MEKELLE UNIVERSITY

COLLEGE OF NATURAL AND COMPUTETIONAL SCIENCE

DEPARTMENT OF BIOLOGY

A Thesis On:

Role of Small-Scale Irrigation on improving Food Security of Households: A case study of two peasant Association Tabia Maytuem and Betyehannes in Adwa district, Tigray Regional state.

Submitted to the Department of Biology in Partial Fulfillment of the Requirements for the Degree of Master of Science in Biology.

By

Yemane Tesfay (ID No: cncs/psbi/ 0043/08)

Under the supervision of

Tsegazeabe Hadush Haileselasie (PhD)

Sep**, 2013 E.C.**

Mekelle, Ethiopia

APPROVAL SHEET

MEKELLE UNIVERSITY

COLLEGE OF NATURAL AND COMPUTETIONAL SCIENCE

DEPARTMENT OF BIOLOGY

A Thesis on: ***Role of Small-Scale Irrigation on improving Food Security of Households: A case study of two peasant Association Tabia Maytuem and Betyehannes in Adwa district, Tigray Regional state.***

SUBMITTED BY: **Yemane Tesfay** **cncs/psbi/0043/08** _____ _____

Student's name **ID. No.** **Signature** **Date**

APPROVED BY: 1. **Tsegazeabe Hadush Haileselasie (PhD)** _____ _____

Advisor's name **Signature** **Date**

2. **Luel Kidane (PhD)** _____ _____

Department Head **Signature** **Date**

3._____ _____ _____

Chairperson **Signature** **Date**

4. _____ _____ _____

Internal examiner **Signature** **Date**

5. _____ _____ _____

External Examiner **Signature** **Date**

Declaration

I, the undersigned, declare that this thesis entitled *"Role of Small-Scale Irrigation on improving Food Security of Households: A case study of two peasant Association Tabia Maytuem and Betyehannes in Adwa district, Tigray Regional state"* is my original work and has not been presented for any other award, and that all sources of materials used in this thesis are duly acknowledged. This thesis was carried out under the supervision of my principal advisor Tsegazeabe H. Haileselasie (PhD), Department of Biology, College of Natural and Computational Sciences, Mekelle University in the academic year of 2013 E.C.

Name of student candidate: Yemane Tesfay Desta

Signature with date: _____

This thesis has been submitted for examination with my approval as university advisor/co-advisor.

Name of the advisor: Tsegazeabe H. Haileselasie (PhD)

Signature of the Advisor with date: _____

Name of the co-advisor: _____

Signature of the co-advisor with date: _____

Place: Mekelle University, Mekelle, Ethiopia

Date of submission: _____

Acknowledgment

This study would never be completed without the contribution of many people to whom I would like to express my thanks. My special gratitude goes to my instructor, Tsegazeabe H. Haileselasie (PhD) for his encouragement, guidance and consistent invaluable advice, comments and follows up of my thesis from start to the completion.

I would like to thank households of Wereda Adwa, Wereda Adwa agricultural experts and Wereda Adwa agricultural office for their hospitality and kind response to my inquiries on information about the "Role of Small-Scale Irrigation on improving Food Security of Households: A case study of two peasant Association Tabia Maytuem and Betyehannes in Adwa district, Tigray Regional state".

As well as I would like to say thanks to my friends Gebretsadik Weldegebriel (MSc), Kide Tikue(MSc) and my family for their moral support and encouragements in the course of my study. Finally, I would like to thank to Tigray Education Bureau and Mekelle University for sponsoring and budget to doss this thesis of postgraduate study as well as for the whole teaching and learning process.

Contents Page

List of tables……pages

List of figures……pages

Abbreviations and Acronyms

ADF: African Development Fund

ADLI: Agricultural Development Led Industrialization

CAADP: Comprehensive Africa Agriculture Development Program

ECA: Economic Commission for Africa

FAO: Food and Agriculture organization

FEWS NET: Famine early Warning Systems net work

FNSP: Food and National Security Policy

FSN: Food security and nutrition

FTC: Farmer Training Center

G20: Group 20 Countries

GDP: Gross Domestic product

ICID: International commission on irrigation and Drainage

IFAD: International Fund for Agricultural Development

IFRC: International Federation of Red Cross and Red crescent society

IWMI: International Water Management Institute

MDGs: Millennium Development Goals

MoA: Ministry of Agriculture

MoARD: Ministry of Agriculture and Rural Development

MoFED: Ministry of Finance and Economic Development

NEPAD: New Partnership for African Development

NGOs: Non-Governmental Organizations

SDG: Sustainable Development Goals

SPSS: Statistical Package for Social Science

TDA: Tigray development Association

UN: United Nations

UNDP: United Nations development program

USAID: United State Agency for International Development

WFP: World Food Program

WHO: World Health Organization

Abstract

Food insecurity in the world has been addressed as one of the biggest problems for over several decades due to the result of high population. Ethiopia's agriculture is dominated by small-scale rain-fed production and irregular rainfall pattern. Small-scale irrigation is believed in helping to address this problem thereby reducing rural poverty, food insecurity as well as improving the overall contribution of agriculture to the national economy. The main objective of this study was to investigate role of small-scale irrigation user's on improving food security of households in Adwa Rural District (Tabia Maytuem and Betyehannes). Data was collected from 195 household, 80 irrigation users and 80 non-users, 24 for group discussion, 6 key informative and 5 agricultural experts. Two Tabia was stratified into two strata and random sampling technique was employed to select the sample respondents. According to the findings, small-scale irrigation were very important to increase their yields, income, to keep their health, teach their children, and help their economy gained by rain-fed. The households are interested in getting advice of agricultural experts in order to do highly in irrigation. When compared household's food security improvement who practice irrigation and non-irrigated lands, there was a great difference of diet diversity between the two groups. Irrigators gain alternative and fresh food than non-irrigators; as a result, irrigators' health was better than non-irrigators because non-irrigators' can be affected by deficiency diseases. The researcher obtained different factors that influence small scale irrigation schemes on the improvement of food security like, incomplete infra-structure, shortage of water, fertilizer, medicine, link to marketing, genetically modified crops, vegetables, legumes, fruits, rules of water financing committee, drought, awareness, advise, work-shops, sharing experiences and commitment. Finally, it was recommended that governmental and non-governmental organization should expand access of small- scale irrigation by farm households to improve their food security.

Key word: Climate Change, Households, Food Security, Market, Land Productivity

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Food insecurity in the world has been addressed as one of the biggest problems for over several decades now. One of the reasons for food insecurity in the world is the result of high population. Because of human population was increasing exponentially. Food insecurity in the world is the result of inability of the countries to produce sufficient food, inequality of food distribution within the country or for certain commodities, an imbalance of distribution between countries or the inability of certain sectors of the community to obtain a diet of sufficient quality (Robison, 1983).

In developing countries, reasons for food insecurity include insufficient marketing systems, poor transportation (infrastructure) and communication networks; weather change, demand-outstripping supply, inefficient food crisis management and resource degradation (IRC, 2008). Food insecurity has affected millions of people worldwide who suffer from hunger. In Africa, food security is one of the serious problems. Sub-Saharan Africa is the only region in the world where malnutrition, an outcome of food insecurity is not declining. The major challenge to food security in Africa is low fertility soils, and environmental degradation. 95% of the food in Sub-Saharan Africa is grown under rain fed agriculture hence; food production is vulnerable to adverse weather conditions. The soils continue to degrade leading to a reduction in the productivity of the farms (Mwaniki, 2006).

Improvement of food security is a concern to both developed and developing countries (Mwaniki, 2012). The World Food Summit (1996) defined food security as a situation when all people at all times have access to sufficient, safe, nutritious food in order to maintain a healthy and active life. The Food Security Network (2013) adds that such food must be produced in an environmentally sustainable and socially just manner, and that people should be able to make informed decisions about their food choices. On the other hand, (Bickel *et al., 2000)* defines food insecurity as a situation of limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways.

According to WHO (2013), food security is built on three pillars namely:
1) Food availability (sufficient quantities of food available on a consistent basis)

2) Food access (having sufficient resources to obtain appropriate foods for a nutritious diet) and
3) Food use (appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation). However, FAO (2009) added a fourth pillar of food security to include stability of the aforementioned three pillars. Accordingly, a healthy and sustainable food system therefore is one that focuses on environmental health, economic vitality, human health and social equity. Food Security also means that the people who produce our food are able to earn a decent living wage in the process of growing, catching, producing, processing, transporting, and serving food (FSN, 2013).
Ethiopia is been facing food insecurity every year in different parts of the country. The reasons include changes of climate, environmental degradation, poverty and diseases (IFRC, 2008). Ethiopia is drought prone, but food insecurity in the country is both transitory and chronic in nature (FEWSNET, 2009). Our country is one of the poorest countries in the world, where about 29.2% of its population live below poverty line (World Bank, 2013). Majority of the Ethiopian population lives in rural areas and the livelihood of the greater majority of this is based on rain fed agriculture that is subject to highly irregular rainfall pattern with detrimental impact on agricultural production. Moreover, agriculture accounts for over 40% to the GDP, out of which 95% of the production comes from smallholder farmers (MoARD, 2010, as cited in Tizita Damtew, 2017).

Dependence on natural factors of production as well as small and fragmented holdings, environmental degradation, rapid population growth, few accesses to new agricultural technologies, traditional methods of cultivation, and low institutional support are identified as factors that keep smallholder production at subsistence level in the country (MoFED, 2012). To address these issues, Agricultural Development Led Industrialization (ADLI) Strategy was designed in 1991 where focus was given to the expansion of small-scale irrigation, formation of cooperative societies and access to agricultural technologies to answer the food demand and bring about the socioeconomic development in the country. Small-scale Irrigation was one of the agricultural technologies defined as the man-made application of water to guarantee double cropping as well as steady supply of water in areas where rainfall is unreliable (Mutsvangwa *et al.*, 2006). Hence, the development of small-scale irrigation is one of the major interventions to increase agricultural production in the rural parts of the country. This helps farmers to overcome rainfall constraint by providing continuous supply of water for cultivation and livestock production (FAO, 2003). According to MoARD (2011), the importance of irrigation development, particularly at small holders' level is needed to raise production and ensure food security at household

level in particular and national level at large. In addition, irrigation has the potential to stabilize agricultural production and mitigate the negative impacts of variable or insufficient rainfall.

According to (MoFED, 2006), irrigation development has already been identified as a source of sustainable economic growth and rural development, and is considered as a cornerstone of food security and poverty reduction.

The study area, Adwa rural district, is found in central Zone of Tigray. Small-scale irrigation is being practiced in the study area. Farmers in Adwa rural district has been constructing different small-scale irrigation schemes with the objective of increasing agricultural production and productivity to improve the food security situation of the farming communities and to reduce dependency on the rainfall. Food insecurity in Adwa rural district had been a problem for several years.

1.2 Statement of the Problem

Apparently, the implementation of the National Agricultural Extension Policy and the Strategy for Revitalizing farmers at different times, complemented by other programmers in Ethiopia have not been a solution to solving food insecurity problem. Household food insecurity has continued to be of national concern. The food insecurity situation in many parts of the country is blamed on various factors which include; poor governance; frequent drought and famine; and agricultural dependency on the climate and environment, land grabs and speculations and access to markets among others (RoK, 2009).

In Ethiopia, the problem was aggravated by low production and crop loss mainly caused by low and irregular rainfall among others. Agricultural production was predominantly dependent on rainfall. This has made the country's agricultural-based economy extremely fragile and vulnerable to the impacts of climatic variability which often results in partial or total crop failure and subsequent food shortages and famines. To alleviate the deep-rooted food insecurity at household level, the Government of Ethiopia has recently introduced and begun implementation of policies to minimize risk through full or supplementary irrigation (MoFED, 2010). Irrigation and water management practices are taken to greatly reduce the problem caused by rainfall variability, enhance productivity per unit of land, and increase the volume of annual production significantly. According to Lipton *et al.*,(2004 cited in Haile, 2008) state that irrigated agriculture can reduce poverty through increased production and income, and reduction of food prices, that helps very poor households to meet the basic needs by improving their overall economic welfare, protect them against risks of crop loss due to insufficient rain water supplies

and promote their use of yield enhancing farm inputs which in the long run enable them to move out of the poverty trap.

In the study area there are different rivers and several springs to be found that can be used for irrigation purpose. With this point of fact farmers had been practicing traditional irrigation system such as traditional river diversion and now a days, farmers are practicing some of the modern irrigation mechanisms, especially using water pumps (BWOA, 2015). However, it is not well known to what extent the households that are using irrigation are better off than those who depend on rainfall in the study area. Likewise, the role of small-scale irrigation on household food security is not yet well studied in the study area. Therefore, the main motivation behind this study is to explore whether irrigation access in the study area is making positive change on improving household food security or not.

In Adwa district, where the study would be conducted, there was prevalent food insecurity and worsening of factors supporting food production, including delayed rainfall, flash floods some-times, infertile soils and lack of awareness how to use inputs in increasing food crops as well as lack of access to modern farming system. All these will make the state of food security terrible (deplorable) despite the various progressive measures adopted by the governmental and non-governmental organizations. It would be, therefore, imperative to undertake a study to understand why food insecurity has remained a serious problem in Adwa district despite multiple interventions from the government and other development factors. More precisely, this study assessed how small-scale irrigation influenced the attainment of food security in the study area. This study was critical in support of the attainment of the Sustainable Development Goals in its focus on food security. Indeed, food security falls within the SDG goal aimed at mitigating poverty and extreme hunger. Accordingly, understanding the role of small-scale irrigation on improvement of food security in the study area with a view to generate strategies that would easily be adopted to assist in meeting the food requirement of the residents of Adwa would contribute towards achieving this goal. Although food security awareness had been carried out at district and regional level to develop and help peasants to achieve food security, yet food insecurity still prevails in the district. The study would, therefore, look into the role of small-scale irrigation and its contribution for persistence of food security in the district. This study, therefore, seeks to evaluate the role of small-scale irrigation on improving food security of households.

1.3 Research Objectives

1.3.1 General Objective

The main objective of this study would be to investigate role of small-scale irrigation user's on improving food security of households in Adwa Rural District (Tabia mytuem And Betyehanns).

1.3.2 Specific Objectives

The specific objectives are:

- To Assess the impact of irrigation on improvement of household's food security in the irrigation users and non-users in the study area
- To compare household's food security improvement who practice irrigation and non-irrigated lands whether diet diversity between irrigators and non-irrigators are different
- To identify factors that influence small scale irrigation schemes on improvement of food security

1.4 Research Questions

This study would guide by the following questions: -

- What is the impact of irrigation on improvement of household's food security in the irrigation users and non-users in the study area?
- Is there difference in diet diversity between irrigators and non-irrigators household's food security improvement?
- What are the factors that influence small scale irrigation schemes on improvement of food security?

1.5 Significance of the Study

This study would analyze the role of small-scale irrigation on household to improve food security. It would identify the determinant factors that affect household improvement of food security and major obstacles of irrigation use. The finding of this study can contribute to the strengthening the existing information regarding the topic and helps to conduct further interventions in the area of study. The findings of this study should also be use in guiding policy makers and development planners who would concern about irrigation development for household food security. Moreover, the research findings could be used as an input for researchers to further knowledge generation in concepts related to irrigation development and food security.

Firstly, this study was significant in the sense that it provides new knowledge concerning the role of small-scale irrigation on improvement food security of households. Secondly, the study was important because it would help the policy makers to improve policy strategies on dispensable role of small-scale irrigation improvement on food security of households.

1.6 Limitations of the Study

The study area had difficult topography, lack of transport facilities and data collection would be difficult. To ensure timely data collection, the study would take advantage of the dry season when there will no rain to collect data. The study area has poor infrastructure particularly roads which were hard to travel by bus. The researcher would encounter a number of problems during data collection period. One of the main problems would inaccessibility of respondents because they would engage in different social duties and marketing activities. Moreover, inaccessibility of roads in the community should constrain the transportation facilities and the researcher would enforce to walk longer distance on foot. This would make the data collection process longer than it would plan.

1.7 Scope of the Study

The study would be carried out in Adwa rural district. The studies would household survey. The study would focus on role of small-scale irrigation for the attainment on improvement of food security of households in Adwa district. This study would cover to one administration woreda, two Tabias and the respondents found in these two Tabias. The data of the study would base on a cross sectional survey. The objective of this study would to estimate the outcome of small-scale irrigation on improvement rural household food security.

1.8 Definition of Key Terms

Climate Change: in this study refers to alterations in the earth's weather, including variations in temperature, wind patterns and rainfall.

Governance: is used to refer to a process of policy and enforcement of regulations and standards relating to food security in this study.

Household: Here refers to a unit of people living together and eating from the same pot.

Land Productivity: refers to the measure of the amount of agricultural output produced for a given amount of inputs.

Markets: refer to avenues for buying and selling (in this study) of food.

Food Security: refers to when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life (in this study).

CHAPTER TWO: LITERATURE REVIEW

2.1 History of Irrigation Development in the World

According to FAO, (2003), the history of Irrigation goes back over 5,000 years ago. Due to the scarce of natural rainfall to produce crops Mesopotamia and Egypt started irrigation practice around 6th millennium BCE, according to Archaeological investigation. Beside to that, the earliest record of irrigation in the New World were found in the 'Zana' Valley of the Andes Mountains in Peru, the remains of three canals radiocarbon old from the 3rd, 4th millennium BCE, and the 9th century were found by archaeologists. Civilization of Indus Valley in Pakistan and North India (from 2600 BCE) additionally had an early canal irrigation system.

Generally, through the experience that they got from former civilizations the new comers were started to practice sophisticated irrigation in many areas of the world (L. Shanan, 1987). Some of the irrigation method inherited and still using in some world such as in Asia, the Middle East and North Africa, this is mainly the Qanats, developed in antediluvian Persia in about 800 BCE, which is the oldest kenned irrigation methods. This method holds a kind of network of vertical wells and gently sloping tunnels driven into the sides of cliffs and steep hills to tap groundwater (FAO, 2003).

According L. Shanan, (1987), after wards mainly in around 1441 CE, Korea found the world's first dihydrogen monoxide gauge (woo ryanggyae) by the inventor who was called Jang Young Sil, a Korean engineer of the Cho son Dynasty, under the active direction of the King, Se Jong. It was installed in irrigation tanks as a component of a nationwide system to quantify and amass rainfall for agricultural applications. With this instrument, planners and farmers could make more preponderant utilization of the information amassed in the survey (L. Shanan, 1987). Accordingly, it is said to be History is the greatest teacher of the mankind. Study of the history of irrigation, development of irrigation technology, sustainability of the old irrigation systems provides an insight into the factors that have sustained the outcomes over the generations (ICID, 2013). In general, irrigation in some countries is an old art - as old as civilization - but for many nations of the world, it is a modern science, the science of survival. Even if irrigation is one of the oldest identified agricultural techniques, improvements are still being made in irrigation methods and practices (FOA, 1997/98/99:1) cited in Eliyas (2011).

2.1.1 Status of African Food Security

One of the most urgent and challenging issues facing the African continent is achieving food security for its people. The first formal definition of food security was provided by the United Nations World Food Summit in 1974. The Summit concluded that food security is the "availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" UN Report of the World Food Conference (1974). A more recent definition by the World Food Summit held in Rome in 1996 states that "Food security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (Ellis and Freeman, 2005).

Achieving food security is a major concern for many households and governments in Africa today. This situation has been exacerbated by key issues such as the impact of environmental degradation and climate change on food production, rising food prices as a result of reduced production, a shift of focus from growing food crops for food to providing bio-fuels, the global economic recession being faced by the global market, and the traditional challenges of in equitable access to factors of production by men and women. Breman (2004) states that "food security is one of the most urgent issues facing Africa today", and agrees with Rupiya (2004), who observes that "the African continent is the only region in the world that has not been able to feed itself since the mid –1970s and is unlikely to do so in the near future unless radical policy changes are made to current practice." Most African governments have put fairly good policies aimed at curbing the problem of food security in place. In order for food security to be assured, the issues of access to food and its guaranteed availability at all times are of crucial importance (Stevens *et al*., 2002).

In Africa, the challenge remains to ensure adequate and sustainable production of food, proper distribution to ensure equitable access, as well as knowledge to ensure a balanced diet in terms of nutritive value. In summary, therefore, the concept of food security can be seen in terms of four major components, as outlined by the World Food Programmed. These components are: Availability of food and Access to food by individuals and households Utilization, which has to do with a person's ability to select the food that they prefer, as well as absorb the nutrients in the food Vulnerability of the individual to future shocks (WFP, 2002, 2006, Webb and Rodgers, 2003).

