DETERMINANTS OF SMALL SCALE IRRIGATION USE BY SMALLHOLDER FARMERS: THE CASE OF CHEHA WOREDA, GURAGE ZONE, SNNPRS.

M.A THESIS

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DECLARATION

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

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LIST OF ABBREVIATIONS

BMC	Billion Metric Cubes
CSA	Central Static Agency
DAs	Development Agents
ELSEVIER	Earth and Land System and Environmental science
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
IWMI	International water Management Institute
LSI	Large Scale Irrigation
MOWIE	Ministry of Water, Irrigation Energy
MOWR	Ministry of Water Resource
MSI	Medium Scale Irrigation
RWH	Rain Water Harvesting
SNNPRS	South Nations Nationalities and Peoples Regional State
SSI	Small Scale Irrigation
WSDP	Water Sector Development Program

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ABSTRACT

Irrigated agriculture is one of the critical components of food production, which has contributed significantly to maintaining world food security and to the reduction of rural poverty. Livelihood of the rural people of Ethiopia depends on agriculture. However, erratic nature of rain and prevalence of drought in the country make agricultural production a challenge. In order to combat such problems, currently the Ethiopian government is working on irrigation development by giving special emphasis .The aim of this study was to identify determinants of Small-scale irrigation use by small holder farmers, in Cheha Woreda, Gurage Zone SNNPRS. A total of 172 farmers were randomly selected and interviewed by using close ended interview schedule and focus group discussion was used to get further information on the issue. Various documents were also reviewed to collect secondary data. Descriptive statistics, inferential statistics (chi-square and independent t-test) and econometric model analysis were used to analyze quantitative data. As the binary logistic regression model result indicates, six variables were found to be significant namely household size (labor), access to agricultural inputs and age of household heads had significant and positive effect on the use of small-scale irrigation at 5% probability level. Similarly, availability of water nearest to farm land and access to credit services had significant and positive effect on the use of small-scale irrigation at 10% probability level while, sex of household heads (being female), had significant and negative effect on the use of small-scale irrigation at 10% significance level. Governmental and non-governmental organizations should give emphasis on provision of training to create awareness and skills about irrigation technologies and increases their access to use irrigation water in the study area. They also should give emphasis on intensifying agricultural production in order to enhance the productivity of limited land. Therefore, to alleviate these problems and improve small-scale irrigation utilization, woreda (district) agricultural and rural development office and other concerned bodies should attempt to address those factors that hinder small-scale irrigation utilization in the study area.

KEY WORDS: *Small Scale Irrigation, Determinants, Smallholder Farmers, Food Security, Cheha Woreda.*

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In the agriculture-based countries, which include most of Sub-Saharan Africa, agriculture and its associated industries are essential to growth and to reducing mass poverty and food insecurity. Using agriculture as the basis for economic growth in the agriculture-based countries requires a productivity revolution in smallholder farming (World Bank, 2008).

Improved irrigation access will increase crop yield and production, and in turn, result in increased farm income. Irrigation development and access to irrigation are ultimately typical public goods type of services highly subsidized, almost everywhere in the world, from state coffers for major components of construction and also for service costs. Hence, there is an inherent social responsibility involved here to ensure that the benefits derived from such public goods and services should be distributed, as far as possible, equally among all members of society (Hussain, 2002).

Water resource management in agriculture is a critical contributor factor to the economic and social development of Ethiopia. If successful, irrigation in Ethiopia could represent a cornerstone of the agricultural development of the country, contributing up to ETB 140 billion to the economy and potentially moving up to 6 million households into food security. However, irrigation is not a simple silver bullet: first, it can only work if other components of the agricultural system are also effective (e.g., seeds, extension); second, all the tools in the toolkit will be required – from small-scale irrigation to large-scale schemes – to construct a viable solution (Awlachew et al., 2010). Ethiopia has an important opportunity in water-led development, but it needs to address critical challenges in the planning, design, delivery, and maintenance of its irrigation systems if it is to capture its full potential (Awlachew et al., 2010).

Small-scale irrigation schemes could significantly improve agricultural production and food security. In order to improve and expand small-scale irrigation activities, it is necessary to solve problems such as technical, technological (including agricultural inputs and irrigation technologies), market information and lack of infrastructure through the involvement and joint effort of all stakeholders including the farming community, government, non-government organizations, private sector and also designing well-structured short-term and long-term plans and development programs to fill the capacity gaps (Gebrehiwot et al., 2015).

