THE CONTRIBUTION OF SMALL SCALE IRRIGATION AND INCOME DIVERSIFICATION TO HOUSEHOLD FOOD SECURITY IN DERRA WOREDA NORTH SHEWA, OROMIA REGION

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

By: Garedew Dinku
Advisor: Workneh Negatu (Ph.D)

Approved By Board of Examiners	Signature
1. Workneh Negatu Advisor	
2. Wondwosen Tesfaye Internal Examiner	
3. Degefa Tolossa External Examiner	

Acknowledgement

First of all I would like to thank my God for his kindness for the completion of this work. Second, I would like to express my deep gratitude and indebtedness to my research advisor Dr. Workneh Negatu for his sincere concern to my success. I would like to take this opportunity to express my appreciation and witness that he is dependable academic advisor with rich research experiences in development issues. Thus, his valuable and critical comments and suggestion are worth mention here.

I would like to express my thanks to AAU-RLDS staffs for their assistance and encouragement during my stay in the university. I wish to thanks all my friends in Addis Ababa University for their support and encouragement during my study in the university. Particularly, I would like to appreciate and acknowledge support and encouragement from my friend Aster Tolera, Moges Tufa, Feyisa Girma and Tibabu Wroku is worth mentions here. In every movement of my academic success Aster's and Moges's contributions were there.

Last but not least, I wish to extend my gratitude to staff of Derra integrated rural development project for their assistance. Thanks are also owned to all individuals who helped me in this study mainly enumerators, households, key informants who participated kindly in giving and collecting valuable information.

Table of Contents

Contents **Pages**

CHAPTER TWO: LITERATURE REVIEW

CHAPTER THREE: BACKGROUND OF THE STUDY AREA

CHAPTER FOUR: FINDINGS AND DISCUSSION

List of Tables

Tables Page

List of Acronyms

ADLI: Agricultural Development Led-Industrialization

DA: Development Agent

DIRDP: Derra Integrated Rural Development Project

DPPC: Disaster Prevention and Preparedness Commission

FAO: Food and Agricultural Organization

FDRE: Federal Democratic Republic of Ethiopia

HH: Household

HFS: Household Food Security

HTP: Harmful Traditional Practice

MT: Metric Ton

MEDaC: Ministry of Economic Development and Cooperation

MOFED: Ministry of Finance and Economic Development

MfM: Menschen Fuer Menschen

MOA: Ministry of Agriculture

NGO: Non-Governmental Organization

PA: Peasant Association

SERA: Sustainable Environmental Rehabilitation Appraisal

GDP: Gross Domestic Protract

WB: World Bank

Km: Kilo meter

IFAD: International Fund for Agricultural Development

NWRD: National Water Resources Development

Abstract

This study examines the use of small-scale irrigation and income diversification in Derra woreda. The main objective of the study is the assessment of the contribution of irrigation farming and income diversification to household food security through enabling the household's to increase their income. The basic assumption of the study is that an increase in household income improves household's food security through enhancing their entitlement and access to food.

Two PAS with and without irrigation intervention were selected to see the comparative advantage of irrigated cash crop production two hundred sample households were randomly selected from the two PAs the survey. Focus group discussions, and key informant interview were employed to collect relevant data at the community, household and individual levels. Data related to household's annual harvest, total income earned, household asset endowment, food security conditions of the household were collected using structured questionnaire.

Data was collected with the help of locally recruited and trained enumerators. Data generated through household survey was further consolidated through discussion with focus groups and an interview with key informants. Both qualitative and quantitative data was generated and analyzed using simple statistical tools.

The result obtained from the survey reveal the positive impact of irrigation development. Irrigated cash crop could bring increased agricultural production, better access to agricultural technology and improve the wealth status of the irrigation users. Irrigators were able to produce twice a year and reduce dependence on erratic rain-fed agriculture.

The finding of the study reveals that irrigation promotes the use of agricultural inputs and available land resources through supply of water during the dry season. Such opportunities of irrigation improve food availability and access to food. It has been found that households who are access to irrigation have been able to double their annual income through the production of market-oriented cash crops.

The study has drawn the lesson that the development of small-scale irrigation and household income diversification would contribute to the alleviation of the problem of food shortage if properly planned and implemented.

CHAPTER ONE

INTRODACTION

1.1 General Background

With a population of about 74 million (recent estimate) and a physical size of 1.115 million hectares, Ethiopia is one of the largest and most populated countries in Africa. The country can also be regarded as a microcosm of Africa due to its vast diversity, with a physical diversity ranges from about 200 meters below sea level to over 4000 meters above sea level. Ethiopia's physical and agro-ecological diversity also extends to its population, which comprises of some 85 ethnic or linguistic groups (Sisay and Tesfaye, 2003).

Ethiopian economy is primarily based on agriculture, which accounts for 50% of the gross domestic product (GDP) and employs about 85% of the labor forces. Agriculture accounts for about 90% of total foreign exchange earnings, provides about 70% of the raw materials for food processing, beverages and textile industries (MEDaC, 1999). Subsistence mixed smallholder agriculture is the dominant farming system in the highlands, whereas agro-pastoral and pastoral systems play an important role in the lowland areas of Ethiopia.

The development of both highland smallholder mixed farming and the lowland pastoral systems is paramount to the development of the economy of the country, contributing to food and livelihood security of the majority of the population (Workneh, 2003). Smallholder agriculture, which account of some 7 million farmers, plough about 95% of the cultivated land and produce 90% of agricultural production. About 60% of the total land area is estimated to be potentially suitable for agricultural production, although only 10% is currently under cultivation.

Ethiopia also has a livestock population of about 31 million heads of cattle, 21.7 sheep, 16.7 goats, 7.02 million equines, 1 million camels and 56 million poultry. This makes the country rank first in Africa in livestock population (Sisay Assefa and Tesfaye Zegeye, 2003).

1.2 Food Security Situation in Ethiopia

At the national level, the major features of food security in Ethiopian are a persistent deficit in aggregate food supply, a downward trend in per-capita food production and large variability in output of food items (Alem, 1999). The proportion of population unable to attain their minimum nutritional requirements is estimated at 52% of the rural population and 36% of the urban population (MEDaC, 1999). The World Development Report indicators for the year 2000/01 reveal the prevalence of child malnutrition (children under age 5) is 48% during the period 1992/98. Despite efforts to improve food production through increased use of chemical fertilizers and improved seeds, notable improvement in national food production has not been achieved. At the national level the country continues to depend on food aid and to a lesser extent and mainly on food import (Berhanu, 2004).

The country is categorized as a low-income food deficient country extremely dependent on commercial food import and food aid. During the 1980s average yearly food import was 203 million USD and 147.4 million USD, during 1990s. Between 1980 and 2001, commercial food import was fluctuated from year to year, but rose by over 8 fold from 100,000 MT in 1980 to over 800,000 MT in 1986, which is 400,000 MT per year on averaging (World Bank, 2000. cited in Berhanu, 2004).

Food production in Ethiopia is highly variable and unpredictable mainly due to erratic weather that has triaged famine for centuries. In Ethiopia even a modest decrease in crop and livestock production results in famine of different magnitude oscillating between transitory and chronic food insecurity problems (Devereux, 2000). Food availability was severely restricted due to recurrent disasters such as drought, flood, war and a lack of diversity of food items. Food accessibility was limited due to a weak subsistence-agriculture-based economy, depletion of assets, absence of income diversity and a lack of alternative coping mechanisms. Food intake adequacy was rarely achieved due to food shortages, improper diet and poor sanitary conditions (Nitzan et al., 2001). The subsistence nature of agricultural production and the prevalence of chronic poverty trapped the country in the state of severe food insecurity that manifests itself in the lowest calorie intake, about 1845 calories per-person per day.

Food insecurity is a serious and continuous problem almost in every part of the country. It is estimated that more than half of the population is food insecure of which the largest group is rural people with insufficient land and capital to produce and/or purchase food (Tesfaye and Debebe, 1995). The periods of critical food crisis in the country include 1984/85, 1991/92, 1993/94, and 1999/2000, when about 10% of the population of the country faced annually food shortage on average. The most recent food crisis was occurred in 2002/03, when about 22% of Ethiopians were in need of food aids. During the late 1980s 52% of the Ethiopia's population consumed less than the recommended daily allowance of 2,100 calories. Study reveals that the population estimated as needing assistance in the past five years alone risen from 2.7 million in 1996 to 7.7 million in 2000 (Devereux, 2000).

In the last three decades food production in Ethiopia has never been sufficient to enable the rural populations to be food secure. It was estimated that domestic food production provided in the late 1980s was about 1,620 calories per person per day, while total availability, including imports, was about 1770 calories per person per day, which is 16 % below the minimal level, (2100 calories per person per day, equivalent to 225 kg of grain per person per year (FDRE, 1996).

Cereals production, which is the core of Ethiopian diet, has been steadily declining on per capita basis over more than 45 years (1951-1992), while population continues to grow at high rate without commensurate growth rate in food (cereals) crops production. The production of cereals dropped from about 200 Kg per capita in the early 1950s to less than 150 Kg in 1992 (FDRE, 1996). The average yield for food crops has been about 11 quintals per hectare, and has been growing only about 0.6 percent and lags behind the population growth of about 3 percent, resulting in an annual per capital decline of 2.4% in domestic food production. Ethiopia's population grew from 23 million in 1960 to 65 million in 2001 and it is expected to double in the next 25 years (CSA, 1999).

One indicator of the precariousness of food insecurity in Ethiopia is the rising dependence on foreign food aid (Sisay and Tesfaye, 2003). Food aid has been granted in response to acute food shortages that occur mainly following drought seasons. Between 1984 and 1998, eight such incidences were registered (WB, 2000). The number of drought affected people who require foreign food aid is commonly used as an indicator for Ethiopia's

national and household level food security crises. Data obtained from DPPC's food security profile shows that the share of the drought affected population in Ethiopia raised from slightly over 8% in 1975 to 16% in 2003. During the past three decades there has been no year in which some portion of the population was not affected by problem of food security. Until 1991, the growth rate of the share of population affected by drought was 2.6%, and increased to 4.6% per annum there after. Food aid requirements to mitigate the impacts of drought and famine increased to 1.4 million MT in 2003 from 0.4 MT in 1990. This situation clearly shows the growing incidence of the problem of food insecurity in the country.

In Ethiopia the most food insecure households are those affected most by the decline in food production; the rural poor whose vulnerability increase due to crop failure. It also includes female and elderly headed households; people with disabilities and those affected by HIV/AIDS (Sisay and Tesfaye, 2003).

The current conventional wisdom on food insecurity in Ethiopia asserts that the problem of food insecurity can be simply conceptualized as follows: Land holdings are too small to allow most farming households to achieve food production self-sufficiency; Population increases reduce land holdings further and places intolerable stress on an already fragile natural resources base; Soil fertility is decaling due to intensive cultivation and limited application yield enhancing inputs. Recurrent droughts add food production shocks to abnormally low yields; Limited off-farm employment opportunities restrict diversification and leaving people trapped in increasingly unviable agriculture and persistent problem of food insecurity problem (Devereux, 2000).

1.2 Statement of the Problem

Ethiopia has been structurally food deficit since at least 1980s. Ethiopian farmers do not able to produce enough food to meet their own consumption requirements. Food production in Ethiopia is highly variable and unpredictable mainly due to erratic weather, which has triaged famine for centuries. The food gap rose from 0.75 Million tons in 1979/80 to 5 million tons in 1993/94, falling to 2.6 million tons in 1995/96 despite a record harvest. Even in that year, 240,000 tons of food aids were delivered, suggesting that chronic food insecurity afflicts millions of Ethiopians in the absence of transitory production shocks (Befekadu and Berhanu, 2000).

While what is so far discussed is the picture at the macro level, the problem of food insecurity seems to be worse at the micro (woredas, kebeles and households) levels. Certain parts of the country have been experienced frequent drought, crop failure, food shortages and famine since the turn of the twenty-century. Areas like Amhara region (wollo), Tigray and oromiya region (Hararge and parts of Shewa provinces) have the long history of periodic food crises and famine.

In the study area the situations of food security are not much different from what characterize most parts of the country. According to the baseline study conducted by SERA project (2003) 50% of the landmass of Derra Woreda is located in the lowland areas, with insufficient rainfall distribution to support crop production. This part of the woreda is one of the drought prone regions and encountered periodic food shortage. Due to low productivity of subsistence farming that result from depletion of soil fertility by erosion, limited use of modern technology and land degradation the production obtained from subsistence farming is not in a position of covering the family's annual food grain requirements. Even during good harvest year, there is high shortage of food grains that is covered by different coping mechanisms such as purchase of food and different form of food grain transfers.

Though various alternative models of agricultural development policy (crudely semi-feudalism, state socialism, and market liberalization) was introduced to improve the productivity of smallholder agriculture during the past three decades, the Ethiopian governments has failed to bring food security to the rural Ethiopia or even to halt the steady decline of agricultural production on per-capita in recent period. Food insecurity has become a regular phenomenon in Ethiopia with the only difference in its occurrence year after year (Fuad, 2001). .

At present cognizant of the persistence of food insecurity due to low productivity of arable land, irregularity of rain combined with the shrinking of landholding has forced the Ethiopian government to re-examine the country's agricultural development policy (MEDaC, 2000). Accordingly, new agricultural development program has been put in place by the Ethiopian government. The newly formulated agricultural development policy (ADLI) is rural centered development policy which emphasis the use of small-scale irrigation and water shed management schemes as one possible means of enhancing food production and reduces dependence on rain fed agriculture.

As clearly seen from the current agricultural development program and the national food security strategy irrigation development and expansion of rural income are the main areas of concern to alleviate the current food insecurity problems in the country. The development of irrigation farming is one of the possible alternatives to reduce dependence on unreliable and low productivity rain-fed agriculture, so as to increase food production to meet the food demands of the rapidly growing population of the country and improve income earned by rural population thus, ensure household's food security. Moreover, it is argued that the development of small-scale irrigation schemes provide farmers with a less drought affected additional sources of income and has obvious advantages for ensuring food security (MEDaC, 1996).

Empirical studies on the use of small-scale irrigation for cash cropping and its contribution to household's food security is very limited in Ethiopia in general (Fuad, 2001) and the study area in particular. The existing few studies at the national level have been limited to large-scale irrigation schemes established and run by the government (Fuad, 2001).

In some parts of Derra woreda tradition irrigation farming has been practiced since early time. Many small-scale irrigation schemes were recently developed and other irrigation schemes were upgraded by DIRDP with the prim aim of improving household's food security. Prior to this study the socio economic impact assessment of irrigation development in the study area was nonexistent (Derre woreda agricultural office, 2003). Taking into consideration the advantage of small scale irrigation and the existing gap in knowledge in this area, this research focus on assessing the contribution of small scale irrigation farming and analysis its impact on household's income and food security.

Income diversifications within the agricultural sector (between food crops and cash crops or crops and livestock), combination of agricultural and non-agricultural activities (crafts, weaving, and petty trade) are also current areas of concern to improve household's access to food. However, empirical study is very scarce on the issue of household income diversification as strategy to ensure household food security. Only few studies exist on income diversification by Web and Block on dynamics of livelihood diversification in Ethiopia and recent study by Adugna Lami on the demographic and economic determinants of the dynamics of income diversification in 1994-1997. In the study area empirical study on income diversification is non-existent. Besides, the study of the contribution of small-scale irrigation to food security, this study deals with household income diversification in Derra Woreda and its contribution to household income and food security.

Thus, the attention of the researcher is to prove whether cash crop production and income diversification improve food security at the household level. To this end, the main assumption of the research is that cash crop farming and income diversification have the capacity to reach the grassroots population and can significantly improve household's food security.

1.4 Objective of the Study

1.4.1 General Objective

Based on the above stated research problem, the primary objective of this study is to assess the contribution of small scale irrigation and income diversification in improving the rural economy in general and household food security in particular.

1.4.2 Specific Objectives

More specifically, the study focuses on exploring the following issues:-

1. To assess the contribution of irrigated cash crop farming to the improvement in household's income;
2. To examine the contribution of irrigation to household food security;
3. To assess different sources of household income and their impact on household food security;
4. To describe the major constraints and factors affecting irrigation farming in the study area;
5. To suggest policy lessons for promoting small scale irrigation and income diversification in the study area.

1.5 Significance of the study

The assessment of the impact of peasant based irrigation farming and household income diversification are important to development thinkers concerned with long term objective of enhancing food security in the study area and other similar localities. Without clear information on the contribution of cash cropping and income diversification to the household's income and food security, it could be difficult to reach on conclusion of whether to encourage or discourage irrigation based farming and income diversification as strategy to ensure household's food security.

This study have practical implication since a clear understanding of the contribution of cash cropping and diversified sources of income to household's food security at the grassroots level will help planners, policy makers, donors and non-governmental organizations to appropriate and effective policies and development endeavors in targeting and interventions.

1.6 Scopes and Limitation of the Study

1.6.1 Scope of the study

As the components of integrated rural development approach is too wide, it may not be possible to address all components of rural development due to limited time and resources. Therefore, the study will assess the use of peasant based small-scale irrigation for cash crop production and its impact in improving household's income and food security. Moreover, it examines the impact of diversification of household's income, there by assessing its impacts on household's food security.

1.6.2 Limitation of the study

One of the limitations is the difficult in getting proper response from the sample respondents concerning their annual harvest, income, and the food security conditions and other important socio-economic variable under study. Peasants can only recall the most recent information and it was not possible to get time series data. From their past experience people suspicious about question related to land, income, annual production, asset holding and related it with land redistribution, an increase in land tax, resettlement program. Moreover peasant of the area, also used to see and understand every thing in light of relief assistance. As a result they were reluctant to give objective information on their socio- economic status and they have often under report what they have actually owned. However, different methods such as focus group discussion key informant interview were used to assess cross check the data gathered through questionnaire interview. Moreover, to avoid such suspension the purpose of the study was clearly introduced, to at the beginning of the interview with sample households.

Unavailability of household heads and concerned key informants were another major problems faced during the fieldwork. The only way of reaching the farmers was to visit them on their farm. Even there, they were not willing to spend the required time on the interview. Time and financial constraints was also another problem due to which the researcher had short stay in the study area, which intern limited the collection of data on all aspects, which affect household's food security.

Although the food security measurements (indicators) used for this study cover the key central dimensions of household food insecurity, they do not represent all aspects of possible dimensions of household's food security. The focus is on whether the household had enough food or money to meet its basic food needs and assessment of behavioral and subjective responses of the household to that condition, as reported by the households.

1.7 Organization of the Thesis

The thesis is organized in to five chapters. The first chapter is an introductory section to the study, which contains the general background of the country, food security situation in Ethiopia, statement of the problem, research objectives; research questions and hypothesis, significance, scope and limitation of the study and research methodology.

Chapter two contains review of the related literature on irrigation development, income diversification and food security. Chapter three deal with the general background information of the study area and the description of Derra integrated rural development project and the sample irrigation schemes.

Chapter four presents major findings and discussion of the study on the contribution of small-scale irrigation and income diversification to household's food security. In chapter five conclusion and recommendation is made by addressing the main findings of the study, in relation to the objective of the study.

1.8 Research Methodology

1.8.1 Selection of the Study Area

Two Peasant Associations, Illu-Godachafe and Bacho-Wajitu, were selected through a multi-stage purposive sampling for the survey. In the first stage of sampling Derra Woreda was purposively selected from the 12 Woreda's located in North Shewa Administrative Zone, for the reason that the woreda is known for being food insecure. In the next stage of sampling, Illu-Godachafe and Bacho-Wajitu peasant associations were purposively selected out of the thirty-three peasant associations found in Derra woreda.

Illu-Godachafe PA was selected for its use of peasant based small scale irrigation run by Menchen Feur Menchen to improve the living standards of the grassroots population, with particular emphasis of ensuring household's food security. The other peasant association

was selected for contrasting the contribution of irrigation farming in alleviating problem of food insecurity. This PA has the same agro-ecology (temperature, rain fall distribution, soil types) with the former peasant association. The agro-ecology of the sample PA was identified from the woreda agricultural development office.

Therefore, to assess the impact of irrigation farming on household's food security, irrigator households were selected and compared with non-irrigator households, selected within the same peasant association and from other Peasant Association with similar agro-ecology, where there is no irrigation intervention. For the purpose of this study, irrigator households refer to the group of households who are using the irrigation water for cash crop production or households who are considered the direct beneficiaries of the irrigation scheme.

1.8.2 Methods of Data Collection

To assess the contributions of small-scale irrigation and income diversification to household's food security, primary data were gathered using selective participator rural appraisal techniques and household survey. Moreover, relevant literatures of previous works, both published and unpublished materials were used. Primary data was collected using focus group discussions, semi-structured interview with key-informants, household survey and direct observation of the researcher.

1.8.2.1 Focus Group Discussion

Focus group discussions were held on pre-determined topics to obtain community level information. Five focus group discussions were made with village representatives, women, model farmers, peasant association leaders (chair mans) as well as extension staff of DIRDP and local development agents found in the two Peasant Associations.

1.8.2.2 Key-Informant Interview

Semi-Structured interviews were made with key-informants such as direct beneficiaries of irrigation, project officers, developments agents, Kebeles and woreda administrators and zone, and district food security coordinators. Moreover, direct observation of the researcher was also used as a means of acquiring primary data.

1.8.2.3 Observation

Observation of visual aspects of the variable under study was also used to collect primary data during the field survey.

1.8.2.4 Household survey

Household survey involved the design and use of formal questionnaire to generate the required information at the household level. The questionnaire is designed in such way that it could enable to capture detail information about household's food security condition from small-scale irrigation farming and income diversification. Once the questionnaire is finalized considerable time were given to collect useful data.

During the survey information about household level food availability and access to food (from own production, purchase from market, food transfer through other mechanisms); household's total income were collected. To make data collection easier, household income was divided in to four categories based on source of income (income from sale of cash crop, food grain income, income from livestock and livestock production and income from other sources. Moreover, constraints and factors affecting household's income diversification and irrigation farming in the study area were gathered.

This was done with the help of enumerators selected from development agents of MfM, local development agents, local teachers and others. Following their recruitment the enumerators were trained and familiarized with the questionnaire through several exposure sessions. Pre-testing (pilot study) was conducted to pick-up problems not anticipated by the researcher in developing survey questionnaire before the main survey is undertaken. Thus, any shortcomings identified in the course of pre-testing were ironed out.

