Cash crop refers to vegetable crops produced through irrigation for the purpose of market to increase household cash income. Therefore, farmers in both irrigation systems produce high value horticultural crops such as onion, tomato and pepper, papaya, banana and mango. But in both cases the major cash crops are onion and tomato.

According to the survey, most farmers do not cultivate their irrigable plots all the season by using irrigation. Many reasons were raised during household interview and focus group discussion among which are; shortage of water, low capacity of irrigation pump, lack of capital to purchase farm inputs, inconsistency in market prices and low commitment on the part of irrigators themselves.

As shown in Table 14, the production of Tomato and Onion takes the lion's share in both irrigation systems. The negative aspects of such high degree of production concentration on two crop item create competition among other producers of the same crops for market, which in most cases excess production results in price decline.

Table 14: Cultivated area for Cash Crop Production (ha)

No	**Crop types**	**Oda Qallo**					**Bada Gosa**				
		2011	**2012**	**2013**	**Total**	**Coverage/ %/**	**2011**	**2012**	**2013**	**Total**	**Coverage/%/**
1	Tomato	2.87	3.25	2	**8.12**	**36.93**	1.87	0.5	0	**2.37**	**14.16**
2	Onion	2.25	2	2	**6.25**	**28.42**	2.87	3.25	2.5	**8.62**	**51.49**
3	Maize	0	2	1.25	**3.25**	**14.77**	1.5	1.25	1.25	**4**	**23.89**
4	Green bean	1.87	1.25	0.75	**3.87**	**17.58**	0	0	0	**0**	**0**
5	Pepper	0.25	0.25	0	**0.5**	**2.27**	0	0	0	**0**	**0**
6	Cabbage	0	0	0	0	0	0.13	0.87	0.75	**1.75**	**10.45**
	Total	**7.24**	**8.75**	**6**	**21.99**	**100**	**6.37**	**5.87**	**4.5**	**16.74**	**100**

Source: Survey Results

The average farmland cultivated for cash crop production throughout the three years was varying in both SSI. As noted by the informants, there are two reasons for this. First, due to the drying of Meki River this is water source for Oda Qallo SSI. Secondly, farmers in both SSI the outbreak insect pest which is named as Tuta absoluta is damaging cash crop production and it's still not getting appropriate pesticide/Table 14/.

The size of farmland cultivated for the production of cash crops relates to the experience and technical management skills of individual farmer. The financial status of a farmer is also another important factor to limit farm size. Because cash crop production requires high capital and farmers strong commitment to fully engage themselves in farm activities all along the production season.

According to the discussion held with committee members of irrigation water user's associations, those who use to apply irrigation demands more labour than rain fed cultivators. But under irrigation, water must be applied when it is due, and under harsh climatic conditions a day or two of delay in watering may result in serious crop losses. Most of irrigation farm household members are therefore much more tied to their land when it is irrigated.

Table 15: Average income from Sells of Cash Crop Products (in Birr)

No	**Crop types**	**Oda Qallo**					**Bada Gosa**				
		2011	**2012**	**2013**	**Total**	**Coverage/%**	**2011**	**2012**	**2013**	**Total**	**Coverage/%**
	Tomato	245600	202000	315000	**762600**	**63.75**	58400	26000	0	**84400**	**14.85**
	Onion	140500	131000	48800	**320300**	**26.77**	18395	224380	119200	**361975**	**63.56**
	Maize	0	25839	6300	**32139**	**2.7**	28780	24579	34296	**87655**	**15.39**
	Green bean	44050	28800	7200	**80050**	**6.69**	0	0	0	**0**	**0**
	Pepper	800	400	0	**1200**	**0.1**	0	0	0	**0**	**0**
	Cabbage	0	0	0	**0**	**0**	5000	20000	10500	**35500**	**6.2**
	Total	**432961**	**390051**	**379313**	**1196289**	**100**	**112586**	**296971**	**166009**	**569530**	**100**

Source: Survey Results

On the other hand farmers noted that they do grow perennial horticultural crops in small amount on their farm boundary. The reason why they grow in small area converge is that fruits requires long time for maturity and production and this is not tolerable for subsistence farmers whose livelihood is highly dependent on fast income generating seasonal crops.

The average household incomes obtained from sale of cash crop shows a decreasing trend in Oda Qallo SSI while in Bada Gosa it nearly remains constant. This was due to irrigation motor damage and dry of Meki River during winter time in 2013 for Oda Qallo SSI. The relative high cost of irrigation management and outbreak insect pest which is named as Tuta absoluta is damaging cash crop production and it's still not getting appropriate pesticide in both SSI combined with unreliable market price discouraged farmers to increase irrigated cultivation for cash crop production.