Ethiopia has 12 river basins with an annual runoff volume of 122 billion m^3 of water and an estimated 2.6 - 6.5 billion m^3 of ground water potential, which makes an average of 1575 m^3 of physically available water per person per year, a relatively large volume. However, due to lack of water storage infrastructure and large spatial and temporal variations in rainfall, there is not enough water for most farmers to produce more than one crop per year. The potential irrigable land in Ethiopia is about 3.7million hectares, from this total estimated area of irrigated agriculture in the country is 107,265.65 hectares out of which 20,038.39 hectares is from small-scale, 30,291.26 hectares is from medium-scale and 56,936 hectares is from large scale (IWMI, 2007).

Approximately 62 percent of the area under irrigation so far is located in the Rift Valley, while 29 percent is located in the Nile basin. The remaining nine percent is located in the Shebele-Juba basin. Nearly 100 percent of the irrigated land is supplied from surface water, while groundwater use has just been started on a pilot scale. There are two major categories of irrigation in the country; these are traditional (38 percent), modem (62 percent) (IWMI, 2007).

According to the above information the irrigated area of the country is by far lower than the total estimated potential. Likewise, the study area has considerable potential for the development of

small-scale Irrigation. However, the irrigated area is extremely small and lower than the expected potential. Therefore, the aim of this paper is to assess the determinants of small-scale irrigation use in the study area.

1.2 Statement of the Problem

Agriculture remains one of the important sectors with enormous contribution to socio-economic wellbeing of the world population. In the African continent, the livelihood of more than 60% population and most the poor depend on the lowly productive Agriculture sector. The low productivity of African Agriculture sector is attributed to the unreliable rainfall resulting in lower produce and unpredictable weather condition have worsen the case, subjecting the small-scale farmers to adverse impact of climate fluctuation (Todaro, M & Smith, S. 2012).

Ethiopia remains largely dependent on rain fed agriculture. The country receives significant rainfall, although distribution and intensity vary, generally decreases from southwest to northeast. Droughts occur every four or five years (FAO, 2015). If well managed, Ethiopia's surface water and groundwater systems are sufficient to meet most domestic and irrigation purposes water supply. But the lack of installed water infrastructure and other constraints provides a serious constraint to irrigation development (FAO, 2015).

Irrigation development is the most important interface between water and land resource. These resources are available in adequate amount in Ethiopia. Irrigation has been regarded as a powerful factor for providing food security, protection against adverse drought conditions, increased prospects for employment and stable income, and greater opportunity for multiple cropping and crop diversification (Seifu, 2018).

Cheha Woreda has 57693 ha of land and about 5 permanent rivers, seasonal streams, natural springs and other water sources (Woreda Agricultural Office Report, 2020). This indicates that the woreda has considerable potential for small scale irrigation. By considering this potential, the

regional government of SNNP launches projects namely, Gotam irrigation scheme which covers 250 ha of land, Winque irrigation which covers 1000ha of land and Kecher irrigation scheme which covers 1000ha of land and also the woreda agricultural office has been promoting small scale irrigation to small holder farmers by planning an average 6000ha of land for small scale irrigation in the woreda in the last five years (Woreda Agricultural office, 2020). However, in the woreda most of the farmers are dependent on rain fed Agriculture and the irrigable land of the area being occupied by ***Eucalyptus Tree*** and shrubs. Even if there are studies regarding this issue, such as (Agidew, 2016; Petros, 2017; Seifu, 2018) the scope and several determinants such as socioeconomic, institutional, demographic and biophysical determinants, pests and diseases that means which influence the use of small-scale irrigation were not studied in depth. Specifically, in the Cheha area there is no any studies conducted regarding this topic as I referred still. Hence, this study could help to narrow the knowledge gap in the topic specially, in the study area and its environs.

1.3 Objectives of the Study

1.3.1 General objective

The general objective of this study was to assess determinants of small- scale irrigation use by smallholder farmers in Cheha Woreda, Gurage Zone, SNNPRS.

1.3.2 Specific objectives

The specific objectives of this study were:-

1. To assess the status of household level utilization of small-scale irrigation.
2. To identify determinants of small- scale irrigation farming in the study area.