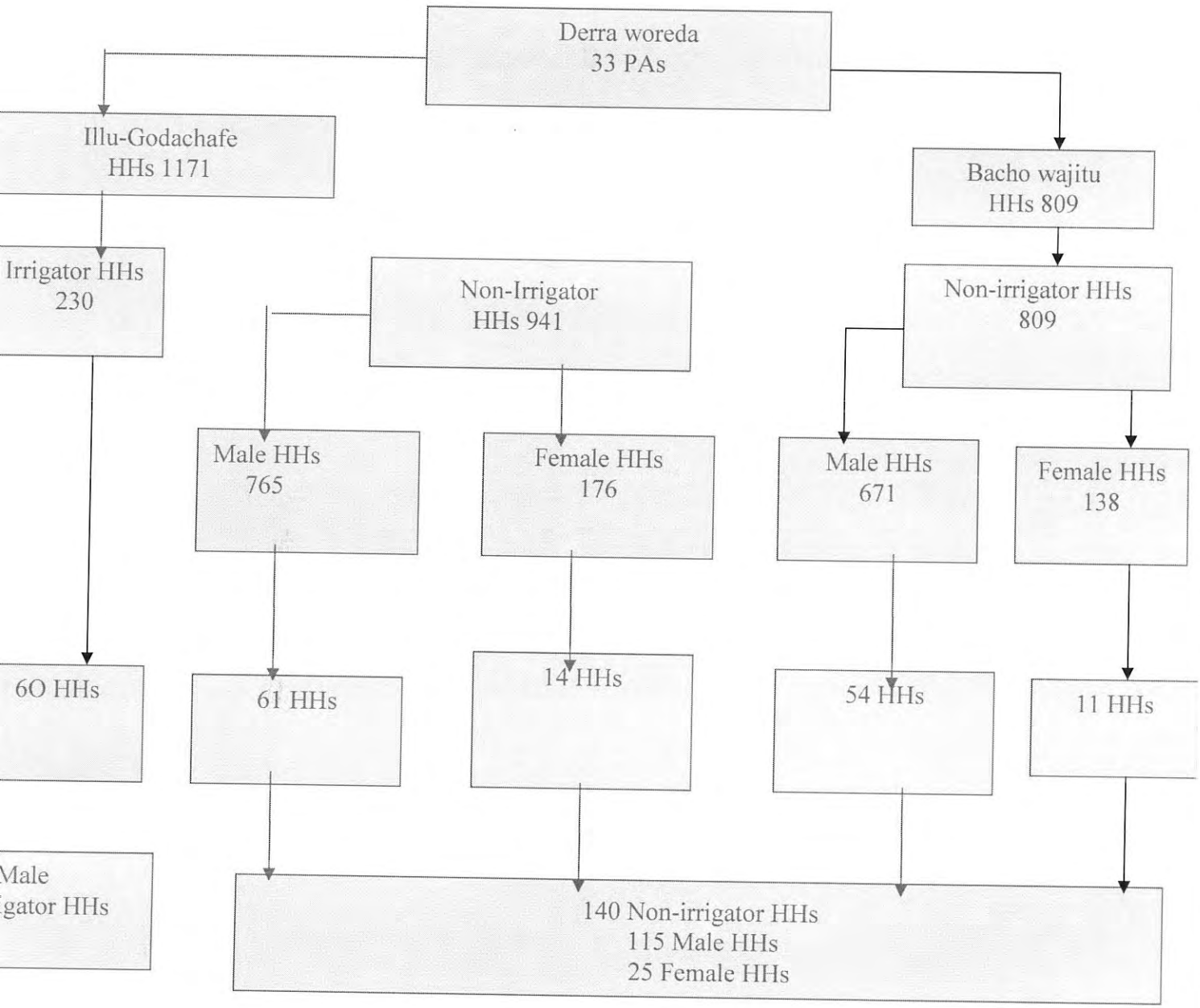
1.8.2.5 Secondary Document Review

Relevant literatures of previous works, both published and unpublished materials were reviewed. A number of institutions involved in integrated rural development and food security programs where contacted to collect information related to recent trends of food security of the household. The main sources of document in this aspect are organization like the ministry of agriculture, DIRDP, department of planning and economic development in northern shewa, regional, zonal, and district food security coordinators offices. In addition, different libraries and Internet explorer were intensively used to collect seconded data.

1.8.3 Sampling

Prior to the selection of sample households, the sampling frame was obtained from the chairman of the two PAs. The population for the study is the entire population (households) lives in the selected Farmers Associations. Once, the sampling frame was obtained, the population was stratified in to two strata based on their access to irrigation farming. The two strata are irrigator and non-irrigator households. To overcome the gender sensitivity of sampling, another classification was established based on sex of the household head (male headed household and female headed household). Representative households were selected using simple random sampling from each stratum to make the total households required for the questionnaire-based survey.

Summary of Sampling Procedures



1.8.4 Data Analysis

After the completion of the fieldwork data was organized for analysis. Both the qualitative and the quantitative data were analyzed. Quantitative data was entered in to computer after data was coded. Quantitative data was analyzed using simple statistical package for social scientists (SPSS).

In order to see the contribution of irrigation and income diversification to household's food security comparative analysis were made between irrigation and non-irrigation household in terms of their total income and food security status. The findings of the survey (quantitative data) were discussed together with the qualitative information collected using semi-structured interview with key- informants and from focus-group discussion.

CHAPTER TWO: LITERATURE REVIEW

2.1 Definitions and Conceptual Frameworks

Whether viewed globally, within the nation, the state or in local community food security is an essential universal dimension of household and personnel wellbeing (Bickle, et al., 2000). Food security stands as a fundamental need basic to all human needs and the organization of social life. Access to necessary nutrients is fundamental not only to life but also to stable and enduring social order (Hopkins, 1986). The root of concerning with food security can be traced back to the world food crises of 1972-1974 and to the universal declaration of human right in 1974, which recognized the right to food as core elements of adequate standards to living (UN, 1948).

World Bank (1986) defined food security as "Access by all people at all times to enough food required for an active and healthy life". Many definitions of food security focus on four core concepts; **'sufficiency'** (defined as the kilocalories required for an active and healthy life), **'access'** to food (through production, purchase, exchange or gift), **'security'** (defined as the balance between vulnerability, risk and insurance) and **'time'** (which food security can be chronic, transitory or cyclically (Maxwell and Smith, 1992).

Food security is achieved "when all people at all times have physical and economic access to sufficient, safe and nutritious food for a healthy and active life." Food security exists when the food system operates in such a way as to remove the fear that there will not be enough to eat. In particular, food security will be achieved when the poor and vulnerable, particularly women and children and those living in marginal areas, have secure access to the food they want (Maxwell, 1988). Thus, the highest state of food security requires not just secure and stable access to a sufficient quantity of food but also access to food that is nutritionally of adequate quantity, culturally acceptable, procured without any loss of dignity and self-determination, and consistent with the realization of the basic need (Maxwell, 1988).

Food security can be analyzed at the household, community, regional or national levels. Food security at the household level can be defined as the ability of the household to secure enough food to ensure adequate dietary intake for all its members. Household food insecurity can exist even where national food security exist. National food security crises is usually started by widespread losses of household food security, for example, following crop failure, logistical and distribution failures are at the centre of national food security crises, as causes of inability to relieve household food insecurity even when there is sufficient food available in the country to do so (Hubbard, 1995).

Food insecurity is the absence of food security and applies to wide ranges of phenomena, from famine to periodic hunger to uncertain food supply (Bickle et. al., 2000). Food insecurity can be chronic and transitory. Chronic food insecurity means that a household runs a continually high risk of inability to meet the food needs of household members. It is a persistently inadequate diet caused by the continually inability of households to acquire enough food needed for healthy and active life, either through market purchases or through own production (WB, 1986).

In contrast, transitory food insecurity is a temporary decline in household's access to needed food, due to factors such as instability in food prices, decline in product or incomes. Transitory food insecurity occurs, when a household faces a temporary decline in the security of entitlement and the risk of failure to meet needs for short duration. In its worst form transitory food insecurity can result in famine, which represents the most severe form of temporary food insecurity manifesting itself in sudden collapse of food consumption and a dramatic increase in the incidence of diseases and death (Bickle et. al., 2000). The persistence of inadequate diets, caused by the inability of household to acquire food resulted in chronic food insecurity (i.e. chronic food insecurity is the continuous inability of the household either to buy food or to produce enough food.

2.2 An Overview of Indicators Used to Assess Food Security

An indicators used to assess food security has been changed over time due to greater understanding of the situations that lead to food insecurity. During the 1970s food security indicators have been measure of regional and national food supply. This primary focus on food supply/ production as the major cause of food insecurity was given credence at 1974 world food conferences (Davies et al., 1991). In this case the primary concern is with the global and national food security defined in terms of level and reliability of aggregate food supplies (Ibid, 1991).

As a result national and international food policies focused on ways of increasing food production at the global and national levels rather than on policies that focus on ensuring access to food at the household and individual levels. In fact, there has been an increasing trend in per capita food production at the global and national level, yet household level food insecurity that attains famine proportions paralleled with comfortable aggregate food availability

Despite of an increase in global food production, significant portion of population of the world have been suffering from hunger and malnutrition. This is because of the fact that availability of food at the global level does not guarantee acquisition of food at national or household levels. Many countries that are food self-sufficient were found to be food insecure at lower unit of analyses due to lack of efficient food system or due to lack of the capacity to raise food entitlement. Borton and Shoham (1991) realized that food insecurity occurs, in situations where food was available but are not accessible because of an erosion of people's entitlement failure (Borton and Shoham, 1991).

In 1980s, there was a shift in the level of analysis of food security from the primary concern in 1970s with global and national food supplies to a focus on individual and household food security with emphasis on access, entitlement and vulnerability (Sen, 1981). According to Sen (1981) entitlement involves how much food household actually have access to from their own production, income, gathering of wild fruits, community support assets and migration. Moreover, food Entitlement of the household may be based on their capacity to exchange labor for wage or payment in kinds or their ability to call on familial and kin food sharing arrangements (Sen, 1981). The wake of this paradigm shift

arisen needs more on clarification of the concept of vulnerability. Chamber (1989) defined vulnerability as defenselessness, insecure exposure to risk, shocks and stress and difficulty the coping with them. Borton and Shoham (1991) defined vulnerability to food security as "An aggregate measure for a given population or region of the risk of exposure to different types of shocks or disasters events and the households ability to cope up with these events".

Hence, in 1983, FAO expanded the concept of food security to include securing access by vulnerable people to stable supplies, impaling that attention should be balanced between the demand and supply side of the food security equation. FAOs 1983 definitions of food security are "Ensuring that all people at all times have both physical and economic access to the basic food that they need" (FAO, 1983). As result, academic and policy focus started to shift towards micro-level issues affecting food security of individuals, households, and communities. Amartya sen's 'entitlement approach' set theoretical basis for this paradigm shift. The 'entitlement approach' and later works that build on it focus on the access of household to food through own production, income, gathering of wild foods, community support (claims), assets and migrations (Sen, 1981).

Hence, during the 1980s due to the growing incidence of hunger, famine, and malnutrition in many parts of the third world, the concept of food security was redefined in such away that the unit of analyses shifted from national and global levels to household and individual levels. It was also made to focus on food availability as well as on access to food.

In early 1980s, the argument on 'access' was a turning point to the progress of the concept and assessment of food insecurity. The concept was developed and improved through time because of increasing development in modern economic relationships, which has caused significant changes and new paths in the systems of food acquisition. As indicated above, particularly, the theory of 'entitlement' has given an impetus to the development of the concept of 'access' drawing more attention to' food entitlement' than to food availability. In this approach, hunger and famine are the results of failure in specific socio-economic groups in the society to obtain adequate food by legitimate economic ways. This means, lack of physical, human, or social resources causes people's access to food to fall below their subsistence needs.

The new paradigm of food security stresses that victims of food in security are not passive agents. They adopt a variety of behavioral responses to minimize the risk of food insecurity and its negative implication current and future household welfare. This responses or coping strategies include a wide range of modifications to production, consumption, and saving behavior of households induced by the desire to maintain a relatively smooth stream of food consumption. Coping strategies involve a variety of mechanisms that minimize risk ex-ante as well as mechanisms that minimize adverse effects of entitlement failure on future productive capacity and current levels of nutrition (Maxwell, 1989).

2.2.1 Types of Food Insecurity Indicators

Household food security can be delineating by using **process indicators that** reflect both food supply and access to food and **outcome indicators**, which serve as proxies for food consumption. *Process indicators* are one of the food security indicators that deal with factors that play a role in limiting or facilitating food availability and options that households have for food access. A household stable access to food will be determined by its means of procuring food (produced, purchased, gathered, transferred) and the social mechanisms that butter households from periodic shocks (Borton & Shoham, 1992).

Food availability and the options household have for food access can be limited by a number of factors. These include inputs and agricultural production (metrological data) ecological data market infrastructures and exposure to regional conflicts or its consequences (influx of refugees), access to common property resources and reliance on wild food are very important (Frankenberger, 1988).

Outcome Indicators are usually proxies for adequate food consumption. It measures nutritional status in addition to food. Outcome indicators can be grouped in to direct and indirect indicators. Direct indicators of food consumption include those that are closest to actual food consumption rather than marketing channels information or medical status (Ibid, 1988).

Direct indictors include households budget and consumption survey (i.e. the money spent on food by individual or households), household perception of food security (i.e. extent of self- provisioning). It is number of months of self-provisioning as perceived by the household through household production and receipts in kind either from labor transactions or claims (Frenkenberger, 1988). Food frequency assessments which involves the collection of minimum amounts of food consumption data; information on food items which are aggregated by food groups, asking for frequency of food items rather than the quantity of consumption (O'Brien & Place, 1988).

Indirect Indicators are used when direct indicators are either unavailable or too costly in terms of time and cost. Indirect indicators of household food consumption include storage estimate (estimates of food in storage during critical times of the year) can give some indication of a household food security status, in households that produce much of their own food.

In addition nutritional status assessments, which involve measuring the prevalence of malnutrition in a population by measuring the nutritional status of random sample of children under five, weight for age and height for age, are widely used in nutrition surveillance programs. Nutritional status has been one of the most popular indictors for household food security. However, it was criticized on the basis that nutritional status is a result of several factors in addition food consumption; it does not always correlate with food availability and access. Factors such as health status (disease prevalence), sanitation, mother care, and level of activity of individual, can influence nutritional status (O'Brien, place & Frankenberger, 1988). Secure access to enough food to meet household food need is a necessary but not sufficient condition for good nutritional status (ibid, 1988). Moreover, they are often late indicators of a food crisis (Borton & York, 1987); there is a time lag between food shortage and changes in body size and consumption (Galvin, 1988).

2.2.2 Selection of Food Security Indicators

Indicators of food security are selected for a specific purpose, to evaluate the success of development interventions, monitoring system or to develop a HFS strategy for the country. The criteria used include ***resources availability, relevance & accuracy*** and ***timeliness***.

The selection of food security indicators and methods of analysis are based on availability of resources such as financial, human, institutional, and infrastructural resources. Availability of these resources determines the types of indicators used in assessing food security and analysis. Methods used to collect data depend on what is feasible given existing resources as well as what is desirable (Frankenberger, 1988, Davies et al. 1991).

Relevance of food security indicators is enhanced, when indicators are selected based on a good understanding of the local conditions leading to the food insecure situation (Davies et al., 1991). This is because appropriate indicators will be sensitive to changing conditions of stress for households in a given area. Thus, development of food location specific food crises indicators may hold to determine the most appropriate indicators for a community or regions (Ibid, 1991).

Accuracy refers to how the defined variables are close to food intake of the household. The collection of accurate data may seriously limited by access to resources such as financial, human, institutional and infrastructural resources. As chamber (1990) describe food security monitoring systems should not try to fined out more than needed and should not needed to measure accurately more than practical purpose (Chamber, 1990).

Finally, timeliness refers to predicting food shortage, changes to entitlement and the response to the changes in household's entitlement. Currently, two techniques are used to enhance timeliness. These are risk Vulnerability maps that are used to identify the areas and groups of the population that are most vulnerable to food insecure and contingency plans which involve formulating a set of actions that are closely tied to pre-deter mined warning strategies derived formal locally based food security monitoring system (Buchanan, Smith et al., 1991).

2.3 The Concept of Income Diversification

Income diversification involves adding income-generating activities at the farm-household level, including livestock, local non-farm activities, and off-farm pursuits undertaken by farm households (Barrett et al., 2001). Diversification of income sources, assets, and occupations is the norm for individuals or households in different economies.

Households in Sub-Saharan Africa whose livelihood heavily depends on agriculture and related activities are no exceptions to this phenomenon. Engaging in multiply activities is an important way that helps to reduce risks and uncertainty. In rural areas of developing countries, the need for income diversification is also growing overtime and now accounts for considerable share of household income (Reardon, et al., 1998).

Diversification of food and income sources (in cash and kind, farm and non-farm) is considered one of the main "buffers" households can develop against risk in agrarian environment. It is vital to any understanding of household coping and survival strategies and ultimately to the effective design of food security strategies that the relatively importance of different income sources, the characteristics of these income sources...etc and the response of individuals and households to these characteristically (Ibid, 1997).

In developing countries, few households derive the bulk of their income from a single source. The literature on livelihood sustainability under conditions of economic uncertainty concludes that most households avoid an extended period of dependence on only one or two sources of income (Bryceson, 1999). Evidence abound which suggests that income diversification is a key way of ex-ante risk management or ex-post coping with shocks (Rosenzweig & Binswanger, 1993).

In most parts of the Ethiopia, farming is the most import sources of activity for the majority of the rural households. Most Ethiopians are 'sub-subsistence farmers' who have been forced to diversify into off-farm incomes to bridge their annual consumption gap, while some are effectively landless and depend entirely on non-agricultural sources of food and income, including food aid. The typical rural livelihood strategy combines crop and livestock agriculture, off-farm income-generating activities (daily labor, petty-trading, and seasonal migration) and dependence on food aid, mostly delivered with a work requirement (Devereux, 2000).

The main problem with available off-farm economic activities, apart from their low returns is that most are directly or indirectly affected by rainfall, which limits their risk-spreading potential. In areas where farming is unable to generate viable livelihoods, and this cannot be solved through land redistribution or intensification, the solution is not to focus policy attention on agriculture, but to promote non-covariate non-agricultural livelihood options (Ibid, 2000).

Off-farm employment opportunities in rural Ethiopia are limited in both availability and income-generating potential. Only 44% of rural households surveyed by the Ministry of Labor in 1996 reported any non-agricultural sources of income, and these contributed only 10% to household income (Befekadu & Berhanu, 2000).

Another survey in Hararghe region confirmed that off-farm activities generated only petty-incomes: women collect and sell firewood and forage, men, women seek irregular low-paid work as farm laborers, and some men migrate seasonally. Household survey in Amhara region indicate that only 25% of households had one or more members migrate during the dry season in search of work, mostly to nearby rural/ urban areas. One in three migrants had difficulty securing employment, while half brought back no food or income for their families (FSCO, 1999).

2.3.1 Measuring Income Diversification

Measures of diversification so far mostly available for rural areas have focused mainly on estimation of non-farm income share in the total household income (Block and Webb 2001; Barrett and Webb 2001; Lanjouw et al. 2001). The assumption is that higher share of off-farm income amount to higher income share diversification and less vulnerability to weather related shocks, the major risk factors in rural areas where agriculture is the mainstay of livelihood.

However, Lire Ersado (2006) developed a richer measure of income diversification based on a more disaggregated classification of income sources beyond the simple farm and non-farm categorization. He developed a diversification measure based on the relative contribution of income source-earner combination to the total income of a given household.

The rationale to incorporate number of sources of income is based on the idea that households' desire to pursue more than one source of income may arise from the concerns to risk emanating, for instance, from macroeconomic policies that may result in job losses due to shrinking of the public sector employment. Moreover, different sources of income show varying degree of liquidity and vulnerability to risk. The same amount of non-farm income from a single source and multiple sources will have different implication for households risk management. Likewise, households may prefer to depend on more than one income earner to manage idiosyncratic risks such as sickness of a gainfully employed family member. A diversification measure based on the number of sources of income-earner combination address some of the short coming inherited in non-farm income share in the total income of the households. Thus, he developed a diversification measure based on the relative contribution of income sources-earner combination to the total household income. For the purpose of this study the number of household's sources of income is used to determine the diversification status of households.

2.4 Irrigation Potential and Utilization in Ethiopia

There have been different estimates of the irrigation potential of the country, and the figure varies across literature. One of the earliest estimations was made by the World Bank (1973), which suggested a figure of between 1.0 and 1.5 million hectares. However, According to the Ministry of Agriculture (1986), the total irrigable land in the country measures 2.3 million hectares. The International Fund for Agricultural Development (IFAD, 1987), on the other hand, gives a figure of 2.8 million hectares, while the Office of the National Committee for Central Planning's 1990 figure, which is based on WRDA's estimations, is 2.7 million hectares. However, considering availability of water and land resources, technology, and economics, the irrigation potential of Ethiopia is estimated to be about 2.7 million ha. Based on the 2002 data from the Ministry of Water Resource Development, the irrigation potential; of the country is summarized in table 2.1 below

Table 2.1: Surface water resources by basins

Major Rivers	Volume of water (Billion 3 Year	Potential irrigable area
Tekeze	8.20	200,000
Abay	54.84	1,700,000
Baro -Akobo	23.24	1,050,000
Omo-Gibe	16.60	248,000
Ganel-Dawa	5.88	423,000
Rift-Valley	5.63	50,000
Wabie Sheblle	3.16	355,000
Awash	4.60	184,000

Source: Ministry of Water Resources, 2002

In spite of the immense water resource of the country, Ethiopia is one of the least irrigation water using countries in the world. According to the Ethiopia's office of the national committee for central planning (Dessalegn, 1999), the total irrigation potential of the country in early 1990s was estimated to be 2.7 million hectares. However, according to the MoA report of 1993, the total coverage of irrigation in the country was only 168,000 hectares, which is less than six percent of the country's irrigation potential. These include 79,000 hectares of land irrigated by small-scale irrigation, which accounts for about 47% of the total irrigation coverage of the country (Dessalegn 1999, cited in Fuad, 2000).