5.1.4.2. Rain fed crop production

The sizes of farmland cultivated under rain fed for the production of grain food crops is larger than farmland cultivated by applying irrigation water. For instance, the average farmland cultivated by rain fed for the production of food grain crops for the three years period (2011-2013) is 2.5 hectares and 2.34 hectares in Oda Qallo and Bada Gosa SSI respectively. This shows farmers' largely use rain fed cultivation to produce food grain crops than producing under irrigation (Table 13).

The major grain crops grown by using rain fed are maize, wheat, teff and haricot bean. Maize and Wheat are two crops can be considered as the strategic crops for future development systems. Maize is a major source of food /staple food/ and at the same time it is the most important source of animal feed than any other crop items. On the other hand, Wheat is a useful

crop, which is produced mostly for the market. This is due to its relatively better demand and good market price that encourages.

Table -16: Area cultivated under Rain fed Agriculture

No	Crop types	Oda Qallo					Bada Gosa				
		2011	**2012**	**2013**	**Total**	**Coverage/%**	**2011**	**2012**	**2013**	**Total**	**Coverage/%**
	Maize	25.75	25.5	19.25	**70.5**	**37.5**	11.75	8	7.5	**27.25**	**22.2**
	Teff	20.25	21.75	18.25	**60.25**	**32**	11	12	19	**42**	**34.25**
	Wheat	14.75	18.5	16	**49.25**	**26.25**	11	15	19	**45**	**36.65**
	Harcotbean	4	2	2	**8**	**4.25**	3.75	1.75	3	**8.5**	**6.9**
	Total	**64.75**	**67.75**	**55.5**	**188**	**100**	**37.5**	**36.75**	**48.5**	**122.75**	**100**

Source: Survey Results

The climate and soil are also very conducive for the production of these two crops. Local seeds that are adaptable for the climate are available in both study area. In this case, it would be easy to increase the contribution of these two crops provided that certain technical and institutional constraints are removed or at least minimized.

The production of food grain crops under rain fed cultivation per hectare was lower than the production under irrigation cultivation. The reason for low difference between the two production systems was that crops affected equally by the existing input constraints, productivity of the crops, dependence on rain fall and produced once a year.

As indicated in Table 17 below the income obtained from food grain crops production was based on farmers' estimation of market price during the study periods.

Table 17: Household Income Obtained from Rain Fed rain Sells (Birr)

No	Crop types	Oda Qallo					Bada Gosa				
		2011	2012	2013	**Total**	**Coverage/%**	2011	2012	2013	**Total**	**Coverage/%**
	Maize	145250	179150	126100	**450500**	**35.78**	10200	7300	0	**17500**	**11**
	Teff	111960	196450	125950	**434360**	**34.54**	6900	6400	4900	**18200**	**11.5**
	Wheat	145020	122200	65540	**332760**	**26.4**	30000	38100	46470	**114570**	**72**
	Harcotbean	34950	3800	2550	**41300**	**3.28**	5100	2400	800	**8300**	**5.3**
	Total	**437180**	**501600**	**320140**	**1258920**	**100**	**52200**	**54200**	**52170**	**158570**	**100**

Source: Survey Results

The rain fed agricultural performance of the year 2013 is also very low especially for both SSI. This is because crop production was partially damaged as a result of severe drought that occurred in the area during the specified period especially for Maize production.

5.1.4.3 Livestock Farming

Animal husbandry forms an essential source of livelihood for the SSI users. Livestock contribute to the households' economy in different ways in the area-as a source of draft power, source of cash income, source of food, and means of transport. In addition, livestock is means of security and coping mechanism during crop failures and other calamities.

Some of farmers have grazing areas which they graze their animals in the summer season when the land is occupied by food crops and the lake shore is covered by water. Almost all the livestock depend on grazing field and crop residues for feeding except in the cases of few owners give some industrial products.

Table 18: Livestock Population in the Study Area

SSI	**No House Hold**	**Sheep**	**Goat**	**Horse**	**Poultry**	**Oxen**	**Cow**	**Donkey**	**Total**
Oda Qallo	24	70	60	0	121	85	88	21	445
Bada Gosa	19	37	32	1	94	26	40	12	242
Total	**43**	**107**	**92**	**1**	**215**	**111**	**128**	**33**	**687**
Mean		**2.48**	**2.14**	**0**	**5**	**2.58**	**3**	**0.77**	**15.98**

Source: Survey Results

As indicated in the table 18, the mean distribution of oxen among the irrigation community is about 2 for both SSI

Study result shows that the irrigation schemes are observed to have a positive effect on livestock rearing for both SSI users. Some farmers are observed feeding border-growing grasses, some weed species crop residues and few farmers raise grasses on the shores of irrigation canals for their oxen and milking cows to obtain income from them. Therefore the features of irrigation have a beneficial effect on cattle farming and vice versa

Table 19: Income from Sells of Livestock from 2011 - 2013(Birr)

No		No House hold	Income from sell of livestock/birr/						
			Cow	Ox	Sheep	Goat	Donkey	Poultry	Total
1	Oda Qallo	24	27900	101700	9150	4200	9600	2580	**155130**
2	Bada Gosa	19	22000	77700	17300	11100	10800	1300	**140200**
	Total	**43**	**49900**	**179400**	**26450**	**15300**	**20400**	**3880**	**295330**
	Average		**1160**	**4172**	**615**	**355**	**474**	**90**	**6868**

Source: Survey Results

5.1.4.4 Comparison of Households' Source of Income

As discussed earlier, there are different sources of household income in the study area. The degree of contribution of each source of income depends upon the economic situation of individual farmers.

