



**ADDIS ABABA UNIVERSITY
COLLEGE OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL
STUDIES**

**THE CONTRIBUTION OF SMALL SCALE IRRIGATION TO INCREASE
AGRICULTURAL PRODUCTION IN BANJA DISTRICT WITH
PARTICULAR REFERENCE TO KESSA CHEWSA KEBELE, AWI ZONE,
AMHARA REGION, ETHIOPIA**

**BY
AMSALU CHEKOL MEKONNEN**

**AUGUST 2024
ADDIS ABABA, ETHIOPIA**

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ENVIRONMENTAL STUDIES OF ADDIS ABABA UNIVERSITY, IN PARTIAL
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GEOGRAPHY AND ENVIRONMENTAL STUDIES**

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ADDIS ABABA, ETHIOPIA

LETTER OF APPROVAL

This is to certify that the thesis prepared by Amsalu Chekol Mekonnen entitled: the contribution of the small scale irrigation to increase the agricultural production and productivity in Kessa Chewsä Kebele at Banja district in Awi zone Amhara Region, Ethiopia and submitted in partial fulfillment for the degree of master of arts in Geography and Environmental Studies in the College of Social Science in Addis Ababa University merits with the accepted standards in respect to original and quality.

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The Statement of Author

First, I declare that this is my own work and that all source of materials used in the thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for degree of Master of Arts in Geography and Environmental Studies at Addis Ababa University and is deposited at the University Library to make available to borrowers under rules of the library.

Name: Amsalu Chekol Signature _____

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DEDICATION

I declared this endeavor to my family and to all those have provided me with moral as well as material and financial support, encouragements and sacrifices throughout this process.

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LIST OF ACRONOYOMS

ACSI	Amhara Credit and Saving Institution
ANRS	Amhara National Regional State
AWM	Agricultural Water Management
DAs	Development Agents
FGD	Focused Group Discussion
FSP	Food Security Program
FTC	Farmer Training Center
GDP	Gross Domestic Product
KII	Key Informative Interview
ML	Millimeters
MOA	Ministry of Agriculture
MOWE	Ministry of Water Resource and Engineering
MSSI	Modern Small Scale Irrigation
NMTIP	National Medium Term Investment Program
PASDEP	Plane for Accelerated and Sustained Development to Eradicate Poverty
PSNP	Production Safety Net Program
SPSS	Statistical Package for Social Science
SNNPR	South Nation, Nationalities and Peoples Region
SSA	Sub Sahara Africa
SSI	Small Scale Irrigation
TYPDP -	Ten Year Pespective Devvelopement Progarm
WSDP	Water Sector Development Program
WUA	Water Users Association

ABSTRACT

Assessing how small-scale irrigation affects agricultural productivity is the study's primary objective. In this survey, a mixed research technique used to utilizing both qualitative and quantitative methods was employed. In addition, the study has utilized a descriptive research design in order to accomplish the aforementioned goal. Questionnaires were used to gather socioeconomic data from 286 randomly selected sample households in the sample kebele, including both irrigation users and non-users. Additional data also obtained from secondary sources, KII, FGD, and firsthand observations. Statistical methods for descriptive and inferential analysis were applied in order to arrange, examine, and present the data. This study, which examined the effects of SSI production, produced some significant findings, including the fact that irrigation users and non-users differ significantly in terms of income, asset ownership, the security of food crop production, and living conditions. High rates of extension service delivery, non-farm income, and market and credit and training accessibilities, and farming technology availability have all been demonstrated to be critical elements of the area's irrigation farming determinants. The government also encouraged high productivity and SSI output. Permanent trees that have spread over a significant percentage of the area probably reduce the quantity of irrigable land that each household owns. The study found that irrigation farming is more important for agricultural expansion than family labor force, families clearly differ in their economic and food security position, and there is a lack of family labor force. According to the inquiry, the area currently covered in trees should be converted to irrigation farms in order to boost food crop output as well as household income, asset holding, and standard of living. In order to protect food crops' failure, revenue, and assets and to improve their quality of life overall, it is also imperative that actions be taken to change the way some families see and understand irrigation farming. A number of households ought to be granted credit to operate irrigation farming by lowering collateral requirements and devising efficient means of obtaining the loan.

Keywords: Contribution, small scale irrigation, agricultural production, productivity, irrigation users, non-users, Banja district

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

Agriculture is one of the oldest economic activities that emancipated mankind from gathering and hunting livelihood from the natural environment. It has under gone several changes. Also it has indisputable importance in human life and development. According to Uko (2020) agriculture at the minimum accounts for about 40% of the world's economy and 80% of the biophysical needs of the poor. It can be more contributing by promoting climatic and environmental protection and sustainable development.

Small Scale irrigation (SSI) development has shown throughout the developing world that it can be used as a key drought mitigation measure and as a vehicle for long-term agricultural and macro-economic development of a country (Lebdi, 2016).

Ethiopia is predominantly an agrarian country with a vast majority of its population directly or indirectly involved in agriculture. Agriculture is the basis for the national economy which supports industry and trade of the country to a great extent and it is mostly small-scale, and rained, traditional and subsistence farming with limited access to technological and institutional support services Achmad, et al. (2022). The country is believed to have the potential of 5.1 million hectares of land that can be developed for irrigation through the river and spring diversion, pump, gravity, pressure, underground water, water harvesting and other mechanisms (El Gayar, 2020). Irrigation is one of the major inputs of agriculture which plays an important role to stabilize agricultural production and alleviate the negative impacts of variable or inadequate rain fall (Seleiman, et al 2021). It has also potential to increase both yields and cropping intensity (Waha, 2020).

Irrigation development has been given priority in the ten year perspective development strategy of Ethiopia. Under the program, irrigation is planned to be introduced and implemented in areas where agro-ecological conditions are in harmony with the interventions (Scaramuzzi, 2021).

At primary level, the government of Ethiopia, in collaboration with its development stakeholders, has developed a Food Security program (FSP) with in the frame work of Ten Year

Development Program) and the FSP, due emphasis has been given to developing and using the huge potential of the country for irrigated agriculture to produce food crops as well as raw materials needed for agro-industries (Aboye, 2022).

About 50 - 60% of Ethiopians are food grain cultivation insecurity and under poverty line, of this 2.5 million peoples in the region do not have reliable food supply (Kebede, 2020).

Awi Zone is among the eleven zones of Amhara region, in general and Banja district, in particular, are one of the producing areas in the region (ANRS). The households in Awi zone and Banja district are applying the Ten Year Perspective Development program (TYPDP) with the help of the DAs; and are trying to improve household's food production and agricultural productivity.

1.2 Statement of the Problem

Numerous research studies have examined the role that small-scale irrigation and associated factors play in supporting households engaged in irrigation farming across various regions of Ethiopia. Geddafa et al. (2021) have shown that the benefits of small-scale irrigation are not equally distributed across households. Similarly, Jambo et al. (2021) have confirmed that households have limited access to institutional and technological supports. The role that small-scale irrigation plays in raising agricultural productivity is no longer being studied. On the other hand, Jambo et al.'s research findings on the practice of families with small irrigation systems (2021). Muleta, et al. (2021) found that SSI has the ability to boost yield and crop intensity. They have highlighted similarities with my research, despite the fact that we are doing separate topics. SSI helps stabilize agricultural production and reduce greenhouse effects. According to Giller et al. (2021), rain-fed agriculture could not be sufficient to address the nation's significant food need.

The vast majority of Ethiopia's population is concentrated in the high land areas, which is in most cases, experiences adequate rainfall during the main rainy season and supports mixed farming system. Thus, in the past, irrigated agriculture as such has not been priority issue for those particular areas. However, considering the current situation, which includes erratic nature of rain, tremendous loss of fertile top soil, decline of agricultural production at household level and ever increasing population pressure, necessitated close attention to water resource management and small scale irrigation development (Yigezu, 2021).

Awi Zone in ANRS has been known with surplus producing areas of the region. The area is more or less suitable for agricultural crop production practices but through time the area faces difficulties in its production because of the above stated problems and other challenges like population pressure that led to land fragmentation, low inputs and the replacement of farm land by Eucalyptus, Bamboo and Decrens acacia trees, etc. Together with the ever increasing food price and the loss of soil fertility badly need great attention and wise intervention to the problems. Thus, I have firmly initiated to conduct this study to assess the contribution of small scale irrigation to increase agricultural production and productivity of crop yield which is the major target of livelihood food security and asset holding status of area by households of irrigation and rain-fed framings in the study.

The study region has a lot of water potential, and the local farmers have long used both conventional and contemporary small-scale irrigation techniques. It is believed that small-scale irrigation will increase food security and agricultural productivity. It is unclear, nonetheless, to what degree households in the research area that rely on irrigation, `also known as irrigation users, are better off than those that do not,in terms of household income, the sufficiency of food crop production, living standards, and asset holding status. In order to boost agricultural productivity and output and to determine what factors influence rural households' involvement in small-scale irrigation, there has also been a dearth of significant research in this field that has looked at the assistance of agricultural development agents and the function of government-based supportive services.

The research project was therefore designed to evaluate the role of small-scale irrigation to increase agricultural production in the study area under the premise that it would improve household asset holding status, income, and food grain production.

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of the study was to assess the contribution of small scale irrigation to increase agricultural production between the sampled household head irrigation users and non-

users in the context of annual food security sufficiency, income, living condition and asset holding status.

1.3.2. Specific Objectives

- i. To assess the application of small scale irrigation activities in the area
- ii. Examine the contribution of small scale irrigation to households' in their farm income, improved living condition, food security and asset holding status.
- iii. To identify factors influencing the activity of small scale agricultural irrigation based production and productivity of the study area.
- iv. To explore the role government based service delivery in support of agricultural production activities to increase the efficiency of small scale irrigation users.

1.4. Research Questions

This thesis has proposed to answer the following research questions.

1. What look like the application of small scale irrigation activities in the area?
2. How the SSI contributed the households in their income, food crop security, living condition and asset holding status?
3. What are the factors influencing the performance of small scale irrigation at the study area?
4. How the government based service delivery had supported the production of small scale irrigation in the study area?

1.5. Significance of the Study

This study is very important as it will enable small scale farmers to use this theoretical knowledge and become a reference material for future researchers in the study area. The outcome from this study will be used by small scale farmers to improve agricultural production, productivity, income, and private asset holding through implementation of small scale irrigation and provides fundamental knowledge on economic status of users and non users and empowers local leaders and institution to make decisions in SSI in the area.

1.6. Scope of the Study

The study targets Awi Administrative Zone, in Amhara region, particularly, a small part of Banja district, which is known as Kessa Chewsa Kebele. It was based on the specific case of Zengena River small scale irrigation schemes. It shall examined the performance of irrigation and rain fed farming of the household heads in connection with their living condition, annual income, food security and asset holding status in the study area. This study was conducted considering the timeline of 2023 by using mixed approach and descriptive desing to generate assertive conclusion on basic questions drove the investigation to becarried out. It also tried to utilize the conceptual and theoretical literatures to understand the fullest secle of the problem under in investigation.

1.7. Limitations of the Study

The study was subjected to some limitations, such as political instability in the study area, shortage of time, and money, my own technical skill constraint of doing research and limited access for secondary data collected from woreda. Some of the sampled households and extension workers were quite reluctant to collaborate with researcher to provide the required data (information) at a desired time frame. To overcome the shortage of money I tried to collect data using the time by delegating individuals to help me and exploit the allocated money in an effective way and the security issue by gathering information local households that war and conflict would not happen at the area. To fill the skill gap I have consulted experienced individuals and reviewed you tub sources as internet service started by the decision of Ministry of Education of Ethiopia in Amhara region.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter attempts to present related literatures reviews in relation with the contribution of small scale irrigation in improving the socioeconomic status of the practicing households, particularly the definition small scale irrigation, the history of irrigation, the importance of irrigation to households, irrigation practice and development in Ethiopia, different types of irrigation implemented around the world, concept and contribution small scale irrigation, the role of government based service delivery in support of irrigation farming and some lastly reviewed the theoretical literature review written centering the concept and contribution of irrigation farming for applying farmers.

2.2 Definition and Concepts of Irrigation

A case of agricultural development in which technology intervenes to provide control for the soil moisture regimes in the crop root zone in order to achieve a high standard of continuous cropping is irrigation development, as defined by Suna et al. (2023) as the simulated implementation of water resource to crops for the purpose of food and fiber production, overcoming deficiencies in rainfall and helping to create stabilized agriculture. Irrigation is another term for Abhilash et al. (2020)'s definition of ministering land by artificial water application to ensure double cropping and a consistent supply of water in locations with unpredictable rainfall.

Irrigation is one component of Agricultural Water Management (AWM). It is about applying water to crops, orchards, grasses or other cultivated plants from surface and ground water sources when natural rainfall is not enough to, reliably, produce desired crop yield and quality. Irrigation is an important technology as food, fiber, and bio-energy crops all need water to grow and lots of it. In arid region it is not possible to grow crops without irrigation while, in more temperate regions, natural rainfall may not be sufficient or sufficiently reliable to produce acceptable yields and good crops quality and so farmers practice supplementary irrigation to make up the short fall.

2.3 The History of Irrigation

The history of irrigation goes back to ancient Egypt, India, china, Spain and Portugal; they are the pioneers of irrigation farming (Aubriot, 2022). Aubriot wrote irrigation to be one of the oldest agricultural practices adopted by mankind before recorded history. The writer had specified that such ancient countries as Babylon, Assyrian, Persia, Ceylon, China, Palestine, etc. irrigation practiced long ago between 4000 – 2000 B.C (Ravindran, 2023). At Gobdera, near Axum cultivated seeds of finger millet dating about 5000 years were found as evidence. It can be taken as indication of beginning of crop domestication in Africa between the last 20,000 and 4000 years Smith, C., & Berger, E. (2023). The human race was cradled and grew to maturity in irrigation countries “reminds that Ethiopia is the mother of mankind that began irrigation farming, Berger, et al. (2023). Water harvesting began since the last 9000 years ago. This practice is decisive for irrigation in Ethiopia (Tufa, 2021). By 4000 B.C India and Axum had advanced irrigation practices (Fuller, 2020).

2.4 The Importance of Irrigation

Irrigation is like indemnity, it enables farmers to produce good, reliable crop yields, often 2-3 times more than those of rain fed crops, provided they have all the other agricultural input such as improved and good seeds, fertilizers, and pesticides. Irrigation can reduce the impacts of frequent and severe drought but does not eliminate all the risks of water shortages. During severe drought, water for irrigation may not always be available as the water source may be vulnerable to local rainfall condition as cropping. Irrigation farming systems play an important role in global food security. Some 300 million hectare is irrigated land produced over 40% of the world’s food and natural fiber. What is not always recognized is that 70% of the world’s fresh water with drawls is already committed to irrigated agriculture. In developing countries including some in Sub-Sahara Africa (SSA), this figure can reach more than 90% of available water nationally (Jha, P., & Schmidt, 2021). Irrigation is also assumed to be a major contributor to the increase in food production that changed countries like Bangladesh and India from famine-prone regions to food surplus regions (Alamgir, 2023). Apart from producing crops, irrigation systems in developing countries are vital to rural livelihoods, providing water for livestock and fish production, domestic use and many small enterprises. The primary reason for irrigation was

to improve agricultural productivity in areas where surface soils are naturally drier that would be real cause for people to suffer from food security.

2.5. Irrigation development in Ethiopia

The Ethiopian economy is dominated by small holder agriculture, which accounts for 46% of the GDP, 87% of the export commodities and 66% of the employment (Muluye, 2021). The majority of the sector depends on rainfall. Irrigation and improved agricultural water management provide opportunities to cope with the impacts of climatic variability and to enhance productivity per unit of land and to increase the production value. Irrigated agriculture is not an entirely new phenomenon in Ethiopia. As some literatures indicated, small scale traditional irrigation has been practiced for decades throughout the highlands where small farmers could be diverted seasonally for limited dry season cropping (Tufa, 2021). According to Gebul, (2021) modern irrigation has documented in the 1960s where the government designed large scale irrigation project in the Awash Valley to produce food crops for domestic consumption and industrial crops (sugarcane and cotton) for export value and raw materials for industries. It was strongly believed that rain fed agriculture should be supplemented by irrigation in order to achieve national food self-sufficiency and ensure household food security. The total irrigation potential in Ethiopia is 3,798,782 hectares but currently irrigation schemes have covered only 368,160 ha, 10% of the potential (Abdiyo, 2021). According to Golmohammadi, (2021) the reason for the poor development of irrigation in the country are fragmented and small farmland, political instability, lack of technologies, government owned land policy, lack of financial resources and weak institutional set up in the country.

2.6. Types of Irrigation

There are different criteria for the classification of irrigation schemes around the world. The main criteria frequently used for the classification of irrigation schemes are the irrigated area, scale of operation and management types. The most commonly used classification is Small, Medium, and Large scale irrigation schemes, though the interpretation of these categories may vary from country to country. For example, in Ghana an irrigation scheme of 300 hectares is classified as small-scale, where as in India 10,000 hectares is categorized as small-scale (Jain, 2024).

In Ethiopia during the Derg regime, Irrigation schemes were categorized in to three types based on its size in to small-scale (less than 200 hectares), Medium scale (200-3000 hectares), and Large scale (more than 3000 hectares) (Getnet, 2022). The three types of small irrigation are

- Small-scale irrigation- which is often community based traditional methods covering less than 200 hectares.
- Medium scale irrigation which community based or publicly sponsored, covering 200 to 3000 hectares.
- Large scale irrigation covering more than 3000 hectares, which is typically commercially or publicly sponsored.

Another classification takes in to account size and management (Rocha, et al, 2023).

- Traditional small-scale irrigation schemes up to 100 hectares built and operated by farmers in local communities.
- Modern commercial schemes up to 200 hectares built by government agencies with farmer participation.
- Modern private schemes up to 2,000 hectares owned and operated by private investors individually, in partnership, or as corporations.
- Public schemes of over 3,000 hectares owned and operated by public enterprise as state farms.

Irrigation also can be typified in to various kinds in reference to techniques of applying water to crops (Singh, 2021). They can be considered as irrigation techniques or methods. They include Surface, Sub-Surface, Drip and Sprinkler.

2.7 Type of Small Scale Irrigation

2.7.1 Traditional River Diversion

Traditional river diversion was the dominantly applied method of small scale irrigation farming practiced by households in the study area. This irrigation system was very simple for household to practice and does not need high level technological application instead they use inherited indigenous knowledge from parents and grandparents. Although, the geographical location of the study area is situated in the highland area where moisture availability is relatively high, the household heads were suffering from minimal amount of water and seasonality of rivers. Many

households use traditional irrigation type of farming to complement their cultivation systems mainly on the river Zengena. There are also couples of very small streams used for irrigation in the sampled kebele.



Figure 2:1 The canal of water for traditional irrigation farming
Source: own field survey, 2023

2.7.2 Motorized Pump

Motorized pumps were less used in irrigation systems in the study area compared to that of traditional irrigation method. Most of the household heads were dependent on the use of traditional river diversion based irrigation type so as to subsidize their family food grain production and food crop security, income, living condition and wealth creation by households.



Figure 2:2 Simple stream diversions for irrigation
Source: own field survey, 2023

2.7.3 Rope Pump

This is a type of small-scale irrigation with pumping arrangement for lifting water mainly from underground water using a rope to fetch water to the surface where diversion by gravity may not be feasible. This is vitally important technology used in the expansion and development irrigation farming in the agricultural economy.



Figure 2:3 Water from a well being pulled to a surface for irrigation
Source: own field survey, 2023

2.8 Concept, and Contribution of Small Scale Irrigation

2.8.1 Concepts of Small- Scale Irrigation

Small scale irrigation is a type of irrigation that defined as schemes that are controlled and managed by the users. In the same way small scale irrigation is a type of irrigation defined as irrigation, on small plots, in which farmers have the controlling influence and must be involved in the design process and decision about boundaries, the layout of the canals, and the position of out let and bridges, (Bharil, 2022). The small scale irrigation provides employment opportunities, the production exportable products, and generates foreign exchange.

The Federal or Regional Government Bureau of Water Resource, Irrigation Authorities or Commissions for Environment and Sustainable Development are responsible for the construction of modern small-scale irrigation schemes. These bureaus or authorities transfer irrigation

schemes to WUAs after the construction is completed for management, operation and maintenance with professional support from concerned regional bureaus or authorities.

Modern Small Scale Irrigation(MSSI) development and management started in the 1970's initiated by the Ministry of Agriculture (MoA) in response to major drought, which caused wide spread crop failures and food insecurity. After the Ethiopian rural land proclamation of 1975, the government nationalized the large irrigated farms and the small scale irrigation schemes were transformed in to cooperatives. The government began to focus on the potential of small scale irrigation through giving assistance and support to adopt modern technologies, rehabilitation and up grading of traditional schemes after major famines in Ethiopia (Yohannes, 2020)

2.8.2 The Contribution of Small-Scale Irrigation to Households

The study considered the economic contribution of small scale irrigation on household food crop production, annual farm income improvement and asset holding status. Irrigation investment in India enabled farmers to increase diversification of crops, and use of more chemical inputs like pesticides, fertilizers or improved seed varieties (Kamble, 2023) and switched from low-value subsistence production to high-value market oriented production in china (Ahmad, 2020).

In many developing countries, Small scale irrigation schemes were considering as a means to increase production, reduce food insecurity and employment to poor farmers (Hlophe & Mpandeli, 2021). Small scale irrigation is a policy priority in Ethiopia for rural poverty alleviation, food security and growth. It enables households to generate more income, increase their resilience's, and in some cases transform their livelihoods (Geda, 2023).

Small scale Irrigation in Ethiopia contributes to increase farmer's income, household resilience (Mume, 2021) and buffering livelihoods against shocks and stress by producing higher value crops for sale at market and to harvest more than once per year. In turn, this provided them to build up their assets, by more food and non-food household items, educate their children, and reinvest in further increasing their production by buying farm inputs or livestock. However, the benefits are varying; unevenly distributed among households (Tadele, 2021).

2.9 The roles of government based service delivery in the development of small scale irrigation in Ethiopia

The expected roles of the government in Ethiopian economy in general and small scale irrigation expansion and development in particular ranges paramount extent of duties. Enacting policies and strategies, for instance, to stimulate the growth and development of domestic economy by creating suitable environment for participants is one of amongst grand duties of the government in Ethiopia. Major responsibilities of the government in the development of Ethiopian small scale irrigation agriculture constitutes provision of law and order, training of households on saving and production methodologies, funding the small scale irrigations projects, etc. in order to ensure wellbeing of small householder farmers and sustained agricultural development.

2.10 An Overview of Ethiopia's Agricultural Production and Productivity

Agricultural production and productivity in Ethiopia has been affected by increasing population, deforestation and land distribution. This reflected in a decrease in household production, grazing land. Hence, it has become a common phenomenon to ask for emergency food assistance for acutely food insecure people in Ethiopia (Melese, 2022).

According to Yigezu, (2021) in Ethiopia, due to the situations of people who do not have the capacity to produce or buy enough to meet their annual food needs even under normal weather and market conditions a total of 5.23 million people would need emergency food assistance.

2.11 Determinants of Household Irrigation Participation and Food Security

Different studies were conducted to identify determinants of irrigation participation and food security in different countries including Ethiopia. For example, a study conducted by Yirdaw, (2021) found that household head education level, gender of the head, age of household head, land holding, livestock units, access to credit from financial institutions, farm land size, distance to markets, household sizes, access to market information, road transportation, and training are some the factors that would influence the participation of households in irrigation farming. Similar studies found that rural association, information access are vital instrument to bring attitudinal change and motivate respondents to adopt new technologies through informal education, panel discussion, public meeting and other demonstration (Wolfe, 2021). According to Bryan, et al (2021), farmers who are member of the formal and informal institutional (Water

User Association, Peasant Association and Local leadership), education are factors influenced to participate in irrigation farming.

2.12 Theoretical Literature Review

An essential agricultural practice is irrigation, which is the artificial application of water to crops to augment natural rainfall. A number of theories have been evolved over time to explain the tenets and practices of irrigation. These theories offer insightful information on the various facets of irrigation, such as crop productivity, environmental sustainability, and water management

2.12.1 Water Balance Theory

The water balance theory, which highlights the significance of preserving a balance between water supply and demand in agricultural systems, is one of the fundamental ideas of irrigation. This idea states that in order to guarantee the best possible growth and production, the amount of water given to crops needs to be carefully controlled. In order to reduce water waste and increase agricultural output, this theory also emphasizes the necessity of effective water management techniques, such as sprinkler systems and drip irrigation (Ambomsa, 2020).

2.12.2 Soil Moisture Theory

The soil moisture hypothesis, which emphasizes the function of soil moisture in plant growth and development, is another significant theory of irrigation. According to this hypothesis, sustaining appropriate soil moisture levels is necessary to guarantee that crops' roots develop properly and that nutrients are absorbed. Farmers can avoid water stress and maximize crop development by monitoring soil moisture levels and modifying irrigation schedules accordingly (Jones, 2019).

2.12.3 Economic Theory

The issue of water scarcity is central to the economic theory of irrigation. Water supplies are scarce in many areas and rivalry for water among various users including homes, businesses, and agriculture, can result in unrest and inefficiencies (AlEmadi, 2021). Economists examine how water supplies are distributed among various uses, accounting for elements including pricing structures, water rights, and the possibility of increasing water efficiency and conservation. The analysis of irrigation systems' costs and benefits is a crucial component of the economic theory of irrigation, as demonstrated by Gupta, R., & Sharma, S. (2018). Farmers must consider the

upfront costs of establishing and maintaining irrigation systems against the possible increase in yield from their crop. Irrigation infrastructure, such as canals, pumps, and irrigation networks, demands significant investment. Cost-benefit analysis is a tool used by economists to determine the best amount of investment to make in irrigation infrastructure as well as the economic sustainability of irrigation projects. The economic theory of irrigation also takes into account how irrigation affects overall economic development and agricultural output. Crop diversification and income generation are made possible for farmers by irrigation, which can also boost crop yields and improve crop quality. Higher agricultural output can therefore promote economic expansion, open up job opportunities, and lessen rural poverty. Economists research how irrigation affects agricultural output, economic growth, and sustainability. They also evaluate how government actions and policies affect these relationships and how best to use irrigation to benefit society as a whole. To sum up, the economic theory of irrigation offers important insights into the allocation of water resources, the costs and benefits of irrigation systems, and the effects of irrigation on agricultural output and economic growth.

All things considered, irrigation theories are quite important for directing farming methods and encouraging sustainable water management. Farmers are better able to make decisions regarding crop yield, water consumption, and environmental preservation when they have a solid understanding of irrigation principles and techniques. In order to solve the issues of water scarcity and climate change and ensure food security for future generations, more research and development in this area is needed.

2.13 Conceptual Framework of the Study

In increasing agricultural production and productivity, irrigation agriculture plays a crucial role in the sustainable livelihoods of rural communities. Improvement in access to irrigation water serves as a powerful tool to diversify livelihoods and reduce vulnerability for smallholder producers (Etana, et al, 2021). There are five key dimensions how irrigation agriculture contributes to socioeconomic uplift of rural communities. These are production, income, consumption, employment, food security, and other social impacts contributing to overall improved welfare (Darko, et al, 2020).

Irrigation can benefit the poor communities through raising yields and production, lowering the risk of crop failure, and generating higher and year-round farm and nonfarm employment. It can enable smallholders to adopt more diversified cropping patterns and to shift from low-value subsistence production to high value market-oriented production, which increase income of household. Furthermore, Akudugu, et al (2021) explains use of irrigation will enable farm households to produce high value crops, in most cases vegetables, which eventually increase crop and income. Increased income creates consumption stability since the farmers will have access to purchase enough food for households.

In short, small scale irrigation farming enables the households to produce their food crops and commercialized agricultural products to increase food security thereby reducing the risk of rainfall variability problems on their lives and also provides alternative employment opportunity. This in turn drives the formation of surplus food crops that would raise the level of income, asset holding status and maintaining gradual improvements in living condition of the households. The household food production might be influenced by the socio economic situation the households, the size of households, physical environment where they live and various government and private institutions.

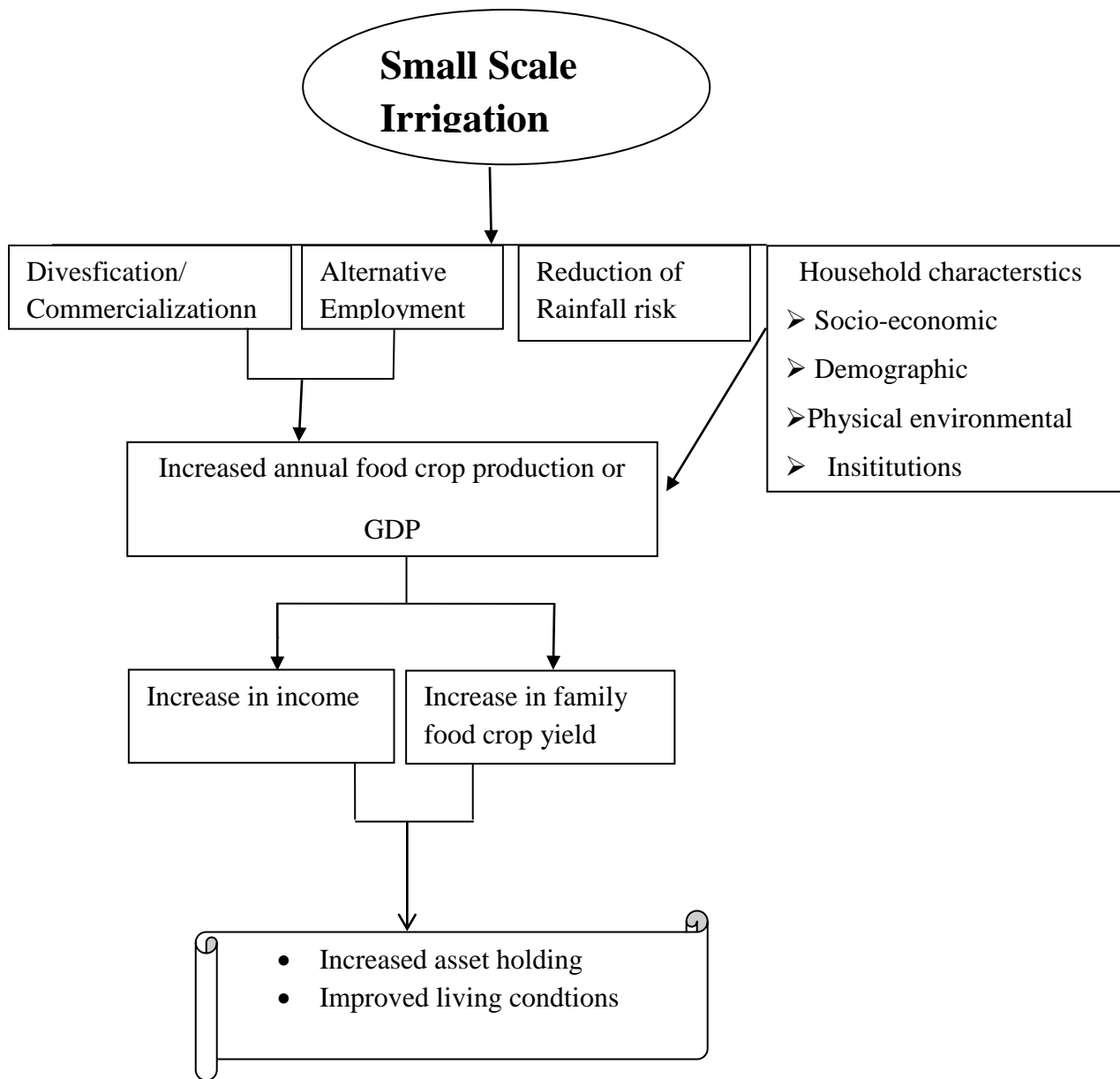


Figure 2:4 Conceptual Frameworks
 Source: The researcher adapted from (Getenet, 2014)

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter deals with description of the study area, research methodology, and the variables involved in irrigation farming and its efficiency. Banja district's location, climate, topography and economic activities are explained very in details. The area also endowed with nithosoil used for different farming practices including vegetation of different plant species. Drainage of the area involves the flow of rivers and streams. Then it tries considering the research design and approach in an integrated manner used to conduct the study to address the problem in the investigation to draw credible conclusion. Data sources and collection tools and sampling size and its techniques used to analyze and present data in the study. Finally, it attempts point out the list of dependent and independent variables.

3.2 Description of the Study Area

3.2.1 Location

Banja district is one of the known districts, for its small scale irrigation found in Awi zone, Amhara Region. It is located between **10°55' 00" to 11° 2'00"North** latitude and **36°26'00" to 37° 8' 00"East** longitude. Injibara is the main town of the district which is 122 kilometers away to the Southwest from the regional capital of Bahir Dar town. Furthermore, the relative location of Banja district is north of Ankesha Goagusa woreda, south of Fagita Lekoma woreda, west of GogusaShikudad woreda and east of Gouangoa woreda. The sample study area located within the district is known as Kessa Chewsa kebele; it is located 4kilometers to the south east of Injibara town. It is one of the 20 rural Kebeles found in the district. The study area is bounded by four rural kebeles, namely **GashanaAkayta** kebele in the north, **Den Zuria**; Kebele in the south, **Wusilakindikan** kebele in the east and **ChabaGisa** kebele in the west.

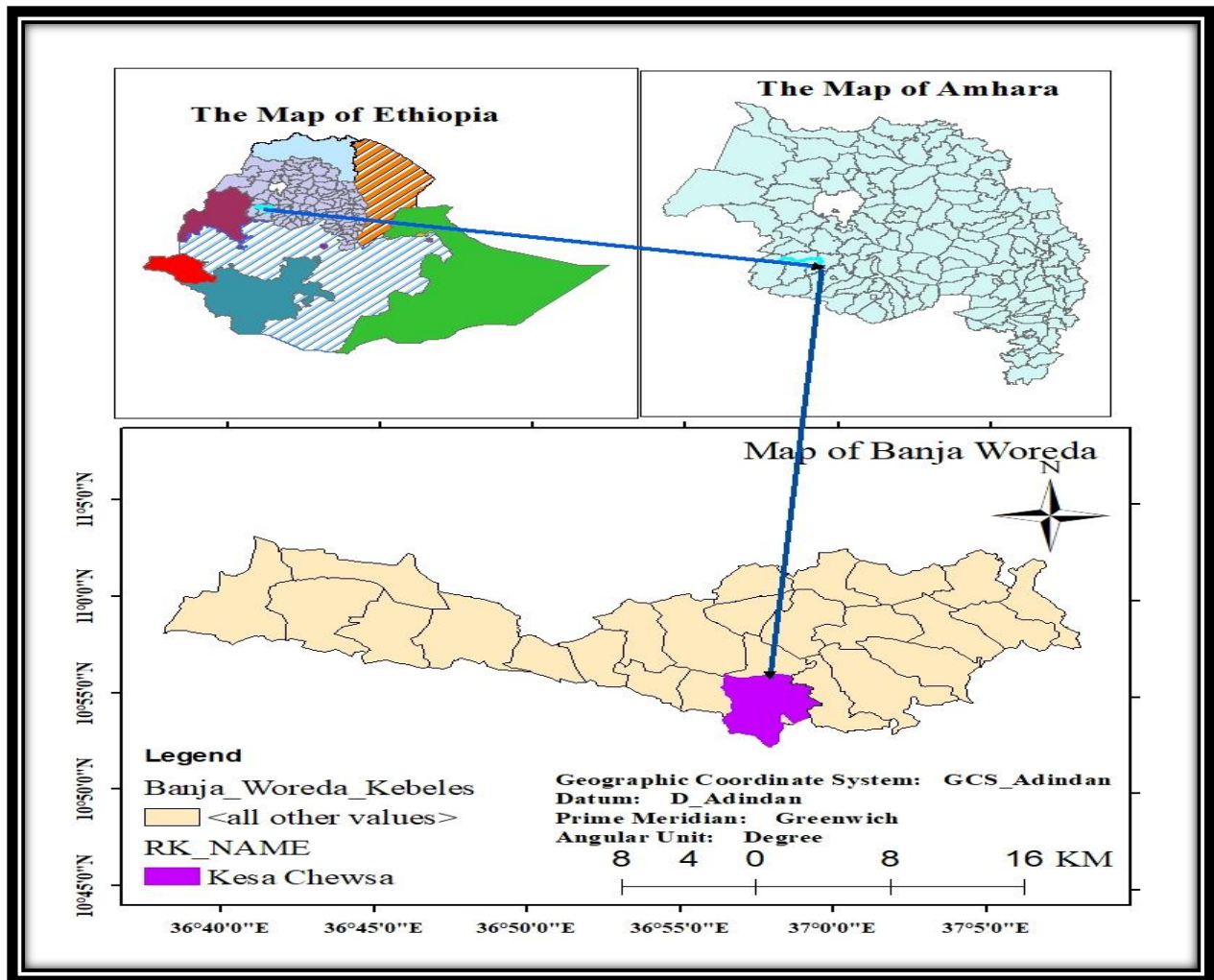


Figure 3:1 Location map of the study area

Source: ArcGis

3.2.2. Climate

The Ethiopian Agro-Climatic Zone division categorizes Banja district under two types of climate zones; woinadega (subtropical) and dega (temperate) climate with moderate temperature and amount of rain fall distribution. However, the climate of Kessa Chewsa kebele is purely the dega (temperate) Climate. The annual rain fall of the Banja district area ranges from 1365 and 1623 millimeters and average temperature of the study area is ranges from 15 to 25°C. its altitude ranges from 1500 – 2600 m.a.s.l which implies under Temperate Agro-climatic zones. This is completely true in case of Kessa Chewssa kebele. Banja district is composed of dega climate which nearly accounts 85% of the land scape lies under this climate type and also woina dega

constituted 15% climate of the area. According to the land survey study of Awi Zone (2017), the study area lies in temperate (dega) climate of the Banja district.

3.2.3 Topography

The study area is situated in the North Western High lands of Ethiopia, which is part of physiographic region characterized by rugged topography branded by modest low mountains, valleys and undulating and rolling plains which enabled to practice of mixed farming system

3.2.4 Economic Activity

Agriculture is the dominant economic activity of the communities living in the study area like in other parts of the country. The farmers of Kessa Chewsa Kebele dominantly produces potatoes, wheat, barley, teff and other crops such as family food grain products and others as cash income generating items using small scale irrigation besides rain-fed farming.



Figure 3.2 Main crops grown in the study area

Source: own survey, 2023

3.2.5 Soil Type

The study area is dominated by Nithosols (red brown soils) which provides the production of different cereals (mainly wheat, barley and teff) and root crops (mainly potato, carrot and onion).

3.2.6 Land Use Types

The land use pattern of the study area experienced multi functionality which categorized under agricultural, pastoral, forestry and settlement purposes. Demographically Kessa Chewsa Kebele had a population of 1008 of which 740 males and 268 females are inhabitants of the

study area. The entire area of the study area in kilometer square is 26.59 or 2659 hectares of which 202 hectares (nearly 8%) of the land is utilized for small scale irrigation purpose.

3.2.7 Vegetation Type

Natural forests dominated by indigenous trees and anthropogenic vegetation types mostly eucalyptus, and decruncse acacia trees are the main vegetation types of the study area. Many areas of the land in the study area are also covered by highland Bamboos which served as cash crops for the household heads residing here.

3.2.8 Drainage System

Banja district is drained by numerous streams and rivers that flow in different directions. The presence of a number of rivers in the district large family size the consequence of reducing food security of a household provided with foundation of small scale irrigation practice that enabled many household heads to conduct small scale irrigation to produce different food crops. The main rivers are Zengena, Fetam and Ayo and all other rivers drain immediately in to river Ayo and Fetam and eventually into the Abay River.

3.3 Research Method

3.3.1 Research Design

This study has adopted mixed research approaches which include both qualitative and quantitative approach which alternatively used to carry out this research. Mixed-method enables the researcher to draw on all possibilities and provides a broader perspective to the study as the qualitative data helps to describe the aspects the quantitative data cannot address. The reason why the researcher used mixed research approach was that it is useful to derive relevant information by referring different sources of data regarding the contribution of small scale irrigation in the agricultural production and productivity. Thus, the researcher had used quantitative and qualitative research approach to describe and to understand the current status of the subject of the study accompanied by utilizing the descriptive design of investigation sought to generate credible solution to the problem.

3.3.2 Data Sources

In this study both primary and secondary data sources were used. The primary data collected using questionnaires, interviews, FGDs and personal field observations. While secondary data also collected from different sources, such as: MA thesis literature review, written reports of Banja district agricultural office, and documents, books and other related documents of relevant institutions and ministries.

3.3.3 Data Collection Tools

The study area had a total of 286 sampled household heads living in different localities ('Gotts') within a single rural Kebele which is known as Kessa Chewsa. Considering time and cost constraints the questionnaire, interviews, focused group discussion (FDG) and personal field observations were applied for gathering the primary data in the selected kebele. The questionnaire items (close and open ended questions) were used to collect data which classified in to demographic and social, contribution of SSI, factors influencing the activity of farming in the study area such as agricultural extension and related supportive services delivered by the government. Interview based data collected from six concerned bodies (three DAs, and three locally well-known elderly irrigation user farmer) were used to assess the contribution of small scale irrigation in enhancing agricultural production and productivity. Data also collected from the field survey for five days repeatedly by both the researcher and his 3 assistant data collectors. Purposely selected five household heads had conducted the group discussion to derive the answer the research questions.

3.3.4 Sampling Technique and Sample Size Determination

Multi stage sampling procedure was used to select the respondent households for the study. In the first stage, the Banja district was selected purposively due to its high potential to irrigation use. In the second stage, from small scale irrigation potential Kebeles, one kebele was identified randomly from 20 small scale irrigation potential Kebeles of the district. In the third stage, out of the selected kebele household heads were stratified in to two group, (small scale irrigation users and non-irrigation users irrespective of their accesses to irrigation water). In this aspect the sample size or composition of sex (demography) of the respondent household heads was justified by mathematical calculation using the sample population. The sample size was determined using

simple formula developed by Yamane (1967) statistically estimated at 95% of confidence level, degree of variability is 0.05 with 90% level of precision and 2 is the correction factor.

$$n = \frac{N}{1+N(e)^2} = \frac{1008}{1+1008(0.05)^2} = \underline{286 \text{ households}}$$

Where: n is the sample size, N is the population (total household size), and e² is desired precision of results set at 0.05. Based on the number of the total households in the sampling frame, equated and reached a minimum of 286 respondents. Following this, sample proportion to the population decided to be 162 households from irrigation users and 124 households from non-irrigation users were randomly identified.

In order to determine the sample size proportion of each sample unit use the formula n/N, which means 286/1008 = 0.2837, then multiply each status by 0.2837. The sex composition of the sample household size was also determined by multiplying with 0.2837 each of the sample households labeled under different irrigation practices as stated below. Thus, irrigation users of the study area were 570 households of which 420 males and 150 females were involved in the study. On the other hand, non-irrigation users were 438 households of which 320 males and 118 female residents of the study area. In each sampling units, the sex of respondents is determined using the systematic random sampling method that enables avoid bias and increase its validity and reliability.

Table 3:1 Distribution sample irrigation users and non-users in the sample Kebele

Status of Irrigation	Total Household Size			Sex composition of selected sample household in each sample units		
	M	F	T	M	F	T
Users	420	150	570	119	43	162
Non users	320	118	438	91	33	124
Total	740	268	1008	210	76	286

Source: Kessa Chewssa Kebele Agricultural office, 2023

3.4 Data Analysis and Presentation

After data obtained from the aforementioned data sources and tools, it was analyzed using different methods of data analysis. Before analysis, quantitative data gathered using the survey

was coded and entered into statistical software known as Statistical Package for Social Sciences (SPSS –version 20). For the quantitative data, the descriptive statistics technique of data analysis was used. Descriptive statistical techniques such as Frequency, mean and percentage were used for presenting difference in socio-economic variables in the analysis of data. More specifically, the SPSS software was used to analyze most of quantitative data collected in the survey. The relationship between determinants of small scale irrigation production and productivity performance was analyzed by using binary logistic regression. To verify whether there is difference or not among irrigation uses and non-irrigation users in terms of income, food crop security, living condition and asset holding status improvements (changes) in households in the study area. The study basically engaged itself in to descriptive statics to describe the collected data in different forms (frequencies, percentages, mean and standard deviations) and inferential statistics (binomial logistic regression, two independent sample t-tests and paired sample t-test) to answer the research questions that initiated the study to be carried out.

3.5 Variables

These are factors that would influence the small scale irrigation practice and efficient performance in order to increase the agricultural production taking place at Kessa Chewsa kebele of Banja District in Awi Zone in Amhara Region of Ethiopia.

3.5.1 Dependent Variable

The dependent variables for the study entitled by “the contribution of Small scale irrigation the increased production and productivity of agriculture” carried out by household heads in the study area in their livelihood they established to assess the effect of small scale irrigation practice and performance on context of:-

Household Income

Productive small scale irrigation farming assumed to generate income for the households in the study area through production of cash crops.

Food Security

Providing food grains for households of Ethiopians is very challenging course that would badly need committed initiation and technological investment in irrigation to improve food crop production.

Asset Holding Status

The level of wealth accumulated by households as a result of conducting effective small scale irrigation clearly ensures improved wealth status of the households and living standards. Practical improvements of wealth generated in the study were quantified by numerating real changes occurred in households' asset size such as sheep, horses, etc. in numeric values.

Better Living Condition

Improving the life style of an agrarian community is essentially important agenda for living standards betterment of households in the study area. The sampled households, in the study area, based on their irrigation status in accordance with their capability of building residential houses and facility fulfillments able to education their children in private or public higher institution and possibly money deposition (saving) were clearly considered.

3.5.2 Independent Variables

Independent variables of the study had considered the following research variables namely

Age of Household Head

It measures age of household head in years. As age of household increases, they can acquire more knowledge and experience in farming and pre assume vulnerability and risk conditions of food insecurity. Mostly choice of crops to be grown is influenced by household heads; hence aged farmers would appear better in terms of preference of decision making. Thus, age of household head is hypothesized to affect food grain production status positively. Age and farming experience have strong link in making irrigation farming to be more effective in ensuring crop production. This was justified considering the number of years (experience) of farming by sampled households as an instrument.

Education Level

It is the number of years of schooling attained by the sampled households' heads up to the time of the survey will be critically considered. Education is expected to have a positive effect on household food security status. Households with better education level are believed to have a chance to apply scientific knowledge and better manage their farm activities in good manner, hence advance domestic production to fulfill household consumption needs. This was considered by suggesting literacy level of household from able to read/write to holding diplomas/degrees as achievement which could positively affect small scale irrigation production.

Household Size

Family labor plays an important role, particularly in rural families as a factor of production. Therefore, household with more agricultural labor results with more profitability in food grain production if available farming land can accommodate household productive labor force appropriately otherwise they will be a burden to the family. Hence, increasing by one household labor has positive influence in increasing agricultural production and has positive contribution to household food security. The number of family labor involved in irrigation farming clearly taken into account.

Irrigable Land Size

This refers to total cropping land cultivated by a household in the past one year irrigation production period. It has a direct relation with crop production. A larger size of irrigation based cultivated land implies more production and availability of food grains. Hence, size of cultivated land will be expected to have positive impact on household food security status. The total land holding size and land typically allocated for small scale irrigation was deeply considered.

Access to Credit Service

Credit is very much useful to purchase inputs such as improved seeds and other important inputs. Hence, farmers who have access to credit would have positive effect on crop production due to use of agricultural inputs which enhance food production and ultimately increase household food security status that will indicates the direct relationship of credit and household food security. The time it takes to get credit service and the quality and quantity of credit securing requirements

(collaterals) are best considered in the aspect of raising food crops, income, living condition and asset holding status of households.

Participation in Training Service

Extension service plays an important role for rural farmers in terms of providing advice and information. Among these, training is one of useful service to introduced and develop practices of modern technologies (proper types and rates of fertilizer, improved varieties of seeds, agro-chemicals, etc.) Hence, those household's participated in training organized at FTC or farm demonstration is supposed to apply their knowledge to increase farm production. Thus, households would be in a better position of food security status. The length of training hours and its frequency accompanied by quality of training provision was deeply considered investigation.

Economic Factors

The economic status of the households shows currently that farmers have economic related factors to perform/practice their small scale irrigation. Households conducting small scale irrigation using their own money without loan can easily produce food grains than households doing farming via loan. Hence, SSI production is efficiently supply of food crops when the households are getting their own money and this enables them to manage their farming. The households without own cash could experience inefficiency in small scale irrigation production.

Physical Environmental Factors

Environment is an important aspect in an efficient production practice of small scale irrigation in the study area. Real set up of the landscape affects the effective implementation of small scale irrigation. It is measured through considering the probability of the study area vulnerable to high flooding incidence and its level of devastation in harming the small scale irrigation efficiency.

Access to Information/Media

Informed households tend to be beneficiaries in small scale irrigation production under the assumption of shared idea and knowledge obtained via radio, TV, and mobile phone communications. Being able to get information about agricultural inputs and technology

determines the efficiency of SSI production. Possibly the household could have radio, TV or phone call /Short message service even mailing was considered.

Access to Market /Town and Road Transport

An access to transport facilities by the households initiates them to easily mobilize their agricultural products in to a market that would make them competitive and beneficiaries from it. Considering the relative distance of the study area to nearby town (Injibara Town) so mobilize the agricultural products is critically analyzed.

Access to Agricultural Extension Service

The service of extension given for households believed to cause enabling condition for small scale irrigation production and agricultural productivity at large. The quality, frequency and duration of extension service delivery by DAs were deeply considered to assess the role of extension service delivery for SSI efficient production.

Male / Female Headed Households

Being male or female headed household would have a meaningful impact on the success of small scale irrigation agriculture in terms of household income, food security and asset holding status. Based on hours of work and quantity of agricultural outputs possible measurement was conducted to assess the impact of sex on SSI to increase agricultural production.

Farming Attitude of Households

Households' unstable perception on small scale irrigation contribution directly and negatively affects their production and successful life establishment. Considering the perception about the role of SSI in improving food crop, income, a living condition and asset holding status by households, investigation could have done.

Farming Input Access

Productive farming necessarily depends on the use of the agricultural input utilization that would play the central role in agricultural productivity and production. However, the price and limited access to agricultural inputs is consistently terrifying challenge faced the households in the study

area. In irrigation farming, improved technology encourages the growth of agricultural production and productivity thereby increasing farm income, food security and asset holding status of households. By asking the sample households whether they are getting inputs on time at desirable quantity is measured.

Non-farming income

The sample household heads beyond generating an income via irrigation farming, they also obtained income from non-farm activities such as from the sale of fire and house construction woods, art facts, charcoal, etc., in the budget year. The total amount of money obtained from non-farm income has measured with possible success of SSI production to raise agricultural production.

CHAPTER FOUR

DATA ANALAYSIS, PRESENTATIONN AND INTERPETATION

4.1 Introduction

This chapter provides details of the research data discussion, analysis and presentation categorized into various sections that offer some details on specific topics. The first section of this chapter deals with introduction of the chapter. Second the socio demographic characteristics of the sampled household head respondents in the study area. Economic features of the sampled respondents with their irrigation practice had illustrated in the 3rd section. In the 4th section, the contribution of small scale irrigation to the household heads had considered at a glance. The irrigation and agricultural input utilization, labor deployment and methods of irrigation farming in the study had discussed in the fifth section. In the sixth section, the roles of the government based service delivery which stimulated the irrigation farming expansion and development was briefly rehearsed. In the last section, the determinants of small scale irrigation farming had clearly considered.

4.1.1 Relability Measurement of Data

The quality of data obtained from a suitable sample size plays a crucial role in determining the suitability of a study in fulfilling its intended purpose. A study's ability to derive valid conclusions from its data is dependent on its quality, and any deviation from these standards may lead to growing doubts and, ultimately, the study's rejection. The data used in this analysis has proven to be accurate and dependable, satisfying certain criteria for data measurement (cronbatch alpha measurement). As a result, data entered using computer software (SPSS version -20), the model (cronbatch alpha analysis) generated confirmation statistics of 0.55 (55%) dependability statuses data, indicating the data used in the study is reliable.

4.2 Demographic and Socio Economic Characteristic of Households

4.2.1 Respondents' Sex, irrigation and Marital Status

In this study, the status of irrigation taking place in the study area of the sampled household (286) was computed by using SPSS software. So the data result shows that 162 (56.64%) of the households were irrigation users while 124 (43.36%) households were non-irrigation users (rain

fed farmers). The main reason why the researcher had stated this status of irrigation is that to show the general pattern of the sampled household heads (population) involved under the study for the readers.

The generalized description of the sampled respondents involved in the study in terms of sex composition, irrigation status and marital status was expressed as follows. In this study, 210 (73%) respondent household heads were males of which 119 were irrigation users while 91 were male non irrigation users. The female household heads of 17% were irrigation users and 12% were non irrigation users. There was no single (unmarried) male and female sampled household respondent of irrigation users and non-irrigation users in the study area regarding marital status. The household heads of 77% male and 88% female were married irrigation users while 78% male and 54% were married non irrigation users. The sample respondents of 15% male and 7% females were divorced irrigation users while 24% male and females were divorced non irrigation users. Widowed sample respondents of irrigation users of 9% males and 13% males non –irrigation users were participated. Finally, the sample households of 21% female non irrigation users and 5% of irrigation users were widowed females involved in the study.

Table 4 : 1 Cross tabulation count of respondents’ marital, sex and irrigation statuses

Variables and its measurement scales			Irrigation status of Household heads				Total	
			Users (162)		Non - users (124)		Freq	%
Marital status	Sex	scale	Freq	%	Freq	%		
Marital Status of households	Males	Single	0	0%	0	0%	0	0%
		Married	92	77.31	71	78.02	163	77.61
		Divorce	18	15.12	8	8.79	26	12.38
		Widow	9	7.56	12	13.18	21	10
		Total		119	100	91	100	210
	Females	Single	0	0	0	0	0	0
		Married	38	88.37	18	54.54	56	73.68
		Divorce	3	6.97	8	24.24	11	14.47
		Widow	2	4.65	7	21.21	9	11.84
		Total		43	100	33	100	76
Sum Total			162	100	124	100	286	100

Source: Own Survey 2023

4.2.2 Age of Respondents

Age is one of the determinant variables over the household’s use of irrigation, food crop sufficiency, income, living condition and asset holding status. The household heads aged from 18 - 24 years, as shown in table 4:2 that the sample of 16% and 1% were none irrigation user and

non users respectively. There were also 28% of irrigation user and 31% of none irrigation user household head respondents in the age group from 25 to 35 years of old. The leading household heads of 56% were irrigation users and 44% were non irrigation users within the group of 36 to 50 years old; this implies that this age group relatively represents significantly involving size of household's irrigation farming in the study area. Household of 15% of the sample irrigation user and 9% of non-irrigation user respondents were above 50 years age group.

Table 4: 2 Age of respondents and Irrigation status of the Households
Cross tabulation

Age of respondents in years	Irrigation status of Households				Total	
	Irrigation Users		Non -users		Freq	%
	Freq	%	Freq	%		
18 - 24 years	2	1	20	16	22	8
25 - 35 years	46	28	39	31	85	30
36 - 50 years	90	56	54	44	144	50
> 50 years	24	15	11	9	35	12
Total	162	100	124	100	286	100

Source: own survey, 2023

4.2.3 Educational Status of the Respondents

The summarized result presented in the next graph had clearly demonstrated that, most of the sampled household head respondents who able to read and / or write were 78 (48%) of irrigation user and also 67 (54 %) of non – irrigation user. This implies that the highest level of educational status of the household heads involved in the study found in this category of educational level (status). The respondent household heads who had responded as illiterate accounted 3.08% of irrigation users and 4.83% of non-irrigation users. The household heads of sampled irrigation users of 28.39% and 23. 38% of non-irrigation users were at the grade level of from grade 1 – 8. The household heads whose educational status had indicated from grade 9 – 12 were 12.96% and 12. 9% were irrigation users and none irrigation users sampled household heads respectively. The study area was also composed of 7.4% of irrigation users and 4.83% of non-irrigation users educated above grade 12 as they confirmed in the questionnaire responses. The dominant participants in irrigation are the households with educational status of only who can read and or write due to limited opportunities of developing desirable skills through formal education.

Table 4 : 3 Educational status of household heads and Irrigation status of Households
Cross tabulation

Variables and measurement scales		Irrigation status of Households				Total	
		Irrigation Users		Non - users		Ferg	%
		Ferg	%	Ferg	%		
Educational status of household heads	Illiterate	5	3.08	6	4.83	11	3.84
	Only Read and /or Write	78	48.14	67	54.03	145	50.69
	Grade 1- 8	46	28.39	29	23.38	75	26.22
	Grade 9 -12	21	12.96	16	12.90	37	12.93
	Above Grade 9 - 12	12	7.40	6	4.83	18	6.29
	Total		162	100	124	100	286

Source: Own Survey, 2023

4.3 Economic Activities of Households in the Study Area

4.3.1 Main Occupational Status of the Respondents

The study area generally involved the practices of various economic activities that sample resident households carried out to support their livelihood in many ways, more precisely in terms of guaranteeing food crop security, increasing farm income, enhancing their standard of living, and enhancing their asset holding status. The primary economic activities in the study region are small-scale irrigation and rain-fed agricultural. In the research region, the primary economic activity of 162 (100%) family heads was irrigated farming (farmers). The primary economic activity of the household head was irrigated farming; no one else engaged in any other type of work. Non-irrigation user household heads of 105 (85%) were deployed in rain-fed farming as a main occupation in the study area. The sampled household heads of non-irrigation users of 5 (4.03%) and 13 (10.48%) were deployed in trade and weaving as a main economic activities respectively to establish his/her better living condition and overall wellbeing of the families of the household heads. The other non-irrigation user sampled household heads of 6 (4.83%) were doing the activities like blacksmith, pottery, and daily laborer as a main occupation of creating their subsistence livelihood for them.

Table 4:4 Main occupation of HH * Irrigation status of Households Cross tabulation

Variable and its measurement scale		Irrigation status of Households				Total	
		Irrigation	Users	Non – users		Freq	%
		Freq	%	Freq	%	Freq	%
Main occupation of HH	Farmer	162	100	105	84.67	267	93.35
	Trade	0	0	5	4.03	5	1.74
	Weaving	0	0	9	7.25	9	3.14
	Others	0	0	5	4.03	5	1.74
Total		162	100	124	100	286	100

Source: Own Survey, 2023

4.3.2 Extra Occupation of Household Heads in the Study Area

The research area is distinguished by the presence of various occupational practices that are undertaken by the households that were sampled as a means of generating secondary income. These activities include trade, construction, weaving, blacksmithing, and other business activities that are rarely practiced by both irrigation users and non-users of irrigation. Accordingly, the sampled households of 36.41% of irrigation users and 10.48% of non-irrigation users were engaged in weaving as a secondary economic activity which is the leading extra occupational practice type exercised by irrigation users in the study area. Irrigation users of 25% and non-irrigation users of 12.29% were also actively involving in different occupations mainly in blacksmiths, daily laborers, and pottery. The households of 17.28% of the irrigation users and 29.03% of non-irrigation users were deployed in carpenter and construction sector of economic activities respectively. The sampled households of 10.49% of the irrigation users and 19.35% of non-irrigation users were engaged in trading activities in the study area. The sampled household irrigation users could be deployed in extra jobs during off farm period appears and as well when they are out of a rain fed farming. In the figure below, vertical and horizontal axes show that the household size and their extra occupational activities respectively in the study area.

Table 4: 5 Household's Extra occupation * Irrigation status of Households Cross tabulation

Variable and its measurements scales	Irrigation status of Households				Total		
	Irrigation Users		Non - users		Freq	%	
	Freq	%	Freq	%			
Household's Extra occupation	Trade	17	10.49	24	19.35	41	14.33
	Construction	18	11.11	37	29.83	55	19.23
	Carpentry	28	17.28	36	29.03	64	22.37
	Weaving	59	36.41	13	10.48	72	25.17
	Others	40	24.69	14	11.29	54	18.88
Total		162	100	124	100	286	100

Source: Own Survey, 2023

4.3.3 Economic Status of the Households in the Study Area

Small-scale irrigation and rain-fed farming, which is comparatively common among the research area's household heads, is the primary economic activity of the sampled heads. Therefore, 1.85% of household heads who used small-scale irrigation had answered on the scale of low economic status, whereas 80.64% of household heads who did not use irrigation had not answered on the scale of low economic status. Household heads that used irrigation made up 4.93% of those who responded middle economic status, whereas 16.12% of those who did not utilize irrigation fell into the group of middle economic level. In the research area, household heads with high economic standing accounted for 87.03 percent of irrigation users' responses, while 3.22% of respondents did not utilize irrigation at all. 6.17% of the heads of households using irrigation reported having a very high economic position. No household head who did not use irrigation had a response indicating a very high economic level. The condensed data gathered from an interview, a concentrated group discussion, and firsthand field observations made it abundantly evident that there are fundamental differences in the economic standing of household heads who use irrigation and those who do not, particularly with regard to the annual food crop security, income, living conditions, and asset holding status of the households in the study area.

Table 4: 6 Economic Status of household heads * Irrigation status of Households Cross tabulation

Variable and its measurement scale		Irrigation status of Households				Total	
		Irrigation Users		Non - users		Freq	%
		Freq	%	Freq	%		
Economic Status of household heads	Low	3	1.85	100	80.64	100	34.96
	Medium	8	4.93	20	16.12	31	10.83
	High	141	87.03	4	3.22	145	50.69
	Very High	10	6.17	0	0	10	3.49
Total		162	100	124	100	286	100

Source: Own Survey, 2023

4.3.4 Food Crop Production for Marketing Purpose in the Study Area

The summarized results of collected data from sampled none Irrigation users had revealed that they were not producing crops primarily for marketing in the study area but irrigation users were producing their crops considering their potential for marketing reason. Irrigation users of 27.16% and 56.17% had responded that they were producing barley and potato respectively. The remaining households of irrigation users 16.66% of irrigation users responded as they produced wheat for themselves. On the other hand, the household heads of 75.8% of none irrigation users were not producing crops purposely for market; instead they have been producing crops mainly for family food consumption purpose. The sample household heads of 6.45% had been producing barley and also 13.7% of them were producing potato as cash crop. 4.03% the non-users have been producing wheat for family consumption. Hence, all irrigation user household heads produce food crops for marketing purpose compared to that of the non-irrigation user household heads, some sort of refraining from production for marketing purpose by non-irrigation users is experienced due to lack of practicing the small scale irrigation and rain-fed farming was not deeply depended on in using appropriate farm technologies and other inputs at large. Evidence collected from Kessa Chewsa kebele and Banja district agricultural office had shown that food crop production and productivity pattern of irrigation performance of ten years represented consistent rising.



Source: Own Survey, 2023

Figure 4.5 Main Food crops grown for market in the study area

Table 4: 7 irrigation status of households: cross tabulation of main cash crops produced

Variables	Main food crops produced for sale								Total	
	None		Barely		Potato		Wheat		Freq	%
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Irrigation Users	0	0	44	27.16	91	56.17	27	16.66	162	100
Non users	94	75.8	8	6.45	17	13.7	5	4.03	124	100
Total	94	75.8	52	33.61	108	69.87	32	20.69	286	100

Source: Own Survey, 2023

4.3.5 Family Labor Assistance in Irrigation farming

The amount of family labor force involvement in small-scale irrigation farming that the households in the research area engage is very limited in quality and quantity, as well as any potential implications of output reductions in the area. Therefore, the household heads' primary supply of labor for supporting the small-scale irrigation came from their own families; there was no other suitable source of labor for farming except their own families and eventually harms irrigation efficiency. Household heads of 49% and 15% had involved the family labor size of less than 3 and exactly four children in the farming respectively. The household heads of 36% were deploying the family labor force more than four children in their irrigation farming by assisting them. The majority of household heads of irrigation users engaged are less than three children who practice irrigation farming to produce food crops, asset, and income and improve a living.

The summarized evidences collected from an interview, focused group discussion and personal field observation had shown that most of participant respondents confirmed that they need extra labor force supporting them in their irrigation farming other than they had deployed currently. Hence, the households are experiencing eminent shortage labor in the SSI because of youth migration from the area for better life and job searching. Consequently, irrigation farming activities are basically suffering from an acute shortage of working and assisting labor force in irrigation farming in the study area.

Table 4 : 8 Family labor source , irrigation status and number of family labor Assisting household's irrigation farming Cross tabulation

Variables	Number of family labor Assisting irrigation						Total	
	Less than 3 Person		Equals to 4 Persons		More than 4 persons		Feq	%
	Feq	%	Feq	%	Feq	%		
Family labor assistance in irrigation	79	48.76	24	14.81	59	36.41	162	100
Total	79	48.76	24	14.81	59	36.41	162	100

Source: Own Survey, 2023

4.3.6 Experience in Irrigation Farming

The distribution of irrigation user households by irrigation practice experience is considered. Accordingly about 60% of the respondents had an experience of practicing 31 to 50 years, while 22% had more than 50 years and 12% of them had only 21 to 30 years in small scale irrigation. 5% of the households have the farming experience of 1 to 20 years in irrigation farming.

Table 4: 9 Irrigation status of and experience of households Cross tabulation

Variables		Experience of households in irrigation farming								Total	
		1 – 20 years		21 – 30 years		31 – 50 years		51 years and above		Feq	%
Irrigation status	Irrigation Users	Feq	%	Feq	%	Feq	%	Feq	%		
		8	4.93	20	12.34	98	60	35	22	162	100
Total		5	4.93	20	12.34	98	60.49	35	22	162	100

Source: Own Survey, 2023

4.4 Economic Contribution of Small Scale Irrigation to Households

4.4.1 Food Crop production and its contribution to household food security

According to the paragraph that follows, SSI farming has significantly changed in the context of providing comparatively surplus food crops for irrigation users. Accordingly, the users of 74% and non users of 7% respondents confirmed that they had achieved significantly high improvements mainly in food crops for their family members to most of months in a year While, non-irrigation user households of 81% and none users of 5% have produced low amount of food crops and unsecured food status to their family partly due to low credit access and limited initiation and knowledge how create good living for them. The sample household non irrigation users of 16% and 32% of irrigation users were able to maintain an average (medium) quantity of food crops in a year for their family food demand. The sample households of 5% irrigation users have achieved very high significant amount of food crops from irrigation farming but non-irrigation users were not beneficiaries (contributed) from irrigation farming. There were no households of users and non-users in irrigation farming have gained nothing from small scale irrigation. Thus, the above data discussion revealed that there is meaningful difference between irrigation user and non-user sample households in terms of family food security status.

Table 4: 10 Months for sufficient food before starting irrigation * Irrigation status of Households Cross tabulation

Variables and its Measurement		Irrigation status of Households				Total	
		Irrigation Users		Non - users		Freq	%
		Freq	%	Freq	%		
Months for sufficient food before starting irrigation	Low	8	4.93	101	81	107	37.41
	Medium	26	16.04	14	11.29	40	32
	High	120	74.07	9	7.25	129	45.1
	Very High	8	4.93	0	0	0	0
Total		162	100	124	100	286	100

Source: Own survey, 2023

4.4.2 Food Crop Security Status after Irrigation Farming

Food crop security is one of the chronic problems of Ethiopian people. Agricultural production and productivity would be enhanced when partly irrigation agriculture is practiced based on using modern agricultural inputs and environmentally capable technology to secure food problems. The study was conducted to investigate food crop security to family of the household heads in the study area by using paired sample t-test tool to verify whether there is the significant improvements happened in the lives of household heads following the start of practicing the small scale irrigation farming and the result had shown as follows.

Table 4:11 The paired sample t- test for food crop security sufficiency before and after irrigation farming started

Paired Samples Statistics					
Measurement scales		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Months for sufficient food before starting irrigation	1.73	286	.651	.038
	Months to get sufficient food after starting irrigation	2.33	286	1.103	.065

Paired sample test

Variables	Paired Differences					T	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Months for sufficient food before starting irrigation - Months to get sufficient food after starting irrigation	-.598	.558	.033	-.663	-.533	-18.119	285	.000

Source: Own Survey, 20223

A paired sample t- test was conducted to test the effect of irrigation on sample household heads' annual food crop security weighted difference before irrigation farming ($M = 1.73$, $SD = 0.651$) and after irrigation farming ($M = 2.33$, $SD = 1.103$) at the 0.05 level of significance, $t(285) = -18.119$, $n = 285$, $p < 0.05$, 95% CI for mean difference -0.663 to -0.533 . On average the weight was about -0.958 points greater than before irrigation farming commencement. From this it possible to conclude that post irrigation had increased the food crop supply of household heads because weighted mean difference of household heads' food crop production possibility had become negative that ensures post irrigation food crop supply had risen.

4.4.3 Income Status of Household Heads in the Study Area

The sample households generated farm incomes per a year by producing (mobilizing) different agricultural products such as food crops, vegetables, livestock products etc., and bringing surplus products to the market of non-user irrigation sample of households of the area. About 81% of non users and users of 2% have generated an income less than 5000 Birr. The sample households of non-irrigation users which accounts for 13% and user of 7% have generated incomes ranging from 5001 Birr to 15000 Birr per a year. Irrigation users of 39% and non user of 6% have generated income ranging from 15001 to 30000 Birr. The users of 52% have generated an income more than 30000 Birr while non user did not. This data implies that users have generated better income compared the none users asserting significant contribution of the SSI.

Table 4: 12 Average income of household heads * Irrigation status of Households Cross tabulation

Variable and its measurement scales		Irrigation status of Households				Total	
		Irrigation Users		Non - users		Freq	%
		Freq	%	Freq	%		
Average income of household heads	<5000 Birr	3	2	100	81	103	36
	5001 – 15000 Birr	11	7	16	13	27	9
	15001 – 30000 Birr	63	39	8	6	71	25
	> 30000 Birr	85	52	0	0	85	30
Total		162	100	124	100	286	100

Source: Own survey, 2023

4.4.4 Sources of Income for Households in the study Area

Irrigation user of the sampled households had produced an income from the sale of different cereal crops such as barley wheat, and teff on average as much as, 28, 000.00 Birr per a year. Households also gained income from the sale of vegetables such as cabbage, tomato, carrot, potato, onion etc., on average as much, 29,000.00birr per a year. Farm income gained from the livestock products constitutes 26,000.00 birr per a year and permanent tree sale mainly such as bamboo, eyclptus tree, acacia, and fruits such apple, sugarcane, etc., on average 6, 000.00birr per a year. Non-farm incomes obtained from the sale of art facts, alcohol, charcoal, fire wood, construction woods, stone and sale, wage from daily work, etc. as much as, 12,000.00 birr on average in the year. On the other hand, non-user of irrigation sample households of 74 of them

gained income ranging from 11,000 and 12,000 per a year from the sale of cereals and vegetables respectively in the study area. At the same time, households engaged in livestock farming had gained 13,000 birr per a year and from permanent tree sales generated 13,000 birr per a year by rain fed farming method. Farmers had gained as much as 18,000 birr per a year from none farm activities such as art works (mainly blacksmith, pottery and weaving), daily laborer, sand or stone sales for construction, charcoal and firewood, in the study area. Thus, the highest income group for irrigation users is from vegetables and for non-irrigation users income obtained from non-farm incomes such as weaving , blacksmiths and pottery, etc.,.

Table 4:13 Sources of Income for HH * Irrigation status of Households Cross tabulation

Count				
Variable and its measurement scale (in Birr by 2013/14 E.C)	Irrigation status of Households		Total	
	Irrigation Users	Non – users		
Sources of Income for HH	Cereal products	28,000	11,000	39,00
	Vegetable products	29,000	12,00	41,000
	Livestock products	26,000	13,000	39,000
	Permanent Tree products	6,000	13,000	19,000
	None farm products	12,000	18,000	20,000
Total				

Source: Own survey, 2023

4.4.5 Income Improvements and Small Scale Irrigation of Household

The primary motivation for the study's conduct was to determine if the sample households in the study area differed significantly in terms of income, food crop security, living conditions, and asset holding status based on scientific testing. The paired sample t-test was conducted to test the existence of significant difference in annual income of the sampled households. Accordingly, the mean income of households before they started irrigation farming was 2.18, while the mean income after they started the SSI became 3.6. Hence, small scale irrigation is contributing the significant size of income progression as observed in the above table 4:13 and consequently supported the formation of asset by households and their better living condition.

Table 4:14 Paired sample t-test of household heads during post irrigation farming

Paired t-test variables		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Wealth of households before starting irrigation farming	3.35	286	.606	.036
	Wealth of Households after starting irrigation farming	3.60	286	.629	.037

Paired Samples Test

	Paired Differences	t	df	Sig. (2-tailed)					
					Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
								Lower	Upper
Pair 1	Wealth of households before starting irrigation farming - Wealth of Households after starting irrigation farming	-.252	.473	.028	-.307	-.197	-8.993	285	.000

Source: Own Survey, 2023

A paired sample t- test was conducted to test the effect of irrigation on sample household’s mean annual income weighted difference before irrigation farming (M = 3.35, SD = 0. 606 and after irrigation farming (M = 3.60, SD = 0. .629) at 0.05 level of significance, $t(285) = -8.993$, $n = 285$, $p < 0.05$, 95% CI for mean difference -0.307 to - 0.197. On average the weight was about - 0.07 points greater than before irrigation farming commencement. From this it is possible to conclude that post irrigation outputs had increased the income of household heads because weighted mean difference holds negative sign that ensures post irrigation income had increased.

4.4.6 Income Saving and Living Condition of Households

The summarized data collected from sampled households on their saving and living condition has indicated some credible improvements. Accordingly, the role of small scale irrigation farming beyond food crop production and reducing food insecurity challenges of the people, it is also supposed to raise the farm income generation and saving conditions improvements of the households. The saving status of the households of 42% and 34% had experienced slightly increased saving and promising improvements in living condition respectively since they had started irrigation farming. The sampled household 65% responded that they had gained very much increment in saving and 23% had responded in experiencing very much improvement in

their living conditions. Very few of them (1%) had responded that they remained unchanged in their living condition due to low saving of money obtained from farming. Hence, the majority of sample households had confirmed that the small scale irrigation farming contributed more for improved living condition and raising the saving status which derived from efficient irrigation farming practice in the area.

Table 4: 15 income saving and living condition of household heads

Variables	Measurement Scale	Irrigation Users	%
Saving status of household heads	Remained unchanged	0	0
	slightly increased	68	42
	increased very much	94	58
Total		162	100
living condition of household heads	Remains Unchanged	2	1
	Slightly Improved	56	34
	Improved Very Much	105	65
Total		162	100

Source: Own Survey, 2023

4.4.7 Mean Economic status of Households in the Study Area

Part of the study area's focus is on the economic position and means of subsistence of the households, with particular attention paid to food crop security, annual income, living standards, and asset holding status of both irrigation and non-irrigation users in agricultural communities located at Kessa chews kebele of Banja district in Awi Zone at Amhara Region of Ethiopia. The researcher had conducted independent sample t- test in order to verify whether there is mean difference in food crop security, annual household income, living condition and asset holding status of both irrigation user and non-irrigation user household heads in the year. Thus, the mean annual income, living condition and asset holding status of the sample household heads of both agrarian communities of the study area were different as shown in the next table.

An independent sample t-test was conducted to determine if there is a difference between irrigation user and non-user sample household heads in terms of living condition. The overall mean for living condition of irrigation users ($M = 2.19$), $SD = 0.48$ is statistically higher than non-irrigation users for mean living condition ($M = 1.25$, $SD = 0.435$), $t(284) = 17.119$, $P <$

0.05). There is a significant difference between irrigation uses and non- irrigation user household heads in their living condition across the kebele.

An independent sample t-test was conducted to determine if there is a difference between irrigation user and non-user sample household heads in terms of their annual income. The overall mean for annual income of irrigation users (M = 4.46), SD = 0.622 is statistically higher than non-irrigation users for mean living condition (M = 3.746, SD = 0.873), $t(284) = 8.085$, $P < 0.05$). There is a significant difference between irrigation users and non- irrigation user household heads in their annual income gained across the kebele.

An independent sample t-test was conducted to determine if there is a difference between irrigation user and non-user sample households in terms of their asset holding status. The overall mean for annual income of irrigation users (M = 3.72), SD = 1.586 is statistically higher than non-irrigation users for mean living condition (M = 1.59, SD = 1.373 $t(284) = 11.905$, $P < 0.05$). Hence, there is a significant difference between irrigation users and non- irrigation user households in their annual income and asset holding status.

Table 4:16 an independent sample t-test for living condition, annual income and asset holding status of households of irrigation users and non- users

Group Statistics					
	Irrigation status of Households	N	Mean	Std. Deviation	Std. Error Mean
Asset generated by Households	Irrigation Users	162	3.72	1.586	.125
	Non -irrigation users	124	1.59	1.373	.123
Living condition of household heads	Irrigation Users	162	2.19	.480	.038
	Non -irrigation users	124	1.25	.435	.039
Average income of household heads	Irrigation Users	162	4.46	.622	.049
	Non -irrigation users	124	3.74	.873	.078

An Independent sample t-test

		Levene's Test for Equality of Variances		t-test for equality of means						
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI of difference	
									Lower	Upper
Asset generated by Households	Equal variances assumed	16.593	.000	11.905	284	.000	2.127	.179	1.776	2.479
	Equal variances not assumed			12.134	279.648	.000	2.127	.175	1.782	2.472
Living condition of household heads	Equal variances assumed	.030	.862	17.119	284	.000	.941	.055	.833	1.050
	Equal variances not assumed			17.345	275.990	.000	.941	.054	.835	1.048
Average income of household heads	Equal variances assumed	45.413	.000	8.085	284	.000	.715	.088	.541	.889
	Equal variances not assumed			7.740	212.521	.000	.715	.092	.533	.897

Source: Own Survey, 2023

4.4.8 Asset holding status of the Household Heads

The significant contribution of the small scale irrigation have clearly shown in the context of enabling the households to generate household income and improved living condition, which in return, provides the possibility of raising the asset holding status of the households in the study area. The sample households of 88% respondent non-irrigation users had confirmed that they did not generate any asset mainly because of low farm income. Out of the irrigation user sample households 8.3% had constructed most of their residential houses in rural kebele but very few of them had built 2 houses in nearby urban location. The non-irrigation users of 4% also had made residential houses basically in the rural kebele. Out of the sample households 4% of none users and 3% irrigation users had responded that they have bought motor cycles and Bajaj respectively as one of the main asset item. On the contrary, non-irrigation users did buy neither motor cycles nor Bajaj. The dominant size of the sample households of irrigation users 75% had purchased and gained cattle through reproduction while non- irrigation user households 11% had also gained cattle through purchase and reproduction. This clearly indicated that most assets had generated by the sample household heads were cattle purchased or reproduced. Motor pumps were purchased by irrigation user households of 5% to conduct irrigation farming yet non-irrigation users did not buy any motor pumps. The irrigation user sample households of 4% had offered opportunities paid to education for their children at private colleges but there were no any of non-irrigation users do not.

Table 4: 17 Asset generated by Households of Irrigation status of Households Cross tabulation

Variables	Measurement scales	Irrigation status of Households				Total	
		Users		Non -users		Freq	%
		Freq	%	Freq	%		
Asset generated by Households	None	0	0	109	87.9	109	38.11
	Residential house	14	8.64	5	4.03	19	6.64
	Motor cycle	7	4.32	0	0	7	2.44
	Bajaj	5	3.08	0	0	5	1.74
	Cattle	121	74.69	10	8.06	131	45.80
	Motor pump	8	4.93	0	0	8	2.79
	Paid education	7	4.32	0	0	7	2.44
Total		162	100	124	100	286	100

Source: own survey, 2023

4.4.9 The Performance of Small Scale Irrigation production and productivity

The summarized statistics collected data from the sampled households confirmed that 97% of them had experienced year to year increase in small scale irrigation production and productivity in terms of annual food crop security, income, living condition and asset holding status because of improved technological and other inputs supply obtained fairly at the required time of farming. Modern and productive small scale irrigation purely involves the use of agricultural inputs which would increase the supply of food crops for households. The sampled household heads accounting 3% responded that they had experienced unsuccessful farming practice due skill gaps and attitudinally poor farming practice and perception. The household heads of irrigation users had enjoyed relatively better position in the community more particularly in case of food crop production status, income, living condition and asset holding status. On the other hand, non-users of 96.77% have experienced the irrigation farming without significant progression in an annual output but 3% of have considered growth in the farm products. This couclussion more expliend by binary logistic regression model of inferential statistics.

Table 4:18 The Performance of food grain and Irrigation status of Households Cross tabulation

Count		Irrigation status of Households				Total	
Variable and its measurement scale		Irrigation Users		Non - users		Freq	%
		Freq	%	Freq	%		
Performance of food grain production in the area	Decreasing	5	3.08	120	96.77	125	43.7
	Increasing	157	96.91	4	3.22	161	56.29
Total		162	100	124		286	100

Source: own survey, 2023

4.5 Agricultural Input Utilization, Labor Deployment and Methods of Farming

4.5.1 Land Holding Status of Sample Household Heads

Land as factors of production plays the central role in the economy of any country regardless of the economic development status of the countries. In agrarian community like Ethiopia where the value of land is very high due to several factors including high population pressure and land degradation specifically in the high land areas where there is high population densities. The Kessa Chewsa Kebele is among the high land areas of Ethiopia where land holding size per household is small in hectares as compared to land holding size of households in the lowland areas of Ethiopia. Land holding size of households is nearly 1.5 hectare of land in the area per household. The sample households (that accounts for about 9%) were landless they had no their own land, but they had been applying irrigation farming through land renting. Households of 5% have owned the land less than one hectare and 74% of them practice irrigation farming on the land of one hectare. The households that account 56% have owned land ranging from 1 to 2 hectares and 12% of them allocated the land ranging from 1 to 2 hectars. About 33% of the households have owned the land more than two hectares while about 6% have irrigated land greater than two hectares.

Table 4: 19 The distribution of land holding size and irrigated land

Variables	Measurement scale	Irrigation Users	%
Total Household's land holding size	None	8	4.93
	<1Hectar	10	6.17
	1 - 2 Hectare	90	55.55
	>2 Hectare	54	33.33
Total		162	100%
Total Irrigation land size of household heads	None	14	8.64
	<1 Hectare	120	74.07
	1-2 Hectare	20	12.34
	>2 Hectare	8	4.93
Total		162	100

Source: Own Survey, 2023

4.5.2 Agricultural Input Affordability in the Study Area

In the history of modern agricultural production practices, the role of agricultural input (DAP, Urea, etc.) utilization and innovative farming technology in quantity and quality directly yields significant achievements in crop production and farming profit maximization. Accordingly, the sampled households that accounts for 80% had accessed their inputs on fairly reasonable and affordable price margins on righteous farming time of production. However, households of 20% encountered with inaccessible and expensive inputs on required time period and had hampered the prospect of carrying out irrigation farming. The evidences collected from an interview, focused group discussion and personal field observation had revealed that despite the presence of persistent constraints of budget, they had purchased inputs on time provided by government based marketing channels. Inflated prices and others problems such as collateral requirements and unproductive beauracrcy have hindered the households from buying agricultural inputs on right time of farming.

4.5.3 Methods of Irrigation Farming and its Water Sources in the study Area

The irrigation farming taking place in the study area is mainly based on traditional method irrigation production by diverting running river water so as to produce several farm products primarily for family food crop supply and partly for selling purpose. The sampled households in the study area critically in need and are applying very innovative method of farming which substantiate environmentally friend through strongly recommended ways of production by DAs workers. In their everyday activity of irrigation farming, on average they had been receiving exactly face to face support on field farming and very constructive feedbacks through professional consultations. Therefore, the sample households that accounts for about 90% have been dominantly applying traditional river diversion irrigation farming by using running river water which constitutes 90% water source used in the study area. The sample households of 3% and 7% depend on using motor pump and rope irrigation types exploiting underground water respectively.

Table 4: 20 Method of irrigation farming and its water sources

Variables	Measurement Scale	Irrigation Users	%
Irrigation technology applied by household heads	Traditional River Diversion	145	90
	Motor Pump	5	3
	Rope irrigation	12	7
	Others	0	0
Total		162	100
Water sources for irrigation	Running river water	145	90
	Dammed river water	0	0
	Ground water	17	10
	Rain water reservoir	0	0
	Ponds	0	0
	Others	0	0
Total		162	100

Source: Own Survey, 2023

4.6 The Role Government Based service Delivery in irrigation

4.6.1 Government input Subsidy and Cash Donation for households

Government has grand responsibility anywhere in any economy especially in developing countries where agriculture believed to be dominantly contributing sector in the GDP. Hence, Ethiopian government has been striving to curb the poverty level of its people through strengthening the development efforts going on in different sector of economy especially in the agricultural sector. Agricultural development plays the most important role in transforming the lives of several millions of Ethiopians in general and the sampled households in particular. Accordingly, the irrigation user households of 63% and non-irrigation user households of 54% were received low quantities of agricultural input subsidy and cash donation by the government. The households of 30% irrigation users and 32% of none irrigation users have obtained very low agricultural input subsidies and cash money in the form of donation by the government. The sample irrigation user of 3% and non-irrigation user of 12% households confirmed that they received agricultural input subsidies and cash donation relatively at medium quantity. Non-irrigation users did not receive any very high amount of cash donations and agricultural input subsidies from their government. The sample households of 1% had gained very high quantities of agricultural input subsidies and cash donation from the government.

Table 4: 21 Input subsidy and cash donation status in the area

Count		Irrigation status of Households				Total	
		Irrigation Users		Non -users		Freq	%
Input subsidy and cash donation by gov't	Input Subsidy status	Freq	%	Freq	%		
			Very low	49	30.24	40	32.25
	Low	101	62.34	67	54.03	168	58.74
	Medium	5	3.08	15	12.09	20	6.99
	High	5	3.08	2	2	7	2.44
	Very High	2	1.23	0	0	2	0.69
Total		162	162	124	100	286	100

Source: own survey, 2023

4.6.2 Extension Service Delivery to Irrigation Farmers

Extension means in irrigation is the package of service delivery and supply of effective agricultural technologies and other inputs in order to raise the production capacity of the households in the area. Small scale irrigation in particularly and agricultural production in general strongly demands extension service delivery arranged by governments and any other stakeholders in developing economies. The government of Ethiopia plays very significant roles in irrigation farming in order to raise the efficiency of small scale irrigation farming with objective of achieving food crop security and poverty reduction. The majority 64% of sample respondent households had confirmed that they would agree to the significant role of extension service delivered by the government in supporting them to produce the small scale irrigation. The households of 21% confirmed that the extension service delivery designed by government in irrigation farming is strongly productive and efficient. The sample households of 4% of irrigation users had responded that they strongly disagree to the role of extension service offered in their Kebele and also 9% of them ensured that they would disagree to extension service arranged by the government to raise the performance of irrigation farming. The remaining number of 3% of sample household heads felt neither agree nor disagree in line with role of the extension service delivered by DAs in enabling irrigation users to be more effective and productive farming. Interviewed elderly households, personal field observations and focused group discussion participants had confirmed that the DAs have been delivering effective, constructive and consistent extension services in the area.

Table 4: 22 The Opinion of households on extension service *
Irrigation status of Households Cross tabulation

Count		Irrigation users	
		Freq	%
Opinion of households on extension services	Strongly disagree	7	4.32
	Disagree	14	8.64
	Neutral	5	3.08
	Agree	102	63.75
	Strongly Agree	34	20.98
Total		162	100

Source: own survey, 2023

4.6.3 The Households' Training Status in Irrigation

The summarized statistics of the sampled household head responses had revealed that about 82% of them who participated in training on irrigation farming are for about less than 3 hours in a year. This symbolizes that the dominantly provided patterns of training hours given for households in enabling them in order to increase the practice and efficiency of small scale irrigation farming is very low. About 14% of households had participated in training of irrigation farming for about 4 to 10 hours and 4% of them did not take any kinds of training on irrigation farming. There was no training given for household heads which taken more than 10 hours in a year in the area. In other data sources (focused group discussion participants and elderly interviewed household heads) had confirmed that frequency and duration of training given for them was very limited to low ranges implying that limited possibility household heads' in understanding on basic farming skills and innovative method of production. As a result of this certain limitation had observed on some of the household heads in applying appropriately the essential farming skills during practical farming time. This urgently need immediate intervention through frequently provided training and farm live inspections to enable the household heads scaling up the level of farming skill, essential factors in creating difference in household heads' farming performance and achievement.

Table 4: 23 Training provisos in irrigation * irrigation status of households cross tabulation

Count		Irrigation status of Households	
		Irrigation Users	
Extension service by gov't		Freq	%
	None	7	4.32
Training provision status	< 3 hrs	133	82.09
	4 -10 hrs	22	13.58
	11 – 18hr	0	0
Total		162	100

Source: own survey, 2023

4.6.4 Access of Credit to Households

Financial resources allocated to irrigation farming sector would induce extra investment in the sector by the households beginning from feeding themselves up to mobilizing products to market in order to maximize farming profits. The credit access to the households arranged by the government had made significant contribution for the development of food crop production and supply, income rise, improvements in living condition and asset holding status. Accordingly, despite the existence of high collateral requirements and destructive bureaucratic procedure set on, the sample households accounting for about 97% have confirmed that they had obtained money credits on time that enabled them to carry out their irrigation farming at maximum capacity. However, the remaining 3% of sample households who involved in the study area clearly responded that they could not get an access to a credit on time and required amount of money from lending institution particularly from Amhara Credit and Saving Institution (ACSI) due to a failure to meet the demands of the ACSI, collateral requirements and bureaucratic (unproductive) procedures put in place. The summarized evidences collected from an interview, and focused group discussion had indicated that the access for credit by government based institution had created fertile ground for farmers to purchase agricultural inputs on a right farming season by granting effective credit services.

4.6.5 The Purpose of Money Credit

The grand motive behind conducting money credit by households from lending institutions is to purchase agricultural inputs in order to increase the agricultural production and productivity. Accordingly, about 55% of the households had allocated their credit mainly for buying agricultural inputs such chemical fertilizers (DAP and Urea) and other inputs used for agricultural production. Households of 4.32% and 3.08% have been investing their borrowed money to educate children and to pay back their debt respectively. The household heads of 7.4% of have injected the lent money for making different activities such as trading, renting land for farming and planting eucalyptus tree and decerense acacia plants. About 30.24% have made the purchase of cattle by the credited money. Evidences gathered from interview, and focused group discussion had confirmed that most of the borrowers have used their money for agricultural input purchase in order to raise food crop production in the study area.

Table 4: 24 The purpose of credit obtained by households cross tabulation
Count

Extension service by gov't	Irrigation status of Households	
	Irrigation Users Freq	%
Input purchaase	89	54.93
Children Education	7	4.32
Debt payback	5	3.08
Cattel Purchase	49	30.24
Others	12	7.4
Total	162	100

Source: own survey, 2023

4.7 Main Findings of the Study

The aim of this study was to evaluate the impact of small-scale irrigation on agricultural productivity in Banja district, Awi zone, Amhara regional state, Ethiopia. The research specifically yielded the following findings.

- i. Compared to non-users, irrigation users greatly improved food security, income, asset holding, and family living conditions; as a result, irrigation significantly increased the area's yearly agricultural production and productivity.
- ii. Existence of significant difference between irrigation users and non-users based of response variables.

- iii. Significant role of the government in supporting farming by discharging its duties.
- iv. Several factors affected irrigation farming has identified.
- v. Significant size of the land is covered with trees.
- vi. Insufficiency of family labor force in farming.

4.8 Determinants of Small Scale Irrigation Production and Productivity Performance

A logistic regression was ran on the sample size of 286 households in the study area to ascertain the effect of independent variables such as educational status household heads, gender of household heads, irrigable land size, family size of the household heads, farm technology and fertilizer implementation, money available in accounts of household heads, land set up, transport and market access, labor source for farming, age of household heads, non-farming income, farming attitude, farming information, training, and credit access on the performance of irrigation production and its productivity on the likelihood that respondents. A logistic regression model was statically significant ($\chi^2 = 9.128$; $df = 8$; $p < 0.05$). The model explained 35% (Nagelkerke R^2) of the variance in the performance of irrigation agricultural production and productivity and correctly classified 74.1 % of cases as shown in the next table. Each additional unit increase in the household's family size reduces 0.770 more times the food crop sufficiency compared to the household heads with less family size (OR = 0.770, 95%, (CI, 0.577 – 1.027)). The household heads receiving effective extension service on their farming is 1.355 more times successful than the household heads that can't obtain effective extension services on their farming (OR = 1.355, 95%, (CI, 0.982 – 1.870)). It is 1.779 more times likely that the household heads can obtain more non-farm income than, the agricultural income increases for the household heads that do not get non-farm income in the study area. (OR = 1.779, 95%, (CI, 1.167– 2.711)). The sampled household heads that uses an appropriate agricultural farming technology can produce food crops 1.430 more times successful compared to those household heads that do not use an appropriate farm technology (OR = 1.430, 95%, (CI, 1.041–1.965)). As labor insufficiency is high the small scale irrigation production performance gets slow down by 0.726 more times (OR = 0.726, 95%, (0.521 – 1.012)). The agricultural information inaccessibility is high, the small scale irrigation production and productivity slows down by 0.700 more times. As credit access to the household heads is increasing, the production and productivity of small scale irrigation increases by 1.422 more times.

Table 4: 25 Binary logistic regression

Variables	B	S.E.	Wald	D	Sig.	Exp (B) / OR	95% C.I.for EXP(B)	
				f			Lower	Upper
Educational status of the households affect irrigation farming efficiency	.118	.139	.723	1	.395	1.125	.833	1.520
Large family size the consequence of reducing food security of a household	-.261	.133	3.872	1	.049*	.770	.577	1.027
Irrigable land size had decisive impact on raising income and asset holding status of the household heads	-.213	.152	1.962	1	.161	.808	.580	1.124
Technology and inputs like fertilizer affect irrigation farming efficiency	.358	.146	5.969	1	.015*	1.430	1.041	1.965
Money available in the account of a household contributes more than borrowed for farming practices	-.289	.155	3.475	1	.062	.749	.536	1.048
Physical environment or farming land setup is affecting irrigation farming practices	.303	.164	3.421	1	.064	1.353	.949	1.930
Availability of accessible, markets and transport facilities affects farm performance	.164	.141	1.361	1	.243	1.178	.868	1.600
Extension service delivery had made irrigation farming more competitive and effective	.304	.148	4.204	1	.040*	1.355	.982	1.870
Your family labor force is insufficient for irrigation farming	-.320	.153	4.374	1	.037*	.726	.521	1.012
Age of households affects Irrigation farming practice and efficiency	.080	.164	.241	1	.623	1.084	.760	1.545
Non-irrigation farm incomes supplemented my better living	.576	.194	8.804	1	.003*	1.779	1.167	2.711
Gender of household head does not affect irrigation farming performance	-.132	.154	.735	1	.391	.877	.628	1.223
My irrigation farming attitude affects my better future living condition	-.162	.149	1.183	1	.277	.851	.616	1.175
Information about irrigation farming is accessible	-.356	.147	5.894	1	.015*	.700	.509	.963
Training had affected irrigation farming efficiency	-.118	.169	.489	1	.484	.889	.616	1.282
Money Credit had made irrigation farming more effective	.352	.152	5.371	1	.020*	1.422	1.023	1.978
Constant	-1.412	1.775	.634	1	.426	.244		

Source: Own Survey, 2023, * = significant

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The aim of this research was to evaluate the impact of small-scale irrigation farming on agricultural productivity and output in Banja District, Awi zone, Amhara region, Ethiopia. In terms of annual income, family food security, living conditions, and asset holding status, the study specifically sought to compare and contrast irrigation users and non-users. Along with separating the difficulties faced by irrigated farming in the research area, it also identified the function that government-based service delivery plays in enabling irrigation users.

Banja district is one of well-practiced irrigation farming areas of Awi zone in Amhara regional state of Ethiopia producing different food crops mainly potato, barley and wheat. The study area, Kessa Chewsa kebele, is one of the areas that have been practicing irrigation production for several years along the River Zengena mainly by diverting the running river through traditional method. Hence, small scale irrigation farming in the study area was highly affected by a number of determining factors of irrigation agricultural production and productivity.

Irrigation farming is definitely helping the households that depend on it for their living, according to conceptual and theoretical literature studies. The data research has shown that households that practice irrigation are in a better financial situation than those that do not. In order to boost agricultural productivity and output, it is critical to place the proper attention on the households in the research region and throughout the nation that do not practice small-scale irrigation farming. This is the most important way to increase Ethiopia's national food crop supply and, consequently, save millions of agrarian citizens from starvation and food shortages by enhancing the agricultural sector's overall effectiveness through local production capacity

Based on data analysis, essential determinants of small scale irrigation were also identified in the study specifically non-farm income, farming technology, family size, farming information, credit access, family labor size and extension service delivery.

Finally conclusion was drawn based on the collected data and possible recommendations had also suggested to be taken to curve down the problem by reversing the currently existing condition of food security, income deficit, poor living and low asset holding status of households.

5.2 Conclusion

Guided by the evidences collected from the sampled households through questionnaire, interview, focused group discussion responses and personal field observation of their actual life of irrigation farming performance; following conclusion points have drawn:-

- ☞ Despite their unwavering efforts, small-scale irrigation users have encountered a severe labor shortage due to family members moving away from home, which has hampered their ability to operate their farms efficiently
- ☞ Compared to non-irrigation user family heads in the study area, irrigation user household heads were found to be in a better position with regard to food crop security (sufficiency), annual income generating, better living conditions, and asset holding status.
- ☞ Small-scale irrigation farming in the research area has grown rapidly and is performing better thanks primarily to government-based service delivery, which includes information on farming and marketing, extension, training, credit, and the provision of farm technologies and agricultural inputs. The DAs have made a significant and highly applicable positive contribution. As a result, the situation of the yearly food crop output was improved. The government's engagement in providing services is a symbol of the area's important position in the efficient production of small-scale irrigation
- ☞ In the investigation, the most significant small scale irrigation determining factors were identified including non-farm income, extension service delivery, family labor force size, farm technology and input implementation, credit service, family size and farming information.
- ☞ Even though, the price of agricultural inputs (chemical fertilizers) became very expensive, the household heads in the study area were striving to manage the access to inputs relatively on required time period of farming.
- ☞ Household of the study area enjoy relatively accessible transport, farming information and market opportunities to mobilize their products in to the market; they can get to market places in less than 5km distance from their residential area.
- ☞ The farming communities of irrigation users represented better position than those of non-irrigation users in terms of food security, annual income, a living condition, asset holding.

Hence, this ensures that there is significant difference between these household groups relatively all aspect of the economy and way of life in the area.

- ☞ Significant size of land in the study area is covered with different trees and vegetation which reduce the possibility of extended SSI farming.

5.3 Recommendations

Depending on basic findings extracted from collected data analysis, the following recommendations are suggested in order to redo reduce the existing problems in the study area.

- ❖ The issue with irrigable land size, which prevents food crops from growing on the land, affects the research area's sample families that use irrigation. The land is claimed by permanent plants. Trees must be planted on terrain that is not suitable for rain-fed agricultural or irrigation, and plants should be removed so that irrigation can be used. Therefore, it should be necessary for the government to raise irrigation production and productivity through improved land management, efficient use of agricultural inputs, improved seed species, and extension services.
- ❖ The impact of small-scale irrigation farming is heavily influenced by various elements, primarily related to the size of the family work force, access to credit, training programs, and farming attitudes. Therefore, quick action is needed to expand contemporary intensive farming on currently owned property in order to improve irrigated farming's ability to produce food crops, raise yearly revenue, improve quality of life, and enable asset ownership. The heads of households should receive training on farming technology, how to use inputs, how to adopt new seed varieties, and how to modify their mindset so that they may regard irrigated farming as a source of prosperity and well-being. This is primarily excuted by DAs workers.
- ❖ The mean economic difference of irrigation users and non-irrigation users is high and this difference (government) should have to be narrowed through empowering their production and reducing income differences between users and non- users of irrigation. The government should apply an incentive packages (subsidy and tax reduction) that would narrow the gaps happened between these farming communities.

- ❖ The government should continue in playing its key role in supplying agricultural inputs on a required period of time; any delay from due farming season would cause the risk of irrigation production failure and essential extension and credit services should be delivered in order to accelerate the production possibility of food crops by the household heads.
- ❖ Due to a number of reasons, primarily the lending institution's high collateral requirements and ineffective administration, several of the sampled household heads had not been able to acquire loans. In order to facilitate small-scale irrigation production, straightforward standards for collateral needed to obtain credit should be established, as well as efficient processes for providing services. If households are unable to obtain agricultural inputs at the appropriate period of farming, the government should instead offer chemical fertilizers in the form of aid or cash supplies, with the potential of recovering losses in accordance with government subsidies and aid.
- ❖ The investigation had also found out there is young people migration (consistent leaving of the area) in search of better job and income which caused the labor force shortage in small irrigation farming in the area. Thus, responsible body has to intervene in the way that the problem could have been reduced and if possible reversed. It strongly needs another investigation why Youths are keen and dedicated to move away from their area nevertheless farming is effective.

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APPENDICES

Appendix I: - Questionnaire Guide

Addis Ababa University College of Social Science

Department of Geography and Environmental Studies

Dear Respondents: - The main purpose of this questionnaire is to collect information or data to investigate the contribution of small scale irrigation to increase agricultural production and productivity between irrigation users and non users of Kessa Chewsa Kebele of Banja district of Awi zone in Amhara region, Ethiopia. Therefore, you are expected to provide genuine, accurate and balanced information on the contribution of small scale irrigation to increase agricultural production and productivity as well as its contribution on rural households' income, food sufficiency and asset holding status in the area. Your honest information is highly important as it plays a key role in the success of this study. Finally I'm very much appreciative for the dedication you pay to this end and the information gathered will be highly confidential and will be used only for the purpose of this research. If you do not feel free to take in this interview you are not obligated to involve in the interview.

Thank for your cooperation

General Directions

Please encircle your choice of alternative numbers containing potential answers to answer questions that would represent your genuine opinions and views regarding small scale irrigation contribution to raise the agricultural production and productivity. Write also an appropriate answer for blank question. But you do not write your name.

Household's Identification

Household head's village (gott) _____

Code of household head _____

Name of enumerator _____ Signature _____

Part I: - Household demographic and social characteristics

1. Respondent's sex 1) Male 2) Female
2. Marital status of respondent's:-
 - 1) Single 2) Married 3) Divorced 4) Widowed

3. Age of respondent's:-
 1) 18 – 24 years 2) 25 - 35 years 3) 36 – 50 years 4) above 50 years
4. Educational status of respondent's:-
 1) illiterate 2) only Read and /or write
 3) Grade 1-8 4) Grade 9 -12 5) above Grade 9 -12
5. The main occupation of the respondent is _____.
6. Respondent's secondary occupation: 1) Trader 2) Construction
 3) Carpentry 4) Weaving 5) others (specify) -----
7. Are you an irrigation user or non- user? 1) User 2) Non User
8. Respondent's economic level: -
 1) None 2) Low 3) Medium 4) High 5) Very high

Part II. Questions on household food security sufficiency status in 2013/2014 E.C

9. Your total land holding size is ----- hectar or ----- timad.
10. If you are irrigation user, the land employed for irrigation is ___ hectare or _____timad.
11. How long do you spent in farming (farming experience)?
 1) 1 – 20 years 2) 21 – 30 years 3) 31 – 50 years 4) above 50 years
12. You get sufficient food before starting to use irrigation farming for ----- months per a year.
13. You get sufficient food after starting to use irrigation farming for----- months per a year.
14. Is there any affordable and accessible agricultural inputs (DAP, Urea etc) for your farming to take place on time? 1) Yes 2) No
15. If your answer is no for the above question (14), what is the main reason which made you not to use inputs? 1) Expensive price of inputs 3) Limited access for infrastructure
 2) Inaccessible input 4) others (specify) -----
16. How long you received training annually on your framings in hours?
 1) None 2) < 3 hours 3) 4 – 10 hours 4) 11 – 18 hours 5) > 18 hours
17. Is your family's labor assistance is sufficient to operate farming? 1) Yes 2) No
18. The numbers of family assisting you in your irrigation farming is _____.
19. The main source of water you used for farming is :-
 1) Pond 2) Running river water 3) Dammed river water
 4) Ground water 5) Rain water reservoir 6) others
20. Which water applying techniques do you frequently used for your farming?
 1) Traditional river diversion 2) Motor pump 3) Rope irrigation 4) Others
21. Your living condition after irrigation farming is _____.
 1) Remained unchanged 2) slightly improving 3) Improved very much
22. Your farm income saving deposit amount (status) is:-
 1) Remained unchanged 2) slightly increased 3) increased very much
23. I have offered ----- kilo grams of food grains for needy households living around me.
24. Performance of small scale irrigation farming production and productivity from year to year is _____. 1) Unsuccessful 2) successful
25. The contribution of small scale irrigation farming you obtained is
 1) None 2) Low 3) Medium 4) High 5) Very High

Part III – Questions on households' income from their farm activities in 2013/14 E.C

26. An average income you generated in Ethiopian Birr from your farming is _____.
 1) Zero Birr 2) < 5000 Birr
 3) 5001 – 15000 Birr 4) 15001 – 30000 Birr 5) > 30000 Birr

27. The main income source for households in Ethiopian Birr is from sale of :-
- Cereal products (teff, wheat, barley etc.,) is _____ Birr
 - of livestock products (milk, animal fattening (cow, oxen, sheep, and goats), horse, mule, etc.,) ----- Birr
 - vegetable products (tomato, cabbage, carrot, potato, onion, etc.,) _____ Birr
 - Permanent tress (Eucalyptus, Decurens acacia, bamboo, etc, trees) and fruits (apple, peach, sugar cane, etc.) _____ Birr
 - Non-farm income sources such as hand crafts, sale of beverage, sale of wood or charcoal, daily labor work, sale of stone (sand) etc _____ Birr
 - Others (specify) _____
28. Before starting irrigation farming your family food sufficiency, income, asset and living condition was _____
- 1) Very Low 2) Low 3) Medium 4) High 5) Very high
29. After starting irrigation farming your family food sufficiency, income, asset and living condition is _ 1) Very Low 2) Low 3) Medium 4) High 5) Very high

Part iv- Questions on an asset holding status of the households in the year 2013/14 E.C

30. The main type of an asset you generated from your farming is:-
- None 2) Residential house at urban / rural location 3) Motor cycle
 - 4) Bajaj 5) Livestock (oxen, cow, mule, horse, sheep, etc.) 6) Motor pump
 - 7) Paid education for children in private schools, colleges and universities
 - 8) Others -----
31. The role irrigation farming in asset formation is _____,
- 1) Very low 2) Low 3) Medium 4) High 5) Very high
32. From what you get information regarding own irrigation and rain fed farming?
- 1) Phone call conversation 2) Radio broadcast 3) TV show
 - 4) Extension service providers (Das) 5) e- mailing services 6) Written letters (mailing)
33. What is the status of the government agricultural input subsidy and cash money donation to you to improve your irrigation farming income, food crop, asset holding and a good living?
- 1) Very low 2) Low 3) Medium 4) High 5) Very high
34. Do you have an access for money credit on time at desired amount to your farming activities?
- 1) Yes 2) No
35. If your answer for the question 34 is No, what is the main reason?
- 1) Unproductive berucracy
 - 2) High collateral requirement
 - 3) Lack of willingness to help borrowers (households)
 - 4) Political discrimination based on membership of a party
 - 5) Others (specify) _____
36. The main purpose of credited (borrowed) money is _____
37. The main type of cash you produced is _____.
38. Do you think that there is difference between irrigation users and non-users in terms of food security sufficiency, living condition, annual income and wealth status?
- 1) Not at all 2) Yes, but very small 3) Yes, very much
39. If your answer for question no. 38 is yes (2or 3), who do think is better off than one another?
- 1) No difference at all 2) Irrigation users 3) Non users

Part v- Factors influencing the performance of small scale irrigation agricultural production and productivity status of household in the year 2013/2014 E.C

Give your response by putting (√) mark on the corresponding spaces of the scaled questions.

Q. No	Small scale irrigation farming influencing factors	Scales				
		1	2	3	4	5
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
40	Educational status of households affect irrigation farming efficiency					
41	Large family size the consequence of reducing food security of a household					
42	Irrigable land size had decisive impact on raising income and asset holding status of the household heads					
43	Technology and inputs like fertilizer affect irrigation farming efficiency					
44	Money available in the account of a household contributes more than borrowed for farming practices					
45	Physical environment or farming land setup is hampers irrigation farming practices					
46	Availability of accessible, markets and transport facilities supported farm performance					
47	Extension service delivery had made irrigation farming more competitive and effective					
48	Your family labor force is insufficient for irrigation farming					
49	Age of household head affects irrigation farming practice and efficiency					
50	Non-irrigation farm income supplemented my better living and irrigation efficiency					
51	Gender of households do not affect irrigation farming performance					
52	I do not believe that better future living condition would come through increasing efficiency of small scale irrigation.					
53	Information about irrigation farming is accessible					
54	Training had hindered my irrigation farming efficiency					
55	Money Credit had made irrigation farming more effective					

The End

APPENDIX II: INTERVIEW GUID (KII)
Addis Ababa University College of Social Science

Department of Geography and Environmental Studies

A. General information

Name (code) of interviewer's _____

Date of interview -----/-----/----- Sex -----

Age of experience ----- village -----

B. Basic information

1. Would you briefly explain the historical development of River Zengena irrigation farming of Kessa Chewsä Kebele? -----
2. How often do you visit the farmers (farms) of the study area and for what reasons? ---
3. Which irrigation techniques are relevant and is water is available for irrigation? -----
4. What are the most irrigable products they irrigate (you produce) and are they productive related farm characteristics? -----
5. What looks like the contribution of small scale irrigation to increase production and productivity of agriculture; how do you express small scale irrigation related to users and non users? -----
6. What role does have SSI on households' income, food security sufficiency and asset holding status? -----
7. What do think are the main factors influence SSI production and productivity in the study area? -----
8. What support services of the government are available to irrigation farmers related to agricultural extension, market, transport , information, credit, training, etc, for efficient SSI production?-----
9. What do you suggest to improve the SSI farming in the study area? -----
10. In your opinion from irrigation users and non users, who would be beneficial in the Kessa Chewsä Kebele in their household income, food security sufficiency ; living condition and asset holding status? -----

Appendix III: - Questionnaires to FGD

Addis Ababa University College of Social Science

Department of Geography and Environmental Studies

1. How do you explain the historical background of the small scale irrigation in your Kebele?
2. What looks like small scale irrigation practices in your Kebele?
3. What types of agricultural products dominantly you produce from irrigation farming?
4. How long you have been doing your irrigation farming in your kebele?
5. How many family members do you involved in irrigation farming as labor source other than you (household head) to efficiently produce desired products?
6. How far government based service delivery such as provision of training, access of improved technology, opportunities for market, agricultural information, etc., had help you to produce irrigation farming efficiently in Kebele?
7. Do you get agricultural inputs mainly DAP, Urea, pesticides, and herbicides on time at affordable prices to your irrigation farming in the Kebele?
8. What technique of small scale irrigation is dominantly applied in Kebele?
9. How do explain the role of small scale irrigation in households' farm income improvements, food security sufficiency, asset holding status and improvements in living conditions?
10. How do compare the changes in your household status of income, food security sufficiency, asset holding and living condition before and after you started irrigation farming?
11. What are major challenges faced in your irrigation farming in the Kebele?
12. Suggest solution to the challenges faced in your irrigation farming in the Kebele?

Appendix IV Bibliography

Definition of Key Terms

Small Scale irrigation- is farming technique of producing crops during which rainy season is over that would help to increase food security sufficiency of the households in the study area.

Agricultural production is the science and an art of producing crops and rearing of livestock for household consumption or sale purposes in the study area.

Irrigation users- are individual households who are in charge of carrying out small scale irrigation at the study area, and able to produce crops using both dry and summer seasons.

Irrigation Non- Users - indicates the households who are not in charge of carrying out small scale irrigation at the study area, and are mainly deepened on rain fed agriculture.

Productive agriculture referse to the state of agriculture where its contribution is relatively significant (surpluse) generated using modern technology and other agricultural inputs such as chmical fertilizers.

Extension service in SSI irrigation implies that numerous agricultural activities taking place in the area including credit and training offers to make the efficient production of irrigation products.