Food security may also be viewed from macro and micro perspectives. The macro level refers to large players such as governments and regional bodies, while the micro level refers to households

(Haan *et al*., 2001).

Highlight this viewpoint when they state that "household food security is a function of inter-related processes that happen at different geographic scales: international, national, regional/district, community, and intra-household." The opposite of food security is food in security. This can also be viewed from different perspectives (Maxwellin Sijm, 1997). Emphasize, this distinction when he points out that "An additional distinction between mild, severe or acute of food insecurity is made to indicate the gravity of the situation." According to the WHO (2006), "Food insecurity, or the absence of food security, is a state that implies either hunger (due to problems with availability, access and use) or vulnerability to hunger in the future". Food insecurity therefore implies a lack of access to sufficient food or a lack of adequate food in terms of nutritional value, resulting in under- nutrition or malnutrition.

2.1.2 The development of small-scale irrigation in Ethiopia to improve food security

In Ethiopia the use of small-scale irrigation on improvement of households' food security was started in the earlier time. Especially, traditional irrigation was practiced before centuries (Bekele *et al.,* 2012). Moreover, in the highlands of Ethiopia, irrigation practices have long been in use since ancient times for producing subsistence food crops (Awulachew *et al.*, 2007). As Awulachew *et al*., (2005) and Hagos *et al.*, (2010) stated that the development of modern SSIS started since the mid-1980s. Small-scale irrigation systems constructed by either the government or non- governmental organizations with permanent scheme structure and improved water controlling system. The traditional ones are constructed by the local community, commonly diverting water from rivers using local materials. In traditional scheme, reconstruction of the site is needed at every year after the end of the rainy season, but it is sustainable in the modern water management system for a longer period of time. Both traditional and modern small-scale irrigation systems are farmer-managed irrigation systems with their own local leadership of water users' associations or irrigation cooperatives, assisted by public extension systems. (Awulachew *et al.,* 2005).

Traditional water management institutions established with their own initiatives based on their local experience and indigenous knowledge, and perform better than modern water management institutions, such as the Water Users' Association and irrigation users' cooperatives which established through government initiatives. There is involvement of farmers in various aspects of management of small-scale irrigation systems, particularly, in water distribution and operations to improve the performance of irrigated agriculture (Ibid).

Agriculture is the backbone of Ethiopian economy and it is dominated by smallholder farmers. More surprisingly, the smallholders‟ agriculture suffers from lack of technological know-how, soil degradation, recurrent drought and famine; and unfavorable external terms of trade”. This agricultural crisis has resulted in the country depend on food aid for a long time. Thus, the main objectives of this review are to assess the causes of household food insecurity in rural Ethiopia; and to review the coping strategies pursued by rural households (Yenesew, 2015).

Food insecurity incorporates low food intake, variable access to food, and vulnerability a livelihood strategy that generates adequate food in good times but is not resilient against shocks. These outcomes correspond broadly to chronic, cyclical and transitory food insecurity, and all are endemic in Ethiopia. The main triggers of transitory food insecurity in Ethiopia are drought and war. Seasonality is a major cause of cyclical food insecurity. Structural factors contributing to chronic food insecurity include poverty (as both cause and consequence), the fragile natural resource base, weak institutions (notably markets and land tenure) and unhelpful or inconsistent government policies. Ethiopia has been structurally food deficit since at least 1980. The food gap rose from 0.75 million tons in 1979/80 to 5 million tons in 1993/94, falling to 2.6 million tons in 1995/96 despite a record harvest (Befekadu and Berhanu 2000). Even in that year, 240,000 tons of food aids were delivered, suggesting that chronic food insecurity afflicts millions of Ethiopians in the absence of transitory production shocks. The distinction between transitory and chronic food insecurity is increasingly blurred. A subgroup of virtually asset less rural Ethiopians is emerging who are subjected to all forms of food insecurity. They cannot meet their food needs even under ideal weather conditions, they suffer seasonal hunger and malnutrition, and they are acutely vulnerable to famine in years of low or erratic rainfall. Less well understood than the immediate impact of drought on rural livelihoods is the impact of repeated droughts on long term food insecurity. Two vicious cycles are at work: recovery (e.g. of herds) from food crises is cut short by the next drought, and the threat of drought which occurs frequently but is unpredictable in its timing and severity inhibits investment in productivity-enhancing agricultural inputs, because the downside risk for marginal farmers is too high.

Household food security can also be undermined by other threats to off-farm incomes apart from rain failure. For example, thousands of Tigrians used to travel to Eritrea for several months each year to labor in rural areas or in Asmara town. When the border was closed in1997 because of political tension and commodity flows were restricted or taxed, these families lost a vital component of their regular livelihoods (Boudreau 1998).

2.2. Mitigating Food Security in the World

A food security index that ranks individual countries on food affordability, accessibility, availability, nutritional value and safety is used. According to WHO (2013) the index became increasingly important given the growing world population, expected to swell from 7 billion to 9 billion people by 2050 and the potential limits on our ability to provide food in the coming years. Another important factor was the Millennium Development Goal - to halve the proportion of people who suffer from hunger between 1990 and 2015, (WHO, 2013).

In the food security index, security is measured using quality and safety, affordability and availability criteria. The different measures for each criterion are weighted first to neutralize them and then weighted according to the expert panel deciding the significant of each of the measures. According to Mwaniki (2012) the root cause of food insecurity in developing countries is the inability of people to gain access to food due to poverty. While the rest of the world has made significant progress towards poverty alleviation, Africa, in particular sub-Saharan Africa continues to lag behind. Projections show that there will be an increase in food insecurity unless preventive measures are taken (ECA, 2005).

At the continental level the New Partnership for Africa's Development was launched by the 13th Summit of the Organization of African Unity in July 2001 to address the challenges facing African agriculture and it incorporated the MDGs into its framework (ECA, 2005). Then the African Union and NEPAD launched the Comprehensive Africa Agriculture Development Program in 2003 in an effort to accelerate agricultural growth in the region to address the food security challenges. CAADP is a framework that reflects the recognition that in Africa agriculture is central to the alleviation of poverty and hunger (CAADP, 2010).

2.3 Climate Change and Food Security

The impacts of climate change are likely to be spatially variable, and developing countries many in like Ethiopia-generally are considered more vulnerable than developed countries due to their lower capacity to adapt (Thomas and Twyman 2005). Climate variability and change will result in fundamental alterations to ecosystem structures and functions. These in turn will affect human land-use and livelihoods and have the potential to make pastoralists more vulnerable (Galvin and Soper, 1985).

In the future, climate change may become a contributing factor to conflicts, particularly those concerning resource scarcity (Ashton 2002; Fiki and Lee 2004, cited in Boko, 2007). In spite of its important supplementary role, traditional agriculture does not provide enough surpluses to feed people

during the periodic droughts. Furthermore, those groups inhabiting the lake shore are able to supplement their diet with fish from the lake. Irregularity of rainfall is a characteristic feature from year to year and within individual years (Soper, 1985).

Reduced food production in the arable farming areas implies that there is less food available in the markets thus raising the prices of the available food making it out of reach for the poor. Floods also hamper pastoralists' access to food by making it impossible to move food from the food surplus areas to food deficit areas. Food crisis occasioned by ecological disasters are not new in Ethiopia. In the past one century or so, Ethiopia is reported to have experienced close to 20 major droughts with varying magnitudes and spatial concentration (Bates, 2005; Campbel, 1999; FEWS NET 2006; Naomi Shanguhyia, 2008).

The earth's climate has changed over the last century. Increases in average temperatures have been observed around the globe and there is new and stronger evidence that most of the warming observed in the last 50 years is due to human activities *(*Field *et al.,* 200*7)*.

According to Agricultural Land Advisory Service (2009) climate change is a long-term shift in weather conditions identified by changes in temperature, precipitation, winds, and other indicators. Climate change can involve both changes in average conditions and changes in variability, including, for example, extreme events. Climate change has the potential to adversely affect the environment, communities and the economy unless action is taken now to reduce greenhouse gas emissions, bushfires and storm surges the condition will continue (Field *et al.,* 2007*)*.

Ethiopia is currently facing challenges arising from global phenomena, notable among them are global warming (climate change), and global food and financial crises. According to RoK (2011) the frequency of droughts and flash floods is expected to increase both in intensity and spread as a result of climate change. The projected increase in temperatures and rainfall variability will negatively impact crop and livestock enterprises in most areas. Disease and pests associated with high temperatures are also likely to increase. Adaptation interventions that enhance farming communities' resilience to climate change induced effects are critical for the realization of the principle objectives of Food and National Security Policy (FNSP, 2011).

Climate change may affect food systems in several ways ranging from direct effects on crop production (e.g. changes in rainfall leading to drought or flooding, or warmer or cooler temperatures leading to changes in the length of growing season), to changes in markets, food prices and supply chain infrastructure. The relative importance of climate change for food security differs between regions. For

example, in southern Africa, climate is among the most frequently cited drivers of food insecurity because it acts both as an underlying, ongoing issue and as a short-lived shock *(*Gregory *et al.*, 2005*).*

The low ability to cope with shocks and to mitigate long-term stresses means that coping strategies that might be available in other regions are unavailable or inappropriate. In other regions, such as parts of the Indo-Gangetic Plain of India, other drivers, such as labor issues and the availability and quality of ground water for irrigation, rank higher than the direct effects of climate change as factors influencing food security *(*Boxall *et al.*, 2009*).*

With climate change, food will be produced under different climatic conditions in altered ecosystems, which will alter agricultural conditions and be compounded by adaptations to such change. Conditions may be further altered through initiatives from the food industry to mitigate against climate change. Climate change may alter the seasonal patterns and abundance of pests and diseases, which may affect pesticide use, including herbicides and fungicides (Boxal*l et al.,* 2009*).* Climate change could affect existing pathogens or lead to the emergence of new pathogens in food (Tirad*o et al.,* 2010*),* through effects on animal husbandry and animal-to-animal transmission, pathogen survival, and other mechanisms. Previous research, for instance has demonstrated that Salmonella infections in humans are positively associated with temperature *(*Kovats *et al.*, 2004*).*

If rises in food prices occur, then individuals may shift to lower cost food items, which in turn, may have health consequences. During the increases in food prices, there is evidence from Scotland, for example that consumers shifted from more expensive to cheaper brands of food, and away from organic produce. Changes in food consumption because of increasing costs driven by climate change may also affect food safety as different foods carry varying risks of food-borne illness *(*Adak *et al., 2005)* and different levels of pesticide and chemical residues will find its way in the market. For example, as the cost of food increases, consumers may shift from more expensive fresh poultry to frozen poultry, which may increase the likelihood of consuming chicken contaminated with Salmonella, but reduce the likelihood of consuming chicken contaminated with Campylobacter (FSA, 2009).

Some countries have made an impressive effort at tackling their food security challenges. For example, Ghana and some North African countries have shown exemplary leadership in this regard, by meeting the target of halving the proportion of people suffering from hunger and making a giant step into achieving the first MDG based on its stable good governance and sound policies. Ethiopia has been able to mitigate the impact of drought by deploying multi-year investments in safety nets and making significant advances in health and nutrition. These have saved countless lives and protected millions

from the famine experienced elsewhere in the Horn of Africa, according to the United Nations Office for the Coordination of Humanitarian Affairs, (UNDP, 2010).

The term food security is used to describe not only the availability of food, but also the ability to purchase and have access to food. Being food secure for a nation or a family is to have a reliable source of food and sufficient resource to purchase it. This is why it is of paramount importance to identify the underlying causes and the proximate factors of food shortages and of disruptions/losses in real incomes among the most food-needy populations.

The global food crisis that has web-caught the world since 2007 has exacerbated these causes and factors of food insecurity, although it has also provided Africa with an opportunity to find long-term solutions to hunger through agriculture led growth. Approximately 1 billion people - or one sixth of the world's population survive on less than $1 per day, 162 million of them having less than $0.50 per day. Between March 2007 and March 2008, global food prices increased an average of 43 per cent, according to the International Monetary Fund. The most pronounced price rises were on wheat, corn/maize and rice - the main components of the basic diet of billions of people as well as on soybean. Feed for cattle, chicken and other meat-producing animals have also been affected. These price increases have reached at various degrees many local markets in Africa, Asia and other parts of the world, deepening food insecurity in the process, especially among the poor, and raising fears of contagious social unrest and political instability in many regions.

Irrigation development may have both positive and negative impacts on the environment (FAO, 1997).

To a large extent environmental and health issues associated with irrigation and water development in Ethiopia is not to be linked to the limited knowledge of the issue, lack of capacity and resource to invest and mitigate the constraints and limited knowledge of indigenous practices used to protect human health or the environment (Manon court and Murray, 1996).

Negative environmental impacts of irrigation development occur off-site as well as on site. The effects take place upstream of the land to be developed, where a river is to be dammed for the purpose of supplying irrigation. Another set of problem is generated downstream from the irrigated area by the disposal of excess water that may contain harmful concentration of salts, organic waste, pathogenic organisms, agrochemical residues, and causing siltation, water logging and erosion. Sometimes full utilization of the water creates water shortage to downstream affecting the ecosystem negatively (Wag new, 2004).

According to the same study, malaria and schistosomiasis have historically been present in Tigray, but only seasonally during the rainy months. The presence of micro dams has increased the prevalence of these ailments during the other seasons, as standing water provides a favorable environment for disease transmission (MUC, 1994 as cited in Girmay Gebremichael,2013). To be sustainable, irrigation must avoid the negative impacts (FAO, 1997). Carefully designed irrigation dams could significantly improve agricultural production and food security. Construction of small-scale irrigation schemes with proper management results in improved livelihood with positive impacts on microclimatic and environmental conditions (Mintesinot *et al.,* 2002).

In decades, the world had not experienced a food crisis on such a scale. However, from an African perspective, food crises are nothing new. With 45 percent of the African population living on less than one dollar per day and spending 50-75 per cent of their income on staple foods a high proportion of which are imports there were particular concerns for the poor, especially in those countries that are highly dependent on the international market for food and energy (Economic Commission for Africa).

Recurrent seasons of failed or poor rains, sustained high food prices, environmental degradation, outbreaks of disease, and flooding have led to deteriorating food security conditions throughout Ethiopia, straining coping mechanisms, exacerbating existing chronic poverty, and contributing to increased inter-ethnic conflict over access to limited land and water resources (Economic Commission for Africa).

2.4 Theoretical Framework

There is limited literature on theories of food security; however, scattered information attempting to layout the theories are available. Food security may be reviewed as an underlying continuous one-dimensional, but not directly observable quantity that varies from household to household. Higher values of latent food insecurity are indicated by higher probabilities of endorsing or affirming survey items that indicate higher degree of not being able to obtain sufficient food due to lack of economic resources (Norwood ,2006).

Development theories focus with differing emphasis on the agriculture and food aspects and also carry different messages. Whilst for instance dependency theory and basic needs clarifying stress more food production even in subsistence economy and advocate self-sufficiency, structural adjustment and modernization theory are more concerned about export crops. When reviewing development theories with regard to their influence on food security, one particular tendency becomes apparent; in former

days, much work was devoted to global food security and regional, national and sector analysis. Recent thinking relates the micro-level to a micro perspective: families, households, communities and associations, as well as NGOs' and entrepreneurs are seen as actors to be actively involved in the analysis, planning and implementation of development strategies (Kracht and Schulz, 1999).

Ownership of land or access to even small pieces of land for farming has substantial effect on the food security status of rural households, even when income level is controlled for; the prevalence of food insecurity tends to be higher among landless or quasi landless households, who are much more dependent on riskier sources of income than farm income and on the diversification of the rural economy (Joachim, 1992).

Bruce adds that, in Turkana where there is no tradition of legalized, personal ownership of land, all of it being vested in the Crown, the Kenya government will eventually have to set policy on this matter" (Bruce ,1984). Miles and Huberman (1994) and Huberman and Miles (2001) say that a conceptual frame work explains either graphically or in narrative form, the main dimensions of a study-the key factors, constructs or variables and the presumed relationship between them. Y= fxi, Independent variables are; Livelihood, Poverty, climate change and Policy implementation. These are factors that seem to have a huge effect on food security on households in Adwa district. Other independent variables are; Moderating variable is food aid this was because food aid affects the ability of the communities to enhance food security since they might be reliant on food aid thus not giving attention on enhancing food security. Intervening variable is weather condition. This is because this is a factor beyond the researchers control and cannot be influenced. Dependent variable is Food security because its outcome is determined by the independent variables.

2.5 Effects of Poverty on Food Security

For all people to get enough food, agriculture must prosper. Higher yields, however, will not serve to overcome hunger. The purchasing power of those in need must rise too (http: //www. dandc. EU/ register /index.en.shtml).

According to Food and Agriculture Organization of the United States (2002), numerous studies confirm that improving access to land can have a major impact on reducing poverty and hunger. An exhaustive analysis in India found "a robust link between land reform and poverty reduction". The study confirmed that reform significantly reduced rural poverty and stimulated growth in agricultural wages. It appears,

in addition, that the role of hunting and in the food, provisioning is often neglected. The present-day heavy reliance on livestock by certain pastoralist groups, such as the Turkana (Galvin, 1985; Soper, 1985, Cited by Fekri, A. Hassan).

2.6 Food Aid and Food Security

Food aid can play an important role not only in alleviating existing food deficits once they occur, but al so in preventing temporary food shortages. Major approaches to reduce the risk of temporary food shortages resulting from supply instabilities are early warning and immediate response mechanism, multi-annual programming and/or food aid contributions to buffer stocks and emergency food security reserves. These measures apply, in principle, to all types of food aid supplies: programmed, relief and project food aid (Anne Margaret, 1997).

If the present trends continue, the Turkana nomads are more likely to rely on food aid during future droughts than ever before. During future events, planning of successful development may require identification of factors which in the past were responsible for project failures. Unfortunately, there are few instances where development plans have relied on historical analysis to deal with development issues at a regional level (Anderson, 1981). Helen (2001) adds that, the cycles of drought and floods threaten food security and are making more pastoralists and farmers dependent on food. Aid dependency takes pastoralists and farmers out of the production cycle; they risk losing their craft and prevent them from receiving assistance to improve their production practices. The number of families without livestock or farming land is growing rapidly.

2.7 Challenges of Small-Scale Irrigation Utilization

The core focus of the government on repairing irrigation infrastructure while neglecting the soft components relating to capacity building has partly been blamed for the failure of SSIS in South Africa. Capacity building is one of the missing links in smallholder irrigation development and many failures have been attributed to lack of adequately trained farmers and extension staff, particularly in irrigation water management (Fanadzo & Ncube 2018).

Natia *et al*., (2016) studies small scale irrigation in Ghana. His findings show that small scale irrigation schemes have made strides in poverty reduction through the creation of employment, improve household income sources, improve household nutritional status and reduce out-migration. However, lack of storage and processing facilities hamper the production of perishable products. According to ADF (2001) the major problems of the small-scale irrigation in Zambia are poor infrastructure, poor crop

yield, poor access to inputs and inappropriate access to credit by farmers. Other constraints include a weak institutional human resource base and inadequate access to knowledge and information. Land pressure and the inadequate provision of extension not only constrain production but also contribute to soil degradation.

According to MoA (2011), the major constraints regarding the development of irrigation systems in Ethiopia are predominantly the primitive nature of the overall existing production system, shortage of adequate agricultural inputs, limited improved irrigation technologies, limited trained human power, inadequate extension services and heavy capital requirement. In addition, as Dereje, and Desale, (2016) find out, the major problems that seen in small scale irrigation seems to be inappropriate irrigation water utilization, lack of improved seeds, crop disease, weeding problems, increment of input costs, water logging, and absence/low support from DAs.

Also, as Awulachew, (2007) point out that limited technology utilization in small-scale irrigation related with a number of issues such as, limited capacity of farmers, institutional instability, defective project design and lack of adequate community consultation during planning. In most cases farmers built the traditional small-scale schemes on their own initiative, with limited technical and material support. Due to this, the diversion sites of these traditional small-scale irrigation schemes faced to destruction problem as a result the farmers are forced to rebuild the structures after every flood season MoA (2011).