The share of cash crop is significantly higher than any other income source. For instance, the average income of three years study period obtained from irrigated crop production constituted 50.93% as compared to other sources of income in both small scale irrigation.

Table 20: Comparison of Average Household Income by Sources in past three years (in Birr)

No	Income Source	Oda Qallo		Bada Gosa		**Total**	
		Income /birr/	Percent /%/	Income /birr/	Percent /%/	Income /birr/	Percent /%/
1	Cash crop (Irrigated)	1202325	45.95	575566	65.82	**1777891**	**50.93**
2	Rain fed Grain Crop	1258920	48.15	158570	18.18	**1417490**	**40.6**
3	Livestock	155130	5.9	140200	16	**295330**	**8.47**
	Total	**2616375**	**100**	**874336**	**100**	**3490711**	**100**

Source: Survey Results

This shows even under the existence of various constraints, the production of cash crop seems very important to the irrigation communities. In this case, if both irrigation systems manage to apply high crop intensity (growing two to three crops per year) combined with market oriented cropping pattern, the effect would be tremendous.

The average household income obtained from sales of cash crops shows that there is an increasing at decreasing rate for both SSI throughout the three years period. It indicates that farmers are becoming more interested in the production of cash crops as they are becoming

aware of its importance. Irrigation helped much as a coping mechanism to mitigate the problem of food security.

5.2. Management and Institutional Issues of Irrigation Systems

Generally, insufficient attention to the institutional environment in which irrigation takes place to overcome defects in operation and management SSI. The issues of organization and management of irrigation are not well considered problems may arise such as:

- Existence of indefinite regulations or instructions about the share of responsibilities,
- Lack of coordination between different work groups,
- Absence of common meeting point for discussing and settling differences,
- Absence of an effective association to represent the irrigators interests,

The strategy designed to improve such circumstance through the development of community based small-scale irrigation systems is appropriate for both study area. However, the problem of food insecurity is not yet removed. This is because the performance of irrigation did not reach the level it is expected to maintain households' food security.

The problem of inefficiency in irrigation systems can be emanated from technical and non technical factors. Therefore, it is essential to accord due consideration for these issues in order to properly address the problems and to design correct operational strategy.

Obviously, irrigation systems managed by the community should have full responsibility that involve some kind of organizational and management mechanisms that help to insure efficiency and sustainability. This would help to analyze possible constraints that can arise due to policy, institutional and social factors in the implementation and operation of irrigation projects.

5.2.1. Irrigation Facility

In both SSI, the technology used for irrigation water supply from the source made available by using diesel motor pump. The pump discharges water to a concrete sump provided at the top of the raised earth embankment. In-farm water application is through furrows parallel to the contour of the area by gravity using conventional tertiary and field canals.

The critical problem with this irrigation system is low quality of planning and design, minor crack secondary and tertiary canals which causes loss of the limited irrigation water, the motor pump operates only for less than ten hours during the day time, the repair and maintenance cost of the motor pumps and the charges fee for fuel consumption is increasing from time to time. There are of course water losses due to technical problems such as water logging, seepage, flood and lack of knowledge of crop water requirement by irrigators. Therefore the major concern of the irrigators is to consider if the motor pump fails at peak period when they need water for their crops which cause cash crop loss.

5.2.2. Organization management issues

The Irrigation Water Users Associations (IWUAs) of Oda Qallo and Bada Gosa have obtained registration certificate in 2005. General and internal byelaws were formulated by the executive committee with the support of project staff and experts from Cooperative office of Dugda district. The organizational structure of the water user's cooperatives includes: General Assembly, Executive committee, Control committee, Water committee, Auditing committee and loan and marketing committee.

The general Assembly is the highest body in which all members of the irrigation systems collectively discuss the highest-level issues and give the final decision. This body meets twice a year and if necessary the Executive Committee can call urgent meeting. There are also other responsibilities of the general assembly that are indicated in the bylaws of both irrigation systems.

The executive committee is a body elected by the general assembly, which is responsible to undertake day to day activities of the general assembly. Generally, the committee is responsible for the following major activities: takes care of physical structures such as Motor pump, canals and other properties of the association, monitoring pump operation and supervising water distributions and execute other related issues specified in the by-laws.