In comparison with other African countries irrigation development in the country is limited; less than 6 percent of the country's irrigable land is now under irrigation. In contrast, according to FAO data (1987), the three countries in sub-saharan Africa with the largest irrigation are Sudan (2.2 million ha), Madagascar (1.00 m) and Nigeria (0.9 m). In the Sudan, 14 percent of the country's cropped land is under irrigation, while in Madagascar, the figure is 32 percent. In contrast, almost all the cropped land in Egypt is under irrigation. For comparison, irrigation in Ethiopia covers less than two percent of the country's cropped land. Assuming that all the irrigated land is utilised to produce food crops (which in actual fact is not the case as the many of the larger schemes were dedicated to industrial crops), the contribution of irrigation to the production of food cannot exceed two percent (FAO, 1987).

2.4. Classification of Irrigation in Ethiopia

According to the Ethiopian classification irrigation schemes have been classified into three categories, depending on their size, operation and management. These are: Large-scale, Medium scale and small-scale scheme (Dessalegn, 1999). *Large-scale is irrigation scheme* used to irrigate 3000 hectares of land. Such irrigation is constructed by different government water development authorities mainly for the benefit of state farms (Dessalegn, 1999). *Medium scale irrigation scheme* is scheme used to irrigate 200-3000 *hectares* of land. Head works, main and secondary canals constructed by WRDA, and tertiary and farm canals by IDD, Managed by State Farms and other para-statal enterprises. Small-Scale irrigation is scheme used to irrigate up to 200 hectares of land owned mainly by peasants organized in to community groups or users association or individual basis. It is mainly constructed for the benefit of peasants organised in producers' co-operatives (Ibid, 1999).

Small-scale irrigation can be defined as irrigation, usually on small plots, in which small farmers have the controlling influence, using a level of technology, which they can operate and maintain effectively. Small-scale irrigation is, therefore, farmer-managed: farmers must be involved in the design process and, in particular, with decisions about boundaries, the layout of the canals, and the position of outlets and bridges. Although some small-scale irrigation systems serve an individual farm household, most serve a group of farmers, typically comprising between 5 and 50 households.

Several studies have indicated that large and medium scale schemes have often been used for large-scale commercial crop production run by government enterprises in general, have not been successful in alleviating the problem of food insecurity in many African countries including Ethiopia. Such schemes have had an adverse effect on food security and have demonstrated environmental damages including the displacement of people and livestock (Fuad, 2001). On the contrary, the development of small-scale irrigation schemes provide farmers with a less drought-affected, additional income sources in the form of food and has obvious advantages for food security (Braun, Puetz and Webb, 1989).

In Ethiopia the development of small-scale irrigation can help peasant agriculture in drought prone areas detach from regular food aid and get firmly on its feet. It can help vulnerable peasants in their quest for production increase and reduce dependency on food aid, which may result in disincentives for local food production, if not properly targeted (Dessalegn, 1999).

According to FAO (1986) study, small and indigenous irrigation schemes are the dominant form of irrigation in much of Sub-Saharan Africa. Out of the 34 countries with substantial irrigation programmes, small-scale irrigation covers over 74 percent of the total irrigated land in 17 of them (FAO, 1986). Water resource development programmes in Africa have not given sufficient attention to small-scale and peasant based irrigation experiences and technologies.

According to data available at the moment, small-scale and traditional irrigation serves almost half of the irrigated area Ethiopia. It is thus; clear that small-scale irrigation is widespread and has a vital role to alleviate problems of household food insecurity, because small-scale irrigation schemes are less costly in the fullest sense of the term. Moreover, there is general agreement that the success of small-scale systems is also due to the fact that they are *self-managed* and dedicated to the felt needs of local communities (NWRD, 2002).

According data obtained from regional bureau of agricultural and natural resource departments (2004), the majority of irrigated land was covered by small irrigation. The actual irrigated area by traditional and modern small-scale irrigation schemes by regions are summarized in table 2.2 below.

Table 2.2: Actual Irrigated Area by Regions (Traditional and Modern Small Scale Irrigation Schemes

Regions	Irrigated Area Traditional Schemes (hectares)	Traditional and Modern Small Scale Irrigation Schemes (hectares)	Total (hectares)
Oromiya	56,807	17,690	74,497
Amhara	8,0710	7410	88,120
SNNPR	2,000	11,577	13,577
Yigray	2,607	11,270	12,607
Afar	2,440	-	2,440
Somali	8,200	1,800	10,000
Gambella	46	70	116
Benishangul Gumuz	400	200	1,696
Harari	812	125	937
Dire Dewa	640	1,056	15,000
Addis Abba	352	-	352
Total	***155,014***	***51,198***	***205, 842***

Sources: Regional Bureau of Agricultural and Natural Resource Department of Respective Regions, 2004

2.6 Irrigation Development and Income Diversification as Strategy to Alleviate the Problem of Food Insecurity

In many parts of Africa, empirical evidences suggest that the major threats to food security are more related to low and unstable incomes and unemployment than to food production deficit (Hay, 1988, cited in Salih, 1994). The alternative policy option is to improve food entitlement through direct household's income diversification to protect the entitlement of vulnerable groups (Sen, 1989). Such income generating resources (used not only as immediate relief, but also as risk spreading potential) will enable the beneficiaries to acquire the inputs (food, clothing, etc), which in turn create the desired functioning of life such as living healthy and active life.

The need for diversification has not often been adequately stressed as outlining possible solutions to the food insecurity problem in Africa. Historical experience of many countries in the region tend to be severely underestimated diversification within the agricultural sector (between food crops and cash crops, or crops and livestock), combination of agricultural and non- agricultural activities (crafts, weaving, petty-trade) within the rural

sector and the use of extensive links between different rural regions and between rural and urban areas, through wage employment and remittances. Flexibility in the household's basic livelihood pattern promotes the income of the household, thus, spreading risk management potential of the household.

Nowadays, the need for irrigation development, in drought prone countries, where rainfall is insufficient or unreliable and rain-fed agriculture cannot fully support food production, as a strategy to sustain agricultural production to ensure sustained food security is well understood. In such countries erratic rainfall is a key constraint on further increase in agricultural production and improves food self-sufficiency. This situation forced many national and international development planners to re-examine the agricultural policy and strongly attracted to irrigation development as a means of improving future food production and alleviating the problem of food insecurity (Dessalegn, 1999).

As indicated in IFAD (1985), development of small-scale irrigation would stabilize agricultural production and enhance food supply even in years with inadequate rainfall and increase the overall level of crop production in years with normal rainfall. Elahi (1988) argued that for countries with arid and semi-arid climates the lack of uncertainty about rainfall along with rising demographic pressure on cultivated land would strongly be pointed out to irrigation as a prime candidate to support future food strategies in medium and long term (Elahi, 1988). Irrigation farming plays great roles in enhancing agricultural production and productivity. Increased agricultural productivity is a key to reducing poverty and food insecurity.

Irrigation is one of the basic agricultural inputs for intensification and diversification of agricultural activities and to enhance agricultural production and productivity. In this context it is assumed that the high yields obtained in irrigation coupled with other benefits such as increased incomes and asset owned and income earned from diversified sources enhance food availability and access to food, thus, will assure households food security at the household level.

In its recently finalized water sector development program, the Ethiopian government gives due attentions to irrigation development as strategy to achieve national and households' food security. Expansion of irrigation farming through "Rainwater harvesting" is taken as one of the possible solutions to cope up with the challenges of drought and food insecurity. At present irrigation development has been received a wider acceptance by government, international organizations and NGOs.

It is over spilled in the literature that, Ethiopia cannot hope to meet its large food deficits through rain-fed production alone. In cognizant of this fact, the government has already taken initiatives towards developing irrigation schemes of various scales. The maximum area quoted to be currently under irrigation is estimated at about 5% of the potential, accounting for merely 3% of the country's total food crop production. In the short-term, however, the irrigation development program gives emphasis to the development of small-scale irrigation in which capacity building in the study, design, and implementation of irrigation projects take the forefronts.

The argument for the development of irrigation as strategy to ensure food security can be seen from three different dimensions. Agricultural intensification, expansion and maximizing production with double or multiple cropping can enhance food availability. Taking advantages of modern technologies and high yielding crop varieties intensified agricultural practices, especially in areas where arable land is a scarce, enable irrigators to produces more food crops. Household food availability also can be enhanced through agricultural outputs diversification; irrigation help to diversify product types; which can be sought as a strategy for coping with food insecurity problems.

Irrigation enables producers to grow different crops, which can increase varieties in household's food availability. Moreover, product diversification reduces risk against a number of calamities such as flood, drought, and crop failure. Expansion and diversification are systems by which irrigation enhances number of harvesting times (multiply harvest) within a year and enable the use of unused farmlands for production of food and cash crops to enhance household food security (FAO, 2000).

Another dimension to advantage of irrigation is that it HHs access to food. Access can be maintained by increasing income of the producers through diversifying sources of income from cash crops, employment generation, and petty-trade by providing appropriate credits and market facilities & improve livestock productivity through production of animal forage. Diversified sources of income in turn increase purchasing power to procure food from market. Irrigation can also help producers to grow different crops, which in turn increase varieties in households' food preparation (ibid, 2000).

2.7 An Overview of the Ethiopian Current Food Security Strategy

Food availability (supply) and access to food (demand) are the two major pillars of household food security. The current Ethiopian food security strategy (1996) is designed to address both the supply and the demand sides of the food equation: availability and entitlement, respectively within the framework of the national agricultural and rural development strategies. This could be affected from the perspective of ensuring both food security at national and household levels taking into consideration the diverse nature of the country's agro-ecology. The new strategy is mainly targeted at the chronically food insecure moisture deficit and pastoral areas. It is characterized by a clear focus on environmental rehabilitation as a measure to reverse the current trend in land degradation, which adversely affects food production through deleting soil fertility.

At the same time, the focus on biological measures as a source of income generation for food insecure households marks a departure from the former strategy, water harvesting and the introduction of high value crops, livestock and agro-forestry have been new elements in the current strategy. The currently strategy adopted to ensure food security developed on three pillars: increasing food availability through domestic (own) production, ensuring access to food for food deficit household's and strengthening emergency response capabilities.

Increasing domestic production (supply side actions): Domestic production is the direct consumption for food. The surplus is sold to the non-framing and even to the farming community. This implies that increasing the production and productivity of food in a sustainable manner could address the problem of food shortages in Ethiopia. For food

insecure areas production based entitlement of food will be encouraged through augmenting the supply increases to be obtained from both crop and livestock production.

In this regard, utmost attention is to be given to increasing agricultural production in all agro-ecological zones of the country. To this end, the agricultural extension program is being re-oriented to the specific problems of moisture defect, moisture adequate and pastoral areas. The government will also continue promoting irrigation schemes to create a condition for year-round production activities and diversifying much higher value added enterprises in moisture adequate areas. Researching and supplying appropriate crop and livestock production technologies and inputs for moisture deficit areas; short cycled livestock such as poultry, sheep and goats as well as development of drought tolerant, short cycle and relatively high yielding varieties that fit to the farmers' requirements, will be priority. Another area of intervention for dealing with problems of moisture deficit food insecure and degraded areas in effecting resettlement in suitable and uncultivated areas voluntarily with in each regional state.

Ensuring access to food (demand side): Food insecure farming households as well as the non-farming community gets some and/or all of their food from the market. The farmers need it to supplement own production while the later use it as the only source. To purchase food from the market, households need sufficient income that can cover at least their minimum food and non-food requirements. However, many households in the drought prone and moisture deficit as well as urban areas lack sufficient income to meet their basic need. The current food security strategy has indicated food security measures aimed at addressing demand side problems within the framework of the rural development polices and strategies. The proposed demand side measures are: micro and small scale enterprises development improving the food marketing system, supplementary employment and income generating schemes, targeted programs, and credit services provision. In addition to theses, a number of nutrition and health intervention as well as improving early warning systems and emergency capabilities have been proposed in the new food security strategy.

2.8 Empirical Literatures

Many studies in rural Africa found positive association between non-farm income diversification and household welfare. Readon et al. (1998) made an extensive analysis of household surveys from 1970s through the 1990s, and found an average non-farm income, share of 42% in Africa, followed by 40% in Latin America and 32% in Asia. Reardon's review of 25 case studies (1997) indicates that non-farm income ranges from 22 to 93% of total income with a simple average share of 45%.

Kinsey et al. (1998) examine 400 resettled households in rural Zimbabwe over a 13-year period and found that income diversification is a coping strategy used during times of drought, but that the income sources that can be tapped are likely to be low return activities such as day jobs or agricultural piecework. Haggblade et al. (1989) found that 15 to 65% of agricultural farmers have non-farm activities as a secondary employment. This implies that the agricultural sector is the main provider of labor resources and that non-farm income share can play an important role in income generation.

Studies in Latin America also confirm the significance of income diversification on household's total income. For instance, in Colombia, off-farm employment contributes a significant share (45%) to household income, but the importance of off-farm income and returns to household labor vary over the income distribution (Deininger and Olinto, 2001). In Peruvian rural areas, 51% of the net income of rural households comes from these off-farm activities (Escobal, 2001). In Honduras, income from non-farm wage and self-employment represents 16-25% of farm household income and is especially important for middle and higher income strata (Ruben and van den Berg, 2001). Related studies in Latin America also demonstrate similar results (Yunez-Naude & Taylor, 2001).

Reardon (1997) shows shares of non-farm income in total rural household income for 27 case studies in Africa. That review provides some surprising departures from traditional images of non-farm activities of rural households in Africa. The finding shows that (1) the average share of non-farm income is high, around 45 percent. (2) Non-farm wage labor income commonly, if modestly, exceeds self-employment income (3) Non-farm earnings are typically substantially greater than either agricultural wage employment earnings or migration earnings outside of southern Africa.

The effects of income diversification on household's food security also show significance of diversification. A case study from Burkina Faso before and after the 1984 drought illustrates the typical effects of income diversification on households food security: households with greater income diversification were able to buy food and weather the effects of the drought tended to have higher overall incomes than those who were not able to supplement their farm incomes with rural non-farm incomes (Reardon and Matlon, 1989). Moreover, non-farm income is often a major source of savings for farm households in poor areas, which are then used for food purchase in difficult times (Reardon & Mercado- Peters, 1993).

In Ethiopia empirical studies on income diversification and its impacts on household's income and food security is limited. Only a few studies specifically deal with the significance of off-farm activities are available. The available studies are either regional or focus on drought periods. Carswell (2002), Using data from the southern part of the country, shows the role that women play in income diversification and the particular importance of the contribution of diversification activities to cash incomes for poorer households.

Dercon and Krishnan (1996) analyze the different income portfolios of households using survey data from rural Ethiopia and rural Tanzania. The results of their study contend that the different portfolios held by households cannot be explained by their behavior towards risk; it is better explained by differences in ability, location, and in access to credit (Dercon and Krishnan, 1996).

Using survey data from the northern part of the country, Woldenhanna and Oskam (2001) argue that farm incomes and off-farm incomes are substitutes. They divided the off-farm employment into off-farm wage employment and off-farm self employment and arrive at the finding that farm households diversify their income sources into off-farm wage employment motivated by low farm income and availability of surplus family labor, whereas they enter into off-farm self employment to earn an attractive return (Woldenhanna and Oskam, 2001).

Block and Webb (2001) address the issue of the dynamics of livelihood diversification in Ethiopia. Their study uses the ratio of per capita income derived from crops to the sum of all other incomes as an indicator of livelihood diversification for the years 1989 and 1994. Their study focuses only on drought-prone areas during the survey years. They found that wealthier households tend to have more diversified income streams; households with a greater concentration of assets were more likely to fall in their relative outcome ranking (as were female-headed households); and, initially less diversified households subsequently realized greater gains in income diversification (Block and Webb, 2001).

Adugna Lemi conducts recent study on income diversification in Ethiopia in 2006. His study investigates the demographic and economic determinants of the dynamics of income diversification using 1994 and 1997 harvest year's survey data colleted from rural Ethiopia... The study result shows that farm families who have initially diversified to more off-farm activities subsequently realized less income diversification. Families with more initial crop production from slack harvest season subsequently realized greater income from off-farm activities in 1997(Adugna Lemi, 2006).

In some African and Asian countries empirical studies generally show that beneficiaries of irrigation have been in a better position in terms of socio- economic status (food, income, nutritional status and standards of living than their non-irrigators counterparts). One of these studies was conducted in India by Sing and Misread (1960) on Sarda Canal Irrigators in comparison with non-irrigating villages and made the following observation: gross farm per acre on the whole is higher in irrigated village than the non-irrigated ones. The crop produced from the total farm out put is higher in the irrigator's households than the non-irrigators mainly due to the cropping pattern under irrigation incorporate cash crops. Total inputs per acre are higher in the irrigation than the non-irrigation areas. Payment to outside farm labor is higher in the irrigated area than the outside. The above study clearly shows the benefits from irrigation development in terms of improved crop productivity income earned; input uses and employment creation to the community and give better chance to ensure households food security.

The socio-economic impact of small-scale irrigation in Zimbabwe on Hama Maviare, Hyoyou and Nyaitenga irrigation schemes produce the same result. FAO (1997) reported the result as follows: Farmer's income from irrigated agriculture is significantly higher than incomes from dry land farmers. The report also indicated that levels of inputs in terms of quantity are higher in irrigation schemes than in dry land areas, suggesting that there is more intensive crop production in irrigation schemes than in dry land agricultures."

Another research outputs by (webb, 1991) on the socio-economic impact of irrigation schemes in Gambia in the Chakunda Villages gave the following benefits of irrigation, as reported in FAO, 2000). Irrigation increased household income that was translated in to increased expenditure investment, construction, and involvement in trade: Increase agricultural productivity which in turn increase income of the people engaged in it and there by enhance purchasing power; thus it secure access to marketable food items; Create backward and forward linkages; traders were repeatedly coming to purchase produce (rice) and inurn sell cloths, jewelry, and other consumer items. Merchants brought seeds and other agricultural inputs to irrigators during planting seasons. At the village level, irrigation increase material wealth in the form of construction of a large mosque built through farmers' donations and an improvement of other village social services like education roads clinic. At the household level increased with could be seen in corrugated metal noting built in the village."

In case of our country, empirical studies on the socio–economic impact of small-scale irrigation development are very limited. The only practical observation was undertaken on small-scale irrigation found in central Ethiopia and household food security by Fuad Adem (2001). His study focus on the way irrigated vegetable increase household income and how the households utilize that income. The findings of this study highlights the positive effects of that irrigated vegetable farming as cash crop production brings to agricultural production in the area. Cash cropping has enabled many households to diversify their sources of income and generate more income. It enabled the target households to feed themselves through out the year but also to invest on agricultural production in order to make efficient use of their land and livestock resources (Fuad, 2001).

CHAPTER THREE

General Background of the Study Area

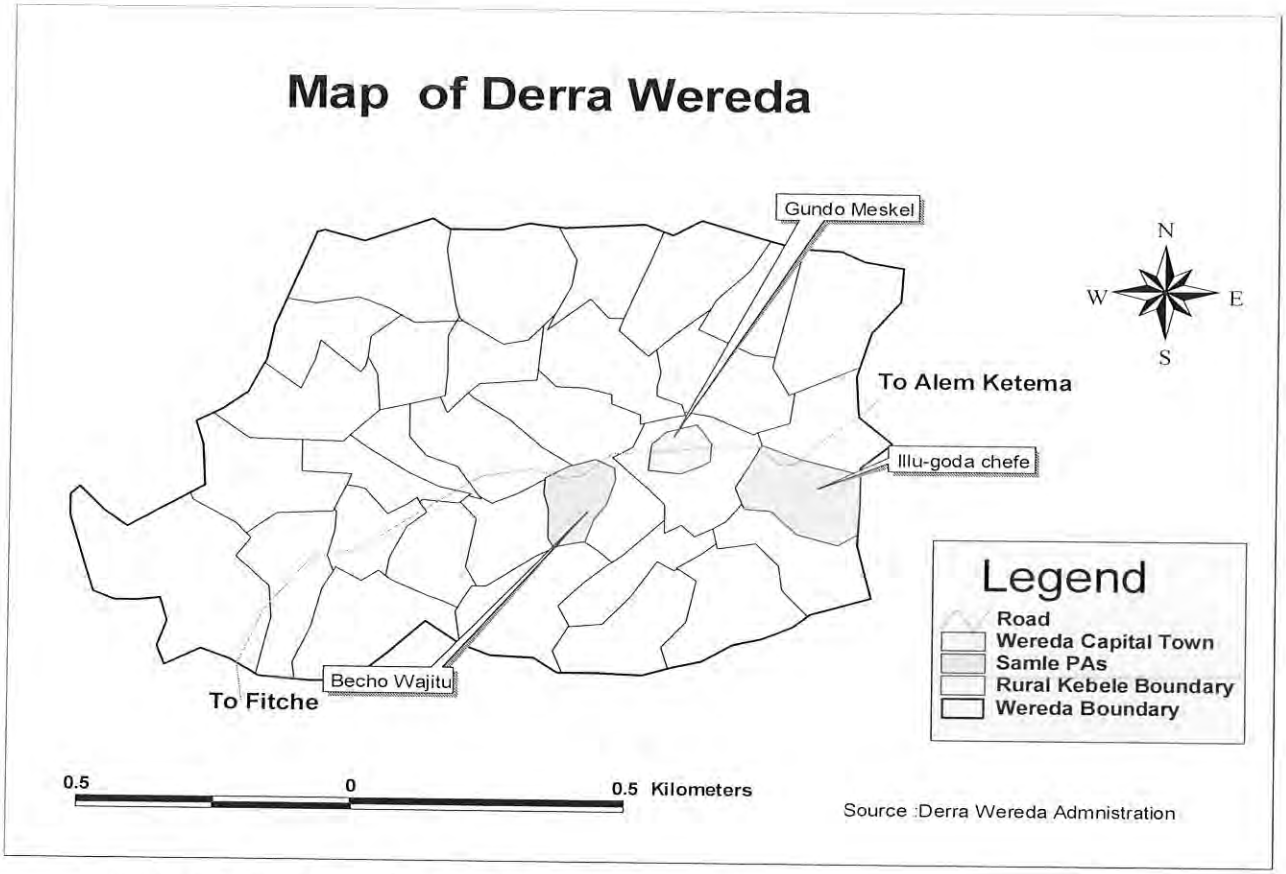
3.1 Physical Features of Derra Woreda

3.1.1 Location and Area

Derra Woreda is located in north shewa administrative zone of Oromia regional state. It is one of the twelve districts found in north shewa zone. Its geographical location is in the northern part of the zone approximately between $10^{0}02'$ to $10^{0}24'$ North latitude and $38^{0}26$ to $38^{0}55'$ East longitude. The woreda has north to south distance of about 41 kms and east to west distance of about 54 kms indicating compactness of the district.

