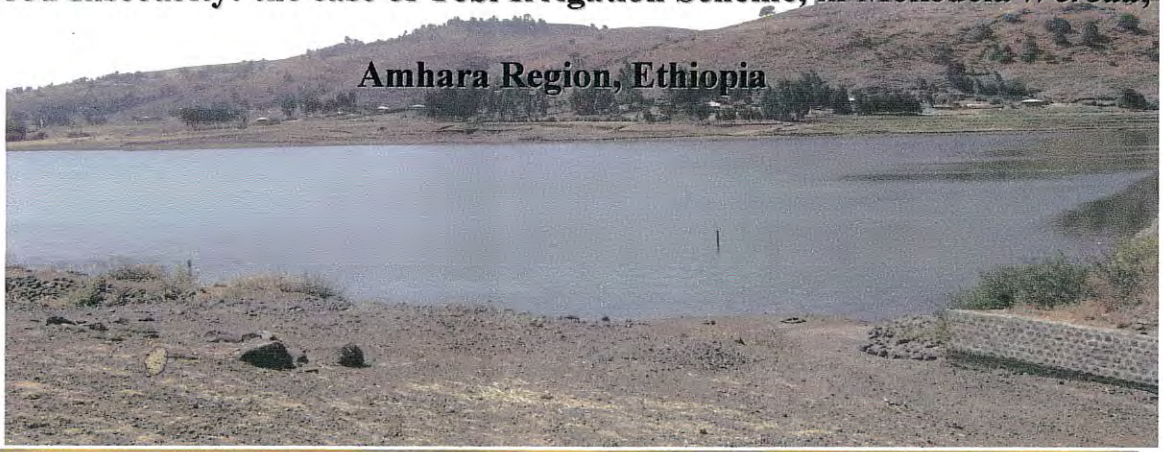
A THESIS SUBMITTED TO SCHOOL OF GRADUATE STUDIES,

ADDIS ABABA UNIVERSTY

COLLEGE OF DEVELOPMENT STUDIES INSTITUTE OF ENVIRONMENT, WATER AND DEVELOPMENT

The Role of Water Resources Development in over Coming Household Food Insecurity: the case of Tebi Irrigation Scheme, in Mekedela *Wereda*, Amhara Region, Ethiopia



IN PARTAL FULFILLMENT OF THE REQUIREMENTS FOR THE MASTER OF ARTS IN ENVIRONMENT AND DEVELOPMENT

BY

Sileshi Temesgen

Advisor; Degefa Tolossa (PhD), AAU

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DEVELOPMENT STUDIES

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Abstract

The study is conducted in Mekedla wereda took Tebi irrigation scheme as a case study, and the main objective is to explore the role of access to irrigation on to household food security through increasing production or food availability, increasing income or food accessibility and improve the household daily food status and also identify challenges of irrigated agriculture development of the study area. In order get sample households, a two stage sampling producers was employed and select 150 sample households (i.e. 103 irrigation users and 47 nonusers randomly and proportionally). The basic data used for the study were both qualitative and quantitative in nature and collected by using sample household survey, focus group discussions and key informants interview. Descriptive statistics were employed for data analysis by using SPSS.

Indicators that used to see the role of irrigated agriculture to households' food security were household's productivity, income; assets and food consumption. The result of the study shows that irrigation users are relatively better in their food security status as compared to nonusers (i.e. 74% of users and 52% of nonusers are food secure). More-over, irrigation users have opportunity of producing high value crops and generating more income from market; accesses to round year production that they can harvest at least twice a year and low vulnerability of environmental risk particularly short and erratic rain condition. Regarding challenges of the water resources development, the study is identified many constraints including management, economic and institutional. But lack of investment is one and main challenge of the development. At last, the study concluded that policy maker and other development partners must give attention and high priority in improving economic access of resources like small scale irrigation to poor small scale households, which enable them out from the prison of poverty and food insecurity.

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Acronyms

ACSI	Amhara Credit and Saving Institution
ANRS	Amhara National Regional State
BoFED	Biro of Finance and Economic Development
BoI	Biro of Information
BoRAD,	Biro of Rural and Agricultural Development
Co-SAERAR	Commission for Sustainable Agricultural and Environmental Rehabilitation of Amhara Region
CSA	Census and Statistics Authority
DAs	Development Agents
EEA	Ethiopia Economist Association
FAO	Food and Agriculture Organization
FDRE,	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
GDP	Gross Domestic Product
HH	Households
IGA	Income Generating Activities
ILRI	International Livestock Research Institute
KAO	Kebele Administration office
KI	Key Informants
MoI	Minster of Information
MoWR	Minster of Water Resources
NGOs	Non Governmental organizations

PASDEP	Plan of Accelerated Sustainable Development to End Poverty
PSNP	Productive Safety Net Program
RESDS	Regional Economic and Social Development Survey
SIDA	Sweden International Development Agency
SSA	Sub Sahara Africa
WAO	Wereda Administration office
WARDO	wereda Agricultural and Rural Development Office
WRD	Water Resource Development
WUC	Water Users Committee

CHAPTER ONE

1. INTRODUCTION

1.1 Background and Justification

In Ethiopia, a combination of natural and manmade factors has resulted in serious food insecurity. According to FAO (2006) around 15 million people were facing food insecurity either chronic or transitory. From the total food insecure population of the country 5-6 million people found under chronic insecure every year (FAO, 2006; FDRE, 2002; Workneh, 2006). Moreover, 10 million people are vulnerable with a weak resilience to any shock or under emergency circumstance so that the likelihood of these people falling back in-to food insecurity is high (FAO, 2006).

According to MoFED (2005), the incidence of poverty in Ethiopia stands up to 38.7%. The figure for rural and urban areas is 39.5% and 35.1% respectively. Agriculture is the main stay of Ethiopian economy. It plays an important role, and contributes for about 50% of the GDP and is used as means of employment for about 85% of the population (MoFED, 2005; Getachew, 2003). Thus, in Ethiopia food security is highly related to farm performance, in particular to the production level of major food crops (cereals, pulses and oilseeds). Which account more than 90% of the total area covered by temporary or permanent crops (EEA, 2000/01, cited in Workneh, 2006).

Ethiopian's agricultural system is not significantly benefiting from the technologies of water management and irrigation (MoWR, 2002). Most of the country's poor people live in rural area are with limited access to agricultural technologies and limited potential to diversify agricultural production. It is widely acknowledged that the main causes of food insecurity are reduced productivity and vulnerability to climate variability. The problem is found in a more serious form, in the Northeast part of the country, like Wollo which is affected by

drought, degradation and weak infrastructural situation compared to other parts of the country (Mesfin, 1984)

Despite this condition, Ethiopia possesses substantial untapped water resource that could play significant role in reducing poverty and accelerating growth. Ethiopia has 12 major rivers basins and 12 large lakes. The total annual surface water is estimated to be 122 billion meter cube. And there is also a further estimated 2.6 billion meter cube of usable ground water (MoFED, 2005; Seleshi et al, 2006).

According to MoFED(2005); MoWR(2002); MoI(2002) Woldeab(2006), various efforts have been made to develop the water resource to increase its contribution to the national economy. However, mainly due to uneven distribution of resource, limitation of financial and technical inputs, limited progress has been made so far. Despite its current limitation of water resource development, many believe that the future increase in food supply and economic prosperity for the rural people in Ethiopia will come mainly from improved agricultural technologies and water management.

Appropriate technology packages have been introduced depending on the socio-economic conditions of food insecure area and households (IWMI, 2004). The packages include provision of improved inputs to increase livestock and crop production and productivity, moisture conservation and utilization, credit, training, support for additional income-generating activities, and provision of market information. These can contribute to achieve the objectives of food security program and to increase food availability and access at household level through (i) increased crop production and productivity (ii) increased livestock production and productivity and (iii) increased access to other non-farm income through agricultural and non-agricultural activities (FAO, 2006).

The challenge of food insecurity that is aggravated by recurrent drought is resulted from declining agricultural production at household level. Ever increasing population pressure which has necessitated to focus on water resource management and small-scale irrigation development (Hune, 2003). Irrigation development is, thus, being promoted by government and non-governmental organizations as one of the development strategies contributing to the overall improvement of the country in general and to rural household food security in particular. The contribution of small-scale irrigation for semi-cash cropping has not been studied, though such schemes cover more than 40 % of the irrigated land in the country (Dessalegn, 1999). The same author also recommends the need to undertake research on the role of small-scale irrigation in production and productivity of rural households.

1.2 Statement of the Problem

Ethiopia is a country with an agrarian society in which the agricultural sector plays an important role in the national economy. Agriculture is used as a means for livelihood and the base for socio-cultural system of the country. As indicated above the sector supports employment for over 85% of the population. It accounts for 50% of the National GDP, and makes the largest contribution to raw materials for agro-industries, food security and foreign exchange earnings (Azemer, 2006). However, the agricultural system is still vulnerable to drought and other global and local environmental changes.

The smallholder agriculture accounts for over 95% of the cultivated land and production (Azemer, 2006). Production system is largely characterized by subsistence orientation, low levels of external inputs, dependency on rainfall, and limited irrigation development. Moreover, the country has so far only developed a very small share of the potentially irrigable land.

The agricultural sector is vulnerable to the vagaries of nature, particularly rainfall instability and drought. Poverty, suffering from food shortage and hunger has worse effect in the drought prone areas. In the Nile basin area of Amahar region, particularly in the eastern parts, there are a number of food insecure *weredas* (districts). Sedentary agriculture is the main mechanism of the farmers' communities. However, mainly due to spatial and temporal uneven distribution of rainfall, rain fed agriculture alone becomes unreliable to sustain the crop production of the households (BoRAD, 2003).

Irrigation agriculture could serve as a means to sustain the household food requirements, if the practice is managed properly. However, the rate of development of overall irrigation scheme is very low and it is not up to the needs and potential of the region (BoRAD, 2003). For instance, the Amhara National Regional State has nearly 700 thousand hectares of land suitable for surface irrigation (BoI, 2008). Because of the prevalence of poverty and food insecurity as well as an increasing trend in the occurrence of drought in the region, the regional government has planned to utilize the exiting irrigation potential in order to reduce poverty of people living in the region.

Mekedela *Wereda* (district) is one of the chronically food insecure and drought prone districts in eastern part of the Amahara region. The area has been designated as a drought prone zone and crop failure is common leading to household level food shortage. Drought induced food insecurity has been a recurrent phenomenon, which has exacerbated the vulnerability of resource poor farm households in the area (BoRAD, 2003). It shows that how insufficient and uneven distribution of rainfall affects the livelihood of the people in the area over the last decades.

Moreover, the area is well known by extreme poverty, insufficient food supply per capital, high population growth rates, low growth rate of agricultural productivity, and a growing

demand for increasing scarce arable land. Shortage and erratic rainfall, falling per capita food production, resources degradation, coupled with fast growing population, and worsening poverty, are serious threats to the rural livelihoods, and household's food security. Shortage of land is critical and the majority cultivates less than half a hectare of land often degraded due to over cultivation for many years (BoRAD, 2003).

Progress in surmounting the area's staggering food deficit will require the application of productive, labor intensive, cost effective and sustainable technologies such as small scale dam and other type of irrigation schemes. Tebi irrigation scheme is an example which is found in Mekedela district in Tebi *kebele* (012). It has been established by Commission for Sustainable Agricultural and Environmental Rehabilitation of Amhara Region (Co-SAERAR). The scheme irrigated a total area of 180 hectares with the cost of Birr 3,286,161, which is Birr 18,256 /hr (BoARD, 2003) and about 605 households are benefiting. There are other small scale irrigation activities, like river diversion, spring development, ground water, etc. However, the effort is very limited as compared to the *wereda* rural population which estimated to 142,623 (CSA, 2007). Despite low level of irrigation development in the area, it is undeniable fact that there exists positive relationship between small scale irrigation, food security, and poverty reduction efforts.

However, there is limited understanding or knowledge about the role of irrigation development, in the household income, food availability and asset building and productivity. In addition, there is no clear understanding about farmers' perception, about the effectiveness of many irrigation technology alternatives as well as limited understanding of the constraints of irrigation development and challenges of sustainability. Besides limited successes and farmers' poor adoption of irrigation technologies and other hot issues relating to irrigation investment decision, require an in-depth analysis to properly understand the

economic impacts, so that right kind and empirical data based measure can be initiated to solve the problem, if any, to boost up agricultural production so as to alleviate poverty, food insecurity, and bring sustainable development. Therefore this research focuses on examining these aforementioned issues and the life in the study area.

1.3 Objective of the Study

The main objective of the research is to assess the role of small-scale irrigation in improving the households' food security status through improving agricultural productivity, income, asset building, and household consumption of food. The research focuses on the following three specific objectives:

1. To assess different demographics, socio-economic and institutional factors are find that affect the food security status of rural households.
2. To explore the role of Tebi irrigation scheme in the rural household food security status, particularly through its implication to households' agricultural productivity, income, asset and own sources, food covering capacity of irrigation users in comparison with nonusers
3. To assess the perception of farmers and other key stakeholders to the challenges of small scale irrigation (water resources) development and farmers' adoption in order to maximize its food security.

1.4 Research Questions

The study addresses the following research questions:

1. How different demographic, socio-economic and institutional factors are found those affect the food security status of rural households in the study area?

2. How do users and nonusers of irrigation find their agriculture productivity, income, asset, food consumption and food security status?

3. What do the perceptions of farmers and other key stakeholders look like towards small scale agriculture irrigation development? And why best practices of WRD could not be adopted by all farmers?

1.5 Significance of the Study

The findings of this study will benefit local government bodies in particular and development practitioners, policy makers in general, in terms of improving their existing knowledge in determining contribution of irrigated agriculture in improving household income, asset, food availability in the drought prone areas of ANRS. It also may give insight to researchers and students interested in similar research theme for further investigation in other areas. In addition to these, it will help to promote water resources development to contribute in poverty reduction and maintaining food security effort.

1.6 Hypothesis

1. There is a difference in food security status, between irrigation users and non users,
2. Irrigation users are more food secured than the non users.