The executive committee facilitate for assistance with NGOs and other supporting organization for intervention such as inputs provision and training by the project developers after which it has been developed. The control committee is elected by the general assembly which is accountable to it. The overall responsibility of this committee is to monitor the activities of the different bodies of the association whether they are operating in accordance with the bylaws.

Better management of irrigation water was observed in both SSI. Therefore, fetching of water for human use and watering animals from irrigation canals is forbidden. The violation of this rule leads to punishment. As a result the charge compels farmers to be more careful in using irrigation water for agriculture.

5.2.3. Agricultural extension service

Agricultural extension service is a means of enhancing the adoption of improved agricultural practices. In a country like ours, where the majority of the farmers are poor and illiterate agricultural extension would play a significant role in assisting them in identifying and analyzing their production and marketing problems and in helping them with awareness of opportunities for improvements. Effectiveness of the other inputs in production, as well, partly relies on availability of sound extension service at community level. On this line the farmers were inquired about extension contact and services they deliver on agricultural crop production and marketing practices.

In this case, the major role of Development Agents/DAs/ should be to enlighten and equip farmers with sufficient and appropriate knowledge in order to change their attitude in a certain desirable direction. But they don't have special training in irrigation water management that enables them to provide proper advice to farmers.

The existing cropping pattern has been found to be ineffective and the cropping intensity is also below the expectation. From the study it was understood that farmers tend to concentrate on rain fed farming during the rainy season and not paying enough attention to their irrigated plot.

As it has been clearly indicated in table 4, some farmers do not want to intensively cultivate all of their irrigable land even under the condition where there is no shortage of irrigation water. Lack of adoption of inter-cropping, weak cropping intensity and absence of market oriented cropping pattern are serious problems that reflect weaknesses of the existing extension service.

Experts of Dugda districts agricultural offices and other concerned organizations explained major constraints which are:

- The inconsistency in organizational set-up and its frequent restructuring was also one of the constraints that hindered the provision of sustainable extension service to the farmers.
- A motivated individual will be more effective in motivating small group of people, with whom one is working closely which determine the success or failure of the extension program. However, as understood from the discussion and practical observation in the field, the reality on the ground is beyond the principle of extension.
- Most of the time district level experts including Development Agents are obliged to cover cost of their field work by themselves no matter how much they stay out. For instance, in addition to absence of predium payment, experts are also required to pay for the maintenance and fuel cost of the motor bicycles from their own pocket that will not be reimbursed. Therefore, there is turnover of qualified and well experienced extension staffs. This condition discourages them to carry out fieldwork.

The development agents also complain that they have no clear job description. In addition to their conventional agricultural extension activities they engage in different tasks such as farm inputs distribution, collection of loans including land use taxes, participation in various administrative and political committees. They believe that this creates suspicion on the part of farmers in relation to DAs role. This would erode DAs confidence of becoming the trusted advisors.

5.3. Farm Input Marketing

Related to the production of high value horticultural crops, both input and output side of marketing is considerably important. In light of various market constraints, inaccessibility and small size of market is the very important limiting factor for both irrigation systems.

From the study it was discovered that acquisition of inputs from local market could not meet the demand of farmers. Therefore, farmers be it irrigators or rain fed cultivators relay on outside dealers.

5.3.1 Seed sources

Seed sources for the SSI users are local retailers, cooperative union, Vegetable traders, personal savings/sources and Melkassa Agricultural Research Center/MARC/. Addis Ababa as a source for inputs is indicated for its service either through direct purchase by the better off peasants or for its service delivery as part of advance both in terms of money and inputs.

Local market is exclusively important source for less expensive vegetables than for more expensive ones (such as onion and tomato). In a focus group discussion, the supply of seeds was reported to be untimely and expensive for more cash fetching. The quality of the variety in terms of yield potential, free from diseases and pests is unknown for those sold in the open market.

It is indicated that the seed of onion and tomato are relatively produced in the study area. As long as those crop seeds can be produced in the area it is important to do so through training and demonstration of SSI users. Therefore, interventions aiming at reducing the seed shortage or

facilitating access should target those SSI user organized farmers. For those more communication is effective than private individuals.

The agronomic management such as seeding rate is important in crop production. The seed rate is among the determinants of the plant population in the field and ultimately of production, productivity and income.

Seeding rate depends on several factors such as crop variety, purposes of production, soil type and other climatic factors. Some farmers use seed rate beyond the recommendation set by research centre especially for Onion crop production(8kg is used per hectare while recommended rate is 4kg per hectare/, which lead to competition of minerals and water due to closely spacing between plants. Hence, appropriate seeding rate is useful for economical use of resources

There are less or no institutions, government or private that are responsible for the multiplication of horticultural crop varieties for transfer to end-users in the study area. This reality obliges farmers to depend entirely on low yielding local crop varieties, which are susceptible to pests and diseases.