Derra woreda has a common boundary with Warra Jarso and Hidhabu Abote districts in the south and southwest. It also has boundary with Amhara regional state in the northwest, northeast and southeast of its landmass (SERA, 2003). The administrative capital town of the woreda is Gundo meskel, situated at a distance of about 220 kms from Addis Ababa and about 110 kms from the zonal capital, Fiche, through Ejere and 255 kms through Merehabite, Addis Alem town.

According to the report from the north shewa planning and economic development department office, Derra woreda is one of the largest districts found in north shewa administrative zone, covering about 12.8% of the total area of the zone and rank the second in size. It has a total land area of about 1528 square kilometers. The landscape of the district constitutes flat land cover 65% of the landmass, steep slop and cliff constitutes 5% and 20%, respectively. Undulating and others cover 10% of the total landmass of the district (Derra woreda administration, 2003).



Sources: Derra Woreda Administration

3.1. 2 Land Use Pattern

Land, from agricultural point of view, is an indispensable factor for production of crops, rearing of livestock and other ancillary agricultural activities. According to the Ethiopian agriculture development office (2003), the total land use is categorized in to five main land use types. These are land under temporary crops, land under permanent crops, grazing land, fallow land, woodland and land for other purpose. The proper utilization of landholdings under different components contributes to the development of the nation's agricultural economy (Ethiopia agricultural sample Enumerator, land use, Vol. II., 2003).

In the study area, information obtained from the woreda agricultural development office (2004) indicates that, four major land use patterns are identified. These are cultivated land, constituting 47.8%, grazing land, forest and woodland and bush land covering 15.8 percent, and non-productive land cover 27.9%. Land used for other purposes constitute 8.5% of the total land area of the district. Land used for other purposes refers to land

owned by holder house and/or building, parking areas, market places, covered by roads ... etc. The average landholding per household is estimated at about 1.87 hectares and households that are landless account for about 12.8 percent of the total population (Derra woreda administration, 2003).

3.1.3 Soil and Topography

Two agro-ecological zones characterize the topography of the study area. The first one is the highland covering about 50% of its landmass and lowlands, sharing the same percent of the total land area of the district. Flat land, plan, gentle and steep slopes, undulating mountains, valleys characterize the landscape of the study area.

According to the data obtained from district agricultural development office, three types of soil are found in Derra woreda. These are sandy soil (45%), clay soil (27%), and sand soil (28%). The degradation and destruction of soil has reached irreversible stage in some parts of the district. Soil erosion is caused by different factors such as over cultivation, overgrazing, and removal of vegetation cover all accelerate the depletion of soil fertility. Most of the vegetation cover in the district has been removed due to distractive human activities such as deforestation and other factors.

3.1.4 Climate

According to the information obtained from Derra woreda agricultural development office (2003), the district received bimodal rain pattern, meher and belg rain. The main rainy season concentrated mostly from June to September with highest amount in July and August. A part from this, the highland parts of the district receive a small amount of rainfall from February to May in the belg season. The belg rain is uncertain and varies from season to season. The mean annual rainfall ranges between 800mm-1500mm in highland and it might be as low as 600mm in the lowland. The average annual temperature of the district rages from 18^{o}C-25^{o}C.

3.1.5 Vegetation Distribution

According to the information obtained from SERA (2003), the vegetation cover of the study area has been jeopardized. Few exotic species, that is less valuable like acacia tree, shrubs and bush, replacing the indigenous and most valuable tree species. Almost all of the original vegetation cover of the district has been destroyed due to accelerated

environmental degradation, which is caused by population growth, with increasing demand for arable land and energy consumption; over cultivation, overgrazing, poor farming practice, removal of vegetation cover and increasing soil erosion. Very few remnants of old forests and vegetation can be found mainly in church compounds and in inaccessible cliffs and gorges (SERA 2003).

3.1.6 Drainage

The study area is endowed with many perennial and intermittent rivers and springs. The major rivers found in the district include Muger, Abay, Jamma, Jara, walaka, Derame, Wanchit and Shankora. Apart from these rivers, there are many streams like Bato, Danse, Hume, Garba, Abu Gurra and others. According to the information obtained from the woreda's water resource development office, except Shankora River, all other rivers can be used for irrigation with application of appropriate technology and skills. In spit of this potential, the district is characterized as one of the least irrigated and food insecure area in north shewa administrative zone (SERA 2003).

3.2 Demographic and Socio-economic Features of Derra Woreda

3.2.1 Population Size and Density

According to the Population and Housing census of 1987(1994 G.C), the population of the district was 139, 661. In the same period crude population density was 91.4 persons per-square kilometer and the average family size was 5.06. The majority of the total population (97.4%) is living in the rural area while (2.6% are urban residents (woreda population office, 2004). The demographic data obtained from the woreda population office is summarized in table 3.1 below. The estimation was based on the Oromiya regional state government urban and rural growth rate, which are 5.29 growth rates

Table 3.1: - Distribution of the Population by sex Size and Residences (From 1994-1997 E.C)

NO	Total Population	Years			
		1994	1995	1996	1997
	Male	84075	86680	88640	91620
	Female	87220	90220	92285	95110
	Total (Male + Female)	171295	176960	180925	186736
	Rural Population	167045	172470	176313	181713
	Male	81852	84510	86380	89039
	Female	85193	87960	89933	92674
	Urban Population				
	Male	2082	2170	2260	2461
	Female	2168	2260/2260	2352	2562
	Total (Male + Female)	4250	4430	4612	5023
	Households				
	Male	20122	23152	26183	28933
	Female	1059	1219	1378	1523
	Total (Male + Female)	21181	24371	27561	30456
	Farming Households				
	Male	19513	22458	25397	28065
	Female	1027	1182	1337	1477
	Total (Male + Female)	20540	2364	26734	29542
	Non-farm households				
	Male	609	1913	2164	2238
	Female	32	37	52	78
	Total (Male + Female)	641	1950	2216	2275

Source: Data from woreda's Population office

As shown in the above table, there is clear indication of potentially rapid population growth in the district. As the result of high population growth, per-capital land holding size is decaling. At present 12% of the population in the district are landless and 9.8% own land less than 0.5 hector.

3.2.2 Ethnicity and Religion

The two dominant ethnic groups settled in the district are Amhara and Oromo. The other ethnic groups found in the district include Tigre, Arbore and walayita. The Oromo ethnic group constitutes the majority of the total population. The common languages spoken in the district are Afaan Oromo and Amharic. More than 60% of the population speaks both languages equally while the rest 40% speaks either language. As far as the religion is

concerned, 65% of the population is adherent of orthodox Christian while the remaining 35% are followers of Islamic religion.

3.2.3 Economy

Agriculture is the dominant economic activities subsisting about 97% of the population. The farming system is a mixed type, which is characterized by interdependent crop production and animal husbandry. Generally, the farming system is characterized by low inputs utilization and dependency on rain feed, which is susceptible to changes in climatic condition resulting in recurrent drought. The following two successive sections present the major types of crops produced and animal reared in Derra woreda (Derra Woreda Agricultural Office, Report, 2003)

3.2.3.1 Crop Production

The major crops cultivated in the district are classified as cereals, pulses and lentils (oil seeds). The dominant crops grown in the highland and lowland areas are teff, sorghum, maize, vetch, wheat and horse bean. The productivity of these crops is very low mainly due to decline in soil fertility, persistent shortage of rain coupled with traditional agricultural practice, ravaging crop pests and diseases and low use of modern farm technology, commonly fertilizer and improved variety seeds. As indicated in table 3.2 below, crops yield per hectare of farm plot is very low due to the reasons discussed so far. The major crops produced and yields per hectare in quintals are summarized in the following table.

Table 3.2: Summary of Crops Produced and Yields per Hectare

Types of crops	Yields per hectare in quintals
Millet	12
Teff	7
Sorghum	14
Chike-Pea	5
Barely	8
Wheat	8
Bean	7
Pea	8
Maize	15
Lentil	4
sufflower	n.a
Sesame	n.a

n.a: Not availabl

Source: Woreda Agricultural Development Office, 2004

3.2.3.2 Livestock Production

The second major components of economic activities practiced in Derra woreda is livestock rearing. Livestock is the main source of food, cash income and traction power in all agro-ecology of the district. The district is endowed with high livestock resources. However, production and productivity of the livestock sector is much below its potential benefit mainly due to poor animal husbandry practice, shortage of animal feed, poor genetic of the local breed, prevalence of livestock diseases and poor veterinary services. The livestock population of the woreda is summarized in the table 3.3 below.

Table 3.3: summary of livestock population by types from 1994-1997 E.C

No 1	Livestock	Years			
		1994	1995	1996	1997
	Cattle	142035	152032	154500	154800
	Sheep	125304	16407	17507	17507
	Goats	57430	57407	58460	5860
	Horse	700	494	800	950
	Mule	1400	686	700	920
	Donkey	13801	14801	16301	16601
	Camel	-	-	-	-
	Asses	-	-	-	-

REMARK: camel and Asses are not found in Derra woreda
Sources: Woreda's Agricultural development Office.

3.2.4 Infrastructure and Social Services

Social and economic infrastructure such as potable water, health and education service, road and communication infrastructures plays a pivotal role in the socio-economic development of a community. In the study area both social and economic infrastructures are under developed (SERA Project, 2003). The same report shows that the district is characterized by poor health services coverage. The over all health service of the district is 34 percent, which is below the average for Oromia region, 52.3%. Available evidences reveal that there are only 13 health institutions (1 health centre, 2 clinics, and 10 health posts), providing health services for the community. Generally, the existing health facilities are very far from adequacy in relation to the growing population. The existing health service is not adequate to provide enough service, in terms of both the number and accessibility, compared to the rapidly population.

Though education plays a pivotal role in the socio-economic development of a community, provision of education service is at its lowest level in the study area. The number of schools, teachers, books, library and other teaching materials are not enough or proportional with the number of existing population. The general school participation rate is low, only 25.6% of the total population is literate while about 85.4% of the population is illiterate. Gender disparity in enrolment rate is so high and currently it is 53.3% for boys and 28.8 percent for girls. The total dropout rate is about 14.5 % with higher proportion for boys, which is 16.6%.

In the study area, the majority of the population (63.5%) does not have access to hygienically impeccable water. Accessibility to potable water supply is only 82.5%, though improving over time. The problem of access to clean water becomes more serious for lowlanders as most of the temporary rivers and streams dry up during the dry season. In the lowland areas, people have to travel long distance to fined water for own and their livestock. This means that they are drinking unprotected water, thus exposed to water born infections diseases such cholera, typhoid, fever, diarrhea and hepatitis, which can be transmitted by contaminated water (SERA Project, 2003).

Road and transport facilities are indispensable for the rural community. It is means through which, farmers transport their produce and get access to essential consumer goods and agricultural inputs as well as access to social service delivery centers. Ethiopia is subject to extremely difficult transport condition due to its rugged landscape. As discussed earlier, the landscape of the study area is characterized by gentle steep slops, cliff, undulating mountains and valley covering 45% of the total land mass. This made the construction of road very difficult as well as costly. The study woreda has poor access to road infrastructure. There is only one all weather road that connects the district with the zone capital and other market centers. This made accessibility to basic service delivery centers, outside the main road very difficult. Especially, lowland areas are exclusively isolated from service delivery centers during the rainy season. During this season, most of the rivers in the district are impassable and often people are cut off from the market places; supplies of agricultural inputs and other social services (SERA Project, 2003)

3.3 Derra Integrated Rural Development Project (DIRDP)

Menschen fuer Menschen is a non-governmental, non-political and non-religious humanitarian NGO, founded in 1981 initiated by Dr. Karl Heinz Bometh. Since its foundation MFM has been engaged in promoting rural development program in Ethiopia. Initially, the prime objectives of the program was to rehabilitates and resettle drought and war affected people from the temporary relief shelter of Babile and Jiggiga to Erer vally and provide them with the necessary agricultural and social services, so as to make them self-reliant in food production and other basic necessities. Later on the development programs of the organization have been changed from relief-cum-rehabilitation to integrated rural development interventions. Today, MfM is carrying out an integrated rural development intervention in many administrative regions of the country, with the overall objective of improving the livelihood of the grassroots population, which geared towards alleviating poverty and achieving sustainable development in the country.

The major areas of its project interventions include; improvement in the productivity of traditional rain-fed agriculture; building rural basic infrastructures; promoting public work programs; income diversification of the rural community, environmental rehabilitation and protection; promoting human capital development through education, training (skills development); provision of basic social services like school, potable water; improving health & nutritional status of the rural population; combating harmful traditional practices and empowering the local peoples are also the major components of the menshcem fuer meschen foundation. Derra rural development project is an integrated rural development project undertaken by Menshcem fuer Meschen foundation. The project is founded in 2000.

The main justification for MFM intervention in the district is the deep-rooted socio-economic development problems, which include sever environmental degradation; problem of Food insecurity; poorly developed infrastructures and social services; discrimination of women and the prevalence of backward traditional practices. Limited capacity of the local government to address all priority problems of the community as well as the absence of any other NGOs, carrying rural development in the area also initiated the foundation of the project.

The project is aimed to promote rural development with particular emphasis towards attainment of food security and protecting and rehabilitating the natural environment. Improving the socio-economic condition of rural women; renovating and construction of school and health posts; development of water points and construction of access roads and bridges, enhancing the capacity of local community and overcoming harmful traditional practices and expansion of employment generation scheme through provision of credit services are the major objectives of the project (DIRDP, 2005).

3.3.1 Components of Derra Integrated Rural Development project

Derra integrated rural development project has four major components. These are agro-ecology, women in development, and development of social and economic infrastructures. The main program components of agro-ecology sub-sector are natural resource conservation and development, and crop and animal husbandry. The overall objective of this sector program is to promote natural resource conservation and development, increase agricultural productivity and production in a sustainable way to achieve food security in the project effect area.

The major activities conducted under natural resource conservation and development includes physical and biological Soil and water conservation measures. May physical soil and water conservation activities are developed by the project such as terracing; bund construction; maintenance of conservation structures; gully rehabilitation and stone house construction. Biological soil and water conservation measures developed by the project include bund stabilization by grass strips and multipurpose trees and a forestation. Various seedlings that are produced by both the project and private run nurseries were planted on communal area closure, in the compounds of different institutions such as schools, mosques, churches, governmental and non-governmental organizations and individual farmlands.

To sustain yield thereby to secure food security throughout the year a wise utilization of the available water resources is essential. The project performed different activities to increase agricultural production and productivity in the study area through development of small-scale irrigation; improvement of the existing traditional irrigation schemes and promotion of small-scale irrigation devices. More over, promotion of vegetable gardening,

introduction and promotion of agronomical useful crops; introduction and promotion of organic manure are also the major activities performed to improve the productivity of the subsistence agriculture. In addition to all these, activities such as forage extension; provision of veterinary service; breed improvement and improvement of small ruminants are conducted to improve animal production and productivity by the project.

The second major component of DIRDP is improving the socio-economic condition of rural women. The main objective of the sector is improving the living condition of the rural women through improving their income status, bringing behavioral and attitudinal change of the community on harmful traditional practices and enhancing the capacity of the rural women through training. To address the economic problem of resource poor women, farmers' backyard poultry production, traditional beekeeping for generating income that used to meet their immediate cash need and thereby ensure food security.

The major activity includes home improvement upon awareness creation through training in the importance of home economics management. This includes partition of the houses, construction of ventilated improved pit (VIP) latrines and waste disposal pits, installation of improved stove. Rural women spend most of their time substantially in collecting firewood for cooking under discomfort situation. Fuel-efficient stoves introduced by the project are substantial in saving firewood thereby minimizes deforestation, time and energy and fire hazards likely to occur because of open firing. Poverty in the project area is deep rooted in which women are the fore-most victims. In order to address this problem, credit and saving scheme is one of the interventions being undertaken in the area.

The most serious problem in Derra woreda that affects community development is the existence of HTPs such as early marriage, female circumcision, rape, etc. The two social groups in the community who are victims of such practice are women and children. To address these problems, changing the attitude of the community through advocacy work is highly essential. Over 95% of the schoolboys and girls come from rural areas where the above-mentioned traditional practices take place at large. The project organizes school clubs; give training for community leaders, and religious leaders to avoid the bad of HTPs. The school clubs play a vital role in changing the attitude of the community through drama, poems and songs that express the bad effect of HTPs.

The third and fourth sector consists of promoting economic and social infrastructures. The social infrastructures include health, water and education development sectors. The overall objectives of the sector are to increase enrollment rate of school age children and improved access of the community to potable water and improving the health status of the population. Access to school for illiterate adults and school age children through promotion of non-formal education are also done by the project. The major activities of education and water development sectors performed by the project include construction and renovation of schools, provision of school furniture and development of water points (DIRDP, 2005). Another important social infrastructure development is improving the health status of the population. The main objective of the sector includes improving access of the community to health service and improving the quality of health services. The main activities performed to improve health status of the population include construction of health posts, polyclinic and provision of ambulance service, prevention of blindness, malaria control and provision of health education and control prevalence of HIV/ADIS through community education.

3.3.2 Description of Balla Gudda and Bacho Irrigation Schemes

Balla Gudda small-scale irrigation scheme is located in Illu Godachafe peasant association, which is one of the 33 PAs found in Derra woreda. It is located at about 23 kms away from Gundo Meskel town, the capital of Derra woreda. This area is known for its deep-rooted social and economic problems. Above all problem of food insecurity is wide spread among the community. The project is developed as one solution to address the problem of food insecurity through the development of small-scale irrigation scheme.

As discussed earlier the area is endowed with many perennial and intermittent rivers and springs. However, lack of capacity hindered the community to develop the existing water resources for cash crop cultivation. Currently, Balla Gudda spring is developed for small-scale irrigation by Derra Integrated rural development project. The irrigation scheme was started its operation in 2004. According to the study conducted by DIRDP, Balla Gudda small-scale irrigation scheme has the capacity to irrigate 40-50 hectares of land and can benefit about 150 households. However, at present the much of the irrigable land is not utilized. 45 households cultivate only 16 hectares of the irrigable land during the period of the survey.

Prior to the development of the scheme the command land was used for the cultivation of crops using rain fed water. After the development of the scheme, the local government officials in agreement with the stockholders distributed the irrigable land for 65 households. The maximum landholding size is 0.5 hectare (given to the former owner of land) and 0.25 hectare allocated to the new comers. The new comers are those households who did not have irrigable land allotted irrigable land as the result of the development of the irrigation scheme. The former owner of farmland (which developed in to irrigation land) was compensated the same size of land from the plot of the new comers elsewhere.

The major cash crops produced in Balla Gudda irrigation scheme include vegetables (onion, cabbage, tomato, groundnut and pepper) and fruit trees such as papaya, mango, avocado, banana and sugarcane. Concerning the marketing of cash crops farmers use local markets to sale their products. There are about five local market places located in the villages and at Gundo Meskel town. There are also markets locally known as 'GULIT' where marketing of cash crops and some industrial commodities are sold on daily or more than 3 days per weeks. However, there is a problem of transportation to get access to markets. Farmers only use pack animals and human power to transport their products to markets.

Another irrigation scheme improved by the project is Bacho Small Scale Irrigation. The scheme is not recently developed by DIRDP, but it is owned and traditionally practiced by the community for a long period. In Bacho-wajitu peasant association there are a number of perennial springs that are traditionally developed for irrigation farming. However, the traditional schemes need substantial improvement of both hydraulic and water management to maximize its benefit. Baseline study was conducted by DIRDP to develop the existing traditional irrigation schemes in to modern irrigation, but most of them are found not feasible for modern irrigation because of unsuitability of the topography of the area and small water discharge. Therefore, the improvement of the existing system has been found a vital task. Accordingly, Bacho small-scale irrigation is one of the traditional schemes improved by the DIRDP. At present 185 households produce cash crops on 76.25 hectares of land

The Improvement activities performed to improve the existing traditional irrigation scheme include construction of simple hydraulic structures such as construction of a simple diversion canals, cross-drainage, night storage ponds that cannot be done by the farmers due to lack of capacity. Farmers' training on water management and extension work on appropriate irrigation practices is also given for farmers.

The major crops produced in Bacho irrigation scheme are vegetables (garlic, onion, potato cabbage, tomato, sugar cane, pepper) and some tree fruits like orange, banana, mango, papaya ...etc. Farmers are provided with extension services and improved variety seeds by the project.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Demographic and Scio-economic Characteristics of Sample Households

According to the result of the baseline study by SERA project (2003), the total number of population who live in Illu-Godachafe and Bacho-wajitu peasant associations are 4712 and 3515, respectively. Out of the total population of the former peasant association, male account 2202(46.73%) while the remaining 2510 (53.27%) is female population. In Bacho-Wajitu peasant association, the number of male population is 1630(46.37%), while the remaining 1885(53.62%) is female population. The demographic and socio-economic characteristics of sample households are summarized in table 4.1 below.

Table 4.1: Demographic Characteristics of Sample Households, 2006

Attributes		Household groups				Total
		N	Irrigators, (%)	N	Non-irrigators, (%)	
Sex of Households	Male HH	60	100	115	82.15	87.5
	Female HH	0	0	25	17.85	12.5
Education of HHs	Literate	17	28.3	46	32.9	31.5
	Illiterate	43	71.7	94	67.1	68.5
Marital status HHs	Married	58	96.7	135	94.4	96.5
	Divorced	0	0	1	0.7	0.5
	Widowed	1	1.7	2	1.4	1.5
	Separated	1	1.7	2	1.4	1.5

Source: Household survey, 2007

Sex of Sample Households

Table 4.1 shows that out of 200 sample households, 25(12.5%) are female households while the remaining, 175 (87.5%) are male-headed households. All of the irrigators are male-headed households. In both sample irrigation schemes, Balla Gudda irrigation, with 45 beneficiaries and Bach irrigation, with 185 beneficiaries, there were no female-headed irrigator households. Female households were not engaged in irrigation farming directly

through cash crop farming or through crop sharing with male households. Especially, Balla-Gudda irrigation scheme are located in lowland area at distance of about 14 kilometers far away from the settlement area of the community. Under such situation, it is difficult for the female-headed household to practice irrigation farming. This could be one possible reason for the absence of female irrigators in this scheme. In case of the non-irrigators, 25(17.85%) female-headed households were included in the sample while the remains are male-headed households.