1.7 Scope and Limitation of the Study

The study tries to cover an irrigation scheme in *Wereda*. Then the following limitations to be noted:

- The sample size is limited to generalize to at wider level (scale).
- Lack of base-line data to compare the difference (before and after irrigation),

- The difficulty to avoid externality such as global economic impact, food price and environment that have influence on food security household level and are beyond the scope of this case study.

CHAPTER TWO

2. LITERATURE REVIEW: IRRIGATION AND FOOD SECURITY

The following section presents an overview of the salient issues of small scale irrigation and household living standard, with its measurement methods and indicators of food security. Thereafter, it tries to cover perspectives on irrigation in relation to household income, asset and its contribution to agricultural productivity particularly to food security and highlight few empirical studies done on contribution of irrigation on household general food security. Finally I attempt to draw conceptual framework from the theoretical perspectives on food security household income and irrigation.

2.1. Concepts and Definition of Food Security

The concept of food security has been familiar, since for quite a long period, because of the growing hunger and malnutrition scenarios in developing countries. In the 1970s, food security was mostly concerned with national and global food supply. Then in the 1980s the focus shifted to questions of access to food at household and individual levels (Sen, 1981). Hence, food availability, access and utilization are three general components in the definition of food security (Smith et al, 1992; Maxwell, 2001). The most cited definition of food security is 'when all people, at all time, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life' (FAO,1996, cited by Degefa and Tesfaye, 2008)

The essential elements of food security definition are available food and ability to acquire it (William et al, 2002). In view of this, 'food insecurity is defined as the lack of access to enough food. Food insecurity is classified as chronic and transitory. Chronic food insecurity is a continuously inadequate food due to household lack of ability to buy or produce.

Transitory food insecurity is a temporary declined household access to food, as result of inability to buy or produce (Degefa 2002: 11).

Besides, household is identified as food secured if entitlements of demand for food security is greater than food needs, which is defined as the aggregation of individual requirements. At individual level, the definition is much more straightforward. An individual is food secure if his or her food consumption is determined by claim the individual has on household food source. This may be affected by individual earning or asset or by individual position in the household (Thomson & Metz, 1997).

From the above definitions the following four core concepts, implicit in the notion "secure access to enough food at all time" are defined by FAO (1996 cited by Degefa and Tesfay 2008). There is access to food, defined by entitlement to produce, purchase, or received as a gift; sufficient food as calorie needed; balance between vulnerability, risk and insurance and time. Therefore, for the purpose of this study, the definition forwarded by FAO (1996) is taken as a working definition of food security.

2.2 Food Security in Ethiopia

A considerable proportion of Ethiopia suffers from famine, chronic and seasonal food insecurity. According to Mesfine (1984), during 1985-1977 in Ethiopia on average 20% the country was under famine and 'quite obviously the worst famine years are 1973-1975, during which more than 50 *Awrajas* were under famine in spite of unprecedented national and international relief aid. Dessalegn (1999) also indicates that in Ethiopia witnesses three major drought between 1983 and 1993. About 22% of Ethiopian was in need of food aid during the recent food crisis of 2002/03 (Workneh, 2006). Ethiopia usually faces significance food gap, mainly due to the poor performance of its agriculture. Food

production of the country has not been sufficient enough to rural population. According to Workneh (2006: 2), 'in the late 1980s, the domestic production provided about 1620 calories per person per day, while total ability, including import was 1770 calories per person per day, which is below the minimum level, 2100 calories per person per day. The production of cereals dropped from about 200kg per person in the early 1950 to, less than 150kg in 1992'. All the above scholars were agreed that the problem is a result of poor and subsistence agricultural development which nearly 85% of the population is employed.

More-over, the agriculture development is highly dependent on rain and due to recurrent drought, environmental change ,ever increasing population sub division of the farm land and lack of on-farm technology, the country may not be able to meet its large food requirement through rain –fed agriculture alone (Desta ,2004; BoARD,2003).

Food insecurity is one of the defining features of rural poverty, particularly in the moisture deficit Northeast and high land plateaus (FDRE, 2002) because of the primary dependence on crop production. In Ethiopia harvest failure leads to household food deficits, which is resulted in the absence of off-farm income opportunity, irrigation facility, and, or timely food aid assistance ,leads to asset depletion and increasing level of destitution at the household level (Yared et al,2003; FDRE,2002).

Amhara National Regional State, one of the big regions in Ethiopia, with a population of more than 17.2 million (CSA, 2007) faces both chronic and transitory food security due to a combination of factors. According to Yacob et al (2006), BoARD (2008), BOI (2008), about 20% of the population of the region, who are chronically food insecure, women and female-headed households, suffer more from poverty than men and male-headed households. Agriculture is the main stay of the economy of Amhara region as the sector contributes about 90% of the labor force is engaged in Agriculture. Performance of

agricultural sector basically dictates the growth rate of the economy. Despite relatively abundant surface and ground water resources and presence of the four major river basins of the country and Lake Tana, poor performance of agricultural sector, mainly due to such erratic and uncertain rainfall, and drought erode the capacity of rural households to withstand the declines in their income. Even attempts during the recent past have not produced satisfactory results. Consequently, farmers are continuing to spiral down economically, and their resilience to withstand the vagaries of nature is dwindling. Even the traditional livelihood coping strategies are continuing to dwindle. Continued poverty is leading to degradation of natural resources on which future development depends. Degradation of the natural resources is also a root cause of the low farm productivity, directly contributing to poverty and food insecurity.

A vicious cycle set in continued poor performance of agriculture is also contributing to out-migration from rural areas to urban areas. More people are being attracted to live and work in the urban areas, thus a significant portion of the economically active population is being siphoned out of the rural areas. This has direct negative effect in the agriculture sector and create burden on the socio- economic development efforts of the urban centers where labor absorptive capacity is insignificant. There is an urgent need to improve the performance of the agriculture sector so that more and more jobs are created in the rural areas. However, these jobs should be economically attractive, which calls for making agriculture more profitable. There is a need to turn agriculture from subsistence to commercial agriculture. There is also need to emphasize on value addition to farm products so that poor farm families can generate additional income from agricultural products. These, however, will require creating environment so that producers have adequate access to both input and output markets. Roads, irrigation schemes, easy access to market information, policy framework for market support, enabling private entrepreneurs to play fair roles, extension

and development support to enable farmers to produce marketable surplus, organizing farmers to have control over output prices, etc. are very important in alleviating rural poverty and improving the livelihood of the farm families.

2.3. Food Security: Measurements and Indicators

There is no single indicator to measure food security. Many different indicators are needed to capture the various dimensions at country, household and individual levels (Hoddinnott, 1999). Since food security is influenced by different interrelated socio-economic, environmental and political factors, it requires multidimensional considerations. As a result, assessing, analyzing and monitoring food security necessitates approaches ranging from a mere quantitative to a combination of both quantitative and qualitative measurement (Degefa, 2005; Ayalew, 2003).

Some indicators may be appropriate for monitoring purpose while others are outcome indicators. It is up to the researcher to select a combination of indicators that suit the objectives of the investigation, the level of aggregation and specific circumstance of the study and study area (Carletto & Morries, 1999; Tesfaye, 2003). Outcome indicators unlike the supply indicators can be disaggregated at lower level. They include household budget and expenditure, subsistence potential, food consumption frequency, national status storage estimate, household perception of food security (Ayalew, 2003). For the purpose of this research work, the researcher has selected household head's perception of food security taken as an indicator.

2.4. Small Scale Irrigation and its Linkage to Food Security

According to Seleshi et al (2006), Woldeab (2006), Solomon (2006), William et al (2002), Dessalgen (1999), Arat Van de Larr (1994), small-scale irrigations are schemes which could

be constructed and managed at individual or group of households' level. It has various advantages over medium and large-scale schemes. They require lower investment cost, which can be managed by farming communities; there is no population displacement involved; they are less demanding in terms of management, operation and maintenance; they do not inflict land tenure and resettlement problems; they do not cause adverse environmental impact; they allow wider diffusion of benefits and they permit farmers to learn irrigation techniques at their own pace in their own way.

According to Yalew (2006), modern SSI schemes are planned, designed and constructed by the government or other external body to irrigate maximum 200 ha of land for the benefit of the farmers with minimum contribution (about 10% of the investment cost) in terms of labor and/or local materials or no contribution by the beneficiaries. Currently, small-scale schemes are becoming popular. Small-scale irrigation schemes involve small dams and diversion of streams and rivers, spring development, etc. After establishment, small-scale schemes are usually "handed over" to water users associations (WUAs) for management, operation and maintenance with the support of personnel from regional bureaus. The focus on large-scale irrigation development and neglect of small-scale schemes was reversed after 1991. ''More emphasis has been given to the development of small-scale irrigation schemes and improvement of farmer-managed traditional schemes' (Brehanu & D.Peden, 2003)

One of the greatest challenges of Ethiopian's agriculture is its vulnerability to vagaries of nature, particularly rainfall variability. Not only is the performance of the sector clearly rainfall dependent, but also that variability of the sector's performance largely affects the national economy. Despite a huge resource potential for irrigated agriculture, the country uses only insignificant portion of this potential. It is said that the country's water resource

provides an estimated potentially irrigable 3.5 million hectares of agricultural land (Azemer, 2006).

Some of the major underlying reasons for inability to use water resources are lack of capital to invest in water resources development, lack of appropriate water resources development strategy for long period, and others. Within the framework of PASDEP, the government agricultural sector five year plans, as well as that of the water sector have promised to give more attention to water resource development. The current government plan shows that irrigation of many hundred thousands of hectares of land will be realized for the purpose of crop and livestock production (growing irrigated fodder crops for livestock).

According to Federal Democratic Republic Government of Ethiopia food security strategy (2002), there is a strong commitment that development of irrigation is the integral part to realize food security and to reduce dependency on rain-fed agricultural conditions and thereby increase the opportunities for year round agriculture production. The objectives are in order of priority, to improve food security in drought–prone areas; increase the volume of production of high value crops, especially fruits and vegetable, open up agricultural land in marginal areas, and use irrigation as a method to increase productivity in area of insufficient rain. And many efforts were made in the Amhara region to identify and promote appropriate technology of household based; water harvesting practices, small dam construction, river diversion, spring development and conservation based sound and efficient management which will be contributing to the objectives of food security.

2.5 Irrigation, Household Income, Asset and Food Security

As Africa lags behind other regions in the adoption of technologies, particularly, irrigation, fertilizer and improved seed verities, numbers of food insecure people will be on the rise by

2020, and the number of malnourished children will increase correspondingly (Rukuni, 2002).

According to ILRI (2003), over the past two decades (1975-95), per capital consumption cereals stagnated in most sub-regions of SSA, Per capital consumption of cereals increased only slightly from 109kg in1975 to114kg 1995 for the entire SSA, the average milk and meat production and consumption are also in a very low level in developing countries. In addition to the above problem as indicated by the ILRI (2002) report, by 2020 the Africa (SSA) developing countries found far behind other developing countries.

The optimistic scenario presents what will take for SSA to reach the level of other developing countries under the base projections. Specially, what are the requirements in SSA necessary to raise daily calories supply to 3232 per capital and reduce the number of malnutrition children to 22 million? However, to meet these and other development objectives, the required cereals yield has to double by 2020 (ILRI, 2002). Irrigation with higher yields can allow countries to grow more of their own food and be less dependent upon imports especially in view of the common occurrence of droughts in the region. Hence, development of the agricultural sector in general and irrigation in particular would be an obvious solution.

Development of agricultural water resources brings significant changes at various levels, from farm to national levels. These are changes in production patterns, land and property values, expansion in the use of complementary inputs (such as high yielding variety seeds, fertilizers, pesticides, etc.), and expansion in overall economic activities through backward and forward linkages.

The impacts of these changes vary greatly from one level to another. Some of the impacts are confined to only farm level, while others spread to the whole project command and others spread to wider region and province/state or national level (Hussain & Bhattarai, 2000). Where conditions are favorable irrigation can raise the incomes of those farmers with access to irrigated land by reducing production risk and farm output diversification, thereby encouraging farmers to gain the benefits of greater specialization and commercialization and at the same time enabling farmers to adapt timing of production to take into account market demand and higher prices (Hasnip et al, 2001)

In areas where communities and households depend to a great extent on agriculture for their livelihoods, access to irrigation is a necessary, but not a sufficient condition for poverty alleviation. Access to other production inputs and services by the poor and marginal farmers is also important to enhance benefits of irrigation for poverty alleviation (Hussain, 2004).

Brehanu & D.Peden (2003) indicated the need for policy and institutional interventions to enhance the impacts of irrigation so as to enhance its contribution to sustainable livelihoods of rural people. This could be achieved through household asset building by strengthening market access, by promoting high-value crops, and improving systems for providing extension and technical support to smallholder irrigation.

The challenge that Ethiopia, and in the particular the study *Wereda* (Mekedela) faces food insecurity is associated with both inadequate food production even during good rain years and natural failures due to erratic rainfall. Therefore, one means by which agricultural production can be increased to meet the growing food demands is through increasing agricultural yield and increasing cropping intensity (number of crops per year). Increasing yields in both rain-fed and irrigated agriculture and cropping intensity in irrigated areas

through various methods and technologies are the most viable options for achieving food security in Ethiopia (Mekuria, 2003).

2.6 Empirical Studies

According to Aart van laor (1994: 7) 'irrigation contributes to agricultural production in basically three ways: (i) Stabilization of harvest fluctuation with attendant improvement in average yields brought about through the provision of dependable throughout the growing season, (ii) In some circumstance improve control over available water resource may make a second or ever a third crops possible, (iii) The availability of reliable water supplies makes it possible to use improved seeds, to introduce new farming techniques and to increase the use of chemical fertilizer all of which require adequate water to supply large relative increases in productivity'.

Irrigation has a strong land augmenting impact. The value of per hectare crop production under irrigated settings is about twice that of under rain-fed settings. Household income and consumption are much higher in irrigated settings than in rain-fed settings, and a 50 percent point gap is not uncommon (FAO, 2006).

Impact study carried out by Desta (2004), In Oromeya region, Ethiopia, revealed that contribution of irrigated agriculture to income is about 70 % in the highly irrigated areas as compared to 60 % in two other low irrigated areas. At the same time, the absolute size of agricultural income is also the highest in the highly irrigated village despite the lower land holding size and cultivated holding by more than 30% over the low irrigated village.