Nata and Bheema (2010), in their study of Hayelom watershed, discovered that the majority of farmers are not market oriented; As a result, they face market problems. Also, according to Mintesinot *et al*., (2004), cited in Nata and Bheema (2010), creating better access to markets, especially for perishable and high value crops, might encourage farmers to cultivate more crops, and a greater variety, to increase their income. Apart from marketing factors, water scarcity is a major. A study conducted by Shimelis *et al*., (2006) also indicated that in the Gibe Lemu irrigation scheme the main problems that constrained the supply of adequate irrigation water in the command area were turn abuses, water scarcity, and poor coordination of water distribution Limitation in the area. A study conducted by Oruonye (2011), inaccessibility to irrigation farmland, Lack of farm inputs, fertilizer and chemicals, lack adequate startup capital and lack of sufficient water are the greatest challenges to sustainable small-scale irrigation in the study area.

2.8 The Concept of Food Security

Food security is defined by different agencies and organizations differently without much change in the basic concept. UN (1990 as cited in Girmay Gebremichael, 2013) defines household food security as "The ability of household members to assure themselves sustained access to sufficient quantity and quality of food to live active healthy life." Food security can be described as status in which production, markets and social systems work in such a way that food consumption needs of a country and its people are always met. FAO (1992) defines food security not only in terms of access to, and availability of food, but also in terms of resource distribution to produce food and purchasing power to buy food, where it is produced. USAID (1992) defines food security as: "when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life." Here food security includes at a minimum the availability of nutritionally adequate and safe food, and assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies). One of the most influential definitions of food security is that of the World Bank (1986). The Bank defines it as "access by all people at all times to enough food for an active and healthy life." This definition encompasses many issues. It deals with production in relation to food availability; it addresses distribution in that the produce should be accessed by all; it covers consumption in the sense that individual food needs are met in order for that individual to be active and healthy. The availability and accessibility of food to meet individual food needs should also be sustainable. This implies that early warning systems of food insecurity should monitor indicators related to food production, distribution, and consumption. Among the various definitions of household food security, this study adopted the definition given by the World Bank. Often, the term household food security and 'food security' are intermingled. Food security is defined in its basic form as access by all people at all times to the food needed for a healthy life. The focus in 'household' food security is on the household as the most basic social unit in a society. The distinction between food security and household food security is important because activities directed towards improving household food security may be quite different from those aimed at improving national level food security. The latter often related to macro-level production, marketing, distribution and acquisition of food by the population as a whole (FAO, 2003).

The focus in household food security is on how members of a household produce or acquire food throughout the year, how they store, process and preserve their food to overcome seasonal shortages or

improve the quality and safety of their food supply. Household food security is also concerned with food distribution within the household and priorities related to food production, acquisition, utilization and consumption.

The generation of household food security is dependent on the physical availability of food at the market or community level, the ability of household to access the available food, the ability of individuals particularly those especially susceptible to food deficits such as women, infants and children-to eat the food, and finally the body's ability to process the nutrients consumed (Bouis and Hunt, 1999). The assessment of food security extends to consider the health of those eating the food-the objective is a healthy and active life. Here nutritional consideration begins to come to the fore (Benson, 2004).

Nutrition security is defined as the appropriate quantity and combination of inputs such as food, nutrition, health service and caretaker's time needed to ensure an active and healthy life at all times for all people. The quality of food to which an individual or household has access must be considered. To enjoy a productive, healthy and active life, all people require sufficient and balanced level of carbohydrate, protein, fat, vitamin and minerals in their diets. Households or individuals facing deficiencies or other imbalances in diet because they lack access to the necessary food for balanced diets are not food secure (Benson, 2004).

Reflecting the different perspectives that have been dominating over the last decades, the concept of food security has continuously evolved throughout the years. As a result of this long process, the complexity and the multi-dimensionality of the issue is now recognized and other important dimensions have been incorporated into the concept, gradually expanding the former narrow perspective which mainly focused on the concept of food availability.

At the World Food Summit held in FAO in 1996, the following definition of Food Security was adopted and included in the final report as one of the major outcomes of the meeting: "Food Security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO,1996).

The widely accepted definition agreed during the FAO World Food Summit in 1996 finally opened the door to other and crucial dimensions of food security. Since 1996, food security was no longer to be seen only in terms of availability, namely the amount of food of appropriate quality provided by domestic production or imports, food stocks and food aid.

2.9 Access to Markets and Food Security

Access to markets is the second huddle that smallholders have to overcome (Mwaniki, (2012). According to Adwa the problem is in many-holds namely poor infrastructure and barriers in penetrating the market caused by their limited resource base, lack of information, lack of or inadequate support institutions and poor policies in place among other factors. Poor infrastructure literally limits the markets to which farmers can profitably take their produce by increasing the cost of transportation, and hence also act as a barrier to market penetration. Other barriers include market standards, limited information, requirements for large initial capital investments, limited product differentiation, and handicapping policies. According to Masson (2006), economic growth in developing countries is often constrained by a lack of access to regional and global markets. Without reliable access to fair, transparent markets, the poor in developing countries stand little chance of escaping poverty and hunger. In recent years, the call for structural reforms of global markets has increased, focusing largely on protectionist trade policies such as export restrictions and tariffs. The International Organization report to the G20, states that "substantially reducing trade and production distorting domestic support, improving market access opportunities, eliminating export subsidies and strengthening the disciplines on export restrictions will improve the enabling environment for investment and productivity growth." Reforming the global market structure and reducing harmful trade policies will help further the G20's goals of sustainable economic growth and global food security. Agricultural markets have changed significantly over the past 30 years. Modern value chains serving national and regional markets – particularly in urban areas have emerged rapidly in most developing countries. Traditional markets often continue to exist alongside the modern *(*Field *et al.,* 2007). Field *et al.,* (2007*)* continues to say that although the distinction between modern and traditional chains is not always clear-cut, there are some notable differences between the two. As value chains become more modern, they become better organized and more highly integrated and coordinated. Relationships among participants tend to become more codified and institutionalized, and processors and retailers often use preferred suppliers and a limited number of specialized businesses. Traditional supply chains, on the other hand, are less coordinated or less formally so and there tends to be more players or 'links' in the chain. Patterns of transaction are more erratic, and the actors involved change frequently. According to IFAD (2013) strong links to markets for poor rural producers are essential to increasing agricultural production, generating economic growth in rural areas and reducing hunger and poverty. It is further reported by IFAD (2013) that improving these links creates a virtuous circle by boosting productivity, increasing

incomes and strengthening food security. Better access by small producers to domestic and international markets means that they can reliably sell more produce at higher prices. This in turn encourages farmers to invest in their own businesses and increase the quantity, quality and diversity of the goods they produce. However, FAO (2008) reports that there are many pieces to the puzzle. Safe storage facilities, all-weather roads and affordable transportation are basic needs. In addition to infrastructure there is information − knowing in real time about market prices and demand is vital for participation in modern value chains. Being an active member of an effective farmers' organization also brings many essential benefits (FAO, 2008).

Market accessibility is explained by distance to the nearest tarred/tar marc road, distance to the nearest market and distance to the nearest deport. Tembo and Simtowe (2009) showed that distance to the market has a positive and insignificant effect on daily percapita calories consumed for urban households and for rural Malawi households, distance to the nearest tarred road and nearest market had insignificantly effect on household food security. Bhatta (2004) in his findings suggested that households that are near to tarred roads have higher chances of obtaining positive household food security. In addition, market liberalization in Malawi is reported to have resulted in many challenges faced by rural households. While almost any of the farm produce sells at the village level market, Mwaniki (2012) finds that consumers are quick to discriminate against produce that is comparatively inferior. Hence farmers have, over time, adapted to selling only that which will sell. This is a highly subjective process that has worked traditionally. However, when the same farmer wants to sale the produce to high-end markets, then subjective standards no longer work. The farmer is forced to meet objective standards such as size, quantity, and quality. The quality aspect of the standards is of major concern and gets more rigid where the food crop is for export. It is as detailed as the nutritional content per serving size, allowable bacterial load, and residual pesticide. Some markets have zero tolerance on the latter. The other aspect of the problem is the variation in the standards between markets.

They are so varied that they necessitate the farmer to identify the market before production (Mwaniki, 2012).

2.10 Land Use and Food Security

Research has demonstrated that relatively egalitarian land distribution patterns have tended to generate higher rates of economic growth than highly concentrated ones (Herbst, 2000). Herbst further says that the reason for this is that equitable land distribution is more likely to produce broad-based and inclusive

agricultural growth. Broad-based agricultural growth tends to generate greater demand for goods and services produced in rural areas and towns. In this way, rural and urban populations create a market for each other. These beneficial growth effects tend to be much weaker when the source of agricultural growth is concentrated in relatively few hands. Thus, the rate of growth is likely to be affected by the distribution of assets in the agricultural sector, particularly land (Herbst, 2000). Small scale irrigation management According to Byrnes (1992) irrigation management activities include three dimensions. These are (1) water use activities (2) control structure activities and (3) organizational activities Water use activities: management activities focusing on the provision of water to crops in an adequate and timely manner includes acquisition, allocation, distribution and drainage. Acquisition is the first management activity concerning the acquisition of water from surface or subsurface sources, either by creating and operating physical structure such as dams' weirs or wells or by actions to obtain some share of an existing supply.

Allocation refers to the assignment of rights to users thereby determining who shall have access to water. Distribution refers to the physical process of taking the water from a source and dividing it among users at certain places, in certain amounts, and at certain times. Drainage is important where excess water must be removed (Byrnes, 1992). Control structure activities: management activities focusing on the structures required for water control include design, construction, operation and maintenance. Design involves the design of dams' diversions or well to acquire water, of systems of rules to allocate it, of channels and gates to distribute it and of drains to remove it. Construction involves the construction of the structures to acquire, distribute and remove water, or implementation of rules that allocate it.

Operation refers to the operation of the structures that acquire, allocate, distribute or remove water. According to some determined plan of allocation. Maintenances is the final control structure activity. This provides for the continued and efficient acquisition, allocation, distribution and drainage. Organizational activities: management activities focusing on the organization of efforts to manage the structures that control irrigation water include resource mobilization conflict resolution communication and decision-making. The activity of resource mobilization entails marshaling management and utilization of funds manpower, materials, information or other inputs needed to control water through structures or to undertake various organizational tasks. The activity of communication entails conveying information about decisions made, resource requirements etc. to farmer or any other persons involved in irrigation managements. The activity of decision making entails the processes including planning

involved in making decision about the design, construction, operation or maintenance of structures; acquisition, allocation, distribution or drainage of water or the organization deals with these activities. It was assumed that devolving management responsibility with or without some form of scheme owner ship to the irrigating farmers, improves scheme performance water distribution and productivity, while saving public resources for agencies to carry out such tasks (IWMI, 2005 as cited in Girmay, 2013). Merrey *et al.*, (2002) also indicate that irrigation management transfer helps reduce the government's recurrent expenditures for irrigation. Irrigation systems in many developing countries were established with substantial financial contribution from international donors. It was assumed that the government and water users would be able to incur the cost of operation and maintenance of the systems made possible by enhanced financial gains from improvement in productivity levels of irrigated agriculture.

CHAPTER THREE: METHODOLOGY

3.1 Description of the Study Area

The study area, Adwa Woreda, is located in the central zone of Tigray Region 203 kms north ward from the capital city of the region, Mekelle and at a distance of 1006 kms to north direction from the capital city of the country, Addis Ababa. It is bordered with Merebleke in north, Ahferom in east, Tembien in south and Axum in west direction. Geographically, it is located $14^{o}10'$ N $38^{0}54'$ E longitude, 14.167^{0}N, 38.900^{0} E, latitude at 1,907 kms altitude above sea level with climate average weather condition 21^{0}c wind SE at 24 km/h with 34% humidity.

Source, Adwa Wereda Planning and Financing (2014).

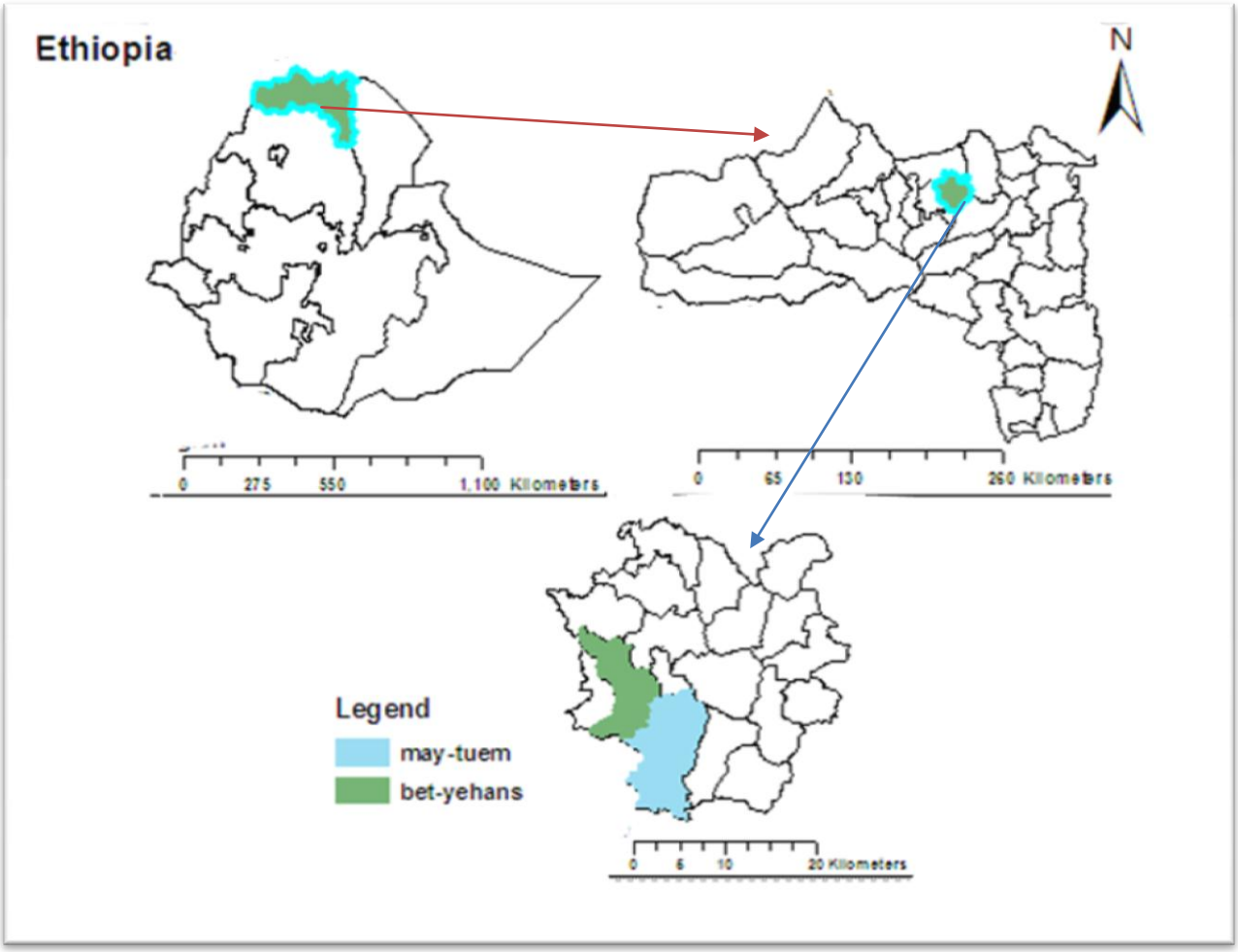

Figure 1: Map of Adwa and the study area

3.2 Research Design

The researcher selected two Tabias from 18 Tabias of Adwa Wereda purposely due to having small-scale irrigation improvement to achieve their food security. The researcher collected data by stratified purposive random sampling method through questionnaires, group discussion from irrigation users and non-users. The purpose of the researcher was to assess the role of small-scale irrigation utilization on the improvement of households. Both qualitative and quantitative approaches had been employed. The combinations of qualitative and quantitative techniques helped the researcher to cross-check/triangulate and complement reliability and validity of the data, and it allowed for the provision of different perspectives in answering various specific questions within a broad area. Both approaches had been employed towards meeting all research objectives. It was a very important method as data was gathered from the sample of respondents, and the researcher described the concepts regarding the role of small-scale irrigation improvement in the selected Tabias of the woreda. The study employed descriptive research design as it gave for the researcher a possibility to observe the phenomenon in a completely natural and unchanged environment. Furthermore, the study employed cross-sectional checking in the sense that all relevant data was collected at a single point in time.

3.3 Sampling Technique and Procedure

The study was designed as cross-sectional survey of households in Adwa Woreda (Tabia Maytuem and Betyehannes). To select the sample for this study, three-stage sampling method was employed. In the first stage, the study woreda was purposely selected. In the second stage, two Tabias was selected randomly from those Tabias which had small scale irrigation improvement access. In the third stage, in the two selected sample Tabias, households were stratified into two strata, namely irrigation users and non-users from which sample households were randomly selected.

This study used probability sampling technique. Frederick and Lori-Ann (2011) claim, in probability sampling, the entire population is known, and sampling occurs by a random process based on the probabilities. This means the probability of each member being selected is known. Wereda Adwa had a population of 108872 people (53599 males and 55273 females). The target population of the study was households who engaged in small scale irrigation improvement from Tabia Maytuem and Tabia Betyehannes. In addition to this, the researcher used six key informants from woreda agricultural office.

Table 1: Total population of the study Tabias

S. No	Name of Tabia	Male	Female	Total
1	Maytuem	2390	2207	4597
2	Betyehannes	2796	3185	5981

As it can be seen from the above data, Tabia Maytuem had 220 irrigation users and Tabia Betyehannes had 180. The sample was 20% i.e. 44 irrigation users from Tabia Maytuem and 36 irrigation users from Tabia Betyehannes. The sampling techniques were stratified purposive random sampling. So, the total sample size was 80 irrigation users and equivalent 80 non-irrigation users. Therefore, the number of households were 80 households from two the Tabias. This was applied for selecting irrigation non-user households. And a total of 80 irrigation users' households were taken for the study from the two Tabias. The main reason to take greater number of sample size was to reduce the sample error and to enable better generalization on the research objectives.

3.4 Data Collection Methods and Tools

Data was collected from the sample group through questionnaires, focus group discussions and observation. To supplement and enhance the information presented, secondary data was accessed from published articles. Therefore, the main sources of information were gathered through the questionnaire, from the farmers of two Tabias, key informants, focus group discussions from woreda agricultural office and farmers as well as observation.

3.4.1 Questionnaire

To generate quantitative information at household level, household survey was undertaken by developing questionnaires. So as to gather primary information, the survey was conducted on the randomly selected 80 sample irrigation users from the two Tabias that apply irrigation in their farming land as they were given to fill the questionnaires, and 80 sample non-irrigation users were given to fill the questionnaires.

The questions were formulated in both open-ended and closed-ended forms and administered through face to face contact with smallholder households. The questionnaire was first prepared in English and later translated into the local language (Tigrigna) so that respondents could easily understand the questions. The questionnaires were distributed for each Tabia, which were employed based on their ability of local language and culture, and experiences in data collection.

3.4.2 Focused Group Discussion

FGD, which is the common data gathering method in qualitative research, is preferable when the aim of a research is to discover what people believe and feel by actually asking their opinion in a group setting (Miller & Brewer, 2003). Focused group discussion was also undertaken to gather primary information from the respondent households in the study area. Focused group discussion was conducted in all two Tabias with 24 selected farmers in four groups. The interviewer introduced a list of questions and encouraged the participants to discuss issues and forward their opinions. The output of the discussion was used as a guide to design the household questionnaires and to get additional supporting qualitative evidence of the current situation of farmers and challenges that farmers have been faced irrigation activity.

3.4.3 Key informant interview through questionnaire

An interview guide was designed to obtain in depth information from key respondents and it helps to test for areas hard to investigate by the use of questionnaire approach. To make the study more comprehensive and reliable interviews of a semi-structured type was carried out by the researcher himself, with key informants chosen based on knowledge of the problems in the study area and 6 key informant interviews carried out to irrigation experts in two Tabias, agricultural experts, the head of woreda Agriculture Office and the woreda department of irrigation.

3.4.4 Questionnaire agricultural experts

An interview guide was designed to obtain in depth information from five agricultural experts and to test for areas hard to investigate by using questionnaire approach. Those agricultural experts were having more knowledge about the handling and manipulating of small-scale irrigation schemes, how to co-ordinate households in small-scale irrigation, even if they could help to reduce factors that influence household's small-scale irrigation, they could prepare different cereals, fruits, vegetables and legumes

3.4.5 Field Observation

Furthermore, field observation was conducted in order to get detailed information about the study area. It was conducted for about three months by actually observing the field of irrigation and the farmers living around there. Therefore, the researcher critically observed how the irrigation is conducted and how the farmers of the local community take part in irrigation.