1.4 Research Questions

This study tried to answer the following research questions:-

1. What is the status of farming households in utilization of small-scale irrigation? And
2. What are the determinants of small- scale irrigation farming in the study area?

1.5 Significance of the Study

The result of this study will help the government, policy makers, and other concerned bodies which are stakeholders of irrigation development. Furthermore this study will help to strengthen the existing information in the topic under investigation and could help to initiate further studies in the topic. In general this study could help as stepping stone for the promotion of irrigated agriculture by providing intervention ideas for food insecurity through small scale irrigation in the study area.

1.6 Scope of the Study

This study was conducted in Cheha woreda, which was found in Gurage zone, SNNPRS. The study mainly deals with socioeconomic, institutional and demographic determinants of small-scale irrigation use by smallholder farmers. Furthermore, biophysical determinants, pests and diseases and crop raider animals are included in this study.

1.7 Limitation of the Study

It would have been better if the study could be conducted in the area including more woredas, but due to the constraints of budget, time, availability of logistic support, this study was delimited only in cheha woreda. Even though the above constraints exerted their counterpart, the researcher used his maximum effort to make better efforts to come up with reliable data and information.

1.8 Organization of the Thesis

This thesis has of five chapters. The first chapter discussed the introduction part which consists, background of the study, statement of the problem, objectives of the study, research question, significance of the study, scope and limitation of the study and organization of the thesis. In chapter two, review of related literature was discussed. In chapter three, methodological issues including

description of the study area, research design, sampling method and sample size determination, sources and type of data, methods of data analysis and description of variables and hypothesis are included. The fourth chapter presents the results of the study and discusses summary of descriptive and econometric model. The final chapter presents, conclusions and recommendations made based on the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Concept and Methods of Irrigation

Irrigation is defined as the artificial application of water to the soil for the purpose of crop production to supplement rain fall and ground water contributions. Or it is the process of applying water to meet the water needs of growing plants Water from rivers, reservoirs, lakes, or aquifers is pumped to or flows by growing through pipes, canals, ditches, or even natural streams (Bjorneberg, 2013). The methods of irrigation are described as follows:-

2.1.1 Surface irrigation

Surface irrigation entails water flowing by gravity over soil. Water is usually supported by gravity from the water surface through canals, pipes, or ditches to the field. Some types of surface irrigation include basin irrigation, furrow irrigation, flood irrigation and border irrigation (Bjorneberg, 2013). Basin irrigation: A basin is a piece of land, small or large, surrounded by earth bunds in which water is pounded. The water can be impounded within it to irrigate trees, vegetables or crops grown in patches. The field is divided in to compartments or checks wholly surrounded by levees. The water is contained at the upper end and completely fills the compartments until it over flows at the lowest point of the levees. Furrow irrigation: In this method, the water is guided in the furrow or channels that pass through the whole field but the water covers only part of the soil surface, so it results in less evaporation. The furrows are separated with ridges. At each ridge, water is conveyed into furrow that can be perceived as narrow basins or borders. Furrowing is applied on seep slops. Flood irrigation: In flood irrigation, all of the soil is covered by the water applied. It is the least controlled of all surface irrigation techniques. Water is conveyed in the ditch at the upper part of the plot and allowed to spread over the land in a manner directed by the natural landscape. Flooding is best applied when the slope is limited. Border irrigation: The border method of irrigation is an

open-field method. Here the land is divided in to elongated plots confined between low earth banks and configured to slope uniformly from the point of supply. The land surface should slope gently in the direction of flow and it is generally leveled laterally, along all cross sections perpendicular to that direction. Water is guided over the land by field ditches.

2.1.2 Sprinkler irrigation

According to Shankar et al.(2002) in this method, water is carried through a network of pipes under medium to high pressure and is forced through a nozzle of small diameter and sprayed on the ground or crop like a rain. It tends to simulate the rainfall but in a way such that the run-off and deep percolation losses are avoided. Irrigation is given under controlled conditions up to the root depth and it is possible to apply the required quantity of water at the required time.

In contrast to surface irrigation, it is possible to apply water uniformly in all places with sprinkler irrigation. In this method, water penetrates only to the root zone with no wastage in the form of deep percolation. Therefore, it is possible to increase the area by one and a half time with same quantity of water. Higher levels of spatial uniformity and efficiency than gravity irrigation is achieved by sprinkler systems. In addition, sprinkler systems could be used advantageously where the land which can't be not irrigated by the gravity methods because of highly undulating topography, high porosity of soil, steep gradients and shallow top soil, and the land that can be irrigated but a part of it is with open ditches. It means land need not be leveled.