The share of agricultural income (in terms of both owned and cultivated land) is also found to increase with the increase in irrigation intensity of the village. The highly irrigated village has higher per hectare agricultural income by over 50% over the low irrigated village.

According to Degefa and Tesfaye study (2008), in Hararge area Ethiopia, developed water access to household food security situation is better (28.1%) other than non accessed household (9.4%), even if the water is developed for domestic purpose, farmers use it for multi-purpose including irrigating their farm and reducing crops failure.

Fuad (2002), shows that cash crop economy offers a wide range of off-farm income possibilities as compared to subsistence farming. About 45% of farmers involved in cash crop production are engaged in income generating off-farm activities while only 13% are from the non-cash crop producers. Tesfaye (2004) studied two irrigation schemes in Doni Kumbi and Bato Degaga peasant associations in East Shewa and he found that the average income obtained from irrigation agriculture for three consecutive years accounted 69%, 76%, 76% in Doni Kumbi and 0, 75%, 61% in Bato Degage.

According to TEBITA (2008), the survey result shows 22 farmers have constructed better house, 17 have purchased Camels, 26 households purchased oxen, 31% of respondents fulfilled all farm tools and 33% of respondents others household furniture after they used the irrigation scheme in the valley. Almost all beneficiary household build the capacity of all production cost such as light, seed, fertilizer, pesticide and other costs. In addition the that the beneficiary households cover all 12 month food amount without any deficit and some household save money and invest in other fields of investment or income generation activities.

According to ILRI (2000), BoI (2006), since 1995 the Commission for Sustainable Agricultural and Environment Rehabilitation of Amhara Region (Co-SAERAR) was established by the regional government with the mandate for irrigation development in the region. The main objective of the commission is promotion and development of small scale irrigated agriculture to improve food production in more than 40 moisture stressed *weredas*

of the region that susceptible to drought. By 1998, the commission had completed 24 irrigation water development projects consisting of river diversion, earth dams and pumps. Tebi earth dam is one of them. The total command area and beneficiaries of these project are estimated at 3647 ha and 10,720 households, respectively (CoSERAR 1999; cited by ILRI, 2000). When the commission was established, an ambitious plan was set to create 540 small scale irrigation schemes (mostly earth dams) in order to irrigate 62,100 ha over a 10 year period; however the organization was dissolved and the approach was changed from high projects to individuals water developments that aim to address all area and population with short period of time.

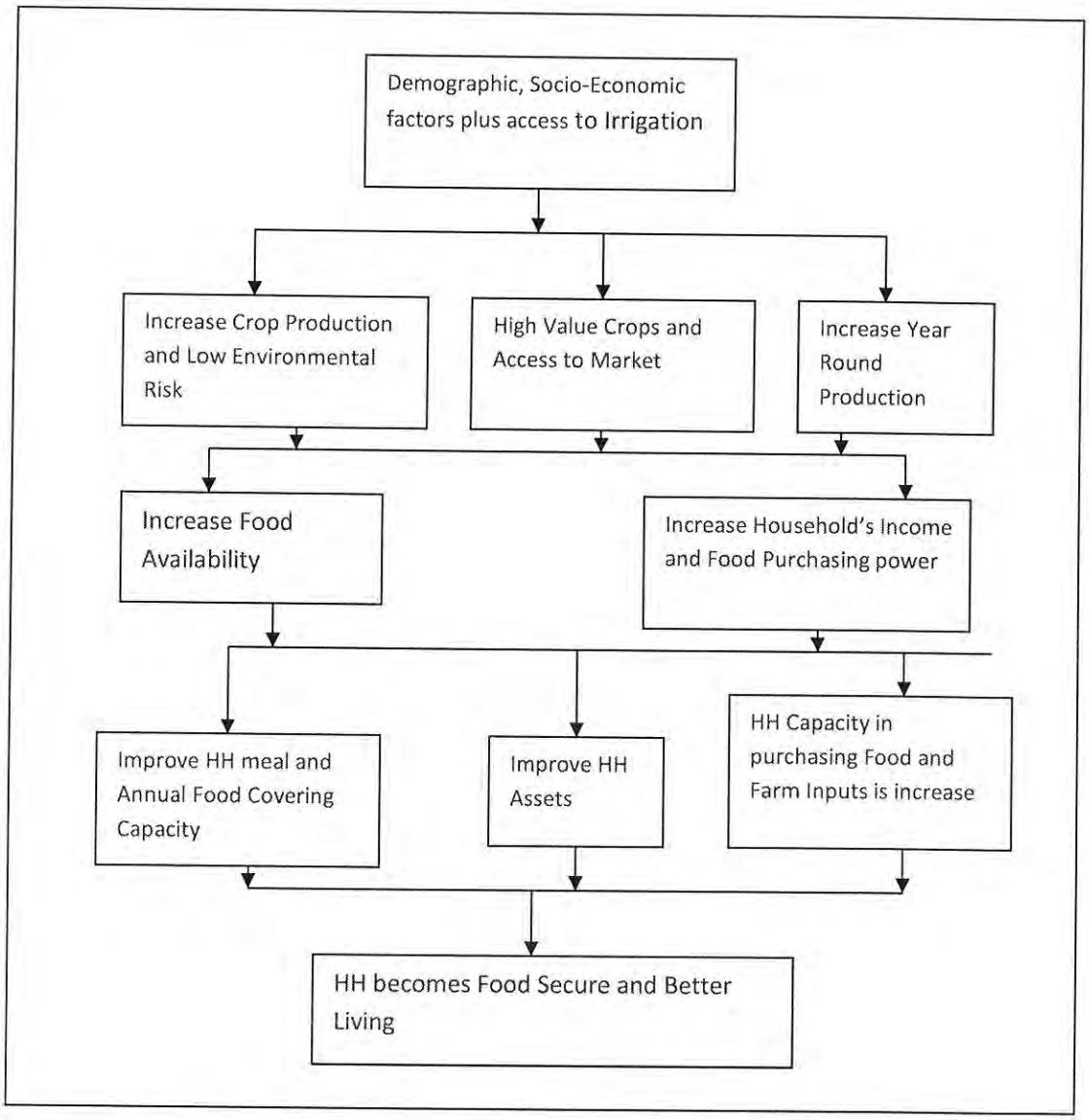
All of these studies are concerned with showing the importance of irrigation development without control the possible role of other variables that may significantly contribute to household food security. So, it's of interest to see the net effect of irrigation to household food security by controlling other variables. Besides, no study has been conducted regarding to the role of small scale irrigation to household food security in the study area of Mekedela *Wereda.* Hence, it would be quite significant to investigate the contribution Tebi irrigation scheme and challenges that limit the WRD in the area to benefit all farmers.

2.7 Conceptual Framework

The following conceptual framework is developed to show the linkage between household food security and access to irrigation water. Farm households who participate in irrigated agriculture would be able to increase crop production through increased use of complementary inputs (such as high yielding variety seeds, fertilizers, pesticides, etc.), which enables, them to produce more and retain food for household consumption, i.e. availability of food in household will be enhanced..

Access to irrigation also creates an opportunity for rural farm households to produce crop throughout a year since water will be available for crop to grow when ever needed, that means risk of crop failure is reduced. Hence, the household will not face consumption shortfall, as production of crops are possible during off periods where food stocks are depleted. Thus, the availability of households' food would be increased. Furthermore, use of irrigation will enable farm households to produce high value crops and enter to market, in most cases vegetables, which eventually increase crop income. Increased income creates consumption stability since the farmers will have access to food through purchase. In addition, irrigation can also increase households' labor productivity and, food purchasing power and other households' asset ownership status those can affect or indicates the households' food security status. But, there are factors which directly or indirectly affect household food security. These include, among others, factors like output and input price policies, market situations, institution and rural household characteristics. Hussen (2004) noted that irrigation can benefit the poor through raising yields and production, lowering risk of crop failure, and generating higher and year-round farm and non-farm employment. It can enable smallholders to adopt more diversified cropping patterns and to shift from low-value subsistence production to high-value market-oriented production, which increase income of household. It is impossible to generalize that only accessing irrigation water by rural poor solves food insecurity and income shortage. There are factors like, institution, actions, policies and other resources that affect directly or indirectly the food security of rural households'. Though water is only a single element, it plays important role in addressing the problem of food insecurity.

Figure 1: Conceptual Framework



Source: My Own Framework, 2009

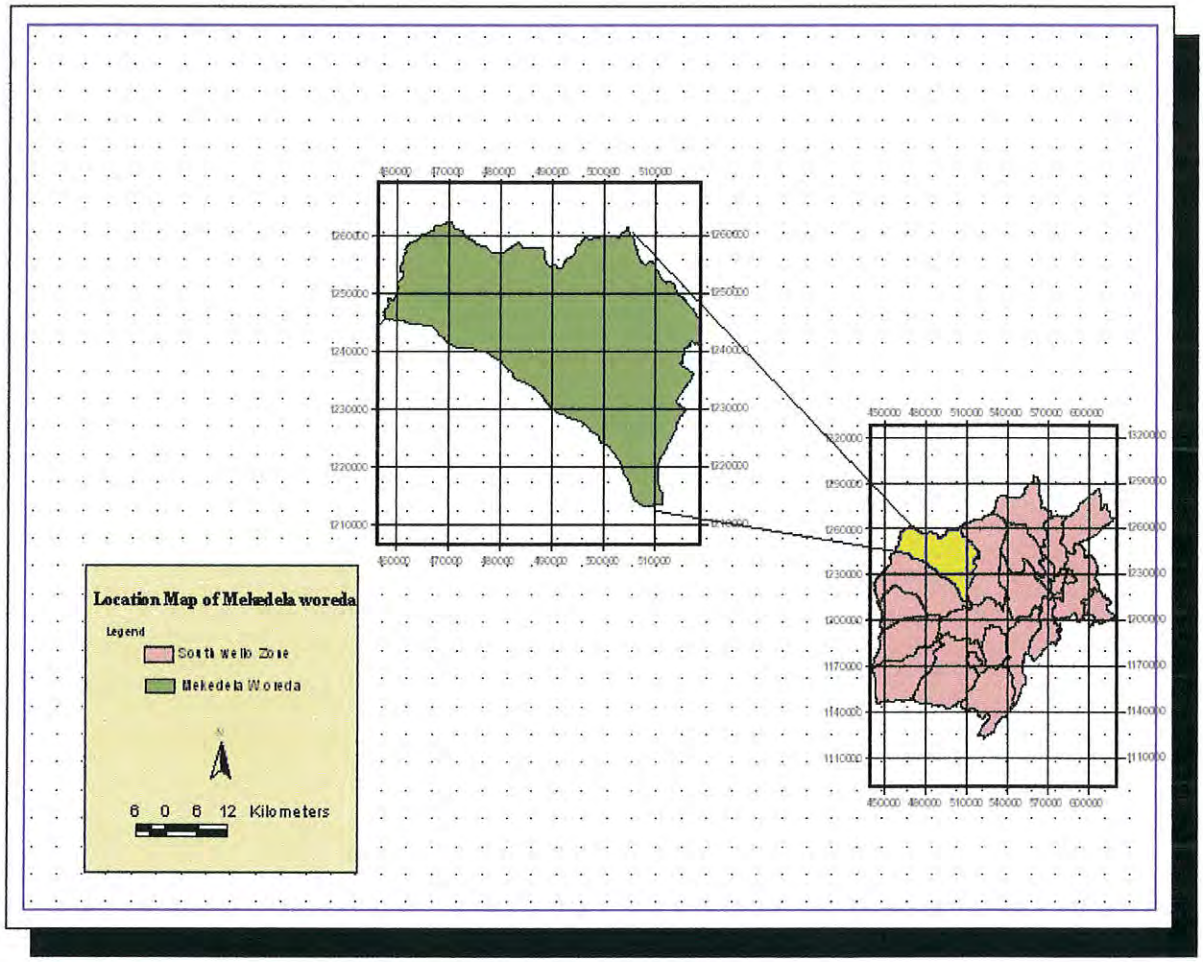
CHAPTER THREE

3. RESEARCH METHODOLOGY

3. 1 Description of the Study Area

The study is a case study of Tebi irrigation scheme found in Mekedela *wereda*, South Wello zone, Amhara National Regional State (ANRS). The general description of the study *wereda* and *kebele* (0 12), where the Tebi irrigation scheme is found, is presented here under:

Figure 2: the map of Mekedela Wereda,



3.1 .1 Geographic Location and Climate

Mekedela *wereda* (district), one of the 21 *weredas* of South Wello zone, is far away about 552 kms to northeast from Addis Ababa, 632 kms from the region's capital Bahir Dar, and

152 kms from Dessie, the Zone captal. The *wereda* shares boundaries, in the north with Tenta *wereda* and North Wello zone, in south with Sayent *wereda*, in the east with Tenta *wereda* and in the west with South Gonder Zone. Including the study kebele Tebi (012), the study *kebele*, the *wereda* has 27 *kebeles*.

According to *Tebi kebele* (012) agriculture office data (2008), from the total area of the *kebele*'s 105 hr (3%) is *dega*, 3220 hr (92%) *waina- dega,* and the remaining 175 hr (5%) is low land *(kolla)*. Based on the *wereda* agriculture office data (2008), the mean monthly temperature ranges from 15 to 27 C^0 and the mean annual rainfall five years average is less than 985 mm, and it has a very erratic nature. The mean rainfall of Tebi *keble* is 885mm. The landscape of the area consists of chain of mountains, hills and valley that causes the natural resource of the area to severe degradation mainly due to erosion.

3.1.2 Tebi Irrigation Dam and Its Development

The Tebi irrigation scheme is found in Tebi (012) *kebele.* The scheme is constructed by CO-SERAR in 2001. The total financial expense of the construction was about Birr 3,773,223, which was financed by the Ethiopia social fund program of the Ethiopian government. In addition to this, the *kebele* people contribute their labor and provide local materials. According to the CO-SERAR report (2002), the overall expenses for the construction of the dam including the community participation is estimated at Birr 4,430,688.24.