5.3.2 Farm Power

Almost all the households use oxen draught for land preparation. As indicated in the previous section (5.1.4.3), 67.5% of farmers having oxen for both SSI. The considerable numbers of households are with one or no oxen (Table 18). The absence of this important asset is a limitation to horticultural and rain fed crop production in the area. However, the remaining hires oxen in different terms that is for land, grain and labor on yearly basis and use some times tractor for first

plough. This may call for introduction of alternative farm power and some improved implements as alternatives to solve such problem.

5.3.3 Farm Implements

Farm implement ownership is an indicator for the level of involvement of the producers because the implements are important through production and marketing processes. The number of farm implements for land preparation seems reasonable because some of the respondents have as low as 0.25 ha of land and they may hire or borrow implements from relatives and friends.

Table 21: Ownership of farm implement

SSI	No house hold	Type of farm implement								
		Mofer and Yolk	Mach ete	Digging Hoe	pulling Hoe	Spade	Sprayer	Sickle	Cart	**Total**
Oda Qallo	24	24	23	47	41	41	11	43	0	**230**
Bada Gosa	19	19	12	26	38	25	8	18	0	**146**
Total	**43**	**43**	**35**	**73**	**79**	**66**	**19**	**61**	**0**	**376**
Mean		**1**	**0.8**	**1.69**	**1.84**	**1.5**	**0.44**	**1.4**	**0**	**8.74**

Source: Field Survey

However, in general the number and type of farm implements is inadequate when intensive management and protection of horticultural crops. The absence can affect the management aspects. In addition to this, borrowing of some of those equipments from each other may contract diseases and insect pests from one farm to another. In this way it becomes risky in spreading diseases that have importance of economic value in reducing production quantity and quality.

5.3.4 Safety Equipment Use

Agrochemicals have their negative side effects on health. This is usually indicated on the packages and containers with some precautions. On this line, an inventory was made of which 27.9% farmers have or use some safety materials to protect themselves from body contact and inhalation of agrochemicals. As some farmers were observed using chemicals without appropriate care unforeseen health problem might be encountered. Thus, taking care is vital for human and environmental health. Appropriate handling and using chemicals has to be considered.

Table 22: Safety equipment or wears Owned

No	Safety Wear	Oda Qallo	Bada Gosa	Total
	Tuta	2	2	**4**
	Eye glasses	1	2	**3**
	Glove and eye glasses	0	2	**2**
	Tuta and eye glasses	2	0	**2**
	Tuta, ear and eye glasses	0	1	**1**
	Total	**5**	**7**	**12**

Source: Field Survey

5.3.5 Fertilizers Sources

Fertility management of the farmer's irrigation plot is performed through chemical fertilizer application. The cooperative union supply for its members for cash crops on request. It is sold in a kind of black-market in retail shop, if any, with more expensive price. This can creates a pressure on small-scale irrigation user horticultural production.

Regarding chemical fertilizer application, DAP and UREA are used. The application of these fertilizer types is relatively intensive on onion and tomato because the crops considered fetching better cash income and demanding more management. However, the application rate was nearly the same for some farmers for DAP and More /200kg/ for UREA than the recommended rate. The recommendations are 200 kg per ha DAP and 100 kg per ha UREA for onion, tomato and pepper (MARC, 2000).

Therefore, the amount of production depends on the amount of fertilizer used provided that all other factors remained same. Among reasons mentioned by majority farmers for not using recommended rate of fertilizer was cash shortage. Generally the application of fertilizer corresponds with farmers' ability to purchase fertilizers.

Although the existing stocks of animal population in the study area provide the opportunity to utilize manure to increase soil fertility, the practical application is very low. Among the reasons for not using manure appropriately is its alternative use as fuel and lack of commitment by some part of the farmers.

5.3.6 Chemical

Concerning agrochemicals, most of the SSI user farmers get pesticides and insecticides from local dealers or retailers, Cooperative union, Woreda Agricultural Development Office. Concerning quality of the chemicals, for those purchases from retailer, most of the users trust the quality when the remaining do not or are indifferent. The quality of chemical gained from cooperatives union as more guarantied than local dealers. However cooperative union was indicated to take longer time in delivery of inputs. The issue is more pressing for pesticides and insecticides, which are in urgent need in crop protection.

5.4 Diseases and Insect Pest Control

Crop protection is critical in horticulture. Horticultural crops grown in Ethiopia experience the common diseases and pests. Late blight, bacterial wilt, early blight viruses, aphides, bore warm are common. Small scale irrigated horticultural producers use different chemicals to control diseases and insect pests. The application is exercised from the knowledge gained through experience rather than timely training or demonstration processes

The chemicals are used alone or in combination. Specifying the rate is somewhat difficult in this study because several unlabelled measurements are used, the frequency differs and different combinations are also applied. However, there is a tendency of applying higher rate or dose than specification. This practice is intentionally done by anticipating avoiding the pests at once or by applying less frequently.