3.5 Data Sources and Analysis

3.5.1 Data Sources

Quantitative and qualitative data were gathered from primary and secondary sources. Household survey was applied by using administrated questionnaires to 80 sample households from two tabias proportionate to their numbers of households. The selected respondents would interview personally with the help of a well-structured questionnaire. To have a better understanding on the role of small-scale irrigation improvement to achieve food security of households in the woreda, key informants were asked general knowledge on the role of small-scale irrigation improvement to achieve food security of households in the woreda understudy. Focus Group Discussion was made to generate information on the role of small-scale irrigation to achieve food security of households in the woreda under study. Four FGDs, each consisted of 6 participants was held in the study. The relevant secondary data was collected from different sources such as published books, journals, reports prepared by different national as well as international institutions. Different websites were visited for the purposes of literature as well as for general analysis of document.

3.5.2 Method of Data Analysis

Mainly the data for this study came from both the primary and secondary sources. The researcher conducted the primary data collection. In this research, rural household users and non-irrigation users were the major sources of primary data. In order to ensure the reliability and validity of the data collected, triangulation of different methods was employed during collection of primary data. These methods include observation, focus group discussion, field observation and interview with randomly selected farmers and other key informants. As part of the primary data, information was also collected from woreda agricultural experts. The primary data obtained from the fieldwork was also supplemented with data obtained from secondary sources in order to fill information gap from primary sources. The secondary sources of information, both published and unpublished materials such as reports, plans, official records, journals, articles, project reports, and data files from internet/web pages records, were obtained from Adwa Woreda agriculture office.

Hence, the collect data, both qualitative and quantitative would statistically processes, summarize and analyze to interpret the result. Descriptive statistics and tabular presentation including graphs and maps were used to characterize on the small-scale irrigation improvement to achieve food security of households in the woreda under study. Moreover, descriptive statistical inferential, mean, mode, median

and Statistical Package for Social Sciences (SPSS) version 20 was used for the analysis of quantitative data.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Results on responses of agricultural experts in role of small-scale irrigation

4.1.1 Demographic characteristics of Wereda Adwa agricultural experts

Responses of Agricultural experts on the role of small-scale irrigation on improving food security in Adwa rural district area were demonstrated in the table below.

Table 2 : Demographic characteristics of Wereda Adwa agricultural experts

Response	Age		Sex		Educational level					Responsibility		Interest to work in rural area	
	20-30	31-40	M	F	Diploma	Degree	1-5	6-10	11-15	Agricultural experts	Agronomy	Yes	No
Frequency	1	4	5	0	0	5	1	3	1	4	1	5	0
Percentage	20 %	80 %	100 %	0	0	100%	20 %	60 %	20 %	80%	20%	100 %	0

According to the agricultural experts of Wereda Adwa, the following responses were made based on age, sex, educational level, work experience, responsibility and interest to work in rural area of Tabia Maytuem and Betyehannes. In general, the demographic characteristics of the respondents illustrated that all of them are young and males, hold first degree, with work experience below 15 years and all of them are committed to work in the rural area. This indicated that the agricultural experts of the study area were the opportunity for the small-scale irrigation as they were young and determined enough to support the farmers.

The age of the agricultural experts of Wereda Adwa as indicated in table 2, 1(20%) respondents were between, 20-30 and 4(80%) respondents were between 31-40 years old. The age of the respondents indicated that most of them were young. Hence, they can travel on foot to observe the handling of irrigators in the field practically. Moreover, they can show how to perform watering, keeping their vegetables, keeping their fruits, preventing from weeds and all in the entire household's irrigation. As the irrigation is found from road up to distantly (around 2 kilometer), they can help and show irrigators to produce high yields in order to meet their objectives.

From the above table, all the Wereda Adwa agricultural experts were males. This is really important because they can travel on foot and manipulate with household's irrigation practically, they can resist for more challenges of rural area like drinking water, heat, hunger and other problems of villages. In other words, this was an opportunity for the effective realization of the small-scale irrigation.

All the agricultural experts held first degree. This implied that the agricultural experts can help effectively for irrigators how to handle their irrigation because they are rich in knowledge of irrigation practically and theoretically. Thus, it was convincing to say that the existence of qualified agricultural experts positively affected the small-scale irrigation of the farmers of the study area.

Majority of the respondents (agricultural experts) were experienced as only one (20%) had below 5 years' experience, three of them (60%) were between 10-15-years' experience and one (20%) had 11-15-years' experience. For this reason, this is important that as they are majority experienced, they can help irrigators effectively how to improve their yields, how to keep their irrigation efficiently, how to use different vegetables, fruits and others in their land.

Regarding the responsibility of the respondents, 4 (80%) graduated in agricultural experts and one (20%) respondent graduated in agronomy. But currently all of them work as agricultural experts and they are committed to work in the rural area. Since they are graduated in the field of agriculture, they are familiar to handling, keeping, solving problems of irrigation, advising, helping and encouraging households in irrigation. Consequently, it was to understand that the experts were qualified enough to deal with the small-scale irrigation.

All the agricultural experts responded that they were committed to work in rural area. As a result, they could help households to increase their yields perfectly. If someone is interested in his/her job, he or she becomes successful in his or her result or job. Therefore, it could be deduced that majority of the agricultural experts were interested in dealing with the given small-scale irrigation which had a positive impact on the study area.

4.1.2 Methods of encouraging, joining with market, correlating and advising

According to the response of agricultural experts of Wereda Adwa in correlating and helping irrigators, they help them by giving advice, extending irrigation, discussing, diversion, making check dump, digging large well, giving different training, sharing experience from different places. Furthermore, the respondents said, "We give technical support and link to marketing as much as we can." And the method of joining households yield with market was by contacting like with hotels, ministry of defense, cajolers, hospitals and factories, such as marble stone, textile factory, cooperative work or they

themselves directly sell in the market. However, some of them did not contact with agricultural experts, so still now they do not contact with market though they are household irrigators.

The agricultural experts were further giving advice for households to produce high yield production from their irrigation by checking their irrigation weekly, giving new technology like genetically modified crops, workshops and chemicals, sawing distantly, giving training in their Tabia and Wereda, to use their water potential effectively, giving reward to use fertilizers, showing the advantage of irrigation, by training how to use new technology, sharing experience, demonstration, giving training to use technology effectively. The findings from the respondents clearly revealed that the assigned experts tried their best to support the household irrigators in order to enhance their yields.

4.1.3 Methods of helping in handling irrigation, acceptance of new technology products and methods of encourage to use fertilizers

According to the responses of the agricultural experts of Wereda Adwa, they help for households in handling their irrigation by showing samples, irrigation extension, giving field work, water financing committee, network, self-learning, giving enough training for the whole family to work together, and they support them in their irrigation practically.

The findings illustrated that some of the households had small-scale irrigation. Nevertheless, some of them used new technology products that increase their yields like: genetically modified crops and fertilizers. In contrast, some of them did not use new technology products due to expensive cost. Moreover, the Wereda agricultural office gave new technology products for 13 component packages to use in their irrigation.

The agricultural experts again helped the households to use fertilizers by supporting through training, giving training on the advantage of fertilizers and showing model farmers. Furthermore, they encouraged to use new technology products like ploughing by tractor to increase their yields, and some households currently had interest and asked help from the Wereda agricultural office them-selves in order to prepare fertilizer, prepare their own compost and help each other.

The agricultural experts give repeated advice, by showing practical work, observing new changes on irrigators that use fertilizers and sharing experience Furthermore, they encourage household irrigators to develop skill, knowledge, and attitude by giving training for those that do not use fertilizers. The agricultural experts again help households to prepare their own green manure by providing enough information to use all packages and to prepare it in their land.

4.1.4 Methods of solving problems that influence irrigation and shortage of water supply

According to the responses of agricultural experts of Wereda Adwa, they solve the problems that influenced household irrigation like weeds, pests, shortage of water and other factors. They alleviate the above stated problems by giving different medicines, the water financing committee decision manage the water resource, the farmer development association discuss with stock holders to put solution.

In addition, the agricultural experts solve shortage of water by giving advice to use water pump, to use vegetables and fruits which mature quickly, to conserve soil humidity and to saw crops, vegetables and fruits that mature quickly, to use water from wells and dig out wells. Hence, the findings illustrated that the agricultural experts were trying their best to help the household irrigators by searching possible mechanisms of addressing their challenges.

4.1.5 Preparation of vegetables, fruits by Wereda agricultural office and using by households

The Wereda agricultural office prepare different vegetables, fruits, cereals and legumes that mature in a short period of time and give high yield according to the interest of irrigators, which are capable of adapting with the environment and some households buy immediately from the Wereda agricultural office while others they use their own fruits, vegetables, and cereals. Thus, the findings depicted that efforts have been made to provide vegetables, fruits and cereals to the households.

4.1.6 Types of vegetables, fruits, cereals and legumes that irrigated

The Wereda Adwa agricultural experts reported that the types of vegetables, fruits, cereals and legumes that were irrigated by households are tomatoes, onion, garlic, cabbage, carrots, salad, mango, barely, lettuce, chick pea, onion seed, green peper, avocado, maize, papaya, orange and lemon. This implies that types of fruits, vegetables and cereals are produced by the households of the study area.

4.2 Result on irrigation user households in role of small-scale irrigation

4.2.1 Demographic characteristics of households that have small-scale irrigation

The researcher took a random of 80 households who participate in small-scale irrigation on the improvement of food security from Tabia Maytuem and Betyehannes.

Table 3 : Demographic characteristics of households that have small-scale irrigation

Roll. No	Age				Sex		Educational level				Work experience			Responsibility in the family		Number of family		
	25-34	35-44	45-54	55-64	M	F	Illiterate	1-4	5-8	9-12	1-3	4-6	7& above	Household	Support	1-3	4-6	7& above
frequency	8	20	39	13	78	2	2	16	32	30	15	56	9	78	2	5	49	26
Percent	10%	25%	48.75%	16.25%	97.5%	2.5%	2.5%	20%	40%	37.5%	18.75%	70%	11.25%	97.5%	2.5%	6.25%	61.25%	32.5%

According to the respondents of households that have irrigation as shown in table 3, 8 (10%) of them were between 25-34 years old, 20 (25%) of them were between 35-44 years old, 39(48.75%) of them were between 45-54 years old and the remaining 13(16.25%) of them were between 55-64 years old. So, majority of the households were between 35-54(73.75%) years old. The households had the ability to work hard day and night to increase their yield production as they were youngsters. Few of them were between, 55-64 (16.3%), but they could work perfectly to improve their economy moderately.

Most of the households that had small-scale irrigation, 78(97.5%) were males but only 2(2.5%) of them were females. But in caring, keeping, watering and other aspect of the irrigation done by boys and girls before school and after school. In the irrigation area all members of the family had the duty to participate; however, the irrigation activities were mainly male oriented.

From the above table 3 households that had small-scale irrigation, 2(2.5%) of them were illiterate,16(20%) of them were from grade 1-4, 32(40%) of them were from grade 5-8 and 30(37.5%) of them were from grade 9-12. Since majority of the respondents were from grade 5-12(77.5%), their education could help them in handling, caring, watering, helping and other necessary aspects of their irrigation. Especially in reading quality and quantity of fertilizers, or new technologies education is very important.

In the above table 3 of households that have small-scale irrigation 15(18.75%) of them had a work experience between 1-3 years, 56(70%) of them had a work experience between 4-6yeras and 9(11.25%) of them had a work experience between 7 and above 7 years. So, majority of the households had a work experience of 4-6 years in using irrigation, they are familiar with handling, keeping and caring of their irrigation perfectly. The households may gain high yields because they are experienced in irrigation utilization.

From the above table 3 responsibility in the family of households that had small-scale irrigation, it could be understand only 2(2.5%) of them support to their family, but 78(97.5%) of them were households that maintain the family. So, majority of the respondents had the duty of monitoring the family, keeping food security, improving yields, keeping children's health and others.

According to number of family of households that had small-scale irrigation, 5(6.3%) of households had a family size between 1-3, 49(61.3%) household's had a family size between 4-6 and the remaining 26(32.5%) households had a family size 7 and above 7. Hence, the family size indicated that most of the households had family size between 4-6(61.3%),who are near to the objectives of Ethiopia. It is good type of family planning in improving food security. As family size decrease, it is unquestionable that improvement of food security becomes simple. Likewise, number of employees decreases, risk to disease decreases, children can attend education easily, can maintain their healthy easily and poverty can decrease.

4.2.2 Factors that initiate to participate in small-scale irrigation and coverage of land

In Wereda Adwa Tabia Maytuem and Betyehannes the households participate in small-scale irrigation due to the following factors. According to the response of households, they are influenced to use irrigation by the advice and encouragement of agricultural experts, to increase their yields, source of income, by discussing with their agricultural experts, to increase their economy and teach their children, help their economy which is gain by rain feed, to grow up their children, obtain alternative food, increase their economy, via advise of agricultural experts and Tabia administrators, their poorness and lack of economy are some of the reasons. And the households irrigate ¼ hectare, ½ hectare, 1 hectare and some 2 hectares. Consequently, the findings revealed that households of the study area were inspired to take part in irrigation because of multidimensional factors.

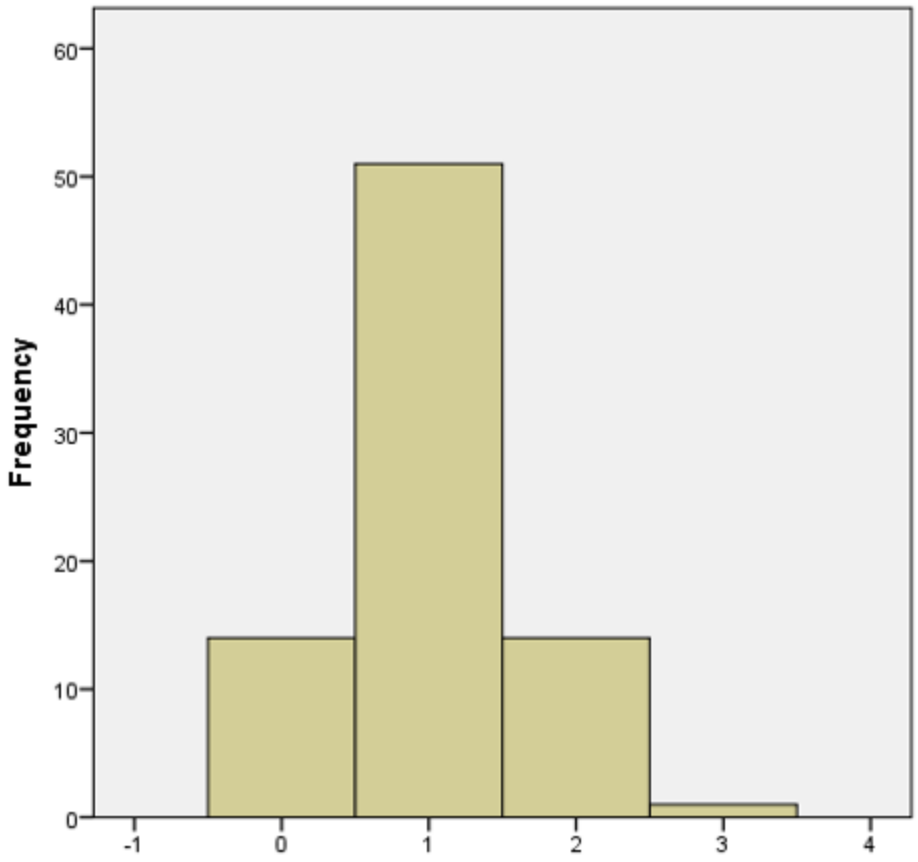

Figure 2: size of irrigated land

The figure above indicated that 51(63.8%) of the households irrigated half hectare which implied that the size of the irrigated land was small. In other words, most of the households had small irrigation despite the fact that they were interested in dealing with irrigational activities. This is a grand problem that can hinder the comfortable life of the households because of shortage of irrigated land. Meanwhile, most of the irrigators irrigated their 2 times per year as indicated in the following figure 3.

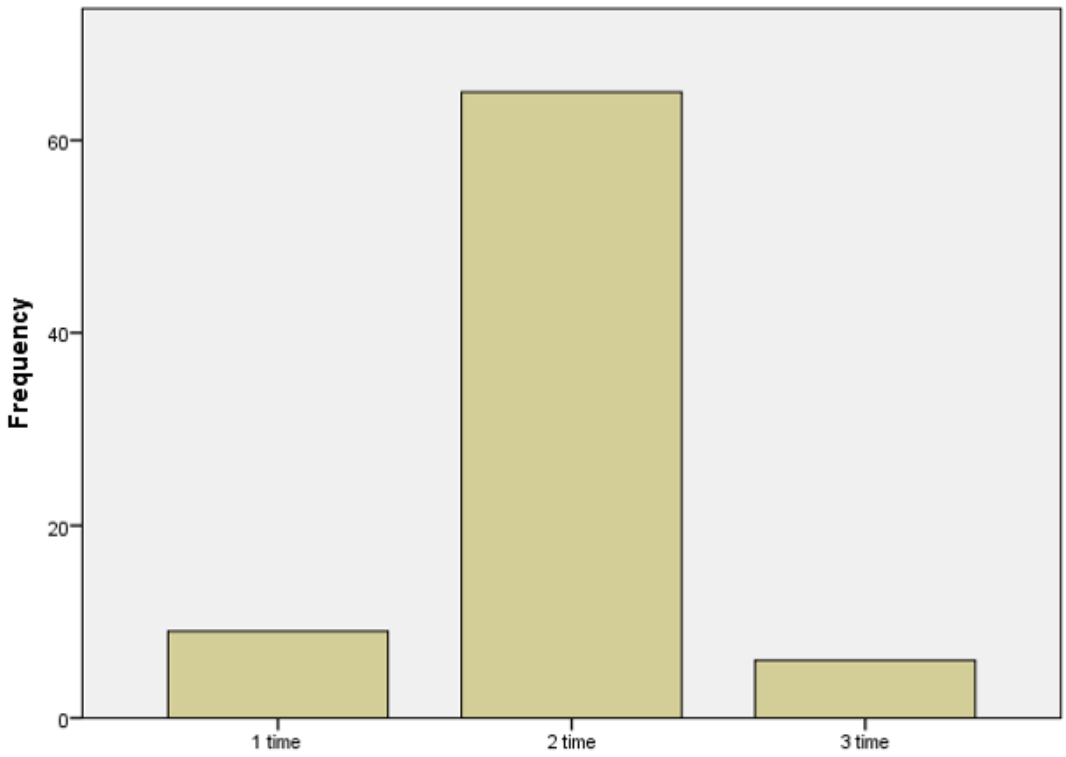

Figure 3: number of using irrigation per year

As indicated in the above figure, around 9(11.3%) of households produce one time per year using irrigation, 65(81.3%) of households produce twice per year using irrigation and 6(7.5%) of households produce three times per year using irrigation. In general, majority of them are capable of irrigating twice per year using irrigation, so they can increase their irrigation effectively. The finding was encouraging as majority of the households are able to produce twice per year though they still need further encouragement.

4.2.3 Factors that influence small-scale irrigation and how to solve

According to the respondents of households that had small-scale irrigation on the improvement of food security, there were many factors that influence their irrigation. Some of them were incomplete infrastructure like road, shortage of water, shortage of fertilizer, shortage of irrigated land, shortage of cereals, expensive fertilizers, shortage of medicine, problem of water rules and regulations, small land for irrigation and lack of advice, problem of linking to marketing, attitude, shortage of water pump, selected breed, shortage of wells, water canal and shortage of cereals, fruits, legumes and vegetables that

mature in short period of time and have the ability to resist heat, shortage of water, pests, weeds and others.

The households that participate in small-scale irrigation again prevent their irrigation products from different weeds, pests and other factors that influence their yields by working with agricultural experts, by buying medicine from private, by removing the weeds them-selves and they use medicine, by discussing with agricultural experts, by buying medicine from the government and they prevent by using chemicals or pesticides. Nevertheless, majority of the households were suffered from shortage of water as follows in the figure.