Figure 3: Tebi Irrigation Dam, Photo by, 2009

According to KAO data (2008), the altitude of the area is 2764 meters high, above mean sea level. The depth of the dam is 17.2 meters. The total area of the scheme is 477 square meters. The dam has two canals which provide water to the farm land. The left wing has a length of 2459 meters, and the right wing has a length of 2420 meters. Both the two canals have the total length of 4879 meters constructed with soil.

The scheme was constructed to irrigate a total of 180 hectares of farm land, and benefits 720 households. However, currently only 155 hectares of land is irrigated and 605 households are benefited. The remaining 25 hectares land could no get access too, due to shortage of water.

According to the DAs office data (2008), in Tebi (012) *kebele* there are 1751 households. Of which, 605 households have accesse to the Tebi irrigation scheme whereas the remaining 1146 households do not have access. However, 871 households, among from non users have been using other types of irrigation methods for short time during the last three years. The ways basically include traditional methods, like rain water harvesting, flood harvesting, and spring water development are majors among others. But this source could not sustain well for long period of time, like the Tebi irrigation scheme. Nearly 278 households were identified by the DAs, as these who do not involve in any irrigation activities during the last three years.

3.1.3 Population

According to CSA (2007) census report, population of Mekedela *wereda* is 142,623, but the *wereda* population as projected by RBoFED is 157, 599 (BoFED, 2008). Of the total population 154,283 (98%) is living in rural and 3316 (2 %) is living in the urban area of the *wereda*. The population number of the study *kebele* (Tebi) is 7417 (KAO, 2008). 3658 (49.3%), are male and 3759 (50.7%) are female.

3.1.4. Economic Bases of the Farming Community.

In the study area, agriculture is the main stay of the people. It is mainly rain-fed except the cases whereby few farmers are practicing irrigated agriculture along the Nile Basin. The common crops which are currently produced by farmers are including, wheat, barley, teff and maize. Some farmers grow vegetables such as onion and tomato in their irrigated farm. In addition to crop production, livestock production is also an important source of household income of the area population. Much of livestock income is derived from the sale of cattle, goats and sheep.

Land is a very important base of the area development. According to the Mekedla *werda* agriculture office information (2008), the total area of the *wereda* is 152,100 hectares. Some 22.1% use for crop production, 29.9 % of the area is covered by bush, 2.8% of the area is covered by forest, 6.3% for grazing purpose and 38.9% is non usable at present. In the study site (Tebi), from total area of 3500 hectares, 51.4 % is used for crop production, 28 % is devoted for grazing, and 3.1% is covered by forest, 2.43% constitutes bush and 17.97% of the area is not utilized at present.

The livestock production plays important role in the household's economy and food security. The *wereda* agriculture office report shows that from the total livestock population found in the *wered*, 57.04% are sheep, 29.4% cattle, 6.5% goats, and 3.5 7% donkeys. According to the *kebele*'s livestock data (2008), from the total 43.8 % are sheep, 27.9 % cattle, and 23.6 % are goats in the study kebele.

3.1.5. Socio-economic Infrastructure

a) Water and energy source: The main source of water for drinking and other domestic purposes are rivers, springs and rainfall. 68.78% of the *Wereda* population has access to potable water, which was constructed by government and NGOs. The remaining 20.57 % of the population use spring water and 10.65 % use river (WAO, 2008). However, the study *kebele* (Tebi) performance is far away the *wereda* average. From total population of the *kebele* 29.28% use water from river, 24.72% use spring water and only 46 % population has accesses to potable water.

b) Transport and communication; Due to strong attention of the current government, the *wereda* has 149 kms roads which were constructed and connecting it from Dessie to Massha, Tenta, Legambo and other part of the region. Massha, the capital city of the *wereda,* has

automatic telephone and electricity. In addition more than 50% of the *wereda kebles* have access to telephone services and 12% *kebeles* are on the way to access hydroelectric power.

C) **Education and health service;** According to information released by the *wereda* administration (2008), there are 30 primary schools, including a high school and a preparatory school. And the primary education gross enrolment reaches 94% (WAO, 2008). In health sector also, there are 30 health posts and 1 health clinic. Total health service coverage also reached 71% (WAO, 2008).

3.2. Data sources, Method of data Collection and analysis

3.2.1 Primary Data

The data generated for the study include both qualitative and quantitative in nature. It was generated using the following three main tools; household survey, focus group discussion and key informant interview.

i) **Household survey:** the survey was conducted using structure questionnaire. The questionnaire contained variables as the demographic characteristics (sex, age, education, family size, and marital status, social responsibilities or status, and religion); socio-economic characteristics (livestock holdings, land holding size, number of farm plot), institutional factors (accessibility of credit, agriculture extension services, training services, market facility, land tenure, PSNP), and perception framers, (irrigation development, major problems in irrigation agriculture development, challenges of WRD), and income and food security status conditions. Before conducting the formal survey, pre-test of the questionnaires was undertaken and the instrument was revised for final use. 12 enumerators were recruited and trained based on their proficiency to communicate using local language

(Amharic), educational background and prior experiences of administering questionnaire. Training was given to enumerators on the content of the schedule and procedures to follow while conducting interview. In addition 2 supervisors were also assigned in addition to the close monitoring of researcher himself.

Sampling Procedure for Household Survey

A two stage sampling processes were employed to draw sample *kebele* and household heads. For survey first, the study *kebele*, where the scheme is found was selected purposely. At the second stage, by using list of farmers in the *kebele* administration households were stratified into two groups, namely, users and nonuser of the irrigation scheme. Again the non-user households were classified into two in order to get pure nonuser households during the last three years either permanently or temporarily. Since all groups are from the same *kebele*, other factors are assumed to be constant and only access to different types of irrigation schemes. Finally, from 605 Tebi irrigation scheme users 103 samples are selected randomly and from 278 households, who are identified as purely nonusers 47 samples were selected. Totally 150 sample households from both groups have been involved in the survey.

ii) Focused group discussion: A total of four group discussions were undertaken. Each group was composed of 7-9 male and female households. The groups were formed and organized as follows; Group one Water Users Committee of Tebi irrigation scheme, group two *kebele* officials, group three the DAs and group four concerned people from the *wereda* administration, agriculture and cooperative offices basically in order to get their view and important information related to irrigation water resources development and its role to food security as well as its challenge of development.

Figure 4: the Member of WUC, 2009

In addition, the nature of the information includes the general features, and problem of food deficiency (insecurity) and the role of irrigation development in minimizing food deficit through increasing users' income, asset and productivity. Especially, with the concerned professional the issue of the scheme and its sustainability was thoroughly discussed.

iii) **Key informant interview:** It was carried out to obtain data from informants regarding the community profile. The informants were elders, DAs working in the study area, and a member from *Kebele* leadership and the chairman of WUC.

3.2.2 The Secondary Data

The data on population, age structure, agriculture productivity, land use pattern, infrastructural situation, crop production trend, meteorological data (rainfall and temperature, irrigation potentials, types of irrigation scheme applied in the study area, types of crops grow and its productivity of irrigation as compared to *Meher* and *Belg* and

household and communal level irrigation have been collected from secondary sources. The data was collected from both published and unpublished documents. Basically information was obtained from Mekedela *wereda* (district) agriculture and rural development office, South Wollo Zone, and RBoARD and SIDA.

3.3. Methods of Data Analysis

Qualitative data were collected through focused group discussion and key informants. To analyze the survey data, it was coded and entered into computer software known as Statistical Package for Social Scientists (SPSS). The specific method of data analysis involved computation of frequency, percentage, and computation of descriptive statistics such as mean, standard deviation, cross tabulation methods and coefficient of variation. In order to make distribution between food insecure and food secure groups of household, household heads' self-reporting was used as a method. To assess the contribution of irrigation to household income, asset, productivity, mainly food security using group comparison of impact analysis were employed between Tebi irrigation users' households and those who are identified as purely non irrigators

CHAPTER FOUR:

4. Demographics Characteristics of Sample Households

4.1 Sex and Marital status

The majority (82.7%) of the sample households were male headed, while the remaining 17.3% were female headed. Regarding their marital status of the households, 80% were married, 6.7% were unmarried, 7.3% were divorced and 9.6% were widowed. 82.5% and 16.5% of the non-users are male headed and female headed households respectively (See, Table 1).

Concerning to food secured status of households from both irrigation users and non users, 83% of food secured households are under male headed and 17% are under female headed. Usually the female headed households are worse off in their food security status us compared to the male headed because they have not enough labor to plough their farm land, low access to technologies as well as information, however the Chi-square test (0.524 NS) showed that there is no significant association between sexes' of household head, and food security status.

Table 1: Sex of the household head * food security status of the household * Do you have access to irrigation Cross tabulation

Do you have access to irrigation			food security status of the household		Total
			secure	insecure	
yes	sex of the household head	male	62	23	85
		female	14	4	18
	Total		76	27	103
no	sex of the household head	male	21	18	39
		female	3	5	8
	Total		24	23	47

4.2 Age and Education Status

Age and education status are other demographics aspects of population characteristics. The majorities (62%) of the sample household heads are found at age category of more than 41 years old (See, Table 1). Regarding access to irrigation scheme of Tebi the highest portion or 65% of household heads who have access to the irrigation were found at age category over 41 years old. Of course the decisive factor of access to irrigation is land holding around the scheme getting through different tenure system.

An educated farmer is able to expect to use modern agriculture technologies (fertilizer, improved seed etc); which are use to increase production. The survey result show that 61.3% sample households were literate, 25.3% were can read and write, 7.3% were primary education and 6% were secondary education. And it indicated that from total illiterate household 52% food secure and 38% were insecure. From household who can only read and write 76% were food secure and the remaining 24% are food insecure. From primary education level sample household only 27% were food secure while 63% were food insecure it is as a result of this group lack farm land. Final from secondary level education household 67% were food secure and 33% food insecure (See Table 1). However chi-square test result (0.197 NS) revealed no significant relationship between educational status and food security status of the sample household.

Table 2: Demographic Characteristic of Sample Households

Items	Irrigation Users		Nonusers		Total	
	No	%	No	%	No	%
1. Sex HHs						
Male	85	83.4	39	83	124	82.7
Female	18	16.6	8	17	26	17.3
2. Marital status						
Married	85	82.5	35	74.5	120	80
Unmarried	8	7.8	2	4.2	10	6.7
Divorced	7	6.8	4	8.5	11	7.3
Widowed	3	2.9	6	12.8	9	6
3. Education						
Illiterate	59	57.4	33	70.2	92	61.3
Read & Write	28	28	10	21.3	38	25.3
Primary Education	8	7.7	3	6.3	11	7.3
Secondary education	8	7.9	1	2.2	9	6
4. Age						
from 18-24	3	2.9	1	2.1	4	2.7
From 25-30	7	6.8	7	14.9	14	9.3
from 31-35	8	7.8	4	8.5	12	8
from36-40	21	20.4	6	12.8	27	18
from 41-50	35	34	13	27.7	48	32
above 50	29	28.2	16	34	45	30
5. Farm experience						
From 5-10	7	6.8	2	4.3	9	6
From 11-20	30	29.1	14	29.8	44	29.3
from 21-30	35	34	10	21.3	45	30
above 30	31	30.1	21	44.7	52	34.7

Sources: Households Survey, 2009

4.3 Household family size of sample households

The survey result revealed that from total sample households, 16% of them have more than 7 members, 46.7% have 5 to 7 members, 33.3% have 2 to 4 members, and 3.3% households have only 1 person in the family. The mean size of family of the total sample household is 5.1 people. Family size of irrigators and non irrigators is 5.1 and 5.2 respectively (See Table 1). There is slight difference between the two groups, however that with t-test at 5% significance

level, result showed that there is no significance difference between the mean household size of the two groups.

Table 3: Number of family * food security status of the household * Do you have access to irrigation Cross tabulation

Do you have access to irrigation			food security status of the household	Total	
			secure	insecure	
yes	Number of family	1	3	0	3
		2-4	23	13	36
		5-7	35	13	48
		more than 7	15	1	16
	Total		76	27	103
no	Number of family	1	2	0	2
		2-4	7	7	14
		5-7	9	13	22
		more than 7	6	3	9
	Total		24	23	47

4.4 Experience of farming

The experience of farming is just a number of years that the head of the households involved in farming activities. From total sampled households of both the two groups, 34.7% of the households have more than 30 years experience, 30% have 21-30 years, 29.3% have 11-20 years and the remaining 6% have less than 11 years experience. 64.1% of irrigation users and 55.3% of non irrigation users have an experience of farming above 21 years. The chi-square test revealed that there is significant association between farm experience and food security status of a household. Because when number years of farm practices is increase the likelihood of increase knowledge of production, risk management and so non leads the family to better

position. The chi-square test revealed that there is significant association between farm experience and food security status of a household.

Table 4: Farm experience of the household head * food security status of the household * Do you have access to irrigation Cross tabulation

Do you have access to irrigation			food security status of the household		Total
			secure	insecure	
yes	farm experience of the household head	from 5-10	5	2	7
		from 11-20	18	12	30
		from 21-30	27	8	35
		above 30	26	5	31
	Total		76	27	103
no	farm experience of the household head	from 5-10	1	1	2
		from 11-20	6	8	14
		from 21-30	7	3	10
		above 30	10	11	21
	Total		24	23	47

CHAPTER FIVE

5. Access to the Production Resources and of the Sample Households

5.1 Land tenure System and Holding Size

In the study area, land is a very critical productive resource of the farming community. According to Degefa (2002), 80% of agricultural output increase in Africa is as a result of expanded farm land size. The survey result indicated that from total sample households, 94.7% have their own farmland and the remaining 5.3% have no their own farm land. According to KAO (2008), the average landholding size of a household is nearly 0.79 hectares. The survey indicated that the average landholding size for irrigators and non irrigators is 0.85 hectare and 0.71 respectively. 55% of sample households have farm land size that falls in a range 0.76-1 hectare. This clearly shows that larger proportion of sample households won small landholding less than the national average of 0.9 ha, upon which their food security and other necessities must be obtained.