In addition to this, some cultural practices such as hoeing and weeding are common in vegetable management, though these were not appropriately practices. This may indicate that the advantages of those cultural practices do not well understand for crop protection. Pest management is done through chemical application. Integrated pest management and other cultural practices are not practiced for purpose of diseases and insect pest management.

5.5. Credit Service

Credit is an essential production factor for small-scale irrigation farmers with scanty capital resource to invest. Credit service is particularly crucial for capital-intensive farming like horticulture. Irrigation farm management requires more financial input than rain fed agriculture. But the majority of irrigators in both study area are not capable to meet capital requirement

needed for the production activity. Although majority of farmers needs credit to purchase farm implements, oxen and other chemical and biological inputs, absence of credit service is affecting irrigation performance.

The members of Cooperative Union receive credit from the institution for selected crops (onion and tomato) and sale the same through the Cooperative in the central market of vegetables and fruits, Addis Ababa, *Atkilt Tera*. The main achievement of the Union is said its ability to enter this Central market, which is usually considered hard to do so. But it is only twice that the farmers sold their produce though this institution in the last years. In this aspect the main constraint was pointed out to be supply problem (in quantity and quality) as the cooperative management body indicated.

Credit is scare for non-Union member SSI user farmers produces and for some other produces (other than onion and tomato). Their bargaining power is limited because the advance the 60 receives from traders, arrangements of transportation facility, and limited information supplies and low production volume. Therefore, the financial constraint considerably weakened irrigation efficiency as a whole.

5.6 Maintenance and Depreciation Funds

The other constraint related to irrigation water is in the management of irrigation motor and facility. All of the SSI users under study operate by using motor pumps for water supply. The irrigation motors have an average age of seven years. It is inherent for such equipment to require for maintenance and fuel. However, saving for maintenance and depreciation purposes is lacking

in most of SSI water user societies or cooperatives except those, which were developed by the assistance of Japan International Cooperative Association (JICA).

Most of the respondents (82) reported to have some problems (break downs of the motor due to old age) with their irrigation motor pump. The financial for maintenance purposes is collected from the members' pockets or supports were requested from Government, Non-Government Organization or Cooperative Union after breakdown or failures of the motor. This was pointed out as a challenge in production process in all group discussions as well in the most cases of the survey

On top to this, minor motor failure required calling for mechanics that request for another financial and time cost. Hence, there is call for devising ways of resolving such technical and management problems for smooth running of the schemes. Mechanisms to solve such problem have to be worked out before embarking on irrigation development in the future, too.

5.7 Output Marketing

In relation to output marketing, even though both schemes are not far from the main road that access to major towns like Adama and Addis Ababa, the marketing system is not well organized. The nearby local markets do not have the capacity to absorb the perishable produce of farmers. At the same time the price received by farmers in the primary markets is relatively lower than what they could have received in other big markets. Market information on the part of farmers is non-existent. As a result, farmers do not have the bargaining power to determine the price of farm produce instead they accept the price given by the traders.

5.8 Problems in Irrigation Water

The water sources of SSI users are Lake Zway, Meki Rivers, and underground water. The number of hectors goes as follows: 29%, 18%, 53% respectively for each water source. There were some constraints facing the farmers. All Meki River users reported that they have water shortage from early dry seasons. It was pointed out that Meki River was drought season from January to May.

This season is when an intensive irrigated horticultural activity is under way. Due to such reason many horticultural producers were in problem of water shortage. During data collection for this study many fields of vegetable crops were suffering from shortage of water.

To curb this problem several wells brought in to view in the horticultural production around Meki River. Several wells were observed in field. Though this is an option for irrigation water development from underground water, study for ground water supply potential and recharging capacity is required for efficient use of the resource and maintaining environmental balance.

On the other hand Lake Ziway aggravated by a shrinking due to lack of soil and water conservation which cause siltation which results in reduction of Lake Ziway and the ever extending up of the main irrigation canal from year to year. This situation needs further verification in order to ensure sustainability and devise mechanism on the appropriate use of the lake. Otherwise, it would have a precarious result on irrigation activity, fish production, tourism (potential) and the entire environmental health

There were also some inconveniences in irrigation water uses between upper and lower canal users. Individuals at the borders of the canal were indicated to get insufficient amount of water

while the payment is uniformly based on time base of water release. Such claims always have to be looked in to cautiously in order to implement a justified water use.

Though it is not always likely to avoid conflicts, it is possible to develop equitable water use system and improving the canal efficiency in the cases of leakages and siltation's through norm studies and discussions with the users.