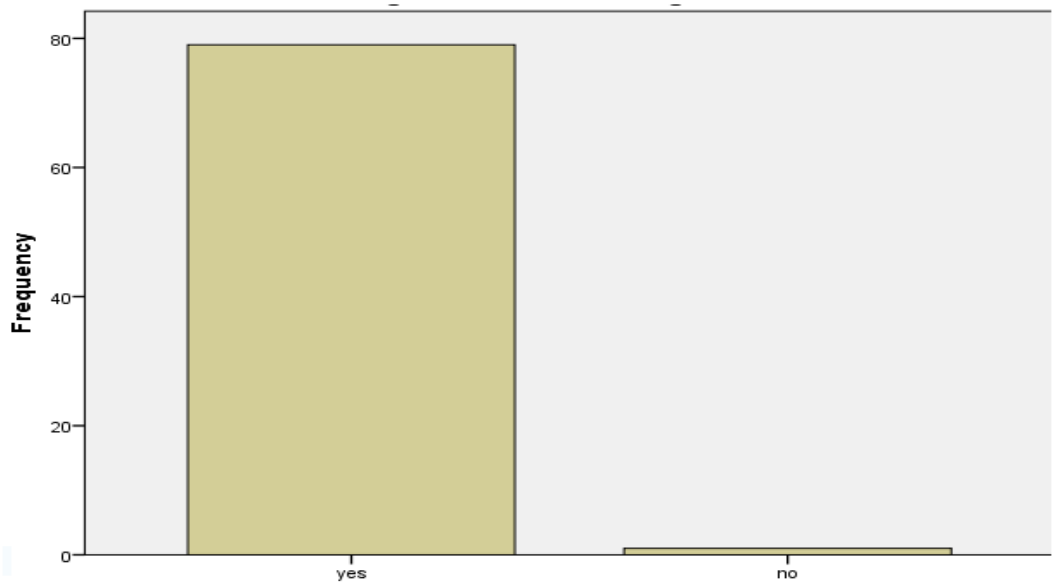

Figure 4: shortage of water for irrigation

As shown in the figure 4 above regarding shortage of water for the household's small-scale irrigation on the improvement of food security, 79(98.8%) of the respondents said there was shortage of water and only one (1.3%) responded there was no shortage of water for irrigation. Nonetheless, the households solve shortage of water by digging wells, renting water pump and no one help them but they try to solve themselves by using water from wells but not sufficient. According to the response of households that had small-scale irrigation, the agricultural experts do not give enough solution for shortage of water.

Table 4 : help of agricultural experts if weeds and pests affect household yields

Response	Frequency	Percent
Yes	51	63.75%
No	29	36.25%
Total	80	100%

In the above table 4 regarding the help of agricultural experts if weeds and pests affect households' yields, 51(63.75%) of the households' responded that the agricultural experts help for irrigators if weeds and pests affect, but 29(36.25%) of the households' responded that the agricultural experts do not help for irrigators if weeds and pests affect. Nevertheless, the households prevent their irrigation products from different weeds, pests and other factors that influence their yields by working with agricultural experts, buying medicine from private, removing the weeds them-selves, discussing with agricultural experts, and buying medicine from the government and using chemicals or pesticides.

4.2.4 Use of new technology, cereals, vegetables, fruits and legumes by households

When the agricultural experts prepare different new technologies, the households use them in different ways and degrees. The following table clearly depicts the households who use new technology and those who do not use in their irrigation.

Table 5: Using of new technology when agricultural experts introduce

Response	Frequency	Percent
Yes	70	87.5%
Not	2	2.5%
yes, but not prepare on time	8	10%
Total	80	100%

The household's response for using of new technology when agricultural experts introduce in the table 5, is 70(87.5%) of the households says yes, we accept when the agricultural experts prepare new technologies, 8(10%) of the households says yes, we accept when the agricultural experts prepare new technologies but the agricultural experts do not prepare on time and 2(2.5%) of the households says, no we do not accept when the agricultural experts prepare new technologies. But majority of the households 78(97.5%) accept new technologies when agricultural experts prepare.

Table 6: Introduction of new cereals and fruits by agricultural experts

Response	Frequency	Percent
Yes	59	73.75%
Medium	12	15%
No	9	11.25%
Total	80	100%

The household's response for the introduction of new cereals and fruits by agricultural experts as 59(73.75%) of them say yes, the agricultural experts prepare new cereals and fruits, 12(15%) of them say the agricultural experts prepare new cereals and fruits but medium mean not sufficient and 9(11.25%) of them say no, the agricultural experts do not prepare new cereals and fruits.

4.2.5 Different types of cereals, vegetables, fruits and legumes that irrigated

The households use different types of cereals, vegetables, fruits and legumes that irrigated for their small-scale irrigation on improvement of food security like tomatoes, onion, garlic, cabbage, carrots, salad, mango, barely, lettuce, chick pea, onion seed, green peper, avocado, maize, papaya, orange and lemon. This implied that the households of the study area produce different kinds of fruits, vegetables and cereals which is really encouraging as it helps them to improve their livelihood by increasing their productivity.

4.2.6 Satisfaction of yields, marketing, transport and its solution by households

The household's that use irrigation response for their satisfaction on their yields in respect to the marketing system as follows.

Table 7: Satisfaction of households by their yield production and market

Response	Frequency	Percent
Yes	40	50%
Medium	20	25%
No	20	25%
Total	80	100%

As it is shown in table 7 with regard satisfaction of households by their yield production and market, 40 (50%) of the households said, they are satisfied by their yield production and market, 20(25%) of the households said they are satisfied but medium by their yield production and market and 20(25%) of the households said they are not satisfied by their yield production and market. Those households that were not satisfied by their yield products and market is due to expensive rent of land for their irrigation and the energy they invest do not match.

Table 8: Access of transportation in to market

Response	Frequency	Percent
Yes	58	72.5%
Medium	18	22.5%
No	2	2.5%
No need	2	2.5%
Total	80	100%

The household's response for access of transportation into market for their yield production was illustrated in the above table. Accordingly, 58(72.5%) of the household's said, they gain access of transportation to the market for their yield production, 18 (22.5%) of them said they gain access of transportation to the market for their yield production as medium (sometimes), 2(2.5%) of the household's said, they do not gain access of transportation to the market for their yield production and 2(2.5%) of the household's said they do not need access of transportation to the market for their yield production because their yield use immediately for them as source of food. Even those households that gain access of transport pay expensive cost to transport their yields to the market for cars and carts. Those that do not gain access of transport to the market transport their yields by their donkeys, by carrying themselves and few of them stay until vehicles come but some of their become out of use.

4.3 Group discussion with households who had small-scale irrigation

4.3. 1 Shortage of food in the past one year

Group discussion was held with the households with small-scale irrigation regarding the shortage of food in the past one year which had a negative impact on the improvement of food security in Tabia Maytuem and Betyehannes.

Table 9: Result of group discussion in households who had small-scale irrigation

Response	Frequency	Percent
Yes	2	50%
No	2	50%
Total	4	100%

From the above table 9 concerning to result of group discussion in households who had small-scale irrigation on the improvement of food security, 2(50%) groups that had 12 member households said there was shortage of food in the past 12 months (one year), but 2(50%) groups that had 12 member households said there was no shortage of food in the past 12 months (one year). The case for those two-group discussions that said there was no shortage of food in our village was due to having few children, irrigating their land effectively, and their irrigation was found near to source of water and they were committed to work. But in the case of the other two group discussion that said there was shortage of food in the past one year was due to having high number of family, small size of land for irrigation, shortage of water and source of water became distantly.

According to the two-group discussion response that said there was shortage of food in the past one year that happens most of the time from July up to September. As a result, up to new cereals mature most of them solve by daily labour, guards, from government by seftnet and especially their children migrate towards the western part of Tigray to work in the summer season.

4.3.2 General opinion in role of small-scale irrigation from group discussion of households

In the group discussion response of households that participate in the role of small-scale irrigation on the improvement of food security of both Tabias said that small-scale irrigation was very important to increase their yields, source of income, their health and teach their children, help their economy gained by rain feed, grow up their children, obtain alternative food, increase their economy. In other words, the

households are interested in getting advice of agricultural experts in order to do highly in irrigation. Moreover, the households require large damp, wells, water cannel, infra-structure, products of new technologies, fertilizers, cereals, legumes, vegetables, fruits, medicines and other advices from the Wereda agricultural office.

4.3.3 Major determinant factors that affect household's food security

The households that participated in the group discussion on the role of small-scale irrigation on the improvement of food security of the two Tabias response on the determinant factors that affect household's food security stated like high number of children due to lack of family planning, small-sized of irrigated land, shortage of water and water cannel, fertilizers, medicines and genetically modified cereals, vegetables, fruits and legumes. In the two Tabia there are water finance committee that gives rules and regulation of water using by households for their irrigation, but some youngsters sometimes become out of the rule of water financing committee. The figure provided below shows the using of water by water financing committee.

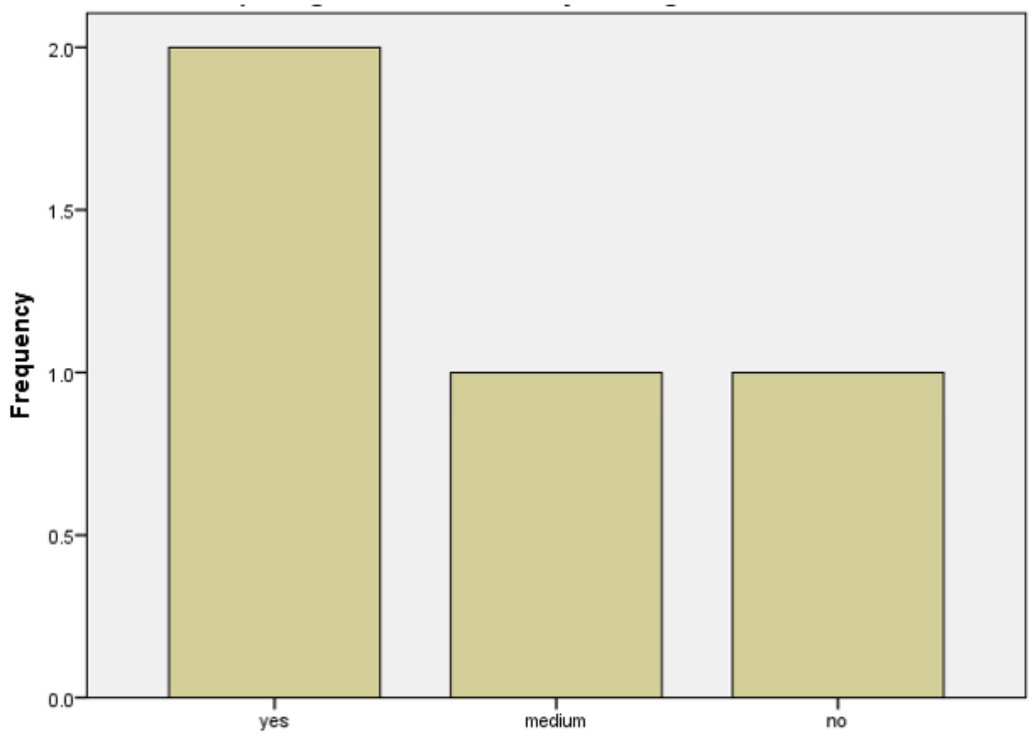

Figure 5: using of water by water financing committee

In the figure 5 above regarding using of water by water financing committee, 2(50%) of the group discussion said that there were rules and regulation of water financing committee and based on that

irrigators use water effectively for their small-scale irrigation, one (25%) %) of the group discussion said that there were rules and regulation of water financing committee and based on that irrigators use water moderately for their small-scale irrigation and one (25%) %) of the group discussion said that there were rules and regulation of water financing committee. Based on the findings it was possible to understand that irrigators did not use water for their small-scale irrigation, especially some youths may influence for females and elders by using water out of the rules of water financing committee. This indicated that there was no equal utilization of water in the Tabias.

Table 10: Result on response of group discussion production of yields per year using irrigation

Response	Frequency	Percent
2 times	3	75%
3 times	1	25%
Total	4	100%

According to the group discussion of the two Tabias household's responses, three (75%) of the groups said that they produce two times per year using irrigation to increase their economy and one (25%) of the groups said that they produce three times per year using irrigation to increase their economy. Those groups that responded they produce three times per year using irrigation was due to having their irrigated land near to the river which was source of irrigation and their land being always used for irrigation but the other groups that response two times produce per year using irrigation were due to having their irrigated land distantly from source of water and also their land cover by different cereals during rain feed.

4.3.4 The difference of food security and diet diversity between irrigators and non-irrigators

In the group discussion of households of the two Tabias of Maytuem and Betyehannes, irrigation users said that those households irrigators and non-irrigators have their own basic difference in food security and diet diversity as irrigators food security and diet diversity was better than non-irrigators due to; households that had irrigation to teach their children, they made home in towns, they participated in trade, irrigators gain additional source of economy because most requirements of different food stuff can gain from their irrigation, increase their yields, their children's healthy become good, irrigators feed

balanced diet. Moreover, they feed fresh foods, vegetables and fruits from their irrigation. Hence, irrigators cannot be affected by shortage of food.

Table 11: Group discussion preferences of irrigated agriculture or rain fed agriculture

Response	Frequency	Percent
From irrigation	3	75%
From rain feed	1	25%
Total	4	100%

As each group had 6 members, the households that had small-scale irrigation responded on preference of irrigation or rain feed type of agriculture as the three group (75%) of the households said irrigation was better than rain feed because in irrigation the cereals, vegetables and legumes gain balanced water, were not affected by floods, ices and no delaying of water. Whereas the one (25%) of the households said that rain feed was better than irrigation because during the summer season households cover all their lands by different cereals, vegetables, fruits and legumes. Consequently, households gain high amount of yield although the irrigators' yield can be affected by weeds and cheap price in respect to their loss of energy.

4.4 Response of key informative in the role of small-scale irrigation

4.4.1 Analysis of key informative on major and determinant factors that affect irrigation activities and their solutions

The key in formatives of Adwa Wereda gave responses on the major determinant factors that affect (hinder)the role of small-scale irrigation on the improvement of food security in Tabia Maytuem and Betyehannes irrigation activities such as poor utilization of water, less conservation of fruits, vegetables, less marketing system, expanding of difficult weeds, shortage of water, small size of land for irrigation, lack of awareness and thinking, lack of awareness to use products of new technologies, weeds and over grazing, due to waste products of Almeda Textile polluted the surrounding then the lands around it become out of use, during spring irrigators yield affect by mildew like yields; tomato, green peper, onion, potatoes, insufficient marketing system, illegal cajolers buy households yields in low cost and less conservation of soil moisture.

Households do not use their land resources effectively as a result of deforestation, less support from government, loss of wealth by wedding ceremony, high number of children, lack of commitment to

work and to irrigate lands, lack of awareness (farmers) to utilize new technology products, new materials of agriculture like ploughing by cars, fertilizers, selective breeds and different facilities. Furthermore, they do not accept and follow agricultural experts' idea, they do not want credits and they had shortage of facilities, lack of cars for transport of household's yields, fragmented water, low productivity land and other traditional ploughing systems.

Table 12: Factors that hinder households from using irrigation technology

Response	Frequency	Percent
Distance of water from irrigated land	1	16.67%
Distance of water from irrigated land and cost of irrigation materials	1	16.67%
Cost of irrigation materials and general cost of new products of technologies	3	50%
General cost of new technologies	1	16.67%
Total	6	100%

As it can see in table 12 with regard to the factors that hinder households from using new irrigation technology products, one (16.7%) of the key informative of Adwa Wereda gave responses on the major and determinant factors that affect (hinder) the role of small-scale irrigation on the improvement of food security in the two Tabias was distance of water from irrigated land. Likewise, one (16.7%) of the key informative of Adwa Wereda gave responses on the major and determinant factors that affect (hinder) role of small-scale irrigation on improvement of food security in Tabias were distance of water from irrigated land and price of irrigation materials. On the other hand, 3(50%) of the key informative of Wereda Adwa gave responses on the major and determinant factors that affect(hinder) role of small-scale irrigation on improvement of food security in Tabias were cost of irrigation materials and general cost of new products of technologies and one(16.7%) of them gave responses on the major and determinant factors that affect(hinder) role of small-scale irrigation on improvement of food security in Tabias was general cost of new technologies.

Table 13: Problem of crop failure while using irrigation

Response	Frequency	Percent
Yes	3	50%
No	3	50%
Total	6	100%

From the table 13 regarding problem of crop failure while using irrigation, according to the response of key informative of the study area, 3(50%) of the key in formatives response on problem of crop failure while they were using irrigation, they boldly said that there was problem of crop failure and 3(50%) of the key informative response on problem of crop failure while they were using irrigation, they said that their irrigation did not affected by it. For those keys in formatives that said the problem of crop failures was due to shortage of marketing as a result motivation to work in their irrigation becomes decrease, damage by diseases, poor adaptations of varieties used, poor administration of water distribution, irrigators collect their yields before maturity, sometimes shortage of water, weeds, pests and problem of protection. But it was not all the time or it was some time.

4.4.2 Analysis of results from key informative on the difference of food security status between irrigators and non-irrigators

Table 14: Difference of food security status between irrigators and non-irrigators

Response	Frequency	Percent
Yes	6	100%
No	0	0
Total	6	100%

According to the response of key in formatives on the difference of food security status between irrigators and non-irrigators, all of them (100%) said that there was a big difference of food security status between irrigators and non-irrigators. Some of the main differences were, irrigators increase their economy, they share experience sometimes to know marketing systems; they sell their product in expensive cost, irrigators economy is higher than non-users, they teach their children, they build homes in towns, they save money. Non-irrigator's economy become low like feeding, dressing, irrigators use more than two times, those who use products of new technology gain more products, irrigators can buy Bajaj, small cars, they have more capitals for their children irrigators obtain balanced diet, and irrigators keep their health effectively.

4.4.3 Analysis of results from key informative on farmer training center and development agent

Table 15: Farmers training center (FTC) in the study area

Response	Frequency	Percent
Yes	5	83.33%
No	1	16.67
Total	6	100%

According to the key in formatives of Adwa Wereda, the following result was obtained: 5(83.3%) of them said there was farmer training center in their Tabia and 1(16.7%) of the said there was no farmer training center in their Tabia. The findings, therefore, indicated that farmers of the study area were not getting adequate training regarding irrigation which had a negative impact on their livelihood.

Table 16: Distance of FTC from households' home in km

Response	Frequency	Percent
1 kilo meter	3	60%
2 kilo meters	1	20%
3 kilo meters	1	20%
Total	5	100%

However, majority of the respondents said that there was farmer training center in their tabia, and the farmer training center was found in one kilo meter distance as 3(60%) of the key in formatives gave response, in distance of 2 kilo meter as one (20%) of the key informative gave response and found around 3 kilo meter distance as one (20%) of the key informative gave response in the above table 16 indicated.

And again, according to the key in formatives of Adwa Wereda, they responded for the presence or absence of development agent as follows.

Table 17: contact with DA/ Development agent of households

Response	Frequency	Percent
Yes	4	66.66%
No	2	33.33%
Total	6	100%

As shown in table 17, regarding Contact with DA/ Development agent of household's response given by key in formatives, 4(66.66%) of them said that the households contact with development agent and 2(33.33%) of them said that the households did not contact with development agent. As the four keys in formatives said with regard to the households contact with development agent, they contact more than two times per a month. This is, in fact, a positive impact as it could help households to improve their productivity.

Table 18: Households production of yields per year using irrigation

Response	Frequency	Percent
1 time	1	16.66%
2 times	2	33.33%
3 times	3	50%
Total	6	100%

The key in formatives again gave response on households' production of yields per year using irrigation as shown in the above table 18. The key in formatives gave response on the households' production of different yields by using irrigation. Thus, 1(16.66%) of them said that the households could produce one time by using irrigation because of shortage of water for their irrigation and distance of irrigated land from source of water. On the other hand, 2(33.33%) of the key in formative said that the households could produce two times by using irrigation because water was found at medium water mass and at medium distance of irrigated land from source of water and 3(50%) of the key in formative said that the households could produce three times by using irrigation because water was found at a near distance to their irrigation with high water mass.

4.4.4 Response of key informative on source of water and distance

According to the key in formatives response, the source of water for irrigation of households were from river, spring, ponds, wells, stagnant water and soil moisture.

Table 19: Distance of water source from irrigated land

Response	Frequency	Percent
1 kilo meter	4	66.66%
2 kilo meters	1	16.66%
3 kilo meters	1	16.66%
Total	6	100%

As it is indicated in table 19 regarding distance of water source from irrigated land, 4(66.66%) of the key in formatives said that the source of water for irrigation of households was 1 kilo meter distance, 1(16.66%) of the key in formative said that the source of water for irrigation of households was 2 kilo meter distance and 1(16.66%) of the key in formative said that the source of water for irrigation of households was around 3 kilo meter distance.