Education and Marriage of Sample Households

When we look at the literacy status of the sample households, 17(28.3%) of irrigators are literate, while the majority 43(71.7%) of the households is non-literate. From the total non-irrigator households 46(32%) are literate while 94 (68%) of the non-irrigators are illiterate. Here, literate household refers to whose households who can read and write in any language. The majority of the sample households in this survey responded that they could read in Amharic but not in any other languages. Only few of them can read in Afaan Oromo. The difference in the literacy level of the sample households is not because of the use of irrigation farming. One possible explanation for the difference in literacy level might be the availability of the education services in the near by area, of household's settlement.

With regarded to the marital status of sample households, 193(96.5%) of the entire sample households are married. In contrast, out of the 140 non-irrigator sample households 135(94.4%) are married. The corresponding figure for the irrigator households is 58(96.7%). In both cases almost all of the sample households are married and households who separated are insignificant. The figure shows only, 1(1.7%) and 2(1.4%) for the irrigator and non-irrigator households.

Age and Family Size of Sample Household

As indicated in table 4.2, the mean age of the sample households' head is found to be 46.25 years. It is 46.87 for the irrigators and 45.62 for the non-irrigator households. Household heads in both groups seem relatively young. The average age in both cases is almost located at the middle of productive age category (15-65).

Household size could have effect on labor resource and on food consumption of the family. In the study area, the average family size for the entire sample households is found to be 6.015. That means, on average each household is expected to feed about six members of its family. The average family size is 5.93 and 6.1 for the irrigators and the non-irrigator households. Comparison of the average family size of the two household groups shows that it is higher in non-irrigator households than the irrigator households. The difference in the family size may have different effects on household's food security as it affect labor availability and food consumption. This is because household's food security condition should be seen in relation to the number of people that a given household is feeding and labor availability that produce or engage in different activities.

Table 4.2: Average Age and Family Size of Sample Households

Household Groups	Family Size of HHs	Age of HHs
Irrigators	5.93	46.57
Non-irrigators	6.1	45.62
Both	6.015	46.25

Sources: Field Survey

Average Landholding

According to the report of the Ethiopian ministry of agriculture (1986), the current average landholding size is less than one hectare in many parts of the country. In the highland areas, it is about 0.5 hectare on average. The shortage of land aggravated by population pressures, as new households have to share the existing cultivated land with their fellow peasant association or their parent land, or in some cases clear forest or grazing land for cultivation. This situation indicates that landholding size would be one of the determinants of the household's food security since it affects production and household income. The landholding size of the sample households is summarized in table 4.3 as follows.

Table 4.3: Average landholding of the sample households, 2006

Household Groups	N	Average total landholding (Hectare)	Average Non-irrigable landholding (ha.)	Average Irrigable landholding (ha.)
Irrigators	60	1.38	1.077	0.3027
Non-irrigators	138	1.53	1.53	-
Both	198	1.445	1.3035	-

Source: Field survey, 2007

As can be seen from the above table, the average landholding size of the entire sample households is found to be 1.445 hectares. There is a difference in average landholding size between the two groups of households. It is 1.38 hectares for irrigator households and 1.53 hectare for non-irrigators. The figure shows that the landholding size is better in non-irrigator households than in the former group. The difference in landholding size could be attributed to the availability of land and population density of the area. The difference in the size of landholding between the irrigators and non-irrigators did not have relation with the use of irrigation. The small size of land in the irrigator households did not give the implication that household's with small landholding size participate in irrigation and whose with large size did not.

The irrigation project was selected and developed based on the availability of water in the project site and no other factors like landholding size, family size, sex and age of the households was taken in to account to select the beneficiaries. Therefore, any differences between irrigators and non-irrigators in the basic socio-economic characteristics described above are not because of the use of irrigation.

Taking into consideration the productivity of land and the existing farming practice of the sample households, the current landholding size is not sufficient to produce enough food for their family which is 5.93 & 6.1, for irrigators and non-irrigator households, respectively (Comparison of households food security from own production is presented in table 4.12).

4.2 Crops and Livestock Production

4.2.1 Crop production

As discussed in chapter three, crop production and animal husbandry are the most important economic activities, on which the livelihood of about 97% of the population of the study area is based. Crop production is one of the common ways of acquiring food for rural farming households. The major crops cultivated include millet, teff, sorghum, chickpea, barley, wheat, horse bean, maize, sesame, lentil and neug. The dominant food crops grown in the study area are teff, sorghum, wheat and maize. According to the focus group discussion with farmers, they grew these crops both for food and cash income. Focus group discussion with farmers indicates that sesame; lentil, neug and teff are particularly cultivated for cash income.

Under normal conditions of farming (rain pattern) farmers produce twice a year using *Belg* rain (from February to May) and main rain (meher) from June to September. In addition, farmers also use irrigation as supplementary to rain-fed agriculture. The recent trend is that food crop production is largely dependent on the main rainy season. Focus group discussion with the local DAs and leaders of the study PAs indicates that there was no *Belg* season harvest during the past five years due to climatic change (unavailability of *Belg rain)*. They also added that this situation in turn adversely affected the food security of the households because the majority of farmers only produce once in a year using rainwater.

They also emphasis that food crop production from meher harvest has not been sustainable mainly due to unreliability and poor distribution of rainfall. The production of food grain is also retarded by small landholding size, which is 1.445 hectare on average and low productivity of subsistence crop production. In addition, limited use of modern agricultural inputs, commonly fertilizer and improved variety seeds, reduced yield per hectare of land, which challenges the availability of food both for the household and markets, due to absence of surplus production. The summary of the amount of food crops produced by sample households in 2006 cropping year is presented in table 4.4.

Table 4.4: Average Food Crops Produced by Sample Households in 2006 (1998-1999 E.C) Cropping Year in Quintals

Household groups	Average landholding (hectare)	Average crop produced (Quintals)
Irrigator HH	1.38	7.5
Non-irrigator HH	1.53	6.12
Both	1.445	6.81

Source: - Field Survey, 2007

As can be seen from table 4.4, the average annual crop production of the entire sample households is 6.81 hectares. In relative terms irrigation households have been able to produce about 1.38 more quintals of food grains as compared to the non-irrigator households. However, the non-irrigators are better in landholding size. One possible explanation for the difference in annual harvest between the two groups is the difference in the use of agricultural technology, commonly fertilizer and better seeds. According to the result of the survey, 72.12% of the sample irrigators used fertilizer for crop production in 2006 cropping year. On the other hand, the survey result reveals that 67.18% of the non-irrigators used chemical fertilizer in 2006 cropping year.

The perception of the farmers towards the long-term impact of using chemical fertilizer is one of the possible explanations for the limited use of modern agricultural inputs. Some farmers believe that farmland gets used to fertilizer will be impossible to produce crops with out fertilizers. Moreover, farmers fear that they might be indebted in case of crop failure and reduction in the price of food grain in market during harvest season. Many respondents also replied that the required installment asked during registration for fertilizer and the inconvenience of payment period is the major constraints to use modern inputs.

Improved variety seed is another important agricultural input for the farming households. An average yield of a parcel of land is also depending on the use of improved variety seeds. Regarding the use of improved variety seeds in the study area, the result of the survey shows insignificant number of users in both groups of households. Out of the total sample households, 27% of the irrigator's and 19.3% of the non-irrigator households used improved variety seeds during 2006 cropping year.

Many household heads respond that low adaptation of improved variety seeds and limited availability of needed seeds, for teff and sorghum, are among the reasons for the limited use of improved varieties seeds. The commonly available improved variety seeds are for wheat and maize. On top of this, the expensiveness of seeds is the major reason for the limited use the input. The survey result indicate that 58% of the responds from the irrigators and 73.2% from the non-irrigators, commonly respond the price of improved variety seeds as the major problems for the limited use of high yield variety seeds.

As the above figure shows the irrigators are in better position in the use of agricultural technology, commonly fertilizer and improved variety seeds. The difference in the use of modern farm inputs could be because of the variation in the purchasing capacity of the households. In case of the irrigators extra income earned from sale of cash crops (irrigated) could be invested on fertilizer and high yield variety seeds. Earlier research by Fuad (2001) in central Ethiopia came across with the findings that the irrigators used chemical fertilizer and improved variety seeds more than their non-irrigator counterpart. Particularly, income from sale of cash crops could cover payments required during registration for inputs, which is identified as the major problem for most of the farmers to get access to modern agricultural inputs.

Concerning the availability of credit services for agricultural inputs, the government is the only source, available to farmers in the study area. The survey reveals that 63.3% of the irrigators and 78% of the non-irrigators households depend on agricultural inputs provided through woreda agricultural development office. Only 1.7% of the non-irrigators and 3.6% of the irrigators gets credits from the non-governmental organization, menshen fuer menshen.

Farmers were asked about the situation of payment for credit service. The result shows that 52.9% of the non-irrigators and 48.3% of the irrigators faced problem to payback credits for agricultural inputs, commonly fertilizer and improved variety seeds. The major repayment problems indicated by the sample households include inconvenience of the payment schedule, decrease of agricultural outputs and high price of inputs.

4.2.2 Livestock Production

Livestock rearing remain an integral part of the livelihood of the farming system in the study area. Crop and livestock production is integrated in such way that they are of mutual benefit to each other. Farmer use animal traction for land preparation (traction power), threshing and transportation of grains as well as manure and other farm inputs to the farm plots to improve the fertility of the land and thus raising crop yields. The income generated from sales of livestock and livestock products is used to purchase agricultural inputs to improve crop productivity. Livestock is also used directly as source of food and cash income. Thus, the livestock sector played a great role in ensuring the food security of the farming household. The summary of livestock ownership of the sample households is summarized in table 4.5 below.

Table4.5: - Summary of Households' livestock ownership by size and type in, 2006 (1998-1999 E.C)

Types of livestock	Irrigators		Non-irrigators	
	N	Average	N	Average
Oxen	60	1.8	133	1.41
Cow	56	1.86	136	1.22
Young animals	58	2.6	137	1.914
Sheep & Goat	59	3.41	140	2.57
Equine	39	1.28	96	1.2
Poultry	48	3.11	131	2.22

Young animal refer to calf, heifer and bull
Source: - Field Survey, 2007

As shown in the above table a significant number of survey respondents had no adequate number of livestock population, which could presumably be one of the major causes of lack of access to adequate food supply for several households. The table shows that both the irrigators and non-irrigator households had no access to a pair of important farm animal, oxen. The survey result shows that the irrigator households own 1.8 oxen on average where as the average share of oxen for the non-irrigator households are 1.41. Out of the 140 non-irrigator households seven of them did not own oxen, which are an important agricultural input for farming households. Shortage of traction oxen is one major problem of subsistence agriculture for farming households. According to the focus group

discussion with farmers an ox-sharing practice is one means of solving the problem, whereby a household share his/her oxen with other partner for a particular workday. However, in traditional agriculture where the calendar should perfectly match with rainy season, ox-sharing practice hinders the timely cultivation of land, being one of the causes of low production and household food insecurity. The ownership of young animals (bull heifer, and calf) is relatively higher in irrigation households than non- irrigation households, which is 2.6 and 1.91 on average, respectively.

Comparison of the distribution of goats and sheep indicates that the irrigation households owned higher number of sheep and goats on average. The figure for sheep and goats is 3.41 for irrigator households where as it is 2.57 for their non-irrigation households. Equines (pack animals) are the scarcest livestock assets owned by farmers in the study area. It accounts about 1.28 & 1.2 for the irrigators and for non-irrigation households, respectively.

As indicated in the background of the study area, market infrastructures, road and modern means of transportation, are poorly developed in the project area. Farmers only use backward means of transportation, pack animals and human power to transport their products to the markets. The difference in the owner of equines could be because of the reason that the irrigators used pack animals for transporting their irrigation products to the markets. Regarding the ownership of poultry, the irrigator households are in a better position than the non-irrigators are. The table shows that irrigators own 3.11 poultry, on average, which is only 2.23 for the non-irrigator households.

The above inquiry, to identify the households' endowment with livestock resources, is based on assumption that those households who owned more quantity and quality (though data was not gathered on quality) of livestock resources are less likely to be affected by food insecurity than those who do not. Particularly, ownership of small animals such as goats, sheep, heifer, calf and poultry are very important for households to get access to food because these animals are the first to be sold whenever the household is in need of cash and faced with food shortage.

In spite of their crucial importance as a direct source of food, means of rural transport and traction power, livestock could be sold during food consumption shortfalls for cash to purchase food items. However, the livestock position of the households could be found to be unremarkable. A significant number of the respondents owned very small number of livestock (see table 4.5).

Generally, the table shows that irrigators are relatively more endowed with livestock resource than their non-irrigation counterpart's are. The above comparison of the irrigators and non-irrigator households in terms of their livestock ownership indicate that the irrigation households owned more livestock assets. This could be because irrigation farming could affect the livestock sectors indirectly through production of forge for livestock, (which improve productivity and production), and directly through investing income from sale of cash crop in to the livestock sector. Income from cash crops directly used to buy livestock assets that could improve the livestock owner ship of households or used to buy other necessary inputs for the production of livestock. Thus, by considering the crucial role of the livestock resources, one can safely say that the non-irrigator households are more likely to be at risk of food insecurity than the beneficiaries of irrigation are.

4.3 Irrigated Cash Crop Production and Marketing

4.3.1 Irrigated Cash Crop Production

As discussed in the literature, the development of small-scale irrigation would stabilize agricultural production and assure food supply even in years with inadequate rainfall and increase the overall level of crop production in years with normal rainfall (Dessalegn, 1999). In areas of small landholding size and unreliable rain-fall situation, irrigation farming plays great role in enhancing agricultural production and productivity. Irrigation households have been able to produce two times a year using the irrigation water and able to increase and sustained their agricultural production, hence, household level food availability and access.

In this thesis, the term 'cash crop' refers to crops (vegetable and fruits) produced using irrigation for the purpose of cash income. This dose not means that household did not consume parts of its produce. It must also be clear that cash crop production in this study

did not refer to the massive production of export or commercial crops such as cotton, tobacco . . . etc that could be produced using large scale irrigation. The study limited only to cash crops produced using small-scale irrigation. However, household's income from sale of cash crops produced using rainwater was collected for both groups of the households.

In this study, the contribution of two irrigation schemes, Bala-Gudda and Bacho small-scale irrigations to households' income and food security will be discussed. The detail description of these schemes is presented in the background section of the study area. The potential, land under cultivation, number of beneficiaries and the major crops cultivated in the two schemes is summarized in table 4.6 as follows.

Table 4.6: Summary of major Cash Crops cultivated in sample irrigation Schemes, 2006

Irrigation Scheme	N	Cash Crop Cultivated	Irrigable Land (Ha.)	Land under Irrigation (ha.)	Average Landholding (ha)
Balla Gudda	45	Onion, potato,tomato,pepper, cabbage, papaya, Avocad, pea-nut, and sugarcane	40-50	16	0.35
Bacho	185	Potato, onion, garlic, pepper, cabbage, tomato	NA	67.25	0.25
Total	230		-	83.25	0.30

NA: Not Available
Source: -Field survey, 2007

According to the estimation made by DIRDP (2003), Balla Gudda irrigation scheme have the potential to irrigate 40-50 hectares of land and can benefit about 150 households. After the development of the scheme, the local government officials in agreement with the stockholders distributed irrigable land for 65 households. The maximum landholding is 0.5 hectare (given to the former owner of land) and 0.25 hectare allocated to the new comers. The former owner of farmland (commanded irrigable land) was compensated the same size of land from the plot of the new comers elsewhere. Out of 65 households, for whom irrigable land was allocated, only 45 households produce cash crops on 16 hectares of land during the period of the survey, which is less than 25% of the potential.

Focus group discussion was held with the irrigators to identify the major problems for the under utilization of the existing potential of the scheme. The major problem raised by the group was the distance between the irrigation scheme and the settlement area of the community. The project was developed following the availability of water in the lowland area, which is not located in the nearby settlement area of the community. On average, the settlement area is located in the highland at a distance of about 14kms faraway from the irrigation site. Since irrigation farming requires intensive labor and close follow up, the distance between the settlement area and the irrigation site is the major obstacle for the irrigator himself or herself. Moreover, farmer's lack of irrigation experience and clear understanding of the advantage of irrigation is other reasons for the under utilization of the existing irrigation potential.

According to an interview made with development agent of DIRDP, the majority of the irrigators were those who could not able to produce sufficient form rain feed agriculture and engaged to supplement their subsistence farming. Recently, many households began to settle around their irrigation scheme supported by the DIRDP. The project provides them with financial and technical supports for house construction and development of social infrastructure like water, health center, building of school and a provision the credit service. However, the resettlement program is constrained by shortage of construction materials. The newly settled households constructed simple houses from stone with the combination of mud.

The major crops grown in Balla Gudda small-scale irrigation scheme include vegetables (onion, potato, garlic, tomato, pepper, cabbage) and perennial tree crops (coffee, banana, papaya, mango, orange, avocado...etc). As observed by the researcher, during the field visit, papaya and mango trees are widely planted in this scheme. In other parts of the district, farmers traditionally cultivated some of these crops but others are recently introduced by Menshen Fuer Menschen Derra Integrated Rural Development project

In Bacho small-scale irrigation scheme 185 households are currently produce cash crops on 67.25. The major cash crops grown include onion, garlic, tomato, cabbage, papaya and perennial crops like coffee, orange and other fruits. This irrigation scheme is not newly developed by the Derra integrated rural development project, but the project provides

technical assistance and inputs for the beneficiaries. The community owns it and farmers traditionally cultivated cash crops for long period prior to the improvement of the scheme. In both the study schemes, the cultivation of cereal crops using irrigation was non-existent. In both schemes, farmers produce market-oriented cash crops to generate income.

In Becho irrigation scheme potato, onion, garlic, pepper and cabbage are the major crops cultivated by farmers. Moreover, perennial trees like mango, orange, banana and papaya are also cultivated. In both schemes, farmers are provided with irrigation extension services on cash crop production, preparation and application of organic manure and water management.

4.3.2 Irrigated Cash Crop Marketing

The availability of market plays a great role for the development of irrigation agriculture. Market is a source of agricultural inputs and center for sale of cash crops. Income obtained from cash crop is also dependent on proximity to markets and availability of market infrastructures.

Concerning the marketing of cash crops in the study area, farmers use local markets to obtain irrigation inputs (seeds and fertilizer ...etc.) and to sell their cash crop products. There are about five market places located in the villages and at Gundo Meskel town, the capital of Derrea woreda. There are also markets locally known as 'GULIT' where marketing of cash crops and some industrial commodities are sold on daily or more than three days per week. However, there is the problem of transportation to get access to the markets. Market infrastructures are poorly developed in the study area and farmers only use pack animals and human power to transport their products to the market. More developed markets and market infrastructures are not available in the study area, which adversely affect the marketing of cash crops. Key informant interview with one of the model farmer in Balla Gudda irrigation scheme, Ato Mohammad, strongly emphasized the problem of market (cheap prices) and market infrastructures (transportation problem). All cash-cropping households produce almost similar types of cash crops and all of them depend on local consumers (local markets). He further added that they receive cheap prices for their outputs for the reason explained above.

Besides, the cash crop community of the study scheme has not organized in a union to deal with the marketing of their products and often their production suffers from low price. Absence of cash crop farmers union reduced their bargaining power for their outputs. Marketing of cash crops is conducted on individual basis creating competition for the market for similar goods.

4.3.3 Major constraints of Irrigation Farming in the Study Area

In the study area, the performance and effective use of traditional small-scale irrigation farming is constrained by multi-dimensional problems, ranging from individual farmers attitude to institutional arrangements. The commonly indicated problems by irrigation users are discussed as follows: -

Small size of irrigation plots is considered by the focus groups to be the major bottleneck of irrigators to maximize their benefits from irrigation. As indicated earlier the average landholding size for the household is less than 0.5 hectares. However, some farmers in Balla Gudda irrigation scheme did not engage in irrigation farming. Though land was distributed for 65 households, only few of them are participated in cash crop production.

As indicated by framers, the allocation of irrigable land has initiated the issue of land tenure insecurity. According to the information obtained from focus group discussion with the former owners of land, the redistribution of their land makes them insecure about their land property right. Household who have larger plot of size are suspicious about their tenure right over their irrigation land. They often believe that the government could develop the area to state owned irrigation farming or further distribute their irrigable land to other households.

Frequent damage of irrigation water structures such as diversion weir and earth canal, is among the major problems responded by the irrigators. During the rainy season, diversion weir and earth canal was destroyed and farmer waste valuable time and energy at the end of the rainy season on repair and construction work. In addition, there was a time when the diversion weir was taken away by flooding and a new system was constructed at the end of rainy season.

Inadequate farmers' knowledge (skills and experience) in irrigated agriculture resulted in poor performance of small-scale irrigation scheme. Irrigation farming was conducted based on traditional methods and farmers own experiences. Recently, DIRDP has started providing technical support and training on water management and the use of organic fertilizer (compost). To reduce dependence on chemical fertilizer, farmers are also given training on how to prepare and apply organic fertilizer (example compost).

Water distribution has central importance in any irrigation scheme. In all irrigation schemes under the study, water is distributed by turns for equal duration, simply following spatial order of plots from the sources of water, regardless of water requirements of the crop cultivated. However, different crops require different amount of water and watering intervals to each crop cultivated. This in turn affects the yield of cash crops and its productivity.

Lack of market and marketing facilities are among the major problem for smallholder irrigators in the sample irrigation sachems. Lack of storage facility and absence of proper functioning farmer organization, all have contributed to low farmers bargaining power especially on the marketing of potato, onion, and tomato. Moreover, absence of transportation facilities forced households to use traditional means of transporting their outputs, which is exhaustive and some times leads to damage of their outputs, especially tomato, cabbage and other simply damaged cash crops. The low price of their outputs in the market was also cited as the major constraints for irrigators.