5.9. Linkages of Irrigation

The idea of linkage in relation to this discussion refers to the development of different aspects of production activities and services created and/or facilitated as a result of small-scale irrigation development. Evaluating the existing linkages is certainly very important to show the contribution and socioeconomic impact of irrigation systems in local economic development.

As far as this study is concerned, four types of linkages of irrigation have been identified although the level of its strength is very low. These are production linkages, consumption linkages, investment linkages and employment linkages. The elements of these linkages are manifested either in the form of forward and backward linkages or by any one of it as discussed below.

5.9.1. Production Linkages

With this type of linkages the modality of forward linkages has not been observed since there are no small-scale processing industries that use farm products as raw materials. What have been observed were only backward linkages in both study area. The increased income obtained by farmers because of irrigation in turn created high demand for modern farm inputs such as

(improved seeds, fertilizers, pesticides, fuel and oil etc.) and farm implements that are used specially for irrigation farm operation.

5.9.2. Livestock and Irrigation

Livestock production is one of the very important aspects of income generation for households in both irrigation systems. They are closely integrated with the range of purposes such as meat and milk production, draught power, transport, and manure production to sustain soil fertility and as a store of wealth.

Small animals such as goats and sheep are kept mostly for sale at time money is crucially needed for the settlement of different household's financial commitments. They are also used as the major source of meat for the household though they are rarely slaughtered. The feed requirement of these animals is not as big as larger animals since their feed is usually depend on grazing and browsing.

The extension service in relation with livestock production is very weak. The development agents assigned in both study area only looks after farmers' crop production neglecting the livestock part. This shows there is no appropriate mandate and integration between crop and livestock production. Although Dugda district agricultural offices undertake different activities such as distribution of improved cattle breed, artificial insemination service, forage seeds and health service was little implemented in the study areas.

Generally, the livestock production in the study area is hampered by multiple factors such as feed shortage, low productivity of local breed, disease prevalence, insufficient veterinary services, poor animal husbandry practices and undeveloped market infrastructure.

In this respect, irrigation should also benefit the livestock sector. Livestock provides the most valuable and cheaper farm input (manure) which is very essential to maintain soil fertility and structure. The output of livestock products such as milk, milk products, meat, hides and skins can also be significant source of income if the benefit of irrigation properly channeled to this sector.

5.9.3. Consumption Linkage

Meki is small market towns where the sells of crops are generally carried out in the open air, as "open markets" without any permanent shelters or retail shops. The out flow of the traded cereal crops to these markets and the surrounding market place is very limited and unreliable. This is because rain fed agriculture in both areas is affected by long-run problems that pose huge challenge to farmers, such as reducing production and income.

Regarding cash crops such as onion and tomato, most part of the products are sold in distant markets like Addis Ababa, Adama and Dire Dawa. Only very little of these vegetable products are sold in the surrounding market places and also consumed by irrigation farm households'. In most cases farmers sell their cash crop products on the farm before harvest for traders who come from the above-mentioned towns. But this does not mean farmers always get good price for their cash crops because the undeveloped market infrastructure and brokers do not allow them to look for other options.

Backward linkages of the consumption linkage modality is reflected by the farmers increased consumption of various types of industrial goods like food oil, kerosene, salt, soap, sugar, cloths, etc. Irrigation has increased households income as a result the ability of irrigation users to spend on different social services such as education and health also increased.

5.9.4. Investment Linkages

The positive implication of irrigation on investment observed more or less on the backward linkage modality. Almost all the owners of the petty trading and services explained during the interview that they believe irrigation played a vital role in creating favorable condition to strengthen their business. In addition, traders that come from Addis Ababa, Adama and Dire Dawa to buy vegetable products are other important costumers. As a result, most hotels have already increased their capacity in quantity and quality of services.

As far as the two irrigation schemes are concerned, the forward aspects of investment linkage is very weak as most of the irrigators are yet found at subsistence level with only few of them saves at small rate. In this case no significant progress has been observed in investment.

5.9.5. Employment Linkages

Skilled and experienced labor is an essential element in horticultural production activity. In the study area the farmers have long experience in field crop farming while their irrigated horticultural practice is limited largely due to the service age of the irrigation schemes.

For instance, Job opportunity has been created of which many landless young people especially poor women subsist as farm labourers and its contribution to minimize the out migration of landless poor people to other places for the search of temporary job. Irrigation being the main economic activity helped the surrounding poor people to work and earn either to supplement their low income or as a means of major income generation.