2.1.3 Drip irrigation

The principle of drip irrigation is to wet dry ground with small amounts of water just where the plants can absorb it. Drip irrigation is practiced in dry, arid regions where water is scarce and must be used sparingly. Water is delivered to the points via a set of plastic lateral tubes laid along the ground or buried at a depth of 15-30 cm and supplied from a field main. These tubes are left in

place throughout the irrigation season. Drip irrigation can save water by reducing the portion of the soil surface that is wetted thus, decreasing the amount of direct evaporation.

2.2 Irrigation - Poverty Linkage

According to United Nations as sited by (Gordon, 2005), poverty is a denial of choices and opportunities, a violation of human dignity. It means lack of basic capacity to participate effectively in society. It means not having enough to feed and cloths a family, not having a school or clinic to go to, not having the land on which to grow one's food or a job to earn one's living and not having access to credit. It means insecurity, powerlessness and exclusion of individuals, households and communities. It means susceptibility to violence, and it often implies living on marginal or fragile environments, without access to clean water or sanitation.

Irrigation has a strong contribution for efficient use of the land resource; the value of per hectare crop production under irrigated settings is about twice that under rain - fed settings. Household income and consumption are much higher in irrigated settings than in rain - fed settings, and a 50 percent point gap is not uncommon. In most settings, poverty incidence is 20 - 30 percent higher in rain - fed settings than in irrigated settings; irrigated systems have a much lower chronic poverty than rain- fed settings; the study suggests that irrigation significantly contributes to reducing the worst kind of poverty, i.e., chronic poverty (Hussain, 2004).

Water resource is the major factor affecting the livelihood of rural people both in terms of basic services and in terms of residence building and vulnerability reduction (FAO, 2009). A synthesis report by a collaborative program of ADB, FAO, EFAD, IWMI AND World Bank indicates that an investment in agricultural water can contribute to Agricultural growth and reduce poverty directly by: Permitting intensification and diversification hence increased from out puts and income Increasing agricultural wage income and employment.

- Reducing local food prices and hence improving real net income. and

- Reduce poverty indirectly via increased rural and urban employment as a result of multiplier effect on growth in rural and urban nonfarm economies

On the other hand, a document of (IWMI, 2002), indicates that an irrigation access is a crucial instrument for reducing poverty and rural poverty in particular. This is not so much through direct impact of increased yield and farm return per se, but more through indirect impacts associated with increased rural employment, especially the scale of economic multipliers operating in rural economy. The level of multiplier effects depends up on the nature of backward and forward linkage effects in the regional economy, i.e the scale of inter linkages within and among the rural enterprises and market infrastructure.

A study by Nugusse et al. *(*2013) indicates that the impact of irrigation on household food security and found that there are significant differences in annual income, asset holding, food consumption, and chemical farm input expenditure between the user and non-user respondents. The expansion of irrigation schemes has encouraged rural people to use more of modern agricultural technologies, diversify their income sources, built up asset holding, and ensured food security.

Another study by Getaneh (2011), concludes that irrigation development has a profound impact on poverty alleviation and identified prevalence of poverty in non-irrigating household is by far greater than in irrigating households.

2.3 Irrigation Development in Ethiopia

Ethiopia offers ample scope for growth in agricultural production through irrigation development as the country is endowed with substantial amount water resources. The country's surface water and ground water resource potential are impressive and remains well placed to develop irrigation based agricultural production (Asfaw et al., 2015).

In the country modern irrigation was started at the Awash River basin with bilateral cooperation of Ethiopia and Dutch company during 1950's for production of commercial crops such as sugarcane

and cotton. Now a day, the policies and strategies of Ethiopia strongly supports the irrigation developments especially the small-scale irrigation (SSI) through the water sector development program (WSDP) and Ethiopian irrigation development program (IDP) (Asfaw et al., 2015). Current irrigation schemes cover about 640,000 ha across the country .These irrigation schemes vary widely in size and structure, from micro irrigation to river diversion, pumping, small or large dams. These schemes can be characterized as: small scale irrigation (SSI), medium scale irrigation (MSI), large scale irrigation (LSI) (Awlachew, 2010).