Settlement pattern of the irrigators are one of the obstacle for irrigation development in Balla Gudda irrigation scheme. This irrigation scheme was currently developed by DIRDP in the lowland area of the Illu-Godachafe peasant association. The beneficiaries of the scheme are located (settled upon the highland) at an area about 14 kms faraway from their irrigation site, (the distance is not based on accurate measurement but in was estimated by focus groups). Moreover, there has been a culture of open grazing system during the dry season, which resulted in water canal and crop damage by livestock. The majority of the respondent's also cited wild animals such as apes, monkey and others damage their crops during night and thieves also took even their products away. In addition the rugged topography of the area, made the journey to the irrigation cite and from there to home.

Level of awareness by itself could pose difficulty in irrigation development. In Balla-Gudda irrigation scheme DIRDP, identified 40-50 hectares of irrigable land during the baseline study of the project but only 16 hectares, of the potential irrigable land, is used for cash crop production during the survey. This is mainly because of lack of clear understanding of the advantage of irrigation farming in addition to the aforementioned reasons.

4.4 Household Income and Income Diversification

As reviewed in the literature, diversification of income is a norm in rural households. Very few farming households collect their income from any single sources, hold all their wealth in the form of any single assets, or use their assets in just one activity (Ersodo, 2006). In normal time, rural households collect their income from sale of food grains, livestock and livestock products, seasonal employment and off-farm income generating activities. This is also the usual pattern of rural household's income sources in the study area.

This research is limited to the study of household's income in the year 2006 (1998-1999 E.C). To make the collection of data and analysis easier, total income of the household is divided into four categories based on the source from which household generated their income. The four categories of the household income are income from sale of cash crops (irrigated and rain fed), food crop production, income from livestock and livestock products and income from off-farm activities. The last three sources of income are common to both groups of households (i.e. irrigator and non-irrigator households). Nevertheless, the irrigator households have additional sources of income from sale of cash crop produced using irrigation. During the survey, data was collected on income of the household's from all sources of income to see the differences in annual income and the food security status of the two groups of sample households.

Income from food crop production refers to the value in Ethiopia Birr (ETB) that obtained from sale of food grains harvested by the household during the reference period. On the other hand, cash crop income refers to income generated from sale of cash crops (vegetables and fruits) produced by the household using irrigation from his/her plots or through share cropping with partner.

It also includes the income from occasional rent of irrigable land during 2006 irrigation harvest reason. Income from livestock production includes the income generated from sale of animals and animal products and income obtained from rent of animals (oxen and pack animals). The fourth important source of household income is income earned from off-farm and non-farm activities. Income obtained from other sources refers to income from wage labor, petty-trade, weaving, sale of firewood and charcoal; sale of local beverage, blacksmith, pottery, remittance... etc.

4.4.1 Income of Irrigator Households

As shown in table 4.6, the average income of irrigator households is 2416.65 ETB. When we look at the average income obtained from different source (cash crop, food grains and livestock production and off-farm activities), income from sale of cash crop comes in the forefront. The average income earned from irrigated cash crops is 1084.6 ETB, which is the highest average income obtained by irrigators, constituting 44.8% of the total income. The corresponding figure for the livestock average income is 712.35 ETB while the average income for food grain and off-farm income is 382.3 and 237.25 ETB, respectively. Income from food grain production accounts for about 15.85% of the total income. Its contribution to household income is not significant as the cash crop and livestock incomes.

Livestock rearing remain an integral part of the livelihood of the farming system in the study area. Livestock is the main source of food, cash income and traction power. As indicated in table 4.7, livestock production is the second important source of household income next to income obtained from cash crops. It accounts about 29.47% of the total household income. Income from off-farm activities is the least contributor to households' total income constituting 9.81% of the total income.

Table 4.7: -Average annual income of sample irrigation Households In 2006 (in ETB)

Source of Income	Average annual Income	Share, (%)
Cash crop	1084.6	44.8
Food grain	382.3	15.82
Livestock	712.35	29.47
Off-farm activities	237.25	9.81
Total	***2416.65***	*100*

Source: Field Survey, 2007

4.4.2 Income of Non-irrigator Households

As indicated in the following table, non-irrigator household earn income from all the three sources (food grains, livestock and off-farm activities) with the exception of income from irrigated cash crops. The majority of the non-irrigators derive their income from subsistence farming, food crop production and livestock rearing. Few households supplement their income from mixed farming by participating in the off-farm activities.

The average total income of the non-irrigation households is 1206.32 ETB, which is the sum of incomes from sale of food grain, livestock and livestock products and income from off-farm activities. The result of the study is summarized in table 4.8 below as follows.

Table 4.8: Average Annual income of Non-irrigator households, 2006

Source of income	Mean (ETB)	Share, %
Food grains	236.75	18.4
Livestock and Livestock products	592.32	46.2
Off-farm income	453.00	35.4
Total	1206.32	100

Source: Field survey, 2006/7

As indicated in table 4.8, non-irrigator households derive their income from three major sources. The highest share of income is earned from Livestock and livestock products, which account for 46.2% of the total income. The figure shows that Livestock Production is the major source of household income in addition to their use directly as food and traction power in agriculture.

The share of income from food grain is not as high as the Livestock income. It only accounts for about 18.4% of the total income of the household. The reduction in food grain income is mainly because of the decline in household's total harvest which is only 6.12 quintals per household on average (look at table 4.4). The result of the study also reveals that off-farm activities are the second major source of income for non-irrigation households. It contributes 35.4% of the total income of the non-irrigators households.

4.4.3 Comparison of Incomes of Irrigator and Non-irrigator Households

In the previous section the average total annual income of the irrigator and non-irrigator households and the contribution of each sources of income to the total income of the household are discussed for both groups of the households. In this section, the comparison of the average total annual income and the percentage contribution of each sources of income to household's total income are discussed. The comparison is based on the total income they earned in ETB from different sources in 2006.The summary of the comparison is shown in table 4.9.

Table 4.9: Comparison of irrigators and non-irrigator Households Average *Incomes by Sources (in Birr), 2006*

Source of incomes	Irrigators		Non- Irrigators	
	Value in Bir	%	Value, in Birr	Share, %
Cash crop income	1084.6	44.8	-	-
Food grains	382.3	15.82	236.75	18.4
Livestock & livestock Products	712.35	29.47	592.32	46.2
Off-farm activities	237.25	9.81	453	35.4
Total	**2416.65**	100	**1206.32**	100

Source: Household survey result, 2007

As elaborated in the above table, the contribution of different sources of income to the total income of irrigators and non-irrigator households is different. Livestock & livestock products are the major source of income for non-irrigator sample households. When we look at the contribution of livestock to household total income, it is significantly higher in the irrigator households in relative terms. The average income obtained from sale of livestock and its products account for about 712.35 and 592.32 ETB for irrigator and non-irrigator households, respectively. This implies that in absolute value terms the irrigator got higher income from livestock and livestock products. An improvement in livestock feed in turn; improve livestock production and productivity, which might be resulted in improvement in household's food security. Income from sale of cash crop could also used to buy livestock assets, which improve livestock owner ship of the households.

Comparison of relative income earned from food crop production reveals that it is higher in irrigator households than in the non-irrigator households. In addition, the irrigators have been able to earn more money from sale of irrigated cash crops, which could be increase households access to food. However, the majority of the non-irrigators depend on income from sales of food grains and livestock for covering household expenditure. It must be clear that the majority of the sample household sell their food grains not because of surplus production but only due to financial constraints, which forced them to do so. Focus group discussion with farmers indicates that much of their annual harvest was sold for land tax and payment for agricultural inputs, commonly fertilizer and better seeds.

The other major source of household income is income generated from the off-farm activities. The contribution of off-farm source of income to the total household income is higher in non-irrigator households than in the irrigators'. The share of income from this source to household's total income is about 237.25 and 453 for irrigators and non-irrigator households. When we compare the contribution of off-farm income, it is less in the irrigator households than in their non-irrigators counterpart.

4.4.4 Participation of Households in Off- Farm Activity

As defined by FAO (1999) rural non-farm income is income derived. ...from wage paying activities and self-employment in commerce, manufacturing, and other activities". Off-farm income is viewed as contributing to the diversification to the households' source of income. Therefore, it is an important factor in rural economy and household's food security as it allows greater access to food. Income from this sector enhances the performance of agriculture by providing the rural poor with cash to invest in agriculture, which in turn improve productivity and production. Cash obtained through off-farm activities are a crucial to rural households.

In the study area, the off-farm income activities are very traditional and practiced in their simplest form. The major activities performed by farm household include weaving, pottery, simple wood work and farm tools, traditional house construction, sales of fire wood and charcoal, petty trade, wage labor. ...etc. As could be learned from the concerned respondents and an interview with key informants the chance to access to some of these activities has been reduced because of several factors such as paralleling rapid

deforestation; recent policy for forest protection; problem of access to infrastructure especially during rainy seasons. Absence of legal credit services and limited market services for their outputs are also the major problems identified by the informants.

As far as the well-organized wage paying rural off-from employment sources are concerned, no such institutions were available in the Derra woreda. The woreda is characterized by complete absence of non-farm rural industries unlike some other parts of the country. Both social and economic infrastructures are poorly developed in the area that would have served as one of the deriving forces for the development of off-farm employment generation activities. This situation might have contributed to the revealing widespread rural poverty and food insecurity problem in the area.

The result of the study reveals that about 38.2% of irrigators and 48.5% of the non-irrigators have been engaged in off-farm activities. The study also reveals that off-farm activities have been adopted for different purpose manly to minimize the risk of food insecurity and as coping mechanism to the existing low agricultural income and frequent shortage of food. Moreover, few respondents that that are engaged in non-farm activities for accumulation purpose (money accumulation), relatively in irrigation households. Others responded that they engaged in non-farm activities to build corrugated house and to buy other productive assets. The following table shows the percentage distribution of sample households' participation in different off-farm activities.

Table 4.10: -Percentage Distribution of Households' Participation in Non-Farm Activities, 2006

Off-farm Activity	Household groups			
	Irrigators		Non-irrigators	
	Frequency	Share, %	Frequency	Share, %
Wage labor	2	3.33	17	12.14
Petty trade	7	11.66	21	15.00
Weaving	6	8.33	12	8.57
Fire wood and charcoal sale	3	5.00	9	6.42
Pottery	1	1.66	2	1.42

Source: Household survey, 2007

When we look at the pattern of diversification in the study area, the majority of non-irrigator households' are engaged in petty trade, weaving, wage labor, sale of firewood and charcoal. On the other hand, almost none of the irrigators have engaged in wage labor and few of them participated in petty-trade, weaving and other activities. Since non-irrigators stay idle throughout the long dry season (slack period), the majority of them engaged in wage labor, petty trade, weaving and other off-farm sources of income. Participation in off-farm activity is high in non-irrigator households than in the irrigators.

4.4.5 Distribution of Households by Number of Source of Income

As discussed in the previous section, household source of income is divided in to four major categories. These are income from sale of food grains, income from sale of cash crops (both irrigated and rain-fed), livestock and livestock product's income and income from off-farm activities. This is only the major category based on sectorial classification of activities (farm and off-farm activities). Farm activities include cash crop production, production of food grains, livestock rearing, bee keeping and others agricultural activities. On the other hand, off-farm activities include wage labor, patty-trade, weaving, firewood and charcoal sale, pottery, blacksmith and other non-agricultural activities.

As revealed in the table 4.11, not all households derive their income from both farm and non-farm activities. Most households have derived their income from farm activities (mainly livestock production and food crop production). Other households derived their income from sale of cash crops (both irrigated and rain feed), sales of food grains, livestock & livestock products and supplement their income from farm activities by participating in off-farm activities. In this case a household might participate in more than one off-farm activities and could be diversifying his/her sources of income. In this case, irrigation households have more advantage than their non-irrigator households do because they derive additional income from cash crop farming. Moreover, income from cash crop farming could be invested in other off-farm activities, which in turn generate additional income for the household. The summary of the distribution of household by number of sources of Income is presented in table 4.11.

Table 4.11: Distribution of Household by Number of Sources of Income (Both farm and non-farm activities), 2006[

Number of Sources Income	Irrigators HH		Non-Irrigators HH	
	Frequency	Share, %	Frequency	Share, %
One	0	-	6	4.3
Two	7	11.66	37	26.42
Three	28	46.6	45	32.14
Four	19	31.67	44	31.42
Five	4	6.66	6	4.3
Five-Seven	2	3.33	2	1.42
Total	60	100	140	100

Source: Field survey, 2007

Comparison of the sample households' in terms of the number of sources of income indicates that irrigation households have much more diversified sources of income than the non-irrigation households. Thus, the former group secured higher total income than their non-irrigator counterpart did. The majority of the irrigators have three and more than three sources of income as compared to the non-irrigator households.

The number of sources of household income determines diversification status of the household. In this study, three sources of income are taken as average. Based on this households' diversification status is divided into two major categories, high diversifier and less diversifier households. A Household engaged in three and more activities is considered as high diversifier whereas a household with less than average (three) source of income is categorized as less diversifier. On the other hand, household with less than average (three) source of income is categorized as less diversifier. Diversification of food and income sources (in cash and kind, farm and off-farm) is considered as one of the main "buffers" households can develop against risk in agrarian environment.

4.4.6 Measuring Income Diversification of Households

As indicated in the literatures, diversification measures, so far mostly available for rural areas have focused mainly on estimation of non-farm income share in the total household income (Block and Webb 2001; Barrett and Webb 2001; Lanjouw et al. 2001). However, Lire Ersado (2006) developed a richer measure of income diversification based on a more disaggregated classification of income sources beyond the simple farm and non-farm

categorization. He developed a diversification measure based on the relative contribution of income sources-earner combination to the total income of a given household.

For the purpose of this study the number of household's sources of income is used to determine the diversification status of households. On the basis of households sources of income in farm and non-farm income activities households have been classified in to high diversifier and less diversifier households. To classify households as high or less diversifier, number of sources of income with the highest frequency is used. In this case, number of sources of income with the highest frequency is three. The result of the study reveals that out of 60 irrigator households 28% of them earned income from three sources during the reference period. In case of the non-irrigator households' 45 households derive their income from three sources of income.

Thus, households with three and more sources of income are classified as high diversifier and whose with less than three sources of income are categorized as less diversifier. On the basis of the above criteria 88.33% of the irrigators and 69.29% of the non-irrigator households are classified as high diversifier households (i.e. they earned income from three and more sources of income during the reference period).

There are marked differences in the diversification status of sample households. The irrigators have more diversified sources of income with less than 11.67% of the irrigators depend on less than three sources of income. In contrast, about 30.71% of the non-irrigator households depend on less than three sources of income. The differences in households' sources of income also have different result on households' total income and food security. As indicated in table 4.9, irrigator households earned more total income than the non-irrigators (refer table 4.9). Improvement in household's income also improves households' access to food through purchase. Comparison of the food security status of the two groups of sample households also confirmed that the irrigator households were more food secure than the non-irrigator households (refer table 4.13).

4.5 Food Security Status of Households

Any single indicator cannot capture the full range of households' food insecurity and hunger. Instead, a household's level food security assessment needs obtaining information on a variety of specific conditions, experiences, and behavior that characterize food self-insufficiency (serve as indicators of the varying degree of severity of the condition). Data on different behavioral paths that reveal the various coping strategies adapted by the households in attempting to deal with food resource inadequacy also indicate the level of food insecurity. Research over the past two decades has identified a particular set of this kind of conditions, experiences and behavior pattern that consistently characterizes the status of food insecurity and hunger as indicated below.

- Anxiety that the household food budget or food supply may be insufficient to meet food requirement;
- The experience of running out of food, without money to obtain more food;
- Perceptions by the respondent that the food eaten by household members was inadequate in quality or quantity;
- Adjustments to normal food use, substituting cheaper food than usual;
- Instances of reduced food intake by adults in the household; and
- Instances of reduced food intake for children in the households (Bickel, Gray, et al., 2000).

In this study a variety of specific conditions, experiences, and behavior (as outlined above) that characterize sample households' food security conditions were collected and used to identify the food security status of the sample households. In the following consecutive sections discussed the procedure and outputs.

4.5.1 Households Food Security Measurement Procedure

Sample households were asked three categories of questions to capture four kinds of household's food security situations during the past 12 months (2006). The three categories of questions contain the qualitative and quantitative aspects of the household food supply as well as household's behavioral and psychological response to food shortage.

The first categories of questions ask whether a condition of food insecurity has occurred within the reference period. At this stage, sample household were screened in to two

groups (Food secure and food insecure households). The response of the household was coded as affirmative and negative answers. Negative response indicates absence of any conditions manifesting food insecurity (Food secure household) and affirmative responses indicate the presence of food insecurity problem, irrespective of the level of food insecurity.

The second category of questions was presented only to households with affirmative response to assess the different conditions, experience of food insecurity and the number of months in which the conditions of food insecurity occurred. The third category of questions presented to food insecure households to identify household's behavioral response (coping mechanism) to the problem of food insecurity (shortage of food). The four kinds of food insecurity situations presented to households' with food insecurity are the following:

1. Anxiety or perception that the household food budget or food supply was inadequate;
2. Household's perception that the food eaten by adult or children was inadequate in quality and quantity and substitution of cheaper food;
3. Reported instance of reduced food intake or skipped meals for adults;
4. Reported instance of reduced food intake for children or skipped child meals and the experiences of going without food for one or more days due to shortage of food or resources to obtain food.

The above situations measure cluster of central conditions or components of the experience of food insecurity and hunger. Based on the overall pattern of household's response to the three clusters of questions the status of household's food security will be determined. The level of food security for each household extends from fully food secure at one limit to a severe level of food insecurity with the experience of hunger, both for adults and children.

For many of these potential indicators established questions were included in the survey questionnaire. During the survey sample households were asked the above kinds of household food conditions, events, behaviors, and subjective reaction to problem of food recess. In addition, each question asks explicitly about circumstance that occurred during the past 12 months (2006 or 1998-1999 E.C).

4.5.2 Comparison of Household Food Self-Sufficiency

One of the methodologies used to assess household level food security is to assess the periods of household's food self-sufficiency from their annual harvest (1998-1999 E.C). This is mainly because own production is the common ways of acquiring food for rural farming households. A household also obtains food from market, food grain transfer through loan, gift, and food aid and other mechanism. Here, the emphasis is to compare the period of irrigator and non-irrigator household's food self-sufficiency from their own production in 2006 cropping year.

Since the concept of adequate food is not universal agreed up on, adequate food in this study refer to what the respondents themselves (perception) feel adequate. Accordingly, one of the interviewed household defined adequate food as follows: A household is food self-sufficient "If he could able to feed his family throughout the year without an anxiety of running out of food, reduction in meals size, skipped meals and without adopting to unusual coping strategy like substituting cheaper food items''. The summary of the result of the survey is presented in table 4.12 below.

Table 4.12: Summary of Households' Food Self-sufficiency Period from own Production In 2006, cropping year

Period of Food Self-Sufficiency	Household Groups	
	Irrigator households, (%)	Non- Irrigators Households (%)
<3 months	3.33	2.9
3-6 months	5.3	13.2
6-9 months	36.8	44.1
>9 but<12 months	39.5	23.4
≥12 months	18.2	13.4

Source: Household Survey, 2007

As can be seen from the above table the comparison of households' food self-sufficiency period (in months) indicate that only 18.2% of irrigators and 13.4% of the non- irrigator households fed themselves for 12 and more months from their own subsistence farming. Based on the above table, it is only 39.5% of the irrigator households' could feed themselves adequately for more than 9 months but less than 12 months. The corresponding figure for the non-irrigators household is 23.4%. The above comparison of households

food self sufficiency form own production during 2006 (1998-1999 E.C) was irrespective of the nutritional status of the food they consumed. The majority of the sample households fed themselves from 6-9 months. The corresponding figure for the irrigators and non-irrigator households' is 36.8% and 44.1%, respectively. Since irrigation farming brings extra income from sale of cash crops, irrigator households could able to purchase more food from market, thus more access to food than their non-irrigators counterpart did. The study indicate that, 23.7% of the irrigator sample households respond that 25% of their food items came through purchase using income from cash crops produced using irrigation.

Comparison of the food self-sufficiency period of the two household groups indicates that the majority of irrigator households fed themselves for a longer period than their non-irrigator counterpart. This is because irrigation farming resulted in an increase in household's income through production of high value market oriented cash crops (vegetables and fruits). In one way an improvement in household's income improve household's entitlement and access to purchased food items, which in turn improve household's food security. Income from sale of cash crops can be used to purchase agricultural inputs like fertilizer; high variety seeds and other needed farm inputs. The use of modern agricultural inputs in turn enhances production and productivity of smallholder agriculture. An increase in production and productivity of farmer also resulted in an increase in food availability at the household level, which in turn improves household food security. In the previous section comparison of annual production of the irrigator and non-irrigator households indicate that the irrigators produce more crops than the non-irrigators. Here, the comparison of their food self-sufficiency from own production also indicates that the irrigators were more food secure than their non-irrigators. This implies that irrigation contribute to households food security through increasing households income.

The other lesson learned from the above comparison of households' food self-security from own production is that there is a gap in food availability for the majority of the households through own production. The gap in households' food availability indicates that rural farm households' in the study area could not able to produce enough food to meet their food requirement. The gap could be filled by various coping mechanisms like food purchase, loan, and transfer through food aid or other coping mechanisms.

4.5.3 Comparing Household Food Security Status

The findings of previous research (Bickel, Gray, et al., 2000) indicate that households go through different experiential and behavioral stages as food insecurity becomes more severe. In the first stage, households experienced inadequacy in food supplies and food budgets feel anxiety about the sufficiency of their food budget to meet basic needs and make adjustment to their food budgets and types of food served. As the situation becomes more severe, the food intake of adults is reduced and adults experience hunger, but they spare the children from this experience. In the third stage, children also suffer reduced food intake and hunger and adults' reductions in food intake are more dramatic.

In this study households' food security status is categorized in to three level based on the variety of specific conditions, experiences, and behaviors that characterize households' food insufficiency as indicated in table 4.13. Each category indicates a meaningful range of severity of food insecurity problem in descending order. The three categories of household food security status are presented in table 4.13 below.