Chapter Six: Conclusion and Recommendation

6.1. Conclusion

- SSI user farmers in the study area have large average family size (seven), long experience in farming, and few years of formal schooling. Regarding the economic base of the farmers the average land holding size is 3.2/3/ hectares that is considerably high as compared to national and the regional averages. The mean livestock holding is 15.98 in terms of Tropical Livestock Unit while the average the number of oxen owned is 2.58. The farming experience, their land holding size and the live stock asset is a good base for the farmers for horticultural production. However farmers' low level of education is observed to be constraining the activity.
- As compared to other household sources of income the average income obtained from irrigation agriculture accounts 45.95% in Oda Qallo and 65.83% in Bada Gosa SSI during the past three years. This may signify the need for smallholder irrigation development as a key draught mitigation measures and improvement of household food security in the study area.
- The major labor source for the farmers is family labor while there is supplementary seasonal or permanent hired labor. Female labor has considerable role in horticultural crop production activities. Female usually participate in planting, weeding, harvesting and marketing. The area has also created job opportunity for daily laborers as it is observed from crowds of people in Meki and Zway during intensive periods of vegetable production (January to May).

- The average crop productivity is low especially for irrigated crop as compared to the yield obtained on research centers and demonstration sites. Diseases, insect pests, irrigation water failure, timely unavailability of inputs, shortage of credit service, inadequate agricultural extension service, lack of adequate knowledge about irrigation agronomic practices, poor field management, inadequate market information on supply and demand of horticulture are deemed the major limitations.
- Agricultural extension services such as production demonstration, training, market information and advice on horticultural crop production and marketing activities was found to be inadequate. In addition to this, more concern and the expertise of the development agents is towards field crops rather than horticultural crops.
- There are water shortages for Meki-River users mainly due to erratic rain fall while, every year, new producers joining the business divert water at the upper stream create additional load to water distribution. This may call for water use arrangements and searching for alternative water use sources such as ground water development but with great cautions for its potential
- The other constraint is related to irrigation water availability and the scheme management. It required longer time to bring irrigation plots into production at the binging of dry season. In Most of the SSI user societies or cooperatives do lack reserve funds for maintenance and depreciation purposes. The majority of the farmers reported frequent irrigation motor failure.
- The cropping intensity in both irrigation systems is similar. i.e., in both irrigation systems more than 90% of vegetable production is concentrated on onion and tomato production that causes competition for market among producers. There is no practice of inter

cropping and crop rotation that contributed to under utilization and production inefficiency in both study area. In most cases farmers do not have the power to bargain with traders since they deal individually. As a result, they remained price takers.

- The target market for small-scale farmers is Addis Ababa for important cash crops such as tomato and onion which are produced at greater bulks. Trader or Cooperative Union arranges transportation and package facilities for Addis Ababa market because the actual sale is performed on the farm itself as far as onion and tomato. The prices highly fluctuate and advance payment limits farmers bargaining power in the face of the daily changing market prices. Low information supply as well as low production and productivity are putting challenges.
- With regard to the impact of irrigation development in the economic life of people in the study area, the result of the survey has shown that different economic linkages emerged that helped people inside and around the study area. There are different linkages created because of irrigation though they are in the infant stage of development. These linkages are production linkages, consumption linkages, investment linkages and employment linkages. These linkages prevailed either in the form of backward and forward modality or in one of it in each case.
- Irrigated crop production occupies a greater portion of the average monetary income of the SSI users. This is an indicator of the importance of horticultural production in that local economy and changing the economic tendency to market oriented farming from subsistence.
- Irrigation water users associations in the two irrigation systems which have got the status of legal entity. But committee members are weak to undertake their responsibility

properly. Due to this, the legal entitlement did not make the schemes to be provided with facilities such as credit, input and market information.

- The vital task of increasing and stabilizing food production in draught-prone regions requires the development of well-managed small-scale irrigation systems that involves improved on farm water management, organizational and other infrastructural development. One of the most important aspects of small scale irrigation development is to know how the irrigation systems operate and how communities undertake irrigation management.
- The study revealed that the main problems of irrigation development in both schemes have been challenged by a number of constraints among which are agronomic, organization and management, institutional and policy related constraints are very severe.

6.2. Recommendations

Several factors involved in production and marketing activities of horticulture call for integrated approach of dealing with the problems of SSI users'. Hence, the following can be the major areas of intervention:-

1. Up grading farmers knowledge through training and demonstrations on organizational matters, in irrigation agronomy, water and facility management.
2. Training technical personnel by giving special focus to vegetable crop management, marketing skill development and information delivery,
3. Promoting crop diversification for improved income and improved household food security,
4. Identifying and promoting some crops with export importance beyond production for domestic dishes use,

5. Ensuring availability and access to some rural infrastructure such as rural road, credit service, farmers' organization and to enhance market information and utilization,
6. Planning ways of raising funds and reserving funds for maintenance and depreciation for irrigation facility,
7. Designing equitable water use mechanisms between the water users association and other private individuals; and within water user association members is needed,
8. Underground water potential and recharging capacity need to be studied before embarking on developing wells,
9. Improve in the supply of appropriate technology use and consequently improve the productivity of irrigation,
10. Devising some means of adding value to vegetable produces: such as establishment small-scale vegetable food processing agro industries,
11. Enforcing irrigable land use policy.

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