Table 5: Land holding size of sample households

Landholding size	Number	%
from 0.12-0.25	18	12.0
from 0.26-0.5	40	26.7
from 0.51-0.75	31	20.7
0.76-1	55	36.7
0ver 1ha	5	3.3

Sources: Households Survey, 2009

The landholding area size of farmland per household has been shrinking for so long due to the ever-increasing human population and the problem of land degradation which has transferred most of the farm land for cultivation. On the top this further expansion of farm land is not possible as the potential is limited by the rugged nature of the local topography. Regarding land tenure arrangements in the study area, there are different tenure systems, including own holding land and share cropping. From the total sample households who have land by rent is 18%; have land by share cropping is 35.5%, and 9.3% of households having landholding through family inheritance, and 4.7% of sample household heads indicated having land by purchase from others.

The landless people livelihood basically depends on other livelihood strategies such as selling their labor, off farm, non farm etc. However, the role of other livelihood strategies is minimal compared to farming activities. In the study area other livelihood strategy considered as a supplementary to the farming activities. Because the major portion of a household's income is generated basically from farming practices including crop and livestock production. It revealed that landholding is a critical condition of households' food security status.

According to Ellis (2000) there are two types of farming practices. The first one is intensive farming and the second extensive farming practices. Intensive farming means produce much products with small size of land, using modern technologies. Extensive farming is just to increase crop production through extensive farm land or creates new land. However, in the study area, the land holding size is very small and it's further extending chance also almost none. Then the only agriculture livelihood strategy of the area would be intensive farming strategy.

Access to irrigation also directly attached to landholding through different land tenure system around the scheme. According to the survey result, from total irrigators sampled household (103), 91% are having their own farm land in the scheme and the remaining 9% of them access to the irrigation through other land tenure systems basically rental and share cropping. From non user households, those who have their own farm land are 85.1% and who have no own farm land, but access by other tenure arrangement are 14.9%.

Land Fragmentation

In the study area the land distribution was conducted since 1991 by EPRDF. Due to shortage of adequate cropland with similar fertility level, having land at more than one place is not expectation but it is rather a norm. According to FGD the land fragmentation has its good opportunity to produce different crops. They also considered as risk aversion strategy during crop failure due to erosion or any other damaging condition. In the negative side it demand additional lobar to harvest at the same time, to keep from wild animals.

The field survey data revealed that there is difference with number of farm plots of the sample households. Majority of the sample households (51.3%) reported that they have from2 to 4 farm plots. and 41% of sample households have more than 4 plots of farm land. The remaining 6.7% of sample households own less than 2 plots. 51.5% of irrigation users and 51.1% of non users have number of plots between 2 to 4.

5.2 Crop and Vegetables Production

In the study area, different crops were produced by the farmers. The majors' crops are teff, wheat, barley and maize. Based on the survey result currently 5 type crops and 5 types of vegetables are produced widely. However, as FGD participants mentioned, the vegetable production was introduced after the scheme was constructed. Of course not all farmers

produce all types of crops and vegetables. But diversification of crops and vegetables has been increasing. In order to minimize risk of crops production, farmers produced diversified crops in a small farm. The role of irrigation to reduce the environmental risks like rain shortage is high, and crops and vegetables production is now led by market or by the demand of customers. This creates additional income to the farmers.

5.3 Livestock Asset of sample households

Livestock production is also one of the livelihoods or income sources of the studied households. In the area, there are different domestic animals which play critical role to the households' livelihood. They include cattle, sheep, goats, mules, donkey, bee and poultry. They are used not only to provide their products like meat and milk but also they serve as drought animals, means of transportation and so on.

In the study area, livestock ownership position of a household indicates its economic and food security level. All FDG and KI participants indicated that livestock rearing is a good livelihood strategy of the households. Household who owned large number of livestock is categorized as rich and better in food security status.

5.4 Oxen Ownership

In rural of Amhara, people believe that the oxen ownership could indicate the wealth position of a household. The food security position of a household is directly related by oxen ownership of a household. Because households, who have large number of oxen could be harvest their farmland and have chance of taking others farmland through share cropping mechanism. It means lack of oxen is one of the major reasons that force the oxen less household to rent out their farmland and their share of harvested crops is low. There are households who have access to irrigation but do not have oxen, and they are obligated to

rent out their irrigated farm land to other farmers who have enough oxen. And their share of production is low and their food security could not easily achieve. There are some landless young people rented in land from aged people and women and take this as a livelihood strategy.

As the FGD participants indicated the oxen less household could not get enough share of crops from their harvest because they must share to harvesters. Traditionally half sometimes more than half of the product goes to oxen owners and all crops residuals which are used to animals' feed is taken by them. Female headed households are affected by lack of oxen and labor and rented out their land and their benefit is relatively less than their male counterparts. Then oxen ownership could make difference in the households' food security status. The average oxen ownership for the total sample households is 1.7, and the average oxen ownership for irrigators and non irrigators is 1.8 and 1.6 respectively.

Table 6: Oxen ownership level of sample households

No of oxen	Irrigation users		Irrigation nonusers		Total	
	N	%	N	%	N	%
Nil	13	12.6	9	19.1	22	14.7
1	54	52.4	28	59.6	82	54.7
2	30	29.2	10	21.3	40	26.6
3	6	5.8	0	0	6	4

Sources: Households Survey, 2009

5.5 Other asset ownership

Other assets are assets of the household except the livestock. It includes house, furniture like bed, radio and other basic needs like clothes and shoes. In the rural Amhara region

households who are found in better economic level try to fulfill these goods that go beyond food. Then the following part tries to show the house and other materials holding of sample households.

House: In the study area, as KI and FGD participants believe that the house standard shows the household economic level. Households with the better economic level are encouraged to constructing iron-roofed house. As they mentioned, in the study area the number of houses with iron roofed is dramatically increased since after 1995 (E.C). I have tried to discuss about the reason behind the growth. An elder informant stated told me about the housing condition of the area, as follows,

'Before few Years we had seen few iron roofed houses here and there, however, today the numbers is changed and increased and it is good'.

At the center of *kebele* a small town is created after 2005. According to the leaders' report, during the first time there were only 5 houses with iron roofed, currently the number of iron roofed houses is increased to 187 which are constructed basically by irrigation users. This figure is in the center only and in the remaining village the numbers of iron roofed houses is also increasing. No one say house condition directly represents the household's food security condition, but people believe that 'no one going out to construct an iron-roofed house when he/ she is found in serious food insecurity'. And it could represent the economic level of household at the same time their food security status in general.

Table 7: Households' assets

Do you have	Irrigation users						Non irrigation users					
	Yes		No		Total		Yes		No		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Iron Roofed. house	81	78.6	28	27.2	102	99	34	72.3	13	27.7	47	100
Tape or radio	62	60.2	41	39.8	103	100	20	42.6	27	57.4	47	100
Blanket	85	82.5	18	17.5	103	100	37	78.7	10	21.3	47	100
Enough clothes	90	87.4	13	12.6	103	100	45	95.7	2	4.3	47	100
Shoes	91	88.3	12	11.7	103	100	41	87.2	6	6	12.8	100
Modern bed	44	42.7	59	57.3	103	100	16	34	30	63,8	46	97.9

Source: Households Survey, 2009

Tape or radio holding: In the study area people believe that ownership of tape and radio also shows the economic position of a household. Even the equipments price is very cheap; still it is used by active and wealthy people of the community. Households who use these technologies would have better opportunities to get information and news which may use for their production activities and entertainment. The study shows that irrigators have more access to these technologies, i.e. 60.2% of users and 42.6% of non irrigator access to this technology.

Blanket, clothes and shoes: These are basic necessities of human being. However, in our society due to sever poverty, numbers of people have not adequate access to this just basic necessity. People go with bare foot, they have not adequate clothe. As of other goods in the study area, these materials can indicate the household economic position and food security level. With its own low level, current change is encouraged. The ownership of these materials directly expressed the households' income level and food security status. More-

over the utilization these goods are just the part of the development goal of the government and a household itself. When farmers bought these it creates market opportunities for other sectors and in turn trade and industries would be promoted.

5.3 Institutional support in the study area

5.3.1 Access to credit

Credit is an essential input of agricultural development. In the study area, there are different types of credit sources. The major ones are credit of food security provided by government; which credit services provided through cooperatives; and the Amhara Credit and Saving Institution (ACSI). The credit which is provided by government is two types. The first one is input credit which is used for buying chemical fertilizers and must be repaid back to the bank one year. The second one is the food security credit. It is basically provided through cooperatives and directly used for asset building, like livestock production activities. Both types of credit provided with interest free, but sometimes ACSI and Cooperatives are collect interest from customers for their administrative expenses.

The ACSI credit is provided basically for income generating activities (IGA), like petty trade and it has interest. Its repayment period is different. The ACSI credit is provided to farmers by using group collateral system in order to take credit by a group of farmers that the group members are considered as collateral to a group member. If one of them does not meet his/her obligation of repayment, the other group members pay the unsettled balance. According to the survey result, 74% of both total sampled households indicated that they have credit access. However, still there are farmers who did not have access to credit; and the amount is not enough too. 24.3% of irrigation users and 25.5% of non users indicated that they do not get sufficient credit.

During FGD, there are issues raised by participants which are related to credit. All of the participants agreed that access to credit has been increasing over the last years. And yet the farmers have identified a number of problems. First, in the revolving fund credit, the cooperative could not collect the loan from former creditors on time. Second, the amount of credit is not enough. Third, the farmers' have fear of the environmental risk and there is no insurance policy and facility to protect them. When risk like rain shortage occurs the non irrigation users are highly negatively affected. Access to irrigation could reduce risk of failures that may occur due to lack of rain. In relation to this a DA explained,

'ACSI encourages more to allocating more credit for irrigation users, because their loan repayment rate is higher. We also believe them than non users'.

All rural credit, which is currently found in the study area, is directly or indirectly under the control of government. All farmers have access and right to take it. When they may the strict system would come, the chance of having credit by the poor people like non irrigators would be reduced because of their low repaid position and high vulnerable to the environmental problems.

5.3.2 Access to Extension service

Extension service is another important support provided to the farmers. In practice, in the *Kebele* there are two types of packages; the minimum package in which all households are involved, and there is a family package designed by professional for selective food insecure households based on their income and targeting an amount of income to reach at the end of the year.

There are 3 DAs in each *kebeles* of the *wereda*. Their fields of profession are plant science, animal science and conservation. In addition to these, in the case of Tebi the numbers of

DAs is 4. There is also an additional DA for irrigation management. They plan and provide services to all farmers. Their services are different based on their profession, but mainly training and advice. The DAs office is found near to the Tebi irrigation scheme. When the researcher was in the area, there were farmers who have taken training about how to use chemical fertilizer and others. From 155 participants of the training, 39 were from non users and 114 are from irrigation users. Because, the irrigation users are found in better place or near to the office of DAs.

In DAs FGD, I have raised question about delivering their services. They indicated that they have responsibility to serve all farmers found in the *kebele.* However, as they sated their stay is largely around the scheme. And they have positive feeling in using more time around the scheme and they feel that their effort is more fruitful.

In relation to this one DA told me the following: *'Without water agriculture development is not fruitful. Water is an entry point for all farm activities. Crops without water are exposed to drought. Livestock production without water is challenged by lack of feed. In order to apply modern technologies like fertilizer, water is mandatory. Without water farm extension is just mingles, thus we are more interested to spend more time around the scheme'*

Then because of these and other reasons the lion share of extension services is taken by irrigation users. Even when other experts are coming from *wereda* agriculture office, much of their time is used in the scheme. The survey result also shows that 45.6% of irrigation users and 23.4% non irrigation users have got training during 2008/09 that is very important for their agriculture practices. And 63.1% of users and 53.7% of non users have got a chance of visits to their farm land by DAs during the same year.

5.3.3 The Productive safety net program (PSNP)

PSNP is a program which is designed as a strategy of food security. In the study *kebele* there are 800 beneficiary households of PSNP are found. The program directly provides job and income to food insecure households through public works. The majority of users are getting income through including in job. The payment is Birr 8 per a day. Kids and elders are considered to get the payment for free. A household doing job for 5 days per month has got payment Birr 40 per person. If a household who have 5 members in the family having Birr 200 a month and if its food gap is 6 months, total the household could getting Birr 1200 in a year.

The activities of public work basically are in the area of watershed management. As people indicated, the aim of public work is integrating the households' effort to the general environment and improving the area water shade.

The main challenge of the program is poor quality of public work. That means people show up in the working place just for sake of participation and taking payment. Almost all FGD participants indicated that without payment, public works is not possible or it increases dependency syndrome. The program of PSNP is on the way to phase out after few years, but still in the study *kebele* there is no a graduated person. Of course there is plan of graduation starting 2008. During FGD, with *wereda* concerned people the issue of graduation was discussed. In other *kebeles* of the *wereda*, there are graduate persons from PSNP, however that is by force and even a person does not accept it. People need to stay more time in the PSNP whereas the government and donors need graduation. But the reality does not invite it. It may be the coming debatable agenda of government and donors in the filed of food security. Regarding involvement sampled households the program, 74.5% of non irrigation users and 32% of irrigation users are involved in the program.

CHAPTER SIX

6. ROLE OF IRRIGATION TO HOUSEHOLD FOOD SECURITY: comparison between irrigation users and non users

This section presents the main aspects of the study and tries to answer the second research question. It aims at showing the role of irrigation development to the household food security, based on comparison of the two sampled groups (i.e. users and non users). In the study area food insecurity is a problem of significant number of people of the area. From total sampled households, 33.3% are food insecure. Households' food insecurity means, they could not cover their food either through production or purchasing. And they do not get enough food for their health on time and to all people. The food insecurity status of non irrigators is worse off than irrigators or irrigators are relatively better in their food security.

The food insecure among irrigators and non irrigators household is 27% and 48%, respectively. Of course irrigation alone could not determine the food security status of a household, as there are other factors which can affect the food security status of a household. Then this part of the paper tries to discuss about crop and livestock production difference, income, food covering capacity and the daily meal differences of both the two groups that is in order to see the role of access to irrigation with assuming other things are remain constant.

6.1 Crop Production and Productivity Differences

Increasing the amount of production per hectare of farm land is one and basic strategy of food security. Then addressing production related problems and increasing production is addressing food insecurity. In the study area, rain problem is one and the main cause of low productivity. The survey result indicates that 65.5% of respondents of the sample

households ranked lack of rain or water as the first cause of food shortage compared to the land scarcity and labor problems.