Finally, the key in formatives put some ideas that were solved by all stockholders which were important for households in their irrigation. They clearly indicated that irrigators need to link their yields with market, and they should grow market-oriented yields. Moreover, they should transfer their products in to factories, and they need different variety of yields as their yields were affected by insects to solve. Furthermore, there was shortage of medicine, shortage of fertilizer, shortage of new products of technologies in medium cost, shortage of water, lack of money to buy water pump. In addition, most farmers do not have the same vision and most of them do not save water during irrigation. Therefore, they need awareness and permanent solution of infrastructure in order to overcome such problems.

4.5 Response of small-scale irrigation non users in role of small-scale irrigation

4.5. 1 Demographic characteristics of small-scale irrigation non users by Age

Table 20: Demographic characteristics of small-scale irrigation non users

Response	Age					Sex		Educational level					Responsibility in the family		Number of family		
	27-36	37-46	47-56	57-66	67 & above	M	F	Illiterate	1-4	5-8	9-12	Diploma & above	Household	Support	2-4	5-7	8& above
frequency	5	14	22	27	12	69	11	18	22	28	11	1	78	2	13	49	18
Percent	6.25%	17.5%	27.5%	33.75%	15%	86.25%	13.75%	22.5%	27.5%	35%	13.75%	1.25%	97.5%	2.5%	16.25%	61.25%	22.25%

According to the result of small-scale irrigation non users of Wereda Adwa rural district area indicated in table 20; 5(6.25%) of the small-scale irrigation non users of Wereda Adwa rural district, their age was between 27- 36 years old, 14(17.5%) of them was between 37- 46 years old. On the other hand, 22(27.5%) of the small-scale irrigation non users of Wereda Adwa rural district, their age was between 47- 56 years old and 27(33.5%) of them was between 57- 66 years old. Meanwhile, 12(15%) of the small-scale irrigation non users of Wereda Adwa rural district, their age was 67 and above 67 years old. What can be understood from the findings is that majority of the small-scale irrigation non users of Wereda Adwa rural district area were between 47-66 (61%) years old, so they can work different jobs if they were committed to increase their economy.

Based on the above table 20, result of small-scale irrigation non users of Wereda Adwa rural district area by sex showed that 69(86.25%) of them were males and 11(13.75%) of them were females. This implied that most of the households were males. Furthermore, the result of small-scale irrigation non users of Wereda Adwa rural district area by educational level revealed that 18(22.5%) of the small-scale irrigation non users were illiterate while 22 (27.5%) of the small-scale irrigation non users were grade 1-

4 completed. On the other hand, 28(35%) of the small-scale irrigation non users were completed grade 5- 8, 11(13.75%) of the small-scale irrigation non users were grade 9- 12 completed and one (1.25%) of the small-scale irrigation non users was Diploma completed. Hence, a total of 40(50%) the small-scale irrigation non users were 5-Diploma completed. For this reason, it is convincing to say that they have enough knowledge on irrigation and to improve their economy.

Furthermore, table 20 showed that 78(97.5%) of the small-scale irrigation non users of Wereda Adwa rural district area were households and 2(2.5%) of them were supporters to the family. But all of them had a great role in keeping the economy of the family. This is a good opportunity for the successful achievement of their yields through effective utilization of irrigation.

In the above table 20, result by number of family on small-scale irrigation non users of Wereda Adwa rural district area is shown. Accordingly, 13(16.25%) of them had a family number of 2-4, 49(61.25%) of them had a family number of 5-7 and 18(22.5%) of them had a family number of 8 and above 8. The findings, therefore, clearly depicted that most of the small-scale irrigation non users had a family number above four (83.75%). In other words, this indicated that the family size and their farming land was not balanced, so they were economically impaired. `

4.5. 6 Factors that prevent to use small-scale irrigation of households

Table 21: Result on factors that prevent to use small-scale irrigation of households

Factors	Frequency	Percent
A (lack of water supply)	17	21.25%
B (lack of vegetables, cereals, legumes and fruits)	7	8.75%
C (lack of farming land for irrigation)	36	45%
D (lack of awareness and advice)	3	3.75%
E (lack of economy)	13	16.25%
F (due to oldness)	4	5%
Total	80	100%

As shown in table 21, result on factors that prevent from using small-scale irrigation of households' response was 17(21.25%) of the households do not use small-scale irrigation due to lack of water supply, and 7(8.75%) of them do not use small-scale irrigation due to lack of vegetables, cereals,

legumes and fruits. On the other hand, 36(45%) of the households do not use small-scale irrigation due to lack of farming land for irrigation while 3(3.75%) of them do not use small-scale irrigation due to lack of awareness and advice. Moreover, 13(16.25%) of the households do not use small-scale irrigation due to lack of economy and 4(5%) of the households not use small-scale irrigation due to oldness.

4.5.7 Encouragement to work households in small-scale irrigation and methods of maintaining

Table 22: Result on encouragement to work households in role of small-scale irrigation

Response	Frequency	Percent
Yes	51	63.75%
No	29	36.25%
Total	80	100%

As indicated in the table above regarding result on encouragement of households to work in small-scale irrigation, 51(63.75%) of the households said the agricultural experts of Wereda Adwa and the Tabia administrator encouraged households to use irrigation and 29(36.25%) of them said, the agricultural experts of Wereda Adwa and the Tabia administrator did not encourage to use irrigation. Furthermore, 51(63.75%) of the households responded that the agricultural experts of Wereda Adwa and the Tabia administrator encouraged households to use irrigation but due to lack of land for irrigation, oldness, expensive rent of land for irrigation, being not committed, poor economy and shortage of water. The response from the agricultural experts of Wereda Adwa and the Tabia administrator indicated certain practical solutions for their problems and suggested creating awareness and other requirements of small-scale irrigation they did not work small-scale irrigation.

And all of them know the impact of small-scale irrigation on improvement of food security like to increase their economy, to improve food security, to teach their children, to gain alternative fresh food, to buy home in towns, and vehicles and keep their healthy. But as they does not work small-scale irrigation their economy achieved by daily labor, guard, seftnet, selling wood, charcoal and grasses. Some of them again achieved only by rain feed.

4.5.8 Interest by stockholders to work households in small-scale irrigation

Table 23: Result on interest by stockholders to work households in small-scale irrigation

Response	Frequency	Percent
Yes	67	83.75%
No	13	16.25%
Total	80	100%

As indicated in table 23 regarding result on question by stockholders to work households in small-scale irrigation, 67(83.75%) of the households asked to solve their problems for all stock holders to work in small-scale irrigation on the improvement of food security and 13(16.25%) of them did not ask to solve their problems for all stock holders to work in small-scale irrigation on improvement of food security. Even if as the households ask to solve their problems for all stock holders to work in small-scale irrigation on improvement of food security, but the response of agricultural experts and Wereda administrators answered positively. Even though practically not applied, they said they would solve tomorrow after tomorrow. Moreover, some agricultural experts were not committed to give advice for households, they said in meeting "ok we will solve", but not practically and again "our children go to town so no one work and help us", but the main reason was lack of land for irrigation which was around the source of water and lack of water for irrigation.

4.6 Field (direct) observation in role of small-scale irrigation

According to the direct observation of the researcher in the study area of Tabia Maytuem and Betyehannes in the role of small-scale irrigation on the improvement of food security, the irrigators use water for their irrigation from river, wells, ponds and by using water pump as well as by water diversion. the irrigators again suffered by weeds, pests, shortage of water, shortage of medicine from the government, shortage of genetically modified vegetables, fruits, cereals and legumes, fertilizers and link to marketing.

In both Tabias there was incomplete infrastructure, most irrigators were using medicine from private sectors. The households used different vegetables, fruits and cereals; such as tomatoes, onion, garlic, cabbage, carrots, salad, mango, barely, lettuce, chick pea, onion seed, green peper, avocado, maize, papaya, orange and lemon.

The households most of the time did not irrigate their land market oriented; they did not link to market. Furthermore, they collect their yields before maturity if price in market become expensive, and some households cover their land for source of food only, some households carry them-selves their yields in to the market, most households use cars to transport their products of irrigation, most households work together, they support each other, most irrigators follow the rules and regulation of water financing committee, and most irrigators irrigated their land two time.

4.7 Discussion and Findings

4.7.1 Discussion of the study on role of small-scale irrigation

As Robison (1983) stated, food insecurity in the world has been addressed as one of the biggest problems for over several decades now. One of the reasons for food insecurity in the world is the result of high population and because of human population was increasing exponentially. In the study area the researcher gained high number of family with in balance of food insecurity, so it was strongly correlated. As IRC (2008) put in developing countries, reasons for food insecurity include insufficient marketing systems, poor transportation (infrastructure), the same was true that the researcher observed and ensured the occurrence of those problems in the study area.

The major challenge to food security in Africa is low fertility of soils, and environmental degradation; 95% of the food in Sub-Saharan Africa is grown under rain fed agriculture. Hence; food production is vulnerable to adverse weather conditions. The soils continue to degrade leading to a reduction in the productivity of the farms (Mwaniki, 2006). Likewise, in Adwa rural area these factors were happening. Therefore, there was relation in facing problem of food insecurity in the study area.

Improvement of food security is a concern to both developed and developing countries (Mwaniki, 2012) so; the households of Adwa were participated in small-scale irrigation to improve their economy. Our country is one of the poorest countries in the world, where about 29.2% of its population live below poverty line (World Bank, 2013). Majority of the Ethiopian population lives in rural areas and the livelihood of the greater majority of this is based on rain fed agriculture that is subject to highly irregular rainfall pattern with detrimental impact on agricultural production. As their economy was less, they require small-scale irrigation. But in the study area, the major problems of irrigation were shortage of, fertilizer, medicine, and water pump, products of new technologies, complete infrastructure, and link to market the product of households.

Small-scale Irrigation was one of the agricultural technologies defined as the man-made application of water to guarantee double cropping as well as steady supply of water in areas where rainfall is unreliable (Mutsvangwa *et al.,* 2006). Hence, the development of small-scale irrigation is one of the major interventions to increase agricultural production in the rural parts of the country. In the study area some households were done small-scale irrigation to improve their economy in addition to rain feed to gain balanced diet, teach their children, keep their heath, and to prevent themselves from hunger.

According to Lipton *et al.,(*2004) as cited in Haile (2008) state that irrigated agriculture can reduce poverty through increased production and income, and reduction of food prices, that helps very poor households to meet the basic needs by improving their overall economic welfare, protect them against risks of crop loss due to insufficient rain water supplies and promote their use of yield enhancing farm inputs which in the long run enable them to move out of the poverty trap, the households of the study area were ensuring, because in the study area there are different rivers and several springs to be found that can be used for irrigation

In Adwa district, where the study would be conducted, there was prevalent food insecurity and worsening of factors supporting food production, including delayed rainfall, flash floods some-times, infertile soils and lack of awareness how to use inputs in increasing food crops as well as lack of access to modern farming system. Small-scale irrigation systems constructed by either the government or non-governmental organizations with permanent scheme structure and improved water controlling system. Like in the study area, the TDA constructed a water diversion in 2011/2012 for 220 households of Tabia Maytuem. The traditional ones are constructed by the local community, commonly diverting water from rivers using local materials. In traditional scheme, reconstruction of the site is needed at every year after the end of the rainy season, but it is sustainable in the modern water management system for a longer period of time. Both traditional and modern small-scale irrigation systems are farmer-managed irrigation systems with their own local leadership of water users' associations or irrigation cooperatives, assisted by public extension systems. (Awulachew *et al.*, 2005).

In the study area there was water financing committee; use how the households took water for their irrigation activities. But some households did not gain sufficient water. Traditional water management institutions established with their own initiatives based on their local experience and indigenous knowledge, and perform better than modern water management institutions such as the Water Users' Association and irrigation users' cooperatives which established through government initiatives. There

is involvement of farmers in various aspects of management of small-scale irrigation systems, particularly, in water distribution and operations to improve the performance of irrigated agriculture.

Agriculture is the backbone of Ethiopian economy and it is dominated by smallholder farmers. The impacts of climate change are likely to be spatially variable, and developing countries many in like Ethiopia-generally are considered more vulnerable than developed countries due to their lower capacity to adapt (Thomas and Twyman 2005). Climate variability and change will result in fundamental alterations to ecosystem structures and functions. These in turn will affect human land-use and livelihoods and have the potential to make pastoralists more vulnerable (Galvin and Soper, 1985). In the study area in some months most households suffer from shortage of water, and they collect their yields before maturity and they did not link to market or other governmental and non-governmental institutions.

According to MoA (2011), the major constraints regarding the development of irrigation systems in Ethiopia are predominantly the primitive nature of the overall existing production system, shortage of adequate agricultural inputs, limited improved irrigation technologies, limited trained human power, inadequate extension services and heavy capital requirement these and like shortage of fertilizer from the government on time, medicine, genetically modified vegetables, fruits, cereals, advise, helping in handling households irrigation were some of the major constrains of Wereda Adwa especially in Tabia Betyehannes and Maytuem.

In addition, as Dereje and Desale, (2016) find out, the major problems that seen in small scale irrigation seems to be inappropriate irrigation water utilization, lack of improved seeds, crop disease, weeding problems, increment of input costs, water logging, and absence/low support from DAs were stated these problems again happened in the study area.

According to Mintesinot et al., (2004), as cited in Nata and Bheema (2010), creating better access to markets, especially for perishable and high value crops, might encourage farmers to cultivate more crops, and a greater variety, to increase their income. Apart from marketing factors, water scarcity is a major. A study conducted by Shimelis *et al*., (2006) also indicated that in the Gibe Lemu irrigation scheme the main problems that constrained the supply of adequate irrigation water in the command area were turn abuses, water scarcity, and poor coordination of water distribution limitation in the area and even in the researcher study area those factors was faced. Other problems were; inaccessibility to

irrigation farmland, lack of farm inputs, fertilizer and chemicals, lack of adequate startup capital and lack of sufficient water are the greatest challenges to sustainable small-scale irrigation in the study area.

4.7.2 Findings of the study on role of small-scale irrigation

When the researcher tried to assess the impact of irrigation on the improvement of household's food security in the irrigation users and non-users in the study area, the households that participated in small-scale irrigation by the advice and encouragement of agricultural experts, to increase their yields, as source of income, by discussing with their agricultural experts, to teach their children, help their economy which is gained by rain feed, to grow up their children, to obtain alternative food, via advise of Tabia administrators, their poorness and lack of economy are some of the reasons that households irrigated their lands. And the households irrigate ¼ hectare, ½ hectare, 1 hectare and some 2 hectares. Consequently, the findings revealed that households of the study area were inspired to take part in irrigation because of multidimensional factors. Some of the positive impacts of households that had small-scale irrigation were very important to increase their yields, source of income, to keep their health and teach their children, help their economy gained by rain feed, grow up their children, obtain alternative food, and increase their economy. In other words, the households are interested in getting advice of agricultural experts in order to do highly in irrigation. Moreover, the households require large damp, wells, water cannel, infra-structure, products of new technologies, fertilizers, cereals, legumes, vegetables, fruits, medicines and other advices from the Wereda agricultural office. And the households that did not had small-scale irrigation were suffered by shortage of food, always they work as daily labour, their economy was low, their children did not learn in private colleges, their health did not keep normally, did not compute market like irrigators, not obtain balanced and fresh nutrients as well as alternative foods, they were dependent under safety net. So, irrigator's food security was improved than non-irrigators.

When compared household's food security improvement that practice irrigation and non-irrigated lands whether diet diversity between irrigators and non-irrigators are different, as stated above there was a great difference of diet diversity between the two groups. For example, irrigators gain alternative and fresh food than non-irrigators; as a result, irrigators' health was better than non-irrigators because non-irrigators' family could result in malnutrition, and they can be affected by different deficiency diseases. Moreover, irrigators' children attend in private colleges than non-irrigators. If drought happens as irrigators save money, they can buy crops even if in expensive price more than non-irrigators.

Furthermore, non-irrigators' children migrate to different areas to find daily work than those of irrigators', and non-irrigators' economy was cash on hand as the size of their farming land was small and narrow. As the households had high number of children, they suffered from buying clothes, shoes and materials of education. In general, non-irrigators' economy was lower than households that practiced small-scaled irrigation in improving their economy.

Finally, the researcher obtained different factors that influence small scale irrigation schemes on the improvement of food security. Incomplete infra-structure, shortage of water, water-canal, fertilizer on time and its price, expensive rent of land for irrigation, medicine from government, pesticides, insecticides, link to marketing, genetically modified crops, vegetables, legumes, fruits, products of new technologies, rules of water financing committee, conservation of water soil moisture, effective utilization of lands and water, drought, migration of children in to towns, less market oriented yields, less of capital to start irrigation, awareness, less cooperation, advise, work-shops, sharing experiences and commitment were some of the factors that hinder households while using small-scale irrigation. In short, the findings clearly depicted that various factors were available that hinder the effective utilization of irrigation.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the findings of the study, the researcher concluded that small-scale irrigation was so important in improving food security than only using rain feed. When households use small-scale irrigation, their economy increases. Moreover, their health was better than non-irrigators because irrigators gain balanced diet, alternative food and fresh food. In addition to this, irrigators did not suffer from malnutrition and deficiency diseases and their children attend education in private colleges. Furthermore, irrigators' children growth rate was higher than those of non-irrigators and irrigators could buy cars, home in towns, and save money.

As the study area had households that participate in small-scale irrigation, these households were suffered from shortage of water, fertilizers, medicines, genetically modified yields, pests, weds, link to marketing with governmental and non-governmental institutions, lack of awareness, incomplete infra-structures and other encouragement from all stock holders.

In the study area, there was high family size. For this reason, households had to participate in small-scale irrigation with their children to increase their economy as irrigation was so important for increasing their economy, gaining fresh and alternative food, keeping their health, saving money, teaching their children in private colleges, and preventing from deficiency diseases. Migration of children in to towns to find best economy was common as the size of their farming land was small, and they were asking for government to obtain additional food in the form of safety net. They were also affected by deficiency diseases; they did not teach their children in private colleges. Besides, they did not obtain fresh food and alternative food; consequently, they become dependent on others. To solve these and other factors the researcher concluded that the agricultural experts should give continuous advice to use irrigation. Especially for those that have land around the source of water for irrigation.

Most of the households that did not have small-scale irrigation were dependent on the government in safety net because their economy was gained only from rain feed. Their children were also going to towns to collect money from daily labor or as a guard. As the size of their farming land was small and had high family size, most of the time they were suffered from shortage of economy from June up to half of September or up to new cereals mature, especially for those households that have high children and their back bone of economy that was agriculture.

5.2 Recommendations

The researcher gathered primary and secondary data from households that had small-scale irrigation, non-irrigators, agricultural experts, key in formatives, and from direct observation and suggested the following recommendations which are important for improving food security through using small-scale irrigations.

1. As the study area had incomplete infrastructure, the government should prepare itself and should participate the society in preparing the necessary infrastructures in order to transport households yield production on time in to the market before denatured.

2. As weeds, pests and insect damage household irrigation production, and according to the response of households that have small-scale irrigation they buy medicine from private sectors in an expensive cost, the agricultural office should prepare different medicines all the time in order to prevent from factors that reduce yield production of households.

3. Households did not obtain sufficient economy from their irrigation due to lack of linking their products to marketing, so the agricultural office should be linking the household products with governmental and non-governmental organizations in order to sell their products in an expensive cost.

4. The households were suffered due to shortage of water for their irrigation products. Hence, the government should make large damp itself or it should introduce water pumps and should participate the society in order to make a large damp for their irrigation.

5. Since fertilizers are important to increase household yields, the government should prepare sufficient fertilizers on time for households and encourage households to use them perfectly. Furthermore, the agricultural office should advise households to use fertilizer by sharing experience from fertilizer users for fertilizer non-users in order to use fertilizer to increase their economy from their irrigations.

6. Finally, the households need different cereals, legumes, fruits and vegetables which mature quickly and produce high yields in irrigation. As a result, the agricultural office and the local administrator should prepare these on time for the households in order to use them effectively and gain sufficient yields, to increase their economy as well as to keep their health.

References

Adak, *et al*., (2005). ***Disease risks from foods***, England and Wales, 1996–2000. Emerge Infect Diseases 11, 365–372.

Ashton, P.J. (2002). ***Avoiding conflicts over Africa's water resources***. Ambio, 31, pp.236-242.

Awulachew, SB, Merrey, JD. (2005). ***Assessment of Small-Scale Irrigation and Water Harvesting In Ethiopian Agricultural Development*** [abstract]. International water management institute: Colombo, Sri Lanka.

Awulachew, SB, Yilma, AD, Loulseged, M, Loiskandl, W. (2007). ***Water Resources and Irrigation Development in Ethiopia***. Colombo, Sri Lanka: International water institute; [Working paper 123].