Table 4.13: Food Security Status of sample Household, 2006

Household Food Security Status	Indicatives of Food Insecurity	Household Groups			
		N	Irrigators	N	Non-irrigators
Food secured households	Show no indicators of food Insecurity	38	63.33	53	37.8
Food insecure without hunger	-Worried food would run out; -Few /low cost food for children (Substitute cheaper food items); -No reduction in member's food intake (meals per day, size…etc)	17	28.33	68	48.6
Food insecure With hunger	-Reduced/ skipped adult meals -Reduced/ skipped children meals -Adults or children did not eat the whole day or night due to shortage of food	5	8.33	19	13.6

N: Refer to number of Households
Source; Field survey, 2007

Table 4.13 shows the level of food security for each households which extend from fully food secure at one limit (i.e. absence of any food insecurity indicators) to a severe level of food insecurity with experience of hunger (reduce/skip meals by household members) due to lack of resources to obtain food. Each of the food insecurity indicators allocates the position of the household food security status with respect to the ordered series of indicators presented in the preceding section.

The first category of household food security status is food secure household. Household's in this category shows no evidences of food insecurity. Out of the total irrigator sample households 38(63.33%) of them reported absence of any food insecurity indicators during the reference period. On the other hand, out of 140 non-irrigator sample households 53(37.8%) reported absence of food insecurity indicators.

The second group of household is food insecure without hunger. Food insecurity is evident in the household members' concerning about adequacy of the household food supply and in adjustments to household food management, including reduced quality of food and increased unusual coping pattern like substitute cheaper food items but no reduction in members' food intake is reported. In this survey, out of the total non-irrigator households 17(28.33%) respond that they experienced situations, which indicates the condition of food insecurity without hunger. On the other hand, the majority of the non-irrigator households respond situations (indicators), which clearly show food insecurity without hunger. The corresponding figure is 68(48.6%) for the non-irrigation households. The figure seems that the majority of the non-irrigator households experienced food insecurity without hunger as compared to the irrigator households.

The third category of household's food security level is food insecure with hunger. At this sage of food insecurity level, household reported instances of reduced food intake by adults and children in the household and cut meals time both for children and for adults. All households with children have reduced the children's food intake to an extent indicating that the children have experienced hunger. Moreover, household also reported that all (both adult and children) members' of the family did not eat for the whole day or night because of shortage of food or money to obtain food. When we look at the sample households in this regard, the situation is worse for the non-irrigator households. Out of the sample food insecure non-irrigator households 19(13.6%) responded that they

reduced/skipped meals both for adults and children during the reference period. In contrast only 5(8.33) of the irrigator households respond situations (indicators) indicating food insecurity with hunger. In the preceding sections the basic features (indicators) of food insecure households (food insecure with and without hunger) and the different coping mechanism adopted by food insecure households to food shortage are discussed.

4.5.4 Indicators of Household Food Insecurity

As discussed in section 4.5.3, food insecure households show different indicative conditions, experiences and behavioral response to food shortage. It has been indicated that out of the sample households, 22 irrigators and 87 non-irrigator households were food insecure. The summary of indicators used to identify the level of severity of the problem of food insecurity within food insecure households and the corresponding percentage of the food insecure households is presented in the table 4.14 below

Table 4.14: *Indicative Conditions of Food Insecure households, 2006*

Indicatives of Food Insecurity	Irrigators		Non-irrigators	
	N	%	N	%
Worry (anxiety) that food will run out before I get money to obtain more food;	12	59.1	54	62.1
My family did not get "enough food", because I neither able to produce nor purchase enough food in quality and quality;	4	18.2	50	57.5
Purchase cheaper food (substitute cheaper food)	10	45.5	28	32.2
Reduced adult food due to shortage of food and Money to obtain more food;	5	22.7	19	21.8
Skipped adult meals because of shortage food or money to obtain food	4	18.2	16	18.4
Reduced child meals because of shortage of food or money to abstain food;	3	13.6	17	19.5
Skipped child meals because of shortage of food or money to obtain food;	2	9.1	13	14.9
Adult members of the family did not eat for the whole day or night because of shortage of food or money to obtain food	2	9.1	8	9.2
Children did not eat for the whole day or night because of shortage of food or money to obtain food	1	4.5	7	8.5

* Multiple responses is possible
Source: Field Survey, 2007

As displayed in table 4.14, one indicator of household's food insecurity condition is anxiety. Anxiety measures the perception that the household food budget or food supply was inadequate during 2006. A Household with inadequate food budget feels anxiety about the gap in his /her family food supply. This indicator measures the two core elementals of food security (i.e. food availability and access to food).

Comparison of the two groups of sample households' food supply (budget) in the period under study reveals that 62.1% of the non -irrigators were worried that they would run out of food before they get money to obtain more food. On the other hand, the perception of running out of food supply without money to obtain more food was less for the irrigator households. Only 59.1% of the irrigators worried that their food budget might not last until they obtain additional food (money to obtain more food). The figure indicates that the fear of running out of food without having enough money to obtain more food was severe in the non-irrigator households. This is mainly because irrigators are more access to food due to extra income earned from sale of irrigated cash crops. Comparison of annual income of sample households shows that irrigators were able to earn more income than the non-irrigators, which in turn enhance their access to marketed food grains. Hence, it reduces anxiety of running out of food with out more money to obtain food.

Comparison of the number of months in which the condition of anxiety occurred indicates that the perception of running out of food is higher in non-irrigators than in the irrigator households. Out of the sample households 11.5% of the non-irrigators and 9.1% of the irrigator households worried often about the insufficiency of their food budget whereas 36.7% of the irrigators and 33.3% of the non-irrigator households worried that they would run out of food before they get money to buy more for many times. About 55.2% of the non-irrigators and 54.4% of the irrigator households reported that they worried for a short period.

The second indicator used to identify the food security status of the household was the perception that the food eaten by family is not "enough" in quality and quantity. Assessment of the perception of the quality and quantity of food eaten by the sample households reveals that 57.5% of the non-irrigators and 18.2% of the irrigator households respond that their family did not eat "enough" food in terms of quality and quantity for the

reason that they neither able to produce nor purchase enough food. According to the above comparison of the two groups of sample household's availability of food and access to food was better in irrigator households than their non-irrigator counterpart.

The duration in which the sample households' depend on less quality and quantity food varies in the two groups of the households. The survey result shows that 13.6% of the irrigators and 9.2% of the non-irrigator households did not get enough food often because they neither able to produce nor purchase enough food in terms of quality and quality. About 25.3% of the non-irrigators and 31.8% of the irrigators respond that they did not get enough food in terms of quantity and quality for many months but not in all months. In contrast, 65.5% of non-irrigators and 54.5% of the irrigators respond that they did not eat "enough" food for a short period during the past 12 months. The above comparison reveals that the irrigators were relatively more access to enough food in terms of quantity and quality than the non-irrigators was in 2006.

The third situation of food insecurity indicators used is the assessment of reported instances of reduced food intake for different age categories (adult and children) of members' of the household. In the study of household food security this is a threshold stage because any reported instances of reduced/skipped food intake in the household indicates that the household food condition is moving from bad to worse. In addition, it indicates the transition of household from food insecure without hunger to food insecure with hunger.

The survey reveals that 21.8% of the non-irrigators and 22.7% of the irrigator households reported instance of reduced food intake for adults. The survey further shows that 4.5% of the irrigators 3.4% of the non-irrigator households cut adult meals in many months but not in all months due to shortage of food or money to obtain food. About 19.5% of the non-irrigators and 13.6% of the irrigator households reported that they cut adult meals in few months for many time during the past 12 months.

A reduction of adult meals (skipped meals) tell as that at least some member or members of the household are experiencing hunger due to insufficiency of household food resources but not necessarily all members. When the household is impacted by food insecurity due to inadequacy of food or money to obtain food, some adult members would t experience

hunger. Preliminary evidences suggest that most of but not all adults in the household are likely to be similarly hungry (USAD, guide to food security measurement, 2000).

The situation for children in the household appears to be quite different. When the household is reporting conditions of sever food insecurity, it does not necessarily indicate that children, especially younger ones in the household are hungry. The common pattern of behavior in most community with children is adults to under go hunger before the first indicators of hunger appear among the children. Thus, in households with children of status "food insecure with hunger" the food security measure shows a clear evidence of adults hunger but does not necessarily show evidences of children's hunger.

Concerning meals of children (<18 years old), 19.5% of the non-irrigators household and 13.6% of the irrigator households cut child meals during the reference period. Moreover, 14.9% of the non-irrigators and 9.1% of the irrigators skipped child meals because of shortage of food or money to obtain food during the past 12 months (2006).

As the food shortage become severe, household's response to the situation was also changed. At the severe stage of food insecurity, adult members of the family did not eat for the whole day or night because of absence or shortage of food. This situation indicates food insecurity with hunger. The survey result shows that 9.1% of adult members' of the irrigators and 9.2% of the non-irrigators did not eat for the whole days or night because of shortage of food. As can be seen from the table the condition is better for irrigators than the non-irrigator households. In the last 12 months (2006), 4.5% of the irrigators and 8.5% of the non-irrigator households respond that their children did not eat for the whole day or night because they could not afford enough child food.

4.5.5 Coping Mechanisms of Food Insecure Households

Looking at households' coping mechanism is one important dimensions of assessing the food security conditions of the household. Household made different behavioral response to the problem of food insecurity. These coping strategies can range from informal safety net, which peoples draw on their social net works to eating less and cheaper meals and searching for wild food. Research findings on food security identified ranges of coping mechanism to specific situations. These coping mechanisms can vary from region to region or from household in to the same regions.

For the purpose of this study, households' coping mechanisms are grouped in to three major categories. These are depleting strategy, maintaining strategy and reductive mechanisms. Sample households were asked to identify the ranges of coping mechanisms that they adopted at different level of severity of the problem of food shortage. The different coping mechanisms employed by sample households and the corresponding percentage of respondents are summarized in table 4.15

Table 4.15: Food Insecure Households' Copping Mechanisms

Types of Coping Mechanisms		Irrigators	Non-Irrigators
Maintaining strategy	- Food loan form neighbors	31.8%	40.2%
	-Engage in labor work	27.3%	36.8%
	-Purchase cheaper food-	413.8%	32.9%
	- Use food aid	9.2%	5.5%
	-Migration	4.5%	11.5%
Reductive strategy	-Reduce meals size& skip meals	22.7%	21.8%
	-Reduce meals variety	27.3%	19.54%
Depleting mechanism	-Renting out land	22.73%	12.6%
	-Sales of livestock	27.3%	29.9%
	-Eat reserved seeds	22.73%	8.1%

* Multiple responses is possible
Source: Field Survey, 2007

As can be seen from table 4.15, household adopted different copping mechanisms to food shortage. The most frequently adapted coping mechanism is purchasing of cheaper food and food loan from neighbors. In fact, as the household is impacted by problem of food shortage, they adjust their food consumption by substituting cheaper food. In the study area, the majority of the interviewed households respond that they sold teff, due to its high price in the market, and bought cheaper food items like wheat, maize, and sorghum. Out of the food insecure irrigator households 10(45.5%) of them employed this adaptive strategy, whereas the corresponding figure for the non-irrigator households is 28(32.9%).

A sale of livestock asset is the major coping mechanism adopted by non-irrigator sample households. In fact, farmers indicated that they sell their livestock assets and buy others for the cheaper price so that they can buy food for grain with the difference from where they found it cheaper. Particularly ownership of small animals such as goats, sheep, heifer, calf and poultry are very important for households to get access to food because these animals are the first to be sold whenever the household is in need of cash and faced food shortage. About 6(27.3%) of the irrigators and 26 (29.9%) of the non-irrigator households sold their livestock and purchased food during the reference period.

As seen from the table, very few sample households responded that they may migrate to other areas even if they faced problem of food insecurity. Only 1(4.5%) of the irrigators and 10(11.5%) of the non-irrigator households have indicated that they went to another place temporarily in search of labor work to cope with the problem of food shortage.

According to the key informant interview with experts from the woreda disaster prevention and preparedness desk (DPPD), farmers under risk of landslide and crop damage are not willing to join the resettlement project. The officer added that recently, three PAs suffered from landslide and total crop damage due to heavy rain. The majority of the victims of these problems refused to resettle in other place, instead they appealed for temporary food relief. This shows that even under such pressure people (farming household) did not want to leave their settlement in their community.

The other coping mechanism adopted by the food insecure households was eating of reserved seeds. Five households (22.7%) from the irrigators and seven households (8.1%) from the non-irrigator households employed this coping mechanism to solve the problem of food shortage.

Renting out of land is also used as adaptive strategy to food shortage. In the study area, farmer who cultivates land on the basis of crop sharing required to give food grains (or money) to the landowner if he/she asked to do so, (wants to cultivate the land for the next harvest season). However, he/she takes the same amount of money or grains during the next harvest season.

On the other hand, farmer also rented out his/her farmland for specific period of time if he/she faced shortage of food grain or money. The survey result show that 5(8.3%) irrigator households and 11 (7.9%) of non-irrigator households rented out their farmland to cope with food shortage during 2006.

As indicated by Grivetti (1978), foods that grow in the wild form a significant part of diet for people in many places. Information about their actual significance is scarce, however, it has been estimated that more than 30% of the total food intake comes from such foods for certain population. Wild food is often called "survival food" during times of stress (Ibid, 1987). However, this study did not come across with this kind of coping mechanism. It had been found that none of the sample households used wild food to cope up with food shortage.

CHAPTER FIVE

Conclusion and Recommendation

5.1 Conclusion

This study deals with small-scale irrigation, income diversification and household food security in Derra woreda, North Shewa zone, Oromiya region. The overall objective of the study is to assess the contributions of small-scale irrigation farming and income diversification to household's food security. Comparative study was conducted to assess the contribution of irrigation farming to the food security of the households. Households with and without irrigation farming were included in the survey to see the comparative advantage of irrigation farming.

To identify the food security status of the sample household period of food self-sufficiency from their annual harvest and different food insecurity indicative conditions, events and behavioral response to the problem of food shortage were used. The finding of the study reveals that the majority of the sample households, both irrigators and non-irrigators, could not be able to feed their family adequately through out the year from their own subsistence production. Taking in to consideration other sources of household food, commonly through purchase, still the majority of the non-irrigator households could not be able to feed their family adequately through out the year.

The finding of the study indicate that 63.3%, 28.33% and 8.33 of the irrigator sample households were food secure, food insecure without hunger and food insecure with hunger, respectively. In comparison, 37.8%, 48.6%, and 13.6% of the non-irrigator households were food secure, food insecure without hunger and food insecure with hunger, respectively. This implies that the condition of food security was relatively good for the beneficiaries of irrigation during the reference period than the non-irrigator households. Food insecure households were not passive agents to the problem of food security. They adopted different coping mechanism to get ride of the problem of food shortage. The finding of this study shows that reducing the variety, size of family food and skipping meals were the major coping mechanism commonly adopted by the households in the study area.

The development of small-scale irrigation would stabilize agricultural production and contribute to food supply even in years with inadequate rainfall and increase the overall

level of crop production in years with normal rainfall. Irrigation households have been able to produce twice a year using the irrigation water and able to increase their annual income, hence, household level food availability and access. The comparison of the total annual income of the irrigators and non-irrigator households reveals that irrigators have been able to make twice as much annual income as their non-irrigation counterpart.

In the study area, the performance and effective use of small-scale irrigation farming is constrained by multi-dimensional problems, ranging from individual farmers attitude to institutional arrangements. The major problems includes small size of irrigation plots; frequent damage of irrigation water structures such as diversion weir and earth canal, inadequate farmers' knowledge and awareness (skills, and experience); lack of market and marketing facilities and settlement pattern of the irrigators and open grazing during summary are the major obstacle for irrigation development.

The finding of this study suggests that the major threats to household food security are more related to low and unstable incomes and unemployment than to food production deficit. The alternative policy option is to improve food entitlement through direct household's income diversification (farm and non-farm) to improve household's access to food. Such income generating activities serve as immediate relief, risk spreading potential and will enable the beneficiaries to acquire the basic needs (food, clothing, etc) which in turn create the desired functioning of life such as living healthy and active life.

Diversification of food and income sources (farm and non-farm activities) is considered to be one of the main "buffers" households can develop against risk in agrarian community. In the study area, off-farm employment opportunities are limited in both availability and income generating potential. The finding of the survey reveals that the non-farm activities are traditional and practiced in their simplest form. Well-organized wage paying rural non-farm employment generation activities are non-existent. Many households derive their income from self-employment activities with low return and wage labor as rural industries does not exist in survey villages. Most non-farm activities are intensive in labor but not capital. The finding of the study induced the conclusion that the development of irrigation and diversification of household sources of income (farm and non-farm diversification) has its own contribution to alleviate household's food insecurity.

5.2 Recommendation

Based on the finding of the study, the following issues are identified for policy consideration to enhance the contribution of irrigation farming and income diversification to household's food security:

- For the growing numbers of chronically food insecure households, who are unable to meet their food requirement alternative off-income generating opportunities is very important;
- The finding of this study indicates that an increase in households income improve households food security. To Improvement household's income the alternative policy option is to identify and invest in alternative farm and off-farm employment opportunities;
- Prompt alternative economic activity through regulations that prompt investment in the study area to expand off-farm employment opportunity;
- Given extreme climatic variability, stabilizing agricultural production is as important as raising yields. Development policy towards interventions such as investing in indigenous small-scale irrigation and improvement of the existing small scale scheme is crucial to reduce the effect of drought and improve food security of the households;
- Policies induced to promote irrigation farming should also need to give due attention to complementary and related sectors such as rural roads, extension services, provision of credits;
- Entry barriers are found to be the major problems to high return diversification options in the study area. Investment options are constrained by incomplete credit markets. Thus,
    - ✓ Provision of credits and inputs;
    - ✓ Improvement in rural infrastructure
    - ✓ Institutional facilitations of voluntary co-operation groups could be beneficiary to household food security.

- Promotions of farmer's group work (co-operatives) and provide them with technical knowledge; credits service could facilitate participation of households in off-farm activities;
- As discussed in chapter four effective use of irrigation potential in the study area was constrained by the settlement pattern of the community. Thus, to minimize the adverse effect of the settlement pattern, the resettlement program initiated by the irrigators must be supported both by DIRDP and by the local government and non-governmental organizations;
- Provision of credit service, inputs and some form of incentive for model farmers is also important to increase effectiveness of irrigation schemes.
- Farmers training in water management, maintenance of infrastructures, crop intensity and input utilization (application) should be carried out to promote the contribution of irrigation scheme to food security;

REFERENCES

Adugna Lami (2006). The Dynamics of Income Diversification in Ethiopia. Department of Economics: University of Massachusetts Boston, United States of America

Alem (1999) Food Security In South Wello, H. Abdulhamid, B. Kello (1999) Poverty and Resources; Ethiopia Rural Realities; Working paper on Ethiopia development, No. 13 (1999), Institute of Development Research (IDR), Addis Ababa university, Addis Ababa

Barrett, C.B., Readron T., Webb, p., (2001). Non-Farm Income Diversification and Household Livelihood Strategies in Rural Africa: Concept. Dynamics and Policy Implications: Food Policy, No. 4, pp 315-31.

Befekadu Degefe and Berhanu Nega (2000). Annual Report on the Ethiopian Economy: Ethiopian Economic Association, Addis Ababa

Berhanu Adenew (2004). The Food Security role of Agriculture in Ethiopia: Ethiopian Economic Policy Research Institute, Vol. 1, No. 1, pp. 138-153, Addis Ababa, Ethiopia.

Bickel, Gray, Mark, Nord, Kiristofer Price, William, Hamilton, and John Cook, (2000). Guide to Measuring Households Food Security, Revised 2000, US Department of Agricultural, Food and Nutrition Service, Alexandria VA.

Block, S. and Patrick, Webb (2001). The Dynamics of Livelihood Diversification in Post Famine Ethiopia: Center for Study of African Economy: Food Policy 26, No (4), pp.333-50.

Block, S. and P. Webb (2001). "The dynamics of livelihood diversification in post-Famine Ethiopia", *Food Policy,* 26 (4), pp.333-50.

Bryceson, D., (1999). "African Rural Labor, Income Diversification & Livelihood Approaches: A Long-term Development Perspective," *Review of African Political Economy*

Carswell, G., (1999). 'Sustainable Livelihoods in Southern Ethiopia: IDS Research Report No. 44, Brighton: Institute of Development Studies

CSA (Central Statistical Authority), (1999), 'Report on the 1998 Welfare Monitoring Survey', Statistical Bulletin 224. Addis Ababa: Federal Democratic Republic of Ethiopia

Christopher, B., (2001). Income Diversification, Poverty Traps and Policy Shocks in Cote d'Ivoire and Kenya: Food *Policy* 26, No. 4, PP.367-84.

Dercon and Krishnan (1996). Income Portfolios in Rural Ethiopia and Tanzania: Choices and Constraints. *Journal of Development Studies* 32, no. 6: 850-75.

Dercon, S. (2002). *Income Risk, Coping Strategies and Safety Nets*. Helsinki: United States

DIRDP (Derra Integrated Rural Development Project) Report (2005), North Shewa Zone, Oromiya Region

Derra Woreda Agricultural Development Office Report (2004), North Shewa Zone, Oromiya Region

Dessalegn Rahmato (1994). 'Land Policy in Ethiopia at the Crossroads', paper presented at the Workshop on Land Tenure and Land Policy. Addis Ababa: Addis Ababa University.

Deninger and Olinto (2001). Rural Non-farm Employment and Incomes in Latin America: Overview and Policy Implications. *World Development* 29, no. 3:395-409.

Dessalegne Rhameto (1999). Water Resource Development in Ethiopia: Issues of Sustainability and Preparation Forum for Social Studies, Addis Ababa.

Devereux, Stephen (2000). *Food Insecurity in Ethiopia:* A Discussion Paper for DFID, IDS Sussex University

DPPC (Disaster Prevention and Preparedness Commission) and Save the Children UK, 2000, Employment Generation Schemes (EGS): 2nd Pilot Review. Addis Ababa: DPPC

Elahi, A., Et Al. (1988) Technical Issues of the Irrigation Development in Sub Sahara Africa, World Bank Technical Paper No. 123, WB, Washington DC

Ersado, Lire (2006). Income Diversification in Zimbabwe: Welfare Implications from Urban and Rural Areas. World Bank Policy Research Working Paper 3964, Washington, DC

Escobar, Javier (2001). The Determinants of Non-farm Income Diversification in Rural Peru. *World Development* 29, no. 3:497-508.

FAO (1983) World Food Security: Reappraisal of the Concept and Approaches; Director General Report, Rome,

FAO (1986). Irrigation in Africa South of the Sahara. FAO Investment Centre Technical Paper 5. FAO, Rome.

FAO (1987). Consultation on Irrigation in Africa. FAO Irrigation and Drainage Paper 42, FAO, Rome.

FAO (2000). Socio-Economic Impact of Smallholder Irrigation Development in Zimbabwe. Case Studies of Ten Irrigation Schemes, Harare, Zimbabwe.

FDRE (1996). Ethiopian Food Security Strategy, Addis Ababa Ethiopia.

FDRE (2002). Food Security Strategy. Addis Ababa, Ethiopia.

FDRE and MOFED (Federal Democratic Republic of Ethiopia Republic of Ethiopia and Ministry of Finance and Economic Development (2000). Sustainable Development and poverty Reduction Program, Addis Ababa, Ethiopia.

Food Security Coordination Office (FSCO), 1999, Report on Household Survey: Kalu Woreda, Wello. Bahir Dar: Amhara Regional State Food Security Coordination Office

Fuad Adam (2001). Small Scale Irrigation and Household Food Security. A Case Study from Central Ethiopia: Forum for Social Studies, Addis Ababa, Ethiopia.

Galvin, K. (1988). Nutritional Status as an Indicator of impeding Food Stress"disaters, 129(2): 147-146

Getachew Alem (2000). Rain Water Harvesting in Ethiopia and Overview of Water Resources Development. V.4 No. 15, Addis Ababa, Ethiopia.

Holden, Stein, Shiferaw, Bekele and Pender, John (2004). Non-farm income, household welfare, and sustainable land management in a less-favored area in the Ethiopian Highlands. *Food Policy*, 29, 369-392.

Hopkins, R.F., (1986) "Food Security, Policy option and the Evolution of the State Responsibility," Food, the State and International Political economy: Dilemma of the Developing Countries," University of Nebraska press, London

IFAD (1987). Staff Appraisal Report. Ethiopia, Special Country Program. Report No. 6393

IFDA (1985). Ethiopia Small Scale Irrigation Main Report. Vo.l. No.13, Addis Ababa, Ethiopia.

Kinsey (1998). "Coping with Drought in Zimbabwe. Survey Evidence on Responses of Rural Households to Risk", *World Development,* 26(1): 89-110.

Maxwell, S. (1989), "Rapid Food Security Assessment: A Pilot exercise in Sudan, International Institute for Environment and Development, No.5, London

Maxwell, S. and Smith, M. (1992). Household Food Security: A Conceptual Review in Waxwell and T.R. Frankberger. Household Food Security: Concept, Indicators, Measurement: A technical Review, New York, and Rome: UNICEF and IFAD

Maxwell, S., (1988). National Food Security Planning First Thought from Sudan," Paper Presented to Work Shop on Food Security on Sudan, IDS, Sussex

MoA (Ministry of Agriculture), (1986). Strategies for Small-Scale Irrigation Development [Amharic] Irrigation Development Department, Addis Ababa

National Water Resources Development Report, 2002

Nitzan, Doritez, et al. (2002). Food Security and Nutrition: The Ethiopian case for Action, Tel Aviv University, Israel, PP.373-381. Email tropic@netvision.net.il

North Shewa Planning and Economic Development Report (2003), North Shewa Zone, Oromiya Region

O' Brien-Place, P. and T.R. Frankenberger (1988). Food Availability and Consumption Indicators. Nutrition in Agriculture Cooperative Agreement Report, No.3. University of Arizona, USA

Reardon, T., (1997). Using evidences of income diversification to inform Study of the rural non-farm labor market, in Africa, world development report, 25(5), pp. 785-747.

Reardon, Thomas, Christopher Delgado, and Peter Matlon (1992). Determinants and Effects of Income Diversification amongst Farm Households in Burkina Faso. *Journal of Development Studies* 28, No. 2:264-96.

Sen, A. (1981). "Poverty and Famine: an Essay on Entitlement and Depravation, Oxford, UK, Claredon Press.

Shoham, J. and J.b., Borton (1989), Targeting Emergence Food Aid: Methods Used by NGOs during the Response to the African Food Crisis of 1983-86. Final Report of Joint Study by the Relief and Development Nutrition Unit, School of Hygiene and Tropical Medicine. London: Overseas Development Institute

Sisay Asefa and Adugna Lemi (2002). Eradicating Rural Poverty and Food Insecurity in Ethiopia: Paper from Ethio-Forum, 2002 Conference

Sisay Asefa and Tesfaye Zegeye (2003). Rural Poverty, Food Insecurity and Environmental Degradation in Ethiopia: A Case Study from South Central Ethiopia Paper prepared for presentation at 2nd EAF/IDR International Symposium on Contemporary Development Issues in Ethiopia, Addis Ababa, Ethiopia

SERA (Sustainable Environmental Rehabilitation Appraisal) Report, 2003

Valdes, A., Panos Konandreas (1981).Assessing Food Security based on National Aggregate in Developing Countries," In Alberto Valdes (eds), Food Security For Developing Countries ,Westview Press, Boulder

Vovn Braun, J., (1992). Improving Food Security of the Poor: Food Policy and Programmes, International Food Policy Research Institute, Washington DC

WB (1986). Poverty and Hunger. Issues and Options for Food Security in Developing Countries. A WB policy study, Washington D.C.

Webb, P. And Von Braun, J., (1994). Famine and Food Security in Ethiopia: Lessons for Africa, IFPRI, Jon Wisey and Sons, Chichester,

Woldenhanna, T., and Arie, Oskam (2001). Income Diversification and Entry Barriers: Evidence from the Tigray Region of Northern Ethiopia. *Food Policy* 26, No. 4:351-65.

Workneh Negatu (2004). Reasons for Food Insecurity of Farm Households in South Wollo, Ethiopia: Explanation at Grass Root Level: Institute of Development Research (IDR), Addis Ababa University, Ethiopia.

WB (1973). Ethiopian Agricultural Sector Review. Volume II, Annex 11. Report No. PA-143a. Washington,

Annex I

Survey Questionnaire Designed to Assess to Food Security Status of Sample Households in Derra Wroeda, North Shewa, Oromiya Region

IDENTIFICATION

a) Enumerator's name _____

b) Name and code of PA _____

c) Village _____

d) Name of Irrigation scheme_____

e) Date of Enumeration _____

Introduction

Good morning /afternoon/ evening, dear respondent:

I am from Addis Ababa University. I am conducting a research on household food security conditions during 2006. Representative sample households have been selected for interview in this survey. It is important that you take part, so that an accurate picture of the view of household is obtained. Every thing you say will be treated confidentially. It is important that you answer all the questions honestly. The researcher or other body will not be able to identify any actual views made by specific households.

An interview will take about one hour. Would it be convenient now or if preferred I could come back at another time? When would be most convenient?

Part I: Personnel and Household Data:

Instruction: Please provide the following details:

1) Sex of the Respondent (HH head):

1) Male ☐ 2) Female ☐

2) Age of the Respondent: _____ years

3) Marital Status:

1) Married ☐ 2) Not married ☐ 3) living as married ☐

4) Divorced ☐ 5) widowed ☐ 6) Separated ☐

4) Educational Status:

☐ ☐ ☐

1) Illiterate 2) Read only 3) Read and write

3) Elementary school ☐ 4) junior secondary school ☐

5) High school ☐ 6) others (specify) _____

5) Size of the Family: _____

1) Children under 15 year ☐ 2) 11 to 15 years ☐

3) 16 to 64 years old ☐ 4) 65+ Years ☐

INSTRUACTION: ***(Tick your answer inside the box)***

1) How much is the landholding size of the family? (Timed, Hectare or other local unit)? _____

2) Have you ever cultivated during the belg season (February –March)

1) Yes ☐ 2) No ☐

3) If yes, to question no.2 indicate the types and the total amount produced in 1998?

1) 9 -10 seasons ☐ 2) 7-8 seasons ☐

3) 5-6 seasons ☐ 4) Less than 5 seasons ☐

4) On the average, what percentage of your irrigation plot is allotted for cash crops each year?

1) Full of my plot ☐ 2) ½ ☐

3) ¼ ☐ 4) ½ of my plot ☐

5) Have you cultivated the total of your irrigable land during the dry season (Bega)?

1) Yes ☐ 2) No ☐

6) If No to Q. 5, what were the reasons? (Tick your answer)

1) Labors shortage in the family ☐ 2) Lack of oxen ☐

3) Lack of seeds ☐ 4) Lack of credit ☐

5) Enough production from main rain cultivation ☐

6) Others (specify) _____

7) Did you rent your irrigable land in 1998?

1) Yes ☐ 2) No ☐

8) If your answer is yes to Q. 7, what amount of your landholding?

1) All of my holding ☐ 2) ½ ☐

3) 3/4 ☐ 4) ¼ ☐

9) Who are the main workers in your irrigated farm usually?

1) All family members ☐ 2) Only male family members ☐

3) Family and relatives ☐ 4) only female Family members ☐

5) Others (specify) _____

10) Did you hire labour in operating your irrigation farm?

1) Yes ☐ 2) No ☐

11) If yes to Q.10, on the average for how many working days each growing seasons?

1) Days ☐ 2) weeks ☐ 3) months ☐

12) Which cash crops (vegetables) you have grown using irrigation?

1) Sugar cane ☐ 2) Onion ☐

3) Garlic ☐ 4) Potato ☐

5) Vegetables (cabbage, carrot, tomato, pepper)

6) Chat ☐ 7) others (specify) _____

13) Why do you choose this /these cash crops?

1) Climatic and environmental adaptation ☐

2) Economic advantage (better marketability) ☐

3) Good production (high yield) ☐ 4) High disease tolerance ☐

5) Easy to cultivate and manage ☐

6) Seeds available ☐

7) Use it for animal fodder ☐

8) Others (specify) _____

14) Which fruits you have often grown using irrigation?

1) Banana ☐ 2) Leman ☐

3) Orange ☐ 4) Avocado ☐

5) Papaya ☐ 6) mango ☐

7) Others (specify) _____

15) Indicate the types and amount of cash crop you produced and the income received form sale of cash crops:

NO	Cash Crops	Unit	Amount Produced	Total Sale In Birr
1	Onion			
2	Potato			
3	Cabbage			
4	Carrot			
5	Tomato			
6	Pepper			
7				
8				
		TOTAL		

Irrigated Cereal Crop Farming

Instruction: Tick your answer inside the box

16) Using irrigation do you grow cereal crops?

1) Yes ☐ 2) No ☐

17) If yes, which cereals you often grow?

1) Maize ☐ 2) Teff ☐ 3) Barely ☐

4) Wheat ☐ 5) Sorghum ☐ 6) Pulses ☐

7) Others (specify) _____

18) Why do you choose this / these cereal crops?

1) Climatic and environmental adaptation ☐

2) Economic advantage (better marketability) ☐

3) Household food demand ☐

4) Use it for animal fodder ☐

5) Other (specify) _____

19) Indicate the types and amount of cereal crops produced, sold and Income received form sale of cereal crops (if you sold):

	Cereals	Unit	Amount Product	Amount Sold	Value In Birr
1	Maize				
2	Teff				
3	Sorghum				
4	Wheat				
5	Barely				
6					
7					
Total					

C. The Following Questions is about the Household Problem in Using Irrigation Scheme (Tick Your Answer inside the Box)

20) Who are the owners of irrigation schemes?

1) The Government ☐ 3) Private Companies ☐

2) Service Cooperative ☐ 4) Individual Farmers (you) ☐

5) Community Based Organizations ☐

6) Other (Specify) _____

21) Have you ever faced problems associated with the using of irrigation?

1) Yes ☐ 2) No ☐

22) If the answer to the above question is 'Yes', Please tick the problems?

1) Shortage of Water ☐ 2) Down stream conflict ☐

3) Delaying of System ☐ 4) Lack of maintenance ☐

5) Land size reduction ☐ 6) Lower quality ☐

7) Water use administration Problem ☐

8) The timing of irrigation water flow ☐

9) Administrative disincentives in the processes of supply ☐

10) Training or lack of knowledge/operation skills ☐

11) Other, specify_____

23) Have you faced any problem of crop failure using irrigation?

1) Yes ☐ 2) No ☐

24) If yes to Q. No. 23, which of the following are the major causes?

1) Water shortage ☐ 2) Production decline ☐

3) Salutation ☐ 4) Crop diseases ☐

5) Poor irrigation maintenance 6) Shortage of labor ☐

7) Over flooding of the farm and consequent erosion

8) Draught ☐ 9) Shortage of seeds ☐

9) Lack of fertilizers ☐ 10) other (specify) _____

25) If the answer to the Question 23 is 'Yes', how many times have you faced a total loss of the harvest?

1) More than 5 times ☐ 2) 5 times ☐ 3) 4 times ☐

4) 3 times ☐ 5) 2 times ☐ 6) 1 times ☐

7) Others (specify) _____

26) Based on the answer for Question 23, how many times have you faced a partial loss of the harvest?

1) More than 5 times ☐ 2) 5 times ☐ 3) 4 times ☐

4) 3 times ☐ 5) 2 times ☐ 6) 1 times ☐

III. Meher production of Households with cash cropping

27) Did you have participated in Meher production in 2006 harvest year?

1) Yes ☐ 2) No ☐

28) If yes to Q.27, Indicate the total amount of your production and amount sold and money earned in ETB in 2006-harvest year

NO	Cereals	Unit (quin.)	Amount produced	Amount Sold	Value In Birr
1	Maize				
2	Teff				
3	Sorghum				

4	Wheat				
5	Barely				
6					
7					
TOTAL					

VI. Source of Household Income

A. Income from livestock:

29) Did you have cattle and other animals?

1) Yes ☐ 2) NO

30) If yes, indicate the number of cattle and other animals you own.

1) Oxen ☐ 2) Cow ☐

3) Other cattle ☐ 4) Sheep ☐

5) Goat ☐ 6) Mule ☐

7) Horse ☐ 8) Donkey ☐

9) Hen ☐ 9) other (specify) _____

31) Did you get income from sale of animals and animals' products in1998?

1) Yes ☐ 2) No ☐

32) If yes, indicate types sold and total income received:

No	Livestock and livestock products	Number /Amount Sold	Value in birr
1	Oxen		
2	Cow		
3	Heifer		
4	Bull		
5	Calf		

6	Sheep		
7	Goat		
8	Mule		
9	Horse		
10	Donkey		
11	Hen/eggs		
12	Milk/butter		
13	Hide and Skins		
14	Hire of Oxen		
		Total	

B. Other Sources of Income

33) Indicate other additional sources of income and mount of income received in ETH. Birr in 19998.

	Activities/ source of income	Income received in birr
1	Wage1abor	
2	Petty Trade	
3	Weaving	
4	Pottery	
5	Black smith	
6	Local beverage	
7	fire wood & charcoal Sale	
8	Sale of crop residues (Straw, Hay, Stalks)	
Total		

V. Assessing Households food security

34) Did you produce enough for family consumption from Meher and irrigation?

1) Yes ☐ 2) No ☐

35) If yes, how was your Meher production harvest for the last year on average?

1) Excess of annual household consumption ☐
2) Sufficient for one year consumption ☐
3) Sufficient for only 6 months ☐
4) Sufficient for about 9 Months ☐
5) Sufficient for less than 4 months ☐
6) Sufficient for 3 months ☐
7) Sufficient for less than two months
8) Others (specify) _____

36) What proportion of the food grains consumed in your household has come from cash crop irrigation?

1) Full ☐ 2) More than half ☐ 3) Quarter ☐
4) Less than quarter ☐ 5) No own production ☐
6) Others (specify) _____

37) What proportion of the food grains consumed in your household has come from market (purchased)?

1) Full ☐ 2) More than half ☐ 3) Quarter ☐
4) Less than quarter ☐ 5) No any food from market ☐
6) Others (specify) _____

38) Did you food assistance in the past three years?

1) Yes ☐ 2) No ☐

39) If yes, are you at present among candidate of any kinds of food support

1) Yes ☐ 2) No ☐

40) Which of the following daily dietary times were experienced in your household since the practice of irrigation system?

1) More than 3 times ☐ 2) 3 times ☐ 3) 2 times ☐
4) Only one time ☐ 5) others, (specify) _____

41) Did you face food shortage during the past three years?

1) Yes ☐ 2) No

42) If yes when (during which month) did you face food shortage often?

1) September ☐ 2) October ☐ 3) November ☐

4) December ☐ 5) February ☐ 6) January ☐

7) March ☐ 8) April ☐ 9) may ☐

10) June ☐ 11) July ☐ 12) August ☐

Instruction: Now I'm going to read you several statements that people have made about their food situation. Please tell me whether the statement was often, sometimes, or never true for you in the last 12 months in your household

(Tick your answer inside the box)

43) Which of these statements are best describes the food eaten in your household in the last 12 months?

1) We always have enough to eat the kinds of food we want ☐
2) We have enough to eat but not always the kinds of food we want ☐
3) Sometimes we don't have enough to eat ☐
4) Often we don't have enough to eat ☐
5) Others (specify) _____

44) I worried whether our food would run out before we got money to by more." Was that often, sometimes, or never true for you in the last 12 months?

1) Often true ☐ 2) Sometimes true ☐
3) Never true ☐
4) Others (specify) _____

45) We couldn't afford to eat balanced meals." Was that often, sometimes, or never true for you in the last 12 months?

1) Often true ☐ 2) Sometimes true ☐
3) Never true for you in the last 12 months ☐
4) Others (specify) _____

46) We couldn't feed the children a balanced meal because we couldn't afford that." Was that often, sometimes, or never true for you in the last 12 months?

1) Often true ☐ 2) sometimes true ☐
3) Never true ☐
4) Others (specify) _____

47) The children were not eating enough because we just couldn't afford enough food" Was that often, sometimes, or never true for you in the last 12 months?

1) Often true ☐ 2) Sometimes true ☐
3) Never true for you ☐
4) Others (specify) _____

48) In the last 12 months, did you or other adults in your household ever cut the size of your meals or skip meals because there wasn't enough money for food?

1. Yes ☐ 2. No ☐

49) If yes to question number 49, how often did this happen?

1) Almost every month ☐ 2) Some months but not every month ☐
3) In only one or two months ☐

50) In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?

1) Yes ☐ 2) No ☐

51) If yes to question number 50, how often did this happen?

1) Almost ever month ☐ 2) Some months but not every month ☐
3) In only one or two months ☐

52) In the last 12 months, were you ever hungry but didn't eat because you couldn't afford enough food?

1) Yes ☐ 2) No ☐

53) If yes to question number 52, how often did this happen?

1) Almost ever month ☐ 2) some months but not every month ☐
3) In only one or two months ☐ 4) others (specify) _____

54) In the last 12 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?

1) Yes ☐ 2) No ☐

55) If yes to question number 54, how often did this happen?

1 Almost ever month ☐ 2) some months but not every month ☐
3 In only one or two months ☐

56) In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food?

1) Yes ☐ 2) No ☐

57) If yes to question number 56, how often did this happen?
1) Almost ever month ☐ 2) Some months but not every month ☐
3) In only one or two months ☐

58) In the last 12 months, did any of the children ever skip meals because there wasn't enough money for food?
1) Yes ☐ 2) No ☐

59) If yes to question number 58, how often did this happen?
1) Almost ever month ☐ 2) some months but not every month ☐
3) In only one or two months ☐

60) In the last 12 months, were the children ever hungry but you just couldn't afford more food?
1) Yes ☐ 2) No ☐

61) If yes to question number 60, how often did this happen?
1) Almost ever month ☐ 2) Some months but not every month ☐
3) In only one or two months ☐

62) In the last 12 months, did any of the children ever not eat for a whole day because there wasn't enough money for food?

1) Yes ☐ 2) No ☐

63) If yes to question number 61, how often did this happen?
1) Almost ever month ☐ 2) some months but not every month ☐
3) In only one or two ☐

V. Household coping mechanism

64. How did you cope up with food shortage?

Coping Mechanisms	Tick
Food loan from neighbors	

Migration	
Engage in labor work	
Eat wild fruits	
Purchase cheaper food	
Renting out land	
Use of food aid	
Reduce meals size and skip meals	
Reduce meals variety	
Sales of livestock assets	
Eat reserved seeds	

Thank you!

Annex II

Checklist for Key Informants interview and Focus Group Discussion

The following checklist were used with questions to guide in the informal interviews and group discussion that held with irrigation scheme, farmer, knowledgeable individual, development Agents, Experts and Woreda and Kebele officials.

I. Cash cropping:

1. What type of water delivery system is used from the source?
2. How the management and operation of the scheme undertaken?
3. Is there an irrigation management committee?
    I. What is its role?
    II. How effective is it?
    III. How is it elected?
4. Is there any bylaw of the irrigation? Can I access the document?
5. How construction and maintenance activities to be performed on the scheme?
6. Who decide the cropping program/types in the irrigation scheme?
7. What type of fees do farmers pay on the scheme?
9. Which cash crops are growing on the scheme?
10. What types of records are maintained in/about the schemes?
    For Example
    a. Area under different crops?
    b. Yield?
    C. Level of input used?
    d. Sales record?
11. How the marketing of cash crops undertaken? How much was farm get price for such crops?

12. In your opinion, what is the impact of the scheme to the villagers in general?
    I. If it is positive in what ways?
    II. If it is negative, what are the reasons for dissatisfaction?
    III. Is there any effect on cropping pattern/ season?
13. In your opinion, does irrigation serve the following purpose?
    I. ensuring households' food availability/accesses
    II. Improve households Income
14. What are the major problems encountered by farmers on this scheme?

Income diversification

15. What are the main sources of household's income in this peasant association?
16. What are the main constraints which hindered households to diversify their sources of income?
17. What are the main opportunities which facilitate conditions for households to diversify their sources of income?

Declaration

I declare that this thesis is my own original work and has not been submitted for a degree in any university and all sources materials used for the thesis are duly acknowledged.

Garedew Dinku

Addis Ababa University

July 2007