The productivity of a farmland is basically attached to the water supply situation of the area. In order to increase the amount of production per hectare, different inputs are required to use. Because the role of utilization of modern inputs (Chemical Fertilizer, Improved seed, and others) is significant. At FGD and KI, people mentioned that utilization of modern input is found at increasing rate, however when the rain becomes short or erratic, the risk of losing production is high. Farmers have fear to invest more on it and they have limited production per hectare of farmland.

Currently, all people agreed that environmental problems and drought become recurrent phenomena of the area. From this point of view, people have seen that access to irrigation for the households' production has significant role; and literary people said that irrigation users are the government 'kids' or they have got 'Tombola'. Of course, there is big difference in production capacity between irrigation users and non users.

The survey also indicated that 97% of irrigation users could produce or harvest twice a year. 3% of them also could produce three times a year. The FGD participants of WUC explained that their interest was to produce three times a year. However, as they mentioned, because of many limitations like; water shortage, labor shortage and lack of farmers' willingness to do more, currently, the majority of users produce only twice a year. They have lost the maximum opportunity of the scheme to contribute in their food security effort.

While the non irrigation users basically have only a chance of harvesting annually that is *meher*, only 37% of them showed that they can produce twice a year when favorable *belg* rain

season is available. If no *belg* rain, no one could have opportunity to produce twice a year. Their environmental risk is also higher than irrigation users.

They have no chance of supplementary irrigation opportunity to prevent them from production lost due to rain failure. The risk of irrigators is relatively low, because they have access to supplementary irrigation.

The DAs explained that the main critical time of crop production is the final or seed making stage of the plant. Usually this stage is coming in September and at that time that rain goes. And the risk of losing or reduction of production is higher. For farmers, who have access to irrigation it is possible to supplementary irrigation and keep their production from failure, while for farmers who have not access to supplementary irrigation things become danger. And the weight damage is some times reached from totally losing the production up to highly reduction of the yield amount per hectare.

The other ways of income generating activities or livelihood opportunity role is very limited. If a household loses its harvest, immediately reduces its asset, some times with short period of time the household easily enter to the category of food insecurity. In the study area, the role of off farm and non farm economic activity is very limited or low share from a household's total income.

In the study area, there are 10 type crops and vegetables which are produced by farmers. There is also difference between the two groups in their production amount per hectare. The yield of crops per a hectare of irrigated farmland is for wheat 42 and maize 59 quintals, whereas the yield of non user is for wheat 36 and maize 35 quintals per hectare respectively (KAO, 2008). However according to the data the region (ARDB, 2008) yield per a hectare for wheat 22.8 and maize 39.5 quintals in rain fed farm and the irrigators are better even the region average.

Table 8: Crop production of sample households

Crop Type	Irrigation users						Irrigation non users						Chi-square
	Yes		No		Total		Yes		No		Total		
	N	%	N	%	N	%	N	%	N	%	N	%	
Teff	100	97	3	2.9	103	100	45	97.7	1	2.1	46	97.8	0.637 (NS)
Wheat	93	90	10	9.7	103	100	45	97.7	2	4.2	47	100	0.211 (NS)
Barley	92	89.3	11	10.7	103	100	39	82.9	8	17	47	100	0.204 (NS)
Maize	59	57.3	44	42.7	103	100	25	53.2	22	46.8	47	100	0.385 (NS)
Sorghum	33	32	70	67.7	103	100	10	21.3	37	78.7	47	100	0.123 (NS)
Onion	66	64	37	35.9	103	100	8	17	39	83	47	100	0.036
Tomato	29	28.2	74	71.8	103	100	2	4.2	45	95.8	47	100	0.045
Potato	43	41.7	60	58.2	103	100	6	12.7	41	87.3	47	100	0.058
Cabbages	43	41.7	60	58.2	103	100	8	17	39	83	47	100	0.032
Carrot	23	22.3	80	77.7	103	100	8	17	39	83	47	100	0.030

Sources: Own Survey, 2009

At a FGD people mentioned that the production level of a small size land is determined by the amount of inputs used and effective farm management. The role of irrigation to fill the gap of rain and give opportunity of harvesting out of rain is significant. It also could promote the amount and types of production. Household's food production and purchasing capacity is increased. The opportunity which is created by irrigation is not only the increase of production and productivity. But it creates opportunity of producing high value or cash crops; like onion, potato, carrot and so on which are not known or produced by the farmers before.

According to FGD participants of the members' of *kebele* administration, before 3 and 4 years, there was difficult market situation for any type of farm products. Today things are different and changed. There is no problem of demand but supply. The price is attractive for producers. The chi-square test also indicated that there significance association between access to irrigation and vegetables production.

In conclusion, irrigation could make change in production and productivity levels of the users as compared to non users. It also leads them to better food security situations. Basically, access to irrigation means access to food or having production and purchasing capacity of a household in addition to other economic activities.

6.2 Livestock Ownership Difference

Livestock production is one of livelihood strategy of the households. Because of the limited and unreliable crop production of the households, the importance and role of livestock is high. In the study area, a household food security status is directly related to livestock ownership. People agreed that households who have better livestock management, providing enough fodder and health treatment, could be more beneficiaries. There are different challenges in livestock management and production. The survey indicated that from total sampled households 52.7%, and 20.7% assured that lack of animals fodder and animal diseases respectively are the critical livestock problems of the area.

The irrigation development creates better opportunity to the users in their livestock production. The focus group discussions and key interviews revealed that the irrigation users are relatively in good position of fodder provision. An elder explained me that:

'Since 2007/08 there was failure the Belg rain and the time was very difficult to provide fodder to livestock, as that time irrigation users were less vulnerable due to irrigation accesses'.

As the informants mentioned, irrigators had the chance of harvesting crops and animal fodder by using their irrigated farmland. The non users did not have this opportunity. They try to feed their livestock through buying fodder from the users with expensive price.

In the study area, among other livestock, ruminants are playing key roles as a source of household's income through selling them. Currently, their price is good and attractive. At the time when I was there, the average price of a fatted sheep was from Birr 600 to 700. The survey result revealed the average ruminants for irrigation user is 5.2 and 3.1 for sheep and goats respectively. While the non irrigation users' average holding size is 4.1 and 2.4 for sheep and goats respectively.

Livestock play an important role to the households' food security through increasing purchasing power of household to buy food from market. The majority of survey households are did not produce to cover their food by their production alone. Rather they produce to the market sale and buy others from market for their household's food and others. According to the survey the livestock ownership position of users is better compared to non users. Thus this could increase their food purchasing power, because their animal growth is relatively with better fodder supply. Then ownership of livestock affect the food security level of the household as the same time irrigation contributes to livestock production of irrigation user households. The following table presents the statistical analysis of t-test at 5% significance level and shows that there is significant difference of livestock ownership of the two groups.

Table 9: livestock of the sampled households

	Irrigation users		Non users		Total		t,value
	Mean	SD	Mean	SD	Mean	SD	
Cows	2.05	0.531	1.91	0.073	2.01	0.525	46.855*
Heifers	1.51	0.593	1.45	0.079	1.49	0.577	31.532*
Bulls	1.36	0.558	1.36	0.071	1.36	0.534	31.166*
Sheep	2.83	1.646	2.49	0.204	2.73	1.575	21.198*
Goats	4.45	1.356	4.45	0.199	4.45	1.354	40.288
Mule	1.22	0.556	1.04	0.030	1.16	0.480	29.511*
Horse	1.14	0.506	1.02	0.021	1.10	0.430	31.359*
Donkey	1.67	0.845	1.51	0.121	1.62	0.841	23.359*
Hen	1.49	1.092	1.70	0.182	1.55	1.144	16.167*
Beehives	1.55	0.926	1.30	0.113	1.47	0.888	20.329*

Source: Own survey 2009, Note: *Significant 5%

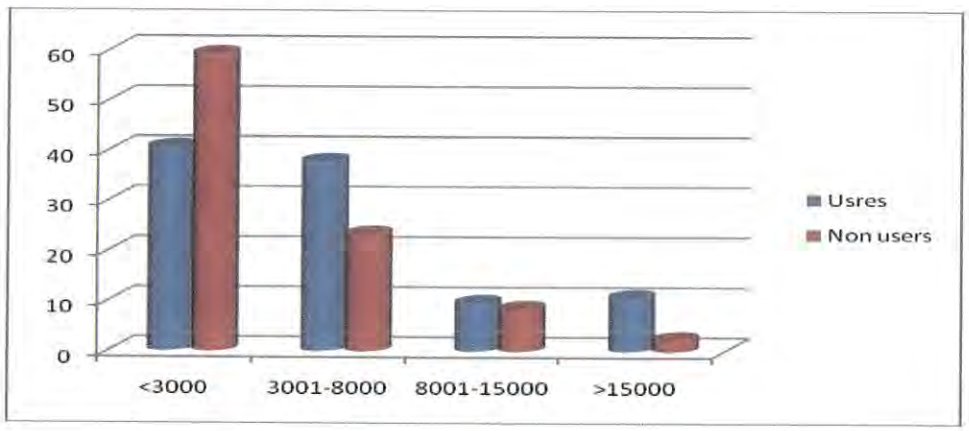
6.3 Households Income Differences

The income of a household allows to the food security status of the household in terms of households' food purchasing power. In the study area, people agreed that the lion share of a household's income is generated from the agriculture sector. It is found out that the income of irrigators is better. Because they could be making money from both irrigated and rain fed farm. They have also access to produce high value cash crops. Their risk of failures due to lack of rain is low as compared to their non irrigators counterparts.

The FGD participants indicated that the price of farm products is going up and encouraging. Farmers are getting better price for their products, but all farmers may not equal opportunity to inter market and generating more income, because of limited access to produce more products due to lack of mean production such irrigation and other technologies.

According to survey result, the average cash income of a household is Birr 6300 annually for both irrigators and non irrigators (it is only one year data of 2007/08). The average cash income for irrigators is Birr 8,120 annually and the average cash income of non irrigators is Birr 6248. Average income of irrigator is over by Birr 1872 and it relatively sets them in better position as compared to the non irrigators.

Figure 5: Income of sample HH



The greater advantage of users is found in better income as clearly seen in less environmental risk, and relatively higher amount of products, year round production, production of high value cash crops, as they could utilize both irrigation and rain feed farms.

In conclusion irrigation could increase the households' income. The households' income could increase the food purchasing power of a household. Ultimately, it increases the household food security status.

Saving money in the bank

Saving money to the bank is another indicator of a household income. Household who could produce surplus production and access to other income generating activities are encouraged to save their money in bank. From total sampled household 12 (8%) indicated that they have saved money in the Amhara credit and saving institution (ACSI). All of them are from irrigation users. It shows that, other things remain constant, irrigation cloud make change. The chi-square test with 10% significances level indicated that there is strong association between access to irrigation and having saved money in bank.

6.4 Annual food subsistence capacity and daily meal of the households

The researcher tries to see the difference between annual food subsistence and daily meal capacity of the two groups. It uses to show the real condition of the households food security status of the study area. Annual subsistence capacity means amount of production produce by household itself to cover its annual food need. Of course the food security concept is different from subsistence because food security did not talking about how the farmers produce for their need alone, rather it is amount how big of production is, even for sale and how the household generating income. But in rural Ethiopia household produce basically for their food now and gradually they are aware to produce for the market. As showing in the following Table food covering capacity of irrigators is relatively better than that of non irrigators.

Table 10: HH annual food covering capacity from their own production

Number of months	Irrigation users %	Irrigation non users %
3 month only food availability	3.90	6.40
6 months only food availability	22.30	46.80
9 months only food availability	33	25.50
12 months food availability	34	21.30
over 12 months food avail	6.80	-

All farmers indicate that all products are not meant for domestic purpose but to the market. During 2008 there was a drought period due to short rain season or *belg* failure and almost all farmers purchased food from market. An elder key informant told me that:

'Today all farmers are producing cash crops like vegetables and this condition may discourage the production of food crops'

Even under this condition irrigation users are found in the better position because they have access to produce at least twice a year. Their environmental risk is relatively lower than the non users. For users the scheme creates better opportunity to produce for both markets and domestic uses.

The household daily meal

The household daily meal cloud be examined from number of meal having per day and it also could be seen from view point of food menu or type food at a meal. Number of meal and menu can indicate the household status of food. Usually, for a household which is found in a better economic level its numbers of meal is expected better.

According to the survey result, from irrigation users 29.1%, households reported to have three meals a day, households who have two meals a day are 67.1%, and 2.8% of HH have only one meal per a day. On the other hand, 60.7% non irrigation users have two meals per day and 38.3% of them have only one meal per day and only 1% has three meals per a day. From this data, we can see that irrigation users are found at a good level of food per day. The chi-square test with 10% significant level indicated that there is high association between access to irrigation and numbers meal of a household.

The FGD as well as KI participants indicated that access to irrigation increases the standard of food of users'. Households, who have access to irrigation, have the opportunity of getting vegetables for home consumption. Especially during harvesting time their opportunity to include vegetables in their menu would increase. Even their product creates opportunity for other households which are categorized as non user for they can access it from the market. The products also have further benefited urban dweller in Massha city.

According to the study, the trend of food status is relatively better than before. 90.3% of irrigation users and 49.1% of non irrigation users indicated that their food consumption trend is in increasing. I have raised a question why some household who have access of irrigation did not improve their food? In FGD people said that there are people who have not sufficient labor, like female headed households which rented out their farm land with share cropping to other farmers, and then they could not get the full benefit of irrigation scheme.

6.5 Labor Productivity and Off Farm Activity

Labor is a means of income of a household. It is also considered as a means of food security. Productivity of labor would be a strategy of food security through increasing the amount of production and purchasing power of a household. To enhance its productivity government and NGOs are promoting and supporting through improving human health and education. In

addition government tries to create better working atmosphere like irrigation scheme and PSNP. The survey result shows that 73% of irrigation users have labor shortage. 59% of them also indicated that they are working for more than 8 hour of a day. On the other side 27% of the non users reported that they have labor shortage and 40% of them indicated working more than 8 hour a day.