Benson, T. (2004). ***Africa's food and nutrition security situation***. Where are we and how did we get here? pp. 7-11. International Food Policy Research Institute. Discussion paper 37, Washington D.C.

Bhatta, B.P. (2004). ***Socioeconomic Transformations and Road Accessibility****: Evidence David de Vaux. (2001). Research Design in Social Research.*

Bouis, H., and J. Hunt, 1999. ***Linking food and nutrition security****: past lesson and future Building Strategy for Ethiopia*. Published by Natural Resources Management Directorate, Natural Resource Sector and the Ministry of Agriculture, Ethiopia.

BWOA (Bona-Zuria Woreda Agriculture Office), (2015). ***Report on irrigation potential and existing irrigation schemes by region***. Bona Zuria woreda unpublished document.

Byrnes, K, (1992). ***Water user's association in World Bank assisted irrigation projects in Countries.*** A World Bank Policy Study. Washington, D.C. development goal report. [Internet]. [cited 2011 July 4]. Addis Ababa, Ethiopia. Available from: http//www.dagethiopia.org. Ethiopia: A case study of Gibe Lemu and Gambella Terre in Western Oromia". MSc Thesis.

Fanadzo, N. (2018). ***Challenges and opportunities for revitalizing smallholder Management institute***; [Working paper 123]. Map (2010-2020).

FAO, (1992). ***Assessing, analyzing and monitoring nutrition situations***. International conference on nutrition. Rome, Italy

FAO - ***Committee on World Food Security (2012), Coming to Terms with Terminology, Food Security, Nutrition Security, Food Security and Nutrition, Food and Nutrition Security,*** Rome - Committee on World Food Security (1996) *in Right to Food and Nutrition Watch, Who Controls the Governance of the World Food System?*

FAO (Food and Agriculture Organization of the United Nations). (2008). ***Climate Change: Implications for Food Safety***. Rome: FAO.

FAO (Food and Agriculture Organization), (2008). ***Guidelines for measuring household and individual dietary diversity***. Rome: Nutrition and Consumer Protection Division.

FAO, (1996). ***Rome Declaration on World Food Security***. Proceeding from the Italy. 129pp. World Food Summit, November 13-17, 1996, Rome. Available from [http://www.fao.org] site visited on 23 November 2011.

FAO, (1996). ***The State of World Food Insecurity***, Rome, Italy. 4pp.

FAO, (2003). ***The state of food insecurity in the World.*** Monitoring progress towards the food summit and millennium development goals. Rome, Italy.24-26p

FAO, (2010). ***The State of Food Insecurity in the World, Addressing food insecurity in protracted crises***. Rome, Italy. 59pp.crises. Rome

FAO, (2010). ***Global Hunger Declining***, But Still Unacceptably High, Economic and Social Development Department 14 September 2010. [http://www.fao.org/ dcrep /012/aI390e/aI390e00.pdf] site visited on 20/6/2012.

FAO, (2003)..***Irrigation in Africa South of the Sahara***. FAO Investment Center Technical Paper 5.

FAO. (1997). ***Irrigation technology transfer in support of food security proceeding of a FAO:*** Rome. Field, C.B., L.D. Mortsch, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. From Northern Ethiopia, Unpublished MSc thesis, Norwegian University of Life.

Folke, C., S.R. Carpenter, B. Walker, M. Scheffer, T. Chapin and J. Rockström. (2010). Running and M.J. Scott (2007). North America. In: Climate Change 2007:

Frederick, J.G., and Lori-Ann, B. Forzano. (2011). ***Research Methods for the Behavioral Sciences***. USA: Cengage Learning, 2011.p. 144.

Getaneh, K. A. (2011). ***The Impact of Selected Small-Scale Irrigation Schemes on Household Income and The Likelihood of Poverty in The Lake Tana Basin of Ethiopia*** © 2011 Getaneh Kebede Ayele Graduate School of Cornell University.

Girmay, G. (2013). **Impact of Mai Nugus Irrigation Scheme on Household Food Security**: A Case Study in Laelay Maichew Woreda, Central Zone of Tigray, Northern Ethiopia Indira Gandhi National open university.

Hagos, F., Makombe, G., Namara, RE., &Awulachew, SB. (2010***). Importance of Irrigated Hague University Press.*** Harvesting in Ethiopian Agricultural Development [abstract]. International Nutrition and Consumer Protection Division Intergovernmental Panel on Climate Change.

Haile T, (2008). ***Impact of irrigation development on poverty reduction in Northern Ethiopia (dissertation***), National University of Ireland, Cork.

Haile, T. (2008). ***Impact of irrigation development on poverty reduction in Northern Ethiopia***, A Doctorate thesis submitted to the department of food business and development National University of Ireland, cork JICA &OIDA, 2001. The study for Meki Irrigation and Rural Development Project in Oromia Region, Ethiopia; Draft Final Report, vol. III

Helen, E. P. (2001). ***African Environmental and Human Security in the 21st Century***.

Herbst, J. (2000). **States and Power in Africa**. Princeton, New Jersey: Princeton University Press. here? pp. 7-11. ***International Food Policy Research Institute***. Discussion paper 37, http://www.ethiopians.com/Ethiopia_GTP_2015.pdf

IFAD, (2013). ***Paper for the World food Summit***, Rome. International New York Times, Mark Bittman, October 18, 2013.

IFRC, (2008). ***Long-term food security: Investing in People and Livelihoods Five-year strategic framework and plan of action on long-term food security for individual dietary diversity***. Rome: Cambridge, Cambridge University Press. Colombo, Sri Lanka: Irrigation Situation Analysis and Capacity Needs Assessment, Addis Ababa, Ethiopia.

Joachim.V.B.and Howarth, B. (1992), ***Improving Food Security of the Poor***: Concept. Policy, And Programs (p. 16). Land Transformation in Agriculture. Publishers: Wiley, J & Sons Ltd.

Miller, R., & Brewer, J. (2003). ***The - z of social research: A dictionary of key social science Irrigation Situation Analysis and Capacity Needs Assessment***, Addis Ababa, Ethiopia.

Margaret, A. (1997). ***Implications of Economic Policy for Food Security***: A Training Manual Vol 40 of Training Materials for Agricultural Planning.

Ministry of Agriculture Natural Resource Sector (2011). ***Small-Scale Irrigation Capacity, Irrigation Development in Ethiopia.***

Ministry of Agriculture. (2011a). ***Natural Resources Management Directorates, Small-Scale Irrigation Development in Ethiopia.***

MoARD (Ministry of Agriculture and Rural Development), (2011). ***Small-Scale irrigation situation Analysis and capacity needs assessment.*** Addis Ababa, Ethiopia.

MoARD, (2010). ***Ethiopia's Agriculture Sector Policy and Investment Framework***: TenYear Road Map (2010-2020).

MoFED (Ministry of Finance and Economic Development), (2006). ***A Plan for Accelerated and Sustained Development to End Poverty*** (PASDEP). (2005/06-2009/10). Ethiopia.

MoFED (Ministry of Finance and Economic Development), (2012). ***Performance and Challenges on International water irrigation schemes by region***. Bona Zuria woreda unpublished document irrigation schemes in South Africa; Review Water SA Vol. 44 No. 3

MOFED (2010). ***Trends and prospects for meeting MDGs by 2015, millennium development goal report***. [Internet]. [cited 2011 July 4]. Addis Ababa, Ethiopia. Available from: http//www.dagethiopia.org.

MOFED.(2010). ***The Federal Democratic Republic of Ethiopia, Growth and Agriculture to the Ethiopian Economy: Capturing the direct net benefits of irrigation***. Addis Ababa University. Addis Ababa, Ethiopia. Addis Ababa. [Internet]. [cited 2011 April 10]. Available from:

Mutsvangwa T. and Doranalli K., (2006). ***Agriculture and Sustainable Development***, Netherlands, The Hague University Press.

Mwaniki, A., (2012) 'Food security in Africa: ***Challenges and issues'***, United Nations, 22 October 2012

Nata, T., & Bheemalinges, W. (2010). ***Prospect sand on strains of Household Irrigation Practices, Hayelom on nutrition***. Rome, Italy opportunities. Asian Development Review, 17 (2): 168-213.

Oruonye, E. D., (2011). ***An assessment of fadama dry season farming through small scale irrigation Pakistan***, World Bank Technical paper 173. Washington, DC, USA.31-39p research concepts. London: SAGE.

Shanan, L. (1987). ***The impact of irrigation***. In: Wolman MG, Fourner FGA, editors.

Sharma, S, R. (Eds.). (2006). Encyclopedia of New Methods of Educational Research Set. New Delhi: Sarup& Sons46.***The Status of Food Security in Africa***, Economic Commission for Africa, Committee on Food security. Policy determination PNAV468. Washington, D.C.

Shimelis, D., (2006). ***Institution management and challenge of small-scale irrigation system in Ethiopia***: A case study of Gibe Lemu and Gambella Terre in Western Oromia. MSc Thesis. Addis Ababa University.

Tizita Damtew, (2017). ***The Effect of Small-Scale Irrigation on Household Food Security in Bona-Zuria Woreda,*** Sidama Zone, Southern Ethiopia Hawassa University College of Agriculture, February.

UNDP, (2007). ***Globalization, Agriculture and the Least Developed Countries [***Internet]. Issues Paper, Istanbul. 9-11 July 2007. Available from: http://www.unohrlls.org.

USAID (1992)***. Definition of food Washington D.C. water management institute***: Colombo, Sri Lanka. Watershed. Department of Earth Science, College of Natural and Computational Sciences, Mekelle University. Ethiopia

World Bank. (1986). ***Poverty and Hunger: Issues and Options for Food Security in Developing Countries***. A World Bank Policy Study. Washington, D.C. World Bank, 2013.http://www.photius.com/rankings/economy/population_below_poverty_line_2013_0.html.

World Food Summit, (1996), Rome. Available from [http://www.fao.org] site visited on 23 November 2011.

Mekelle University

College of natural and computational science

Department of Biology

Questionnaires for Wereda agricultural office

Introduction

The purpose of this questionnaire is to gather information which will be used for study on the role of small-scale Irrigation to improvement food security of household (case study around Adwa town). This study is going to be conduct for the partial fulfillment of MSc degree in biology at Mekelle University. Your full support and willingness' to respond to the question is very essential for the success of the study. Therefore, you are kindly requested to answer all questions and give clear, appropriate and reliable information on the issues. Be sure that the information you provide is only for the purpose of this study. Thanks, you.

1. Age_____
2. Sex_____
3. Education level_____
4. Work experience year_____
5. Responsibility_____
6. Do you have interest to work in rural area? _____
7. How do you correlate and help peoples who participate in small scale irrigation?

   _____

   _____
8. Are you ready to join households yield production with marketing system? How, list the methods you use?

   _____

   _____
9. How do you advise households to produce high yield production?

_____

_____

10.Does households accept new technology that increases their yields? If your answer is no what factors hinderthem?_____

_____

11.How do you help for households in handling their irrigation?

_____

_____

12. How do you solve any problem which faced in the irrigation if it is above capacity of the household?

_____

_____

13. Are you encouraged for households to use fertilizer? And in what way?

_____

_____

14. How do you advise for irrigators to use that do not use fertilizers?

_____

_____

15. Does the wereda agricultural office prepare different vegetables, fruits and cereals for house hold users?

_____

_____

16. Does the households are voluntary to buy and use different vegetables and fruits if you prepared? A. yes B. no If your answer is no what is the reason?

_____

_____

17. Do you encourage households to prepare their own green manure?

_____

_____

18. If water supply decreased before maturity of household's vegetables and fruits, what will be your solution?

_____

_____

19. How do you initiate farmers to participate in irrigation?

_____

_____

20. can you list the types of vegetables, fruits and cereals that irrigated by households?

_____

_____

Mekelle University

College of natural and computational science

Department of Biology

Questionnaire for households who use small scale irrigation

Introduction

The purpose of this questionnaire is to gather information which will be used for study on the role of small-scale Irrigation to achieve food security of household (case study around Adwa town). This study is going to be conduct for the partial fulfillment of MSc degree in biology at Mekelle University. Your full support and willingness' to respond to the question is very essential for the success of the study. Therefore, you are kindly requested to answer all questions and give clear, appropriate and reliable information on the issues. Be sure that the information you provide is only for the purpose of this study. Thanks, you.

1. Age_____
2. Sex_____
3. Education level_____
4. Work experience year in irrigation_____
5. Responsibility_____
6. List number of family_____
7. What factor do you initiate to work on small scale irrigation?

   _____

   _____
8. Can you list the factors that influence your small-scale irrigation?

_____

_____

9. Are you voluntary to follow agricultural experts if introduce new technology? If your answer is no why?

_____

_____

10.How many hectares do you irrigate? _____

11.What types of crop or fruits do you irrigate in your irrigation? List them.

	Vegetables	Fruits	Cereals	Legumes	Others
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					

12. Are you satisfied by your yield production? Marketing system?

_____

_____

13. How do you solve for problems of climatic factors, weeds, pests, and other factors that reduce your yield production?

_____

_____

14. Does the agricultural expert help you in introduction of new cereals and fruits? A. yes B. No If your answer is no? What will be the reason?

_____

_____

15. What question do have to ask for the werda that help your irrigation?

_____

_____

16. How many times do you produce per year using irrigation?

_____

_____

17. D0 you have enough accesses of transportation to the market?

_____

_____

18. Does shortage of water supply face to your irrigation? A. yes B. no If your answer is yes how do you solve it?

_____

_____

19. If transport accesses are not sufficient, how do you solve it and how do you sell you yield production?

_____

_____

20. If weeds and pests affect your irrigation, does the agricultural expert help you in donating pesticides? A. yes B. no If your answer is no how do you solve it?

Mekelle University

College of natural and computational science

Department of Biology

Questionnaire for group discussion

Introduction

The purpose of this questionnaire is to gather information which will be used for study on the role of small-scale Irrigation to achieve food security of household (case study around Adwa town). This study is going to be conduct for the partial fulfillment of MSc degree in biology at Mekelle University. Your full support and willingness' to respond to the question is very essential for the success of the study. Therefore, you are kindly requested to answer all questions and give clear, appropriate and reliable information on the issues. Be sure that the information you provide is only for the purpose of this study. Thanks, you.

1. Is there a shortage of availability of food in your kebeles in the past 12 months? If yes, in which year or month this problem face to you and what did your measurement at that time or how did you solve this problem?

_____

_____

_____

2. What is your general opinion on the role of small-scale irrigation on improvement of food security?

_____

_____

3. What are the determinant factors that affect your household food security?

_____

_____

4. Which do you prefer irrigated agriculture or rain fed agriculture? Why?

_____

_____

5. What are the major factors constraining irrigation activities in your area?

_____

_____

6. Is there any difference food security status between irrigator and non-irrigator? What is the difference between these two groups?

_____

_____

7. Is there any difference diet diversity between irrigator and non-irrigator? What is the difference?

_____

_____

8. Is there equal right to use water for your irrigation area?

_____

_____

9. How many times do you produce per year using irrigation?

_____

_____

_____

Mekelle University

College of natural and computational science

Department of Biology

Questionnaire for Key Informants interview (KII)

Introduction

The purpose of this questionnaire is to gather information which will be used for study on the role of small-scale Irrigation to achieve food security of household (case study around Adwa town). This study is going to be conduct for the partial fulfillment of MSc degree in biology at Mekelle University. Your full support and willingness' to respond to the question is very essential for the success of the study. Therefore, you are kindly requested to answer all questions and give clear, appropriate and reliable information on the issues. Be sure that the information you provide is only for the purpose of this study. Thanks, you.

1. What are the major factors constraining irrigation activities in your area?

_____

_____

2. Is there any difference food security status between irrigators and non-irrigators? A. Yes B. No

If yes, what are the main differences between these two groups?

_____

_____

3. What are the major determinant factors that affect the household food security in your area?

_____

_____

4. Is there farmers training center (FTC) in your kebeles? A. Yes B. No

4.1. If yes, how far is the FTC from your home _____ in Km?

4.2. Do you contact with DA/ Development agent? A. Yes B. No

4.3. If your answer is yes how many times do you contact with DA per month? A. One times

B. Two times C. More than two times

5. How many times do you produce per year using irrigation?

_____

6. Have you ever faced a problem of crop failure while you are using irrigation?

A. Yes B. No

If your answer is yes, what were the possible causes for this problem of crop failure last year?

A. Water shortage B. Damaged by disease C. Poor adaptation of varieties used

D. Poor administration of water distribution E. Others, specify

_____

7. What is the source of water for your irrigation? A. Rivers B. Springs

C. Ponds D. Well E. Other, specify

_____

8. How long the distance between the sources of water to your irrigated land? _____ (in km).

9. What factors hinder you to use irrigation technology? A. Distance of water to farm land

B. Lack of farm land C. Cost of irrigation materials D. Overall cost of technology

10. If you have another problem(idea) state it?

_____

_____

Mekelle University

College of natural and computational science

Department of Biology

Questionnaire for small-scale irrigation non-users

Introduction

The purpose of this questionnaire is to gather information which will be used for study on the role of small-scale Irrigation to achieve food security of household (case study around Adwa town). This study is going to be conduct for the partial fulfillment of MSc degree in biology at Mekelle University. Your full support and willingness' to respond to the question is very essential for the success of the study. Therefore, you are kindly requested to answer all questions and give clear, appropriate and reliable information on the issues. Be sure that the information you provide is only for the purpose of this study. Thanks, you.

1.Age _____

2. Sex _____

3.Education level_____

4.Responsibility_____

5. number of family_____

6. Why do not you use small scale irrigation? A. lack of water supply B. lack of vegetables, cereals and fruits C. lack of farming land for irrigation D. lack of awareness, advise E. economic in balance

F. other and specify

_____

_____

7. Is there anybody encourage you to work in small scale irrigation? A. Yes B. no

If your answer is yes why not participate in small scale irrigation? Specify your reason?

_____

_____

8. Do you know the impact of small-scale irrigation on improving food security? A. yes B. No If your answer is Yes how do you improve your food security?

_____

_____

9. Have you asked your problem for all stockholders? A. Yes B. No

If your answer is yes what was their responses?

_____

_____

10. What is your hope to increase your economy for the future if not use small scale irrigation?

_____

_____

ዩኒቨርሲቲ መቐለ

ተፈጥሮን ቀመር ሳይንስን ኮሌጅ

ክፍሊ ትምህርቲ ስነ-ሂወት

ፅሑፋዊ መሕትት ንወረዳ ኪኢላ ሕርሻ

መእተዊ

ዝኸበርኩም ኪኢላሕርሻ ፡- ናይዚ ፅሑፋዊ መሕትት ቀንዲ ዕላማ ናይ ኣናእሽቲ መስኖታት ዘለዎ ረብሓ ኣብ ምርግጋፅ ውሕስና ምግቢ ኣብ መራሕቲ ስድራ ሓረስቶት ኣብ ጣብያታት ማይ ጥዑምን ቤት ያሃንስን ትኹረት ብምግባር ኣመልኪቱ ሓበሬታ ንምርካብ እዩ። እቲ ዝእከብ ሓበሬታ ንመማልኢ ካልኣይ ዲግሪ ብትምህርቲ ስነ-ሂወት ዘድሊ ኮይኑ ኣብተን ኣብ ላዕሊ ዝተጠቀሳ ጣብያታት ትኹረት ዝገበረ እዩ። ናታትኩም ምትሕብባር ንዕወትነት እዚ መፅናዕቲ ወሳኒ ስለ ዝኾነ ነዚ ፅሑፋዊ መሕትት ብጥንቃቐን ብምስትዉዓልን ንኽትመልእዎ ብትሕትና ይሓትት። እትህብዎ ሓበሬታ ነዚ መፅናዕቲ ጥራሕ ዘገልግልን ምስጢራዊነቱ እዉን ዝተሓለወ እዩ።

ንምትሕብባርኩም ካብ ልበይ የመስግን!!!

1. ዕድመ_____

2. ፆታ_____

3. ብርኪ ትምህርቲ_____

4. ስራሕ ልምዲ_____

5. ዘለዎ ሓላፍነት_____

6. ኣብቲ ወረዳ ንክሰርሑ ዘለዎም ድሌት? _____

7.ብከመይ አቢሎም እዮም ሕ/ሰብ ኣብ ሰራሕቲ ኣናእሽቲ መስኖታት ንክሳተፉ ዝሕግዝዎም?

_____

_____

8. ምህርቲ ኣናእሽቲ መስኖታት ናይቲ ሕ/ሰብ ምስ ዕዳጋ የተሓሕዝዎዶ? ብከመይ እቶም ዝጥቀሙሎም ሜላታት ይዘርዝሩ?