- **Small scale-irrigation (SSI**), which are often community-based and traditional methods, covering less than 200 hectares. Examples of SSIs include household based RWH, hand-dug wells, shallow wells, flooding (spate), individual household-based river diversions and other traditional methods.
- **Medium-scale irrigation (MSI)**, which is community based or publicly sponsored, covering 200 to 3,000 hectares. Examples of MSIs include the Sille, Hare and Ziway irrigation schemes;
- **Large-scale irrigation (LSI**), covering more than 3,000 hectares, which is typically commercially or publicly sponsored. Examples of LSIs include the Wonji-shoa, Methara, Nura Era and Fincha irrigation schemes.

2.4. Potentials and Irrigation Development in Ethiopia

Ethiopia has 12 river basins with annual run off volume of 122 billion m^3 of water and an estimated 2.6- 6.5 billion m^3 of ground water potential, which makes an average of 1575 m^3physically available water per person per year. It is relatively large a volume. However, due lack of water storage infrastructure and large special and temporal variation in rain fall, there is not enough water for most farmers to produce more than one time per year(IWMI, 2007).

According to IWMI document of 2007, the major potential river basins of Ethiopia are Abbay, Tekeze, Baro- Akobo, Omo-Gibe, Rift valley, Awash, Genale Dawa ,Wabeshebele, Danakil, Ogaden and Aysha. The basins which are related and include SNNPR are discussed below:

2.4.1 Abay River Basin

River in the basin is the Blue Nile (Abbay) river, which rises in Lake Tana flowing about 1,450 km long, and merges with the White Nile to form the Nile proper. The river basin has a lowest elevation of 500 m. and a highest elevation of 4261 m. The total mean annual flow from the river basin is estimated to be 54.8 BMC. The rivers of the Abbay basin contribute on average about 62 percent of Nile at Aswan; together with the contribution of BaroAkobo and Tekeze rivers, Ethiopia accounts for at least 86 percent of the runoff at Aswan. According to MoWR data, it is identified that the Abbay river basin has a potential of 211 irrigation projects, of which 90 are small-scale, 69 are medium-scale and 52 are large-scale. A total of 815,581 hectares of potential irrigable land is estimated, out of which 45,856 ha are for small-scale, 130,395 hectares for medium-scale and 639,330 hectares for large-scale development (Awlachew et al., 2007).

2.4.2 Awash River Basin

Awash River basin has a catchment area of 112,696 km^2 .The Awash River originates from Central West part of Ethiopia, flowing 1200 Km long, and provides a number of benefits to Ethiopia. Relatively, the most utilized river basin and the only river entirely in the country, Awash covers parts of the Amhara, Oromia, Afar, Somali regional states, and Dire Dawa, and Addis Ababa City administrative states of the country. The river basin has a lowest elevation of 210 m and a highest elevation of 4195 m. The total mean annual flow from the river basins is estimated to be 4.9 BMC. In this river basin 37 irrigation potential sites are identified out of which 5 are small-scale, 18 are medium-scale, and 14 are large-scale. The estimated irrigation potential is 134,121 hectares. Out of

these, a potential, 30,556 hectares are for small-scale, 24,500 hectares for medium-scale and 79,065 hectares for large-scale development (Awlachew et al., 2007).

2.4.3 Genale Dawa River Basin

Genale Dawa river basin has an area of 171,042 Km^2, covering parts of Oromia, SNNRP, and Somali regions. It is the third largest river basin, after Wabi Shebelle and Abbay river basins. The river basin has a lowest elevation of 171 m and a highest elevation of 4385 m. The total mean annual flow from the river basins is estimated at about 5.8 BMC. The basin falls mainly in the arid and semi-arid zone and is generally drought-prone with erratic rainfall. About 85 irrigation potential sites are identified in the basin, out of which, 18 are small-scale, 28 are medium-scale, and 39 are large-scale. The basin has an estimated total potential of 1,074,720 hectares of irrigable area. Out of these, a potential 1805 hectares are for small-scale, 28,415 hectares for medium-scale and 1,044,500 hectares for large-scale development (Awlachew et al., *2007).*

2.4.4 Baro Akobo River Basin

From the same source above, BaroAkobo river basin has an area of 75,912 Km^2, covering parts of the Benishangul-Gumz, Gambella, Oromia, and SNNPR. The basin has a lowest elevation of 390 m. and highest elevation of 3244 m. The total mean annual flow from the river basins is estimated to be 23.6 BMC. Twenty two large-scale potential irrigation sites are identified in the basin, with an estimated irrigable area of 1,019,523 hectares. The Baro-Akobo basin is the second most important basin, next to Genale Dawa, as far as irrigation potential is concerned (Awlachew, et al., *2007).*

2.4.5 Omo Ghibe River Basin

The Omo-Ghibe river basin has an area of 79,000 Km^2, covering parts of the SNNPRS and Oromia. The total mean annual flow from the river basin is estimated at about 16.6 BMC. Large-scale and medium-scale irrigation potential are identified in the basin, with an estimated irrigable area of

57,900 and 10,028 hectares respectively, and a total irrigable area of 67,928 hectares (Awlachew *et al., 2007).*

2.4.6 Rift Valley Basin

The Rift Valley basin has an area of 52,739 Km^2, covering parts of the Oromia, SNNP regions. The total mean annual flow from the river basins is estimated at about 5.6 BMC. Large-scale irrigation potential is estimated at 45,700 hectares with an estimated total irrigable area of 139,300 hectares (Awlachew et al., 2007*).*

2.5 Challenges of Irrigation Development in Ethiopia

Although the government of Ethiopia gives an emphasis and priority for irrigation development growth and transformation plan of the country, the irrigation sector has encountered by Varity of challenges. According to MOWIE, 2013 the Main challenges of irrigation development in Ethiopia can be narrated as: -

- Inadequate awareness of irrigation water management as in irrigation scheduling techniques, water saving technologies, water measurement techniques, operation and maintenances of irrigation facilities.
- Inadequate knowledge on improved and diversified irrigation agronomic practices.
- Shortage of basic technical knowledge on irrigation pumps, drip irrigation system, sprinkler irrigation surface irrigation methods.
- Scheme based approach rather than area /catchment-based approach for the development of SSI schemes.
- Inadequate baseline data and information on the development of water resources.
- Lack of experience in design construction and supervision of quality irrigation projects.
- Low production of existing irrigation schemes.

- Inadequate community involvement and consultation in scheme planning, construction and implementation of irrigation development.
- Poor economic background of users for irrigation infrastructure development to access irrigation technologies and agricultural inputs, where the price increment is not affordable to farmers.

2.6 Empirical Literature Review

Ethiopia enjoys a fast expanding irrigation subsector due to the enormous untapped irrigation potential, the need to provide food, industrial raw materials, and labor to large and growing population. However, this sector has been hindered by systematic and market barriers, such as technical capacity, limited value chain support and crop marketing, land tenure, water access, access to finance, access to land and credit, lack of farmers knowledge and supply chains (FAO, 2015).

Petros (2017), study the determinants of small-scale irrigation in Boloso sore district, wolaita zone, SNNPR, and the results indicate that the farm size of households, distance from the river, labor and training services have effect on small irrigation use. Another study by Tizita, (2017) showed that the main constraints for small scale irrigation use by farming households are; long distance from water source, lack of suitable land for small scale irrigation, market problem, lack of finance and irrigation tools and presence of pests and disease.

Mamo (2018) study the determinants of performance of small-scale irrigation in improving household's income in Hadiya zone Ethiopia and the results indicate that sex of house hold head, availability of labor, farm distance from water and access to credit significantly determine the use of small-scale irrigation. Results of study by Agidew (2016), show that sex of respondents', household size engaged in the agricultural labor force and number of contact of respondents with agricultural development agents per month, education level and attendance on irrigation related

training had significant positive effect on the use of irrigation water. On the other hand, farm distance from the river and the main irrigation canal had significant negative effect on the use of irrigation water.

Similarly, Dereje (2016) stated that Shortage of water, access to improved seeds, marketing, and increment of farm input costs have been hindering SSI practices. Awareness campaigns for non-irrigators and adequate supervision for the irrigators by development agents (DAs) and district officials are important to improve the livelihood of farmers. A study by Temesgen (2017), revealed that number of oxen, market distance, farm distance from irrigation water source, market information and credit use significantly determine participation in small-scale irrigation.

More over different constraints related with lack of market access, topography associated with distance of land from water source, inadequate government support, and poor or nonexistent market linkage, poor irrigation water management and development were forwarded by the participants. Another study by Kinfe et al. (2012) indicates that gender of the household, education, labor availability, land size, access to credit and annual income of households influence the participation in small scale irrigation.

Abebaw et al.(2015) found in the study that total annual income of households, farm size, financial constraints, access to market information, poor technology choice, conflicts in water use and use right, lack of market access, lack of training, absence of government support and poor extension services determines farmers' decision to participate in small scale irrigation. Similarly, Woldegebrel et al.(2017) found that house hold size, participation in rural association, markets, information access, extension services and rural roads are significant factors affecting farmers' decision to participate in irrigation activities. It was found that the participation in irrigation have positive effect on house hold income too.

Another study by Muez (2014), studied the impact of small-scale irrigation on rural households food security in Amba Alaje , Ethiopia, and the results indicates that SSI development has positive impact on food security status of rural households and the sex of house hold, education level, cultivated land holding, access to credit, access to extension services, distance from FTC(Farmers training center) and availability of irrigation water are the major factors that significantly influence the probability of rural households to participate in small scale irrigation.

USAID, in its Document of 2019, indicates that, Equity in access to water management technology and practices is constrained by, high investment costs, absence of financial services, poor market integration, inadequate information services and labor constraints. In addition, lack of institution for collective management of natural resources, such as water, further restricts access for resource poor farmers, increasing inequity. Furthermore Gebrehiwot (2010), found in his study that the major challenges that inhibit the optimal utilization irrigation are lack of market, poor infrastructure, failure or cultural resistance to adopt modern technology, inefficient water utilization, inadequate government support and very high fertilizer price. In addition study conducted by Agerie (2016), indicates that total live stoke holding, nearest market center, education level, distance from water source, access to extension services, access to information, availability of family labor, access to credit and gender of household head are important determinants of participation in small scale irrigation. More over this study shows that irrigation participation, access to credit, gender, size of cultivated land, access to extension services and total live stoke holding are positively and significantly associated with households' total annual income.

Finding of study by Niguse (2013), describes that education level of the household head, household family sizes, membership in rural associations (social networking), distance from the water-point to the farmland, distance from home to farmers' training centers (development agent

offices), distance from home to all-weather rural roads, and access to information media are the major factors that statistically significant in explicating rural people to practice irrigation.

According to Seifu (2018), sex of household head, age of household head, education level of household head, total annual income, access to information and access to extension services had significantly and positively influenced utilization and intensity of utilization of small scale irrigation while distance from residence to water source had significantly and negatively influenced utilization and intensity of utilization of small scale irrigation by farm house holds.

Given the predominance of rural poverty in SSA, and given that agriculture will remain the main source of livelihood, poverty reduction strategies need to focus on improving productivity in Agriculture sector, especially by investing in agriculture water. However, there is no "one size fits all" approach for improving livelihoods. Different contexts and needs will require different types of investments, in which market or household food security, prevailing Argo climatic conditions and associated farming systems and the overall socio-economic and institutional environment will guide the choice from a non-prescriptive menu of appropriate interventions at different scales (FAO, 2008).

2.7 Analytical Framework of the study

There are many factors that influence the utilization of small-scale irrigation practice by farm households. The findings of different studies conducted on irrigation use in different parts of the world gives an indication on different factors that can influence the irrigation utilization of farmers. These factors which affect farmers to use irrigation practice are categorized into demographic, socio -economic, physical and institutional and knowledge source variables either negatively or positively related to SSI practice participation among farm households and the area of land irrigated by farmers. From the empirical review it can be understood that the most determinants of small-scale irrigation use by farm households are socioeconomic, demographic and institutional factors.

Moreover, some studies indicate that natural factors such as pests and disease and suitable land for irrigation determine utilization of small-scale irrigation. For instance (Mamo, 2018; Kinfe, 2012; Agerie , 2016; Muez, 2014; Seifu, 2018) found that Gender of house hold head, education level, distance from water source, land size, access to extension services and access to information determine farmers participation in small scale irrigation. Other Authors indicate that access to all weather road, participation in rural association, distance from FTC, Cultural resistance, number of live stoke holding etc. determine household's participation in small scale irrigation.

Therefore, the analytical frame work of this study includes socioeconomic, demographic, institutional and some biophysical factors such as disease and pests, crop raider animals.