The labor market of the area, pay for a daily labor price that reaches Birr 30, particularly during harvesting time. But it is just temporary. The main labor market is the PSNP. The program creates employment for 3, 6 and 9 months and it includes all able-bodied family members even they do not work except kids and older people who are entitle to free food distribution. People then like PSNP than selling their labor to the other farmers. The reasons behind preferring PSNP are many. Among them, even if the payment is very low or (i.e. Birr 8 for a day), the type of work is simple and working in the program is on the basis of willingness of the people themselves. Because of these and other reasons to work in PSNP is needed by many households. Only 4% of total sampled households indicate getting income by selling their labor in their area. Traditionally selling labor to the neighbor was considered as shameful. Currently the young people are going far away from their village to places like Dessie, Metema, Humera, Afar region and other parts of the country to making money by selling their labor.

6.6 Modern Farm Technologies

Utilization modern farm technologies, like chemical fertilizer, improved seed, etc could increase the amount production per hectare. In the study area, land is highly degraded and the soil fertility has decreased. In order to survive and for producing more products, using modern technologies is vital. However, using these technologies could not possible out of having money and other favorable environmental conditions. This means it requires money to get

technologies from market. Moreover the environment should be favorable to produce, and risk should be low. Otherwise, farmers could face problems in which they may not be able to repay their credit easily. As FGD participants indicated, farmer who have better income and access to the irrigation are encouraged to buy and use these technologies because they have relatively less environmental risk and have better purchasing power access to irrigation and credit facilities. The government and Amhara Rural Credit Institution (ACSI) have provided credit that is used for buying technologies. But the farmers still have fear of risk due to lack of rain. Under its limitation, utilization of modern technologies is found in increasing rate. According to the survey result 94%, 85.4%, 92.1%, and 32% of irrigation users are using chemical fertilizer, improved seed, compost and modern pesticides respectively. From non irrigation users, 71% used chemical fertilizer, 50% used improved seed, and 89% used compost and 10.6% used modern pesticides. Utilization of modern technologies by both irrigation users and non-users revealed that the technologies are playing important role in increasing their crop production.

A DA in the key informant interview explained that,

'Utilization of modern technologies like fertilizer and improved seed has been increasing. Farmers' awareness is in increasing. The problem is its expensive price. If the price decreases; I hope all farmers will be using more. Even if the fertilizer price is reduced in the world market, the country market is not changed or still expensive. It discourages farmers to use more.

In addition the following points are been discussed; with regard to utilization of inputs,

Chemical Fertilizer: chemical fertilizers utilization of farmers is not still up to the scientific standard. This could not give maximum benefit to the users. All FGD participants believe that using fertilizer and other farm technologies is good thing for increasing

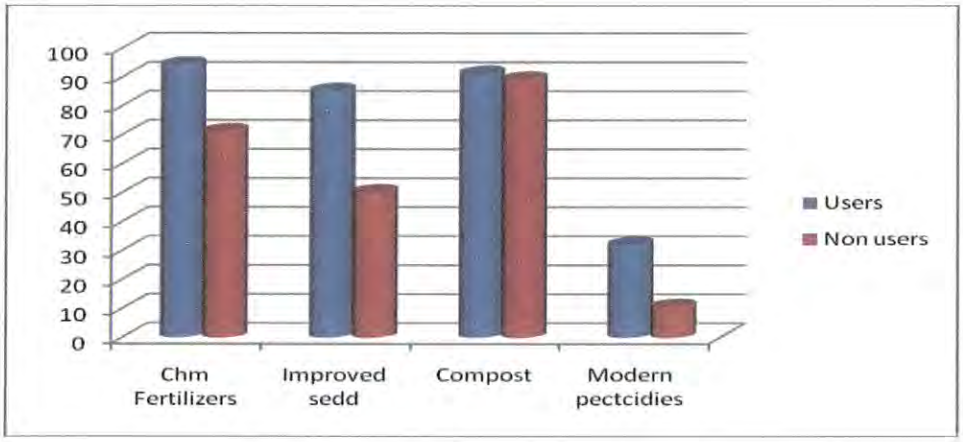
production and they also agreed that sustainable utilization of chemical fertilizer must be attached with sufficient water supply. Then irrigation plays an important role in using chemical fertilizer, because of less environmental risk of irrigated farm.

Regarding utilization of compost: almost all sampled households were found in using compost on their farm land. As DAs indicated, the amount of the compost used per a hectare of farm land is not up to scientific standard and its amount is very small. The main reason is that crop residual and animal wastes are used for other purposes like household energy source. At the *wereda* professional FGD we have discussed this issue. The participants of FGD believe that gradually the energy source would be changing due to wide program of eucalyptus tree plantation. They mentioned that in the study area almost all households are involving in plantation of this tree around their houses with big number. It may encourage the farmers to shift all animal wastes and crops residue from household energy source to compost.

The use of compost in increasing soil fertility is having acceptance by farmers. The only problem that they raised is, it needs much labor and requires work hard. When the technology was introduced first people were not easily convinced about its use. The main reason was that the preparation is difficult and it exposed users to diseases. But gradually the situation is changing and now all farmers use compost with its limitation of low quantity and quality.

Improved seed: It is also another technology which increases amount of production per hectare. The demand of farmer to use improved seed is increasing, while the supply is very limited. According to *kebele* DAs, the only improved seed introduced to the farmers is wheat. Even it could not be easily available with sufficient amount.

Figure 6: HH Modern Input utilization



The awareness of farmers to use improved seed becomes strong. At the time of FGDs with *wereda* staff including the heads of *wereda* administration and agriculture, the participants indicated that they cloud not easily meets the demand of farmers, due to low supply. During 2005 and 2006 by SIDA support program, the *wereda* itself tried to duplicate C1 wheat seed by involving few farmers and it created access to others through cooperative market. However, this had two problems, the first one was once the farmers duplicated C1, just the next seed become C2 not C1, and the second problem was the amount of production was very limited and the price was expensive.

In addition those farmers, who were participated in duplication program of improved seed, were under the support of SIDA. They have not taken it as a business. When SIDA support stopped, the duplication practice was also stopped. And the duplicators shifted their farm to other crops which have a better market price and the program could not be continued. Now there is no mechanism of duplication. The only supplier is the federal government improved seed organization and it has not supplied as of their demand and time.

The farmers' demand of improved seed is still high and the problem is supply. Even with this condition the position of irrigators' to use it is in better level than their non irrigators counterparts. The reasons all irrigators purchasing power, access to extension services; and access to credit which put them in better position. The DAs' office is found near to the scheme and irrigators are easily access to take advice. This and other condition set irrigation users in higher place in accessing improved seed.

In conclusion utilization of modern farm technologies is gradually increased. It creates good opportunity to increase production and productivity of crops. As a result availability of food has also increased. However, there is capacity difference between the two groups. And the capacity of irrigation users to use all types of technologies is found to be better as compared to their non irrigators.

CHAPTER SEVEN

7. CHALLENGES OF IRRIGATION DEVELOPMENT AND FARMERS' ADOPTION

In the following sections try to discuss about challenges of irrigation development and farmers' adoption in the study area. The study shows that irrigation could make difference in the asset, income and food security status of farmers. Irrigation creates opportunity to increase production and productivity, round year production as well as promoting high value crops. However, still not all farmers have accessed it. Then this chapter tries to discuss about challenges and constraints of WRD in the study area.

7.1 Irrigation Development and the Management problem

For Tebi irrigation scheme the management responsibility is in the hand of WUC. The committee is elected by the general assembly of users. It has 7 members 2 of them are women. The committee was organized since the irrigation started. There is re-election of new committee every three years. The functions of the committee include; controlling the dam, distributing water, managing conflicts and maintenance of the system. The committee has responsibility to report its performance to all members of general assembly every three months.

During the FGD with WUC, participants have indicated a number of challenges. The first challenge is water shortage. Especially during the dry season, the amount of water is decreasing. At this time the amount of water is not enough to all. As a result, all water is used by upstream users. This creates clash between users. Handling this problem is just one of a big assignment to the WUC. The second one is that the types of crops harvested by each farmer are different. Different crops need different amount of water. At this time the amount

of water which is allocated to one farmer is not enough. Then they would be going to enter to water tiff and conflict.

The third problem is wastage of water. When water is released to the users there are careless people who cloud not manage their water properly and wasted and exposed others' farmland to flood. At this time conflict has erupted between users. All these and other disputes are basically managed and solved by the WUC. When the problem is over their mandate, the *kebele* leaders and others concerned bodies intervene to resolve the matter.

Low maintenance capacity is also their challenge. Sometimes the problem is beyond their capacity. Currently, the committee has only Birr 26,000 by collecting Birr 30 from each user annually. It is not enough to make maintenance. It needs support to overcome the challenge.

7.1.1 Identified strength and weakness of water development options

In the study area, different types of water development or irrigation methods are applied. Among them dam, river diversion, rain water harvesting and spring development are the major ones. In addition to these, there are both communal and private water development systems. The survey result shows that from total sampled households 86.7%, 7.3%, 2%, 70% and 3.3% (of both irrigation user and non users) preferred dam, river diversion, ground water development, spring development and rain water harvesting types of water development, respectively.

In the FGD there are issues raised regarding the strengths and weaknesses of each water development practices. Without addressing each of these weaknesses, farmers could not maximize their benefits of food security. In the following few paragraphs I discuss about each WRD method strengths and weakness that explain low farmers' adoption.

Regarding dam construction: the main advantage which is pointed out by the participants is its capacity to irrigate large area of farm land, and sustainable water supply at least for some years. On the hand, dam system of irrigation has its own challenges; among many, it needs relatively higher amount of money or investment, which is beyond the capacity of people as well as the local administration. It also requires high level skill of man power and materials which could not easily be available or be acquired at the *wereda* and *kebele* level.

Figure 7: the irrigation layout at the site, photo, 2009

River diversion: is another preferred system of irrigation. Its advantage is that it cloud be constructed with limited money with farmers' skill and materials. According to the FGD participants, the weakness of this system is that it can be easily exposed to erosion damaged and the river would be dry up during dry season.

Spring development: it is highly preferred by farmers or by all FGD participants. The main advantage is that its importance for human and livestock drinking, for other domestic use

and for irrigation. The main weakness is that it has a limited capacity to irrigate wide area of farmland.

Ground water development: is also the other type of irrigation sources. This source is not utilized by many households and it requires much money or beyond the capacity of farmers.

Rain water harvesting: is one of the other important sources of irrigation development. However farmers' acceptance of the sources is low. The reasons indicated in the FGD include failures of technology, the fact that it needs higher household labor, and its land coverage is limited. However, the amount of water contained is not sufficient enough for irrigation. But it could be used for animals and others domestic uses with its limitations, the farmers and experts recognize it as one of the good systems for the future.

Water pump generators: in addition to the above, currently the regional government is promoting water pumps generators. According to BoARD (2009) information, currently the regional government buys and allocates 20000 water pump generators for all *weredas* by using food security budget. In Mekedela *wereda,* 175 generators are reached. The price of a generator is Birr 5500. And credit mechanism also facilitated by ACSI. Farmers have right to buy individually or in group. However, up to the time when I was there, only 17 generators are distributed; 4 of them reached in Tebi *kebele*. The remaining are in the store of *wereda.* The reasons behind low distribution are many. Among different reasons are suspicion of farmers towards its effectiveness and the farmers' syndrome of getting all from government freely. In relation to this a DA told me that:

'Government is trying prompting different technologies of water resource. The water pump generators are one of these. But people talk about why it is not distributed freely, because the source of money is food security program.'

If each of the irrigation development systems would properly function, food security can be realized. Each has its own advantage and disadvantage. Then addressing their weakness and using properly would lead the local people towards achieving food security objectives in the study area.

7.2 Environmental challenges.

Environmental challenges are also other challenges of irrigation development and farmers adoption. These include sedimentation of dams, drying up of rivers and springs, and damage by flood.

Figure 8: water shared of the scheme, 2009

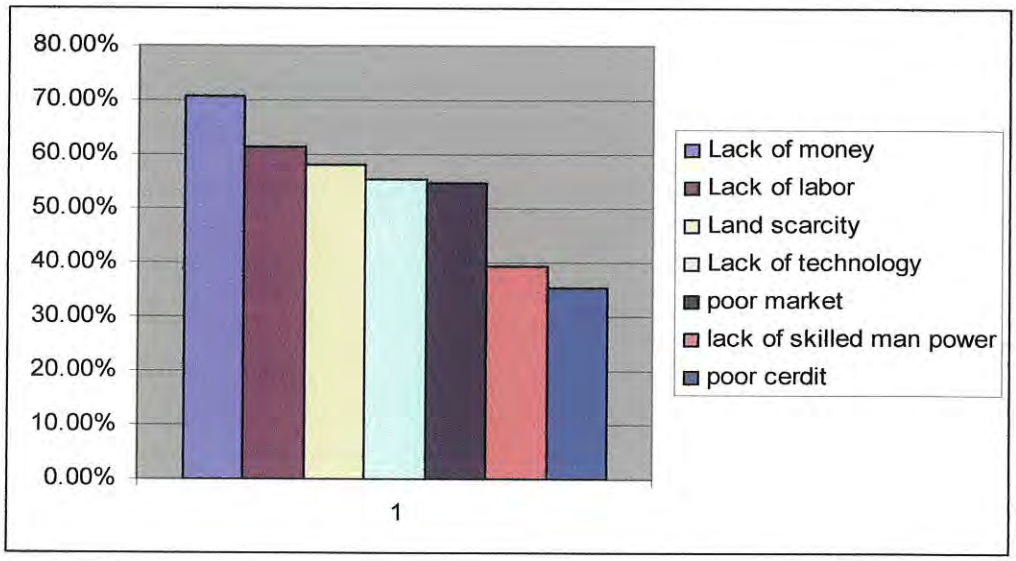
Tebi irrigation dam is an example that is challenged by these problems. When it was constructed, the depth of the dam was 17 meters, but now it reached 11.6 meters (WARDO, 2008). The remaining is already sediments. The dam capacity was estimated to irrigate 180 hectares of farmland, and to benefit 720 households. However, currently the capacity is

downgraded to irrigate only 155 hectares of farmland and benefiting 605 households. The main reason is increasing sedimentation that reduces the dam water contained or storage capacity. It is as a result of poor water-shade management.