_____

_____

9.ኣብ ስራሕቲ ኣናእሽቲ መስኖታት ዝተዋፈሩ ሓረስቶት ምህርቲ መስነኦም ንከዕብዩ ከመይ ይመክርዎም?

_____

_____

10.ተጠቀምቲ ኣናእሽቲ መስኖታት ምህርቶም ዘደንፍዑ ሓደሽቲ ቴክኖሎጂይ ይጥቀሙዶ? ዘይጥቀሙ እንተኮይኖም ዘይጥቀሙሉ ምክንያት ይዘርዝሩ?

_____

_____

11. ኣብ ኣተሓሕዛን ኣታኣላልያን ኣናእሽቲ መስኖታት ብከመይ ኣቢሎም እዮም ንመራሕቲ ስደራ ሓረስቶት ዝሕግዝዎም?

_____

_____

12. ኣብ ኣናእሽቲ መስኖታት ስራሕቲ ልዕሊ ዓቅሚ መስኖ ተጠቀምቲ ፀገማት እንተኣጋጢሞም ብምንታይ ዓይነት ሜላ ዝፈትሕዎም?

_____

_____

13.ንተጠቀምቲ ኣናእሽቲ መስኖታት መሰሰኒ ምህርቲ ንክጥቀሙ የተባብዑዶ?

ብከመይመንገዲ?_____

_____

14. መሰሰኒ ምህርቲ ዘይጥቀሙ መስኖተጠቀምቲ ብከመይ እዮም ንክጥቀሙ ምክሪ ዝህብዎም?

_____

_____

15.ምምሕዳር ወረዳ ዓድዋ ዝተፈላለዩ ኣሕምልቲ፣ፍረምረንዝራእትን ንመሰኖ ተጠቀምቲ የዳልውዶ?

_____

_____

16.ተጠቀምቲ መስኖ ዝተፈላለዩ ኣሕምልቲ፣ፍረምረንዝራእትን ኣብቲ ወረዳ ንምግዛእ ድልዋት ድዮም? ሀ እወ ለ ኣይኮኑን ፡መልስኩም 'ለ' እንተኮይኑንምንታይ?

_____

_____

17. ንተጠቀምቲ መስኖ ተፈጠሮኣዊ መሰሰኒ ምህርቲ/ኮምፓስ/ ንክፍርዩ የተባብዕዎምዶ?

_____

_____

18.ቅድሚ ኣሕምልቲ፣ ፍረምረንዝራእትን ምብፅሑም ሕፅረት ማይ እንተኣጋጢሙ እንታይ ዓይነት መፍትሒ ይጥቀሙ?

_____

_____

19. ከመይ ኣቢሎም እዮም ሓረስቶት መስኖ ንክጥቀሙ ዘተባብዕዎም?

_____

_____

20. **ኣብ ወረዳ ዓድዋ ጣብያ ማይጥዑም /ቤትየሃንስ/ ብሓረስቶት ኣብ መስኖ ዝዘርኦምን ዝተከለሞምን ኣሕምልቲ፣ ፍረምረንዝራእትን ይዘርዝሩ?**

_____

_____

ዩኒቨርሲቲ መቐለ

ተፈጥሮን ቀመር ሳይንስን ኮሌጅ

ክፍሊ ትምህርቲ ስነ-ሂወት

ፅሑፋዊ መሕትት ንመራሕቲ ስድራ ኣናእሽቲ መስኖ ተጠቀምቲ

መእተዊ

ዝኸበርኩም መራሕቲ ስድራ ኣናእሽቲ መስኖ ተጠቀምቲ ፡- ናይዚ ፅሑፋዊ መሕትት ቀንዲ ዕላማ ናይ ኣናእሽቲ መስኖታት ዘለዎ ረብሓ ኣብ ምርግጋፅ ውሕስና ምግቢ ኣብ መራሕቲ ስድራ ሓረስቶት ኣብ ጣብያታት ማይ ጥዑምን ቤት ያሃንስን ትኹረት ብምግባር ኣመልኪቱ ሓበሬታ ንምርካብ እዩ። እቲ ዝእከብ ሓበሬታ ንመማልኢ ካልኣይ ዲግሪ ብትምህርቲ ስነ-ሂወት ዘድሊ ኮይኑ ኣብተን ኣብ ላዕሊ ዝተጠቀሳ ጣብያታት ትኹረት ዝገበረ እዩ። ናታትኩም ምትሕብባር ንዕዉትነት እዚ መፅናዕቲ ወሳኒ ስለ ዝኾነ ነዚ ፅሑፋዊ መሕትት ብጥንቃቐን ብምስትዉዓልን ንኽትመልእዎ ብትሕትና ይሓትት። እትህብዎ ሓበሬታ ነዚ መፅናዕቲ ጥራሕ ዘገልግልን ምስጢራዊነቱ እዉን ዝተሓለወ እዩ።

ንምትሕብባርኩም ካብ ልበይ የመስግን!!!

1. ዕድመ_____

2. ፆታ_____

3. ብርኪ ትምህርቲ_____

4. ክንደይ ዓመት መስኖ ተጠቂሞም? _____

5. ዘለዎም ሓላፍነት_____

6. በዝሒ ስድራ? _____

7. መስኖ ንክትሰርሑ ዘተባበዓኩም ምክንያት?

_____

_____

8. ንስራሕቲ መስኖ ዕንቅፋት ዝኾኑ ነገራት ይዘርዝሩ?

_____

_____

9. ኪኢላ ሕርሻ ወኪላት ሓደሽቲ ናይ ቴክኖሎጂ ውዕኢታት ከተኣታትው ከለው ብፀጋ ይቕበልዎ ዶ? መልሶም ኣይንቕበሎን እንተኾይኑ ምክንያት ይዝርዝሩ?

_____

_____

10. ክንደይ ዝኣክል ሄክታር /ስፍሓትመሬት/ የልምዑ መስኖ ተጠቂሞም?

_____

_____

11. ኣብ መስኖኦም ዘፍርይዎም ኣሕምልቲ፣ ፍረምረንዝራእትን ይዘርዝሩ?

_____

_____

12. ብውዕኢት ምህርቲ መስኖኦም ይዓግቡ ዶ? ብዕደጋ መሸጢ ዕግበት ኣለዎም ዶ?

_____

_____

13.ንፅልዋታት ኩነታትኣየር፣ ፃህያይ፣ ባልዕን ካልኦት ፀገማት ምህርቲ መስኖ ዝቅንሱ ብከመይ ይፈትሕዎ?

_____

_____

14. ኪኢላ ሕርሻ ወኪላት ሓደሽቲ ኣሕምልቲ፣ ፍረምረንዝራእትን የተኣታትውልኩም ዶ? መልስኩም ኣየተኣታትውን ዝብል እንተኾይኑ ምክንያት እንታይ ይከውን?

_____

_____

15. ንስራሕቲ መስኖ ሓገዝቲ ዝኾኑ ነገራት ክትሓተዎ ትደልዩ እንታይ ኣሎ?

_____

_____

16. መስኖ ተጠቂምኩም ኣብ ዓመት ክንደይ ግዜ ተልምዑ?

_____

_____

17.እኩል መጉዓዚ ምህርቲ መስኖ ናብ ዕዳጋ ኣሎ ዶ?

_____

_____

18. ኣብ መስኖኩም ሕፅረት ማይ የጋጥም ዶ? ሀ. እወ ለ. የለን /አየጋጥምን/

መልስኩም ሀ እወ እንተኾይኑ ብከመይ ትፈትሕዎ?

_____

_____

19. ሕፅረት መጉዓዝያ እንተኣጋጢምኩም ብከመይ ትፈትሕዎ? ምህርትኩም ብከመይ ኣቢልኩም ትሸጥዎ?

_____

_____

20. ፃህያይን ባልዕን መስኖኩም ከጥቅዕዎ ከለው ፣ ሕርሻ ወኪላት ናይ ወረዳኩም ይሕግዝኩም ዶ? ሀ. እወ ለ. ኣይሕግዙን

መልስኩም ኣይሕግዙን እንተኾይኑ ብከመይ ትፈትሕዎ?

_____

ዩኒቨርሲቲ መቐለ

ተፈጥሮን ቀመር ሳይንስን ኮሌጅ

ክፍሊ ትምህርቲ ስነ-ሂወት

ፅሑፋዊ መሕትት ንጉጅለ መራሕቲ ስድራ

መእተዊ

ዝኸበርኩም ተሳተፍቲ ጉጅለ መራሕቲ ስድራ ኣናእሽቲ መስኖ ተጠቀምቲ ፡- ናይዚ ፅሑፋዊ መሕትት ቀንዲ ዕላማ ናይ ኣናእሽቲ መስኖታት ዘለዎ ረብሓ ኣብ ምርግጋፅ ውሕስና ምግቢ ኣብ መራሕቲ ስድራ ሓረስቶት ኣብ ጣብያታት ማይ ጥዑምን ቤት ያሃንስን ትኹረት ብምግባር ኣመልኪቱ ሓበሬታ ንምርካብ እዩ። እቲ ዝእከብ ሓበሬታ ንመማልኢ ካልኣይ ዲግሪ ብትምህርቲ ስነ-ሂወት ዘድሊ ኮይኑ ኣብተን ኣብ ላዕሊ ዝተጠቀሳ ጣብያታት ትኹረት ዝገበረ እዩ። ናታትኩም ምትሕብባር ንዕዉትነት እዚ መፅናዕቲ ወሳኒ ስለ ዝኾነ ነዚ ፅሑፋዊ መሕትት ብጥንቃቐን ብምስትዉዓልን ንኽትመልእዎ ብትሕትና ይሓትት። እትህብዎ ሓበሬታ ነዚ መፅናዕቲ ጥራሕ ዘገልግልን ምስጢራዊነቱ እዉን ዝተሓለወ እዩ።

ንምትሕብባርኩም ካብ ልበይ የመስግን!

1. **ዝሓለፉ 12 ኣዋርሕ ሕፅረት ምግቢ ኣጋጢሙ ዶ ይፈልጥ? ሀ. እወ ለ. የለን/አየጋጥምን/ መልስኩም እወ እንተኾይኑ መዓዝ ወርሒ የጋጥም ነይሩ? ነዚ ፀገም ከ ብከመይ ትፈትሕዎ? እንታይ ዓይነት ሜላ መፍትሒ ሕፅረት ምግቢ ትጥቀሙ?**

_____

_____

2. **ኣብ ስራሕቲ መስኖ ዘለኩም ሓሳብ ታይ ይመስል? ኣብ ኣናእሽቲ ስራሕቲ መስኖ ዘለኩም ሓሳብ ኣብ ውሕስና ምግቢ ታይ ይመስል?**

_____

_____

3. ፀገም ውሕስና ምግቢ ዘምፅኡ ነገራት ዘርዝሩ?

_____

_____

4.ብተፈጥሮ ዝናብ ዝርከብ ምህርትን ብመስኖ ትረክብዎ ምህርትን አየንኡ ይበልፅን? ንምንታይ?

_____

_____

5. እቶም ዓበይቲ ሽግራት /ፀገማት/ መስኖ ከምፅኡ ዝክእሉ ነገራት ዘርዝሩ?

_____

_____

6. ኣብ መንነ መስኖ ዘለዎምን ዘየብሎምን ሓረስቶት ውሕስና ምግቢ ኣፈላላይ ኣሎ ዶ? እቲ ኣፈላላይ ዘርዝሩ?

_____

7. ኣብ መንነ መስኖ ተጠቀምትን ዘይተጠቀምትን ናይ ምግቢ ኣፈላላይ /ዓይነትምግቢታት/ ኣሎ ዶ? እንተሃልዩ ዘርዝሩ?

_____

8. ኣብ ከባቢኩም ማዕረ ዝኸነ መንገዲ መስኖ ተጠቀምቲ ማይ ንዝራእቶም ይጥቀሙዶ?

_____

10.ብመስኖ ኣቢልኩም ኣብ ዓመት ክንደይ ግዜ ተልምዑ?

_____

_____

ዩኒቨርሲቲ መቐለ

ተፈጥሮን ቀመር ሳይንስን ኮሌጅ

ክፍሊ ትምህርቲ ስነ-ሂወት

ፅሑፋዊ መሕትት ንቁልፊ ሓበሬታ ወሃብቲ

መእተዊ

ዝኸበርኩም ቁልፊ ሓበሬታ ወሃብቲ መራሕቲ ስድራ፣ ኪኢላ ሕርሻ ሓለፍትን ጣብያ ኣመሓደርትን ፡- ናይዚ ፅሑፋዊ መሕትት ቀንዲ ዕላማ ናይ ኣናእሽቲ መስኖታት ዘለዎ ረብሓ ኣብ ምርግጋፅ ውሕስና ምግቢ ኣብ መራሕቲ ስድራ ሓረስቶት ኣብ ጣብያታት ማይ ጥዑምን ቤት ያሃንስን ትኹረት ብምግባር ኣመልኪቱ ሓበሬታ ንምርካብ እዩ። እቲ ዝእከብ ሓበሬታ ንመማልኢ ካልኣይ ዲግሪ ብትምህርቲ ስነ-ሂወት ዘድሊ ኮይኑ ኣብተን ኣብ ላዕሊ ዝተጠቀሳ ጣብያታት ትኹረት ዝገበረ እዩ። ናታትኩም ምትሕብባር ንዕዉትነት እዚ መፅናዕቲ ወሳኒ ስለ ዝኾነ ነዚ ፅሑፋዊ መሕትት ብጥንቃቐን ብምስትዉዓልን ንኽትመልእዎ ብትሕትና ይሓትት። እትህብዎ ሓበሬታ ነዚ መፅናዕቲ ጥራሕ ዘገልግልን ምስጢራዊነቱ እዉን ዝተሓለወ እዩ።

ንምትሕብባርኩም ካብ ልበይ የመስግን!!!

1.ኣብ ከባቢኩም /ጣብያኩም/ ንዘለው መስኖታት ዓበይቲ ፀገማት ዝፈጠሩ ነገራት ዘርዝሩ?

_____

_____

2.ኣብ መንነ መስኖ ተጠቀምትን ዘይተጠቀምትን ኣፈላላይ ውሕስና ምግቢ ኣሎዶ? ሀ. እወ ለ. የለን/አየጋጥምን/ መልስኩም እወ እንተኾይኑ ዘርዝሩ?

_____

_____

3. **ኣብ ጣብያኩም ንዘለው ሓረስቶት ፀገም ውሕስና ምግቢ ዘምፅኡ ነገራት ዘርዝሩ?**

_____

4. ኣብ ጣብያኩም መሰልጠኒ ሓረስቶት ኣሎ ዶ? ሀ. እወ ለ. የለን

መልስኩም እወ እንተኾይኑ፣ ካብ ገዛኩም ክንደይ ኪሎ ሜትር ይርሕቅ?

_____

5. ምስ ናይ ዕቤት ውሕስና ምግቢ ዘረጋግፅ ትካል ትራከቡ ዶ? ሀ. እወ ለ. የለን

መልስኩም እወ እንተኾይኑ ኣብ ወርሒ ክንደይ ግዜ ትራከቡ? ሀ. ሓደ ግዜ

ለ. ክልተ ግዜ ሐ. ልዕሊ ክልተ ግዜ

6.መስኖ ተጠቂምኩም ኣብ ዓመት ክንደይ ግዜ ተፍርዩ? _____

7. መስኖ ክትጠቀሙ ከለኩም ዝራእትኩም ካብ ጥቕሚ ወፃኢ ይኾኑ ዶ?

ሀ. እወ ለ. ኣይኮንን መልስኩም እወ እንተኾይኑ ብምንታይ ምክንያት?

_____

8. ፍልፍል ማይ ንመስኖ ትጥቀሙሉ ታይ እዩ?

ሀ. ወሓዚ ሩባ ለ. ፍልፍል ማይ ሐ. ዕጅር ማይ መ. ጉድጋድ ማይ ሰ. ካልእ ይገለፅ

9. ትጥቀምዎ ማይ ካብ መስኖ ቦታኩም ክንደይ ዝኣክል ርሕቀት ኣለዎ ብኪሎ ሜትር ይገለፅ?

_____

_____

10.ሓደሽቲ ቴክኖሎጂ ንከይትጥቀሙ ዘዕቕፍኩም ፀገማት ታይ እዮም?

ሀ. ርሕቀት ማይ ካብ መስኖ ዝካደሉ ቦታ ለ. ሕፅረት ንመስኖ ዝውዕል መሬት

ሐ. ዋጋ ናይ መስኖ ኣቁሑት መ. ሓፈሻዊ ዋጋ ናይ ሓደሽቲ ቴክኖሎጂታት

11.ክጥቀስ ዝግበኡ ፀገም እንተሃልዩ ይጥቀሱ?

_____

_____

ዩኒቨርሲቲ መቐለ

ተፈጥሮን ቀመር ሳይንስን ኮሌጅ

ክፍሊ ትምህርቲ ስነ-ሂወት

ፅሑፋዊ መሕትት ንመራሕቲ ስድራ መስኖ ዘይተጠቀምቲ

መእተዊ

ዝኸበርኩም መራሕቲ ስድራ መስኖ ዘይተጠቀምቲ ፡- ናይዚ ፅሑፋዊ መሕትት ቀንዲ ዕላማ ናይ ኣናእሽቲ መስኖታት ዘለዎ ረብሓ ኣብ ምርግጋፅ ውሕስና ምግቢ ኣብ መራሕቲ ስድራ ሓረስቶት ኣብ ጣብያታት ማይ ጥዑምን ቤት ያሃንስን ትኹረት ብምግባር ኣመልኪቱ ሓበሬታ ንምርካብ እዩ። እቲ ዝእከብ ሓበሬታ ንመማልኢ ካልኣይ ዲግሪ ብትምህርቲ ስነ-ሂወት ዘድሊ ኮይኑ ኣብተን ኣብ ላዕሊ ዝተጠቀሳ ጣብያታት ትኹረት ዝገበረ እዩ። ናታትኩም ምትሕብባር ንዕዉትነት እዚ መፅናዕቲ ወሳኒ ስለ ዝኾነ ነዚ ፅሑፋዊ መሕትት ብጥንቃቐን ብምስትዉዓልን ንኽትመልእዎ ብትሕትና ይሓትት። እትህብዎ ሓበሬታ ነዚ መፅናዕቲ ጥራሕ ዘገልግልን ምስጢራዊነቱ እዉን ዝተሓለወ እዩ።

ንምትሕብባርኩም ካብ ልበይ የመስግን!!!

1. **ዕድመ**_____

2. **ፆታ**_____

3. **ብርኪ ትምህርቲ**_____

4. **ዘለዎም ሓላፍነት**_____

5. **በዝሒ ስድራ**? _____

6. **ንምንታይ እኩም ኣናእሽቲ መስኖታት ተጠቀምቲ ዘይኮንኩም**?

ሀ. ሕፅረት ማይ ለ. ሕፅረት ኣሕምልትን ፍራምረን ዝራእትን ሐ. ሕፅረት ንመስኖ ዝከውን መሬት

መ. ሕፅረት ግንዛበን ምክሪን ሰ. ሕፅረት ኢኮኖሚ ረ. ካልእ እንተኮይኑ ይገለፅ

_____

_____

7. መስኖ ንክትጥቀሙ ዘተባበዓኩም ሰብ ኣሎ ዶ? ሀ. እወ ለ. የለን መልስኩም እወ እንተኮይኑ ንምንታይ እኩም ኣናእሽተይ መስኖ ተጠቀምቲ ዘይኮንኩም ምክንያት ይጠቀስ?

_____

_____

8. ኣብ ምርግጋፅ ዒሕስና ምግቢ ኣናእሽተይ መስኖታት ምጥቃም ረብሓ ኣለዎ ዶ ይብሉ?

ሀ. እወ ለ. የብሉን መልስኩም እወ እንተኮይኑ ብከመይ መንገዲ ይገለፅ?

_____

_____

9. ንኩሎም ይግበኣኒ በሃልቲ ኣካላት መስኖ ንክተጥቀሙ ፀገምኩም ንክፍተሐልኩም ቲሓትዎም ዶ? ሀ. እወ ለ. ኣይንሓትትን መልስኩም እወ እንተኮይኑ ዝሃቡኩም መልሲ እንታይ ነይሩ?

_____

_____

10. ኣናእሽቲ መስኖታት ተጠቀምቲ እንድሕር ዘይኮንኩም እኮኖምኩም ብከመይ ተዕብዩ?

_____

_____