7.3 Economical and related constraints

Among the major economic and related problems identified by the survey are lack of money, labor, skilled man power and willingness to adopt technologies.

Figure 9: Challenges of water resources development and farmers adaptation:



According to the survey result, 70.7% of respondents reported, lack of money as a first rank problem of water resource development in their area. In the FGD the *wereda* leaders and experts raised a point regarding irrigation scheme benefits and its challenges to develop as follows:

'We need a numbers of Tebis, but it needs money. Our budget is very limited. We hope that government and donors may give attention. Otherwise there no chances to develop more schemes like Tebi with local administration capacity.'

The FGD participants mentioned that when Tebi was constructed in 2001, the price of construction materials was relatively cheap. Even though, it required more than 3 million Birr out of farmers' contribution. The need of investment is relatively big but essential.

7.4 Social challenges

The social challenge includes lack of farmers' willingness to work together, suspecting of technologies, lack of labor of a household, dependency syndrome, lack of skill and laziness that are reported by the participants of FGD and other respondents. These factors also reduced the effort of the farmers.

7.5 Institutional Constraints

Institutional constraints are also considered as problems. There include lack clear definition of responsibilities and lack of rule and regulations on how to use water efficiently and properly and how to handle water conflict between users upstream and downstream users and so on. The maintenance problem is a critical challenge of WUC and there is no clear division of labor among concerned bodies from *kebele* to the region.

CHAPTER EIGHT

8. Conclusion and Recommendation

8.1 conclusions

From the critical nature of food insecurity in Ethiopia this type of study is essential. The main aim of the study is to identify the role of small scale irrigation development to the households' food security. In the face of rising rural population density, emergency climate change, and land degradation problems of the study area, the importance of WRD is not questionable. It is also the only way out and survival strategy of rural poor of the area and country at large. Irrigation development is the right intervention to attain food security in Ethiopia.

Mekedela *wereda* is one of food insecure *wererda* found in the northeast part of Ethiopia. The *wereda* agriculture development is still dependent on rain. The nature of the rain is erratic and not sufficient. Then with this atmosphere, people are in struggle to make better life and it is so challenging. The study area agricultural development plays critical role in the households' food security. The main livelihood strategy of the households is agricultural development. The land holding size of farmers is very small. The only way out is intensification of agriculture development. Employment opportunity out of the agriculture sector is also minimal and none-existent in some area. The agriculture sector is challenged by many problems such as rain shortage and land degradation. There are efforts that are undergoing to make change in food insecurity. One of them is irrigation development. Irrigation development has positive impact in user households. The following three are the majors advantages identified:

- Irrigation users have the opportunity to produce at least twice a year, while few of them could produce three times a year

- Irrigation users have opportunity to produce high value cash crops and generating better income from market
- Their risk of crop failure or reduction due to rain shortage is reduced, because they have supplementary irrigation access.

In addition to these their average income, oxen ownership, other livestock ownership, house asset ownership, food consumption trend and daily meal status are found to be better compared to the non irrigation users.

Besides their utilization capacity of modern technologies such as chemical fertilizer and improved seed is found to be at better level. All the findings revealed that irrigation development is one of critical inputs of bringing households' food security. While the irrigation development is not going on as it is needed, it is found in a very low level of development. This is explained by many factors including lack of finance, lack of skilled labor, low farmers willingness and poor market.

There are lessons of Tebi irrigation scheme. In strengths side it is good to irrigated relatively large area of farm land compared to other ways of WRD practices, and it also serve for past 8 years and it will expect serve more time. However, its weakness also requires attention because it is under the risk of sedimentation, poor management and maintenance problem, and there is no clear division of responsibilities among many stakeholders, that needs correction majors and generating its benefit for long period of time.

8.2 Recommendation

With the major findings of the research and the conclusion drawn the following policy issues are pointed out.

i) In order to enhance the knowledge of policy maker and other development practitioners, promoting professional empirical studies is essential. It could increase the understanding of them and also shows the relation between food security and water resources development (WRD).

ii) To bring development and assured food security in the drought prone area like Mekedela, the best way out is water resources development. Others efforts are important; bringing water resources development in this area means bringing food security.

iii) Food security is dependent on production capacity and purchasing power of farm households. The production capacity is challenged by rain shortage implying the need to make different irrigation development. Then essential investment should be allocated. Major development investment shall be geared towards irrigation development.

iv) In Ethiopia poverty is, partly caused by drought. However, drought and famine do not necessarily go together. There are countries which are affected by drought, but not affected by famine and food insecurity. Then the main reason is low development of our water resources. Therefore to bring sustainable agriculture and solve food insecurity, more investment and professional support in irrigation is required.

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Declaration

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

Declared by:

Sileshi Temesgen

Candidate

Confirmed by:

Desta Tolossa

Advisor

Appendixes

The objective of the research is to assess the role water resources development to the household food security and the research work is directly for the purpose pf MA thesis, and then to al respondents requests to give their knowledge openly and correctly.

Date /Ethiopia Calendar ----------

Name of Gott ----------

Enumerator Name ----------

Starting time ----------

Ending time ----------

Part I. General information of household head and other family members.

1. Sex of the household head
   1. Male 2. Female
2. Age of the household head
   1. 18-24 2. 25-30 3. 31-35
   4. 36-40 5. 41-50 6. Above 50
3. Educational level of the household head
   1. Illiterate 2. Read and write 3. Primary education
   4. Secondary education 5. Of other specify
4. Social status or responsibilities of the household head
   1. Religious leader
   2. Political leader
   3. Community organization /'Idir'/ leader
   4. None
   5. If other specify ----------
5. Martial status of the household head
   1. Married 2. Unmarried 3. Divorced 4. Widowed
6. Farm experience /number of years since started farming/ of the household head ---------- years
7. Family size of the household ----------

Please list of age category of your family members

Age category /years/	S e x		Total
	Male	Female	
Children < 10 years			
Children 11-14 years			
Adults 15-64			
Elders over 64			

8. Religious of the household head

1. Muslim 2. Christian Orthodox

3. If other specify

Part II Land and other, Socio-economic conditions

9. Do you feel that your family food security status, in terms of production, purchasing power and acquired enough food for health is
1. Secure 2. Insecure

10. If your answer of (Q, 9) is 'secure' please specify the reason ----------
---
---.

11. If your answer of (Q, 9) is 'insecure' please specify the reason ----------
---
---.

12. Do you have access to irrigation?

1. Yes I'm user 2. No I'm not user

13. If your answer of (Q, 12) is 'No' please specify the reason

---
---

14. Do you have farm land
1. Yes 2. No

15. If your answer of (Q, 14) is 'No' Why? ----------
---

16. What is the total area of farm land you cultivated in 2008/09

1. 0.12-0.25 2. 0.26-0.5

3. 0.51-0.75 4. Over 0.75

17. From the total of farm land that you are cultivated how many hectares is irrigated

---.

18. For how long you used irrigation ----------years.
19. Please specify the following information regarding the land you cultivated.

No	Types of land owned	Irrigated(ha)	Rain Fed only (ha)	Total (ha)
20	Own land			
21	Land by rental			
22	Land through share cropping			
213	Land got from parents, relatives inheritance			
24	Land purchased			

25. How many farm plots do you have? ----------
26. How is the trend in total area your cultivate farm over years

1. Increasing 2. Decreasing 3. No change 4. I don't know

27. How do you compare productivity of irrigated land to the rain-fed farm land?

1. Higher 2. Lower 3. Equal 4. I don't know

28. How much Km far away home of your farm land is found?

---

1. Higher 2. Lower 3. Equal 4. I don't know

Part III. Crop production and Productivity

29. How is the trend of total production for unit area of irrigated farm land over past five years?
    1. Increasing 2. Decreasing 3. No change 4. I don't know

30. How do you compare productivity of irrigated farm land compare to rain-fed farm land?
    1. Higher 2. Lower 3. Equal 4. I don't know

Please list crops that you are produced

No	Types of land owned	By using irrigation plus rain		By using rain only	
		Yes	No	Yes	No
31	Wheat				
32	Barely				
33	Teff				
34	Maize				
35	Sorghum				
36	Millet				
37	Onion				
38	Tomato				
39	Cabbage				
40	Potato				
41	Carrot				
42	Noug				
43	Beans				

44. How many times (year round) production you are cultivated with your farm land annually.

1. One times 2. Two times 3. Three times 4. If other specify

45. What kind of crop productivity observed in your irrigated farm land year to year

1. Increasing 2. Decreasing 3. No change 4. I don't know

46. What kind of crop productivity observed in your rain-fed land for the last five year

1. Increasing 2. Decreasing 3. No change 4. I don't know

47. Do you produce enough food for your family?

1. Yes 2. No

48. How many months could you cover of your annual family food?

1. 3 months 2. 6 months 3. 9 months 4. 12 month

5. 12 months plus I can save

49. Do you use modern fertilize

1. Yes 2. No

50. Do you use improved seed?

1. Yes 2. No

51. Do you use manure?

1. Yes 2. No

52. Do you use pesticides?

1. Yes 2. No

53. If your answer of (Q, 49) is 'yes' what of pesticides do you use?

1. Modern 2. Traditional 3. Both

Part IV Asset Ownership

Please list your livestock property owned

No	Types of livestock	Do you have		If you answer 'yes' How many
		Yes	No	
54	Oxen	1= none 2= 2 3= 2 4= 3 5= More than 3		
55	Cow			
56	Heifers			
57	Bulls			
58	Sheep	1= Less than 5 2= 5 3= 6-15 4= More than 15 5= None		
59	Goat			
60	Mule			
61	Horse			
62	Donkey			
63	Poultry(hen)			
64	Bee	1= none 2= 1 3= 2 4= More than 2		

65. What is the trend of your livestock ownership position during last five years?

1. Increasing 2. Decreasing 3. No change 4. I don't know

66. If you are farmers who have access to irrigation how do you measure the role of irrigation to your livestock current position
1. Positively contribute 2. Negatively contribute

3. No change 4. I don't know

67. What is your livestock production challenge now you faced?

1. Feed problem 2. Water problem

3. Both feed & water problems 4. Animals' diseases

5. All 6. None

68. How many houses do you have?

1. One 2. Two 3. Three 4. More than three

Please specify if you have house both in urban & rural---------- ---
---

69. Do you have Iron roofed house?
1. Yes 2. No

70. Do you have Tape recorder?
1. Yes 2. No

71. Do you have Bed?
1. Yes 2. No

72. Do you Blanket?
1. Yes 2. No

73. Do you and your family use shoes?

1. Yes 2. No

74. Do you and your family use shoes?

1. Yes 2. No

75. Do you have saved money in bank?

1. Yes 2. No

Part V. Labor and other issues

76. Do you faced labor shortage
    1. Yes 2. No

77. If your answer of (Q, 76) is 'yes' how do you solve it

    1. Hiring other labors

    2. Traditional community labor arrangement

78. How many hours do you work per a day?

    1. Less than 8 hour 2. 8 hour 3. More than 8 hour

79. How do you see your labor productivity during last five year?

    1. Increasing 2. Decreasing 3. No change 4. I don't know

80. Do you have credit access?

    1. Yes 2. No

81. If your answer of (Q.80) is 'yes' the amount credit is

    1. Enough 2. Not enough

82. Do you pay your credit (liability) on time?

    1. Yes 2. No

83. Do you have market access to your products?

    1. Yes 2. No

Part VI. Income of the household

Please list the following about sources of the household income sources and amount generated during year 2008/09

	Sources of household income	If' 'yes' estimated amount generated by 2008/09	Share by (%) (calculate by the researcher)
84	Form irrigated farm		
85	From rain fed farm		
86	From livestock related(sell of sheep, milk, ox, etc)	1= Less than 2500 2= From 2500-8000 3= From 8001-10000 4= More than 10,000	
87	From off-farm activities(petty-trade, etc)		
88	From forest related products(charcoal, tree. Etc)		
89	From other family member gift		
90	From sell of your labor in other farm or urban works		
91	Other		

Part VII. Constraints (challenges) to scale-up best practice of water resource development

Please specify the following list concerning challenges you faced to adopt, or scale-up best practices of water resources development in your area

No	Constraints (challenges)	Yes	No
92	Lack of awareness		
93	Lack of money(capital)		
94	Lack of labor		
95	Lack willingness from farms side(reluctant ant)		
96	Lack of support of government		
97	Lack of technical capacity professionals		
98	Poor arrangement of farm land		
99	Attitude of land insecurity		
100	Lack of technologies		
101	Poor market		
102	Poor credit facilities		

103. Please specify if there are other challenges ----------

---.

104. Which one of water resource development practice you preferred among money alternatives

1. Communal dam
2. River division
3. Ground water development
4. Spring development
5. Rain water harvesting

105. Which one do you prefer from the following the two
    1. Individual water development practice
    2. Communal water development practice

106. Do you believe that water resource development contribute positive to the house hold food security
    1. Yes 2. No

107. Do you believe that the 'Tebi' dam objective of 'increasing production' is achieved?

    1. Yes 2. No

108. Do you believe that the 'Tebi' irrigation scheme objective of promoting commercial farming' is achieved

    1. Yes 2. No

109. Do you believe that the 'Tebi' irrigation scheme objective of 'increasing round year farming' is achieved?

    1. Yes 2. No

110. Do you believe that the 'Tebi' irrigation scheme objective of promoting high value crops' is achieved?

    1. Yes 2. No

111. Do you involve in productive safest net program

    1. Yes 2. No

112. Did you get training and other extension support form government side by 2008/09?

    1. Yes 2. No

113. Did the development agent visit your form land by 2008/09?

    1. Yes 2. No

114. When the dam was constructed with you agreement and acceptance

    1. Yes 2. No

115. Do you think lack of access to irrigation affect the house hold food security?

    1. Yes 2. No

116. If your answer of (Q, 115) is what way's? Please give response the following

Response	NO ANSWER	
	Agree (1)	Disagree (2)
Vulnerability to drought		
Low crop productivity		
Low access to cash crops		
Low access round year production		
Low access to modern technologies		

117. If your answer of (Q, 115) is 'No' what are the most determinant factors of your household food security, please specify the 1st 3 factors.
    1. _____
    2. _____
    3. _____

118. If you believe that you are food 'secure' with none user of irrigation why?

_____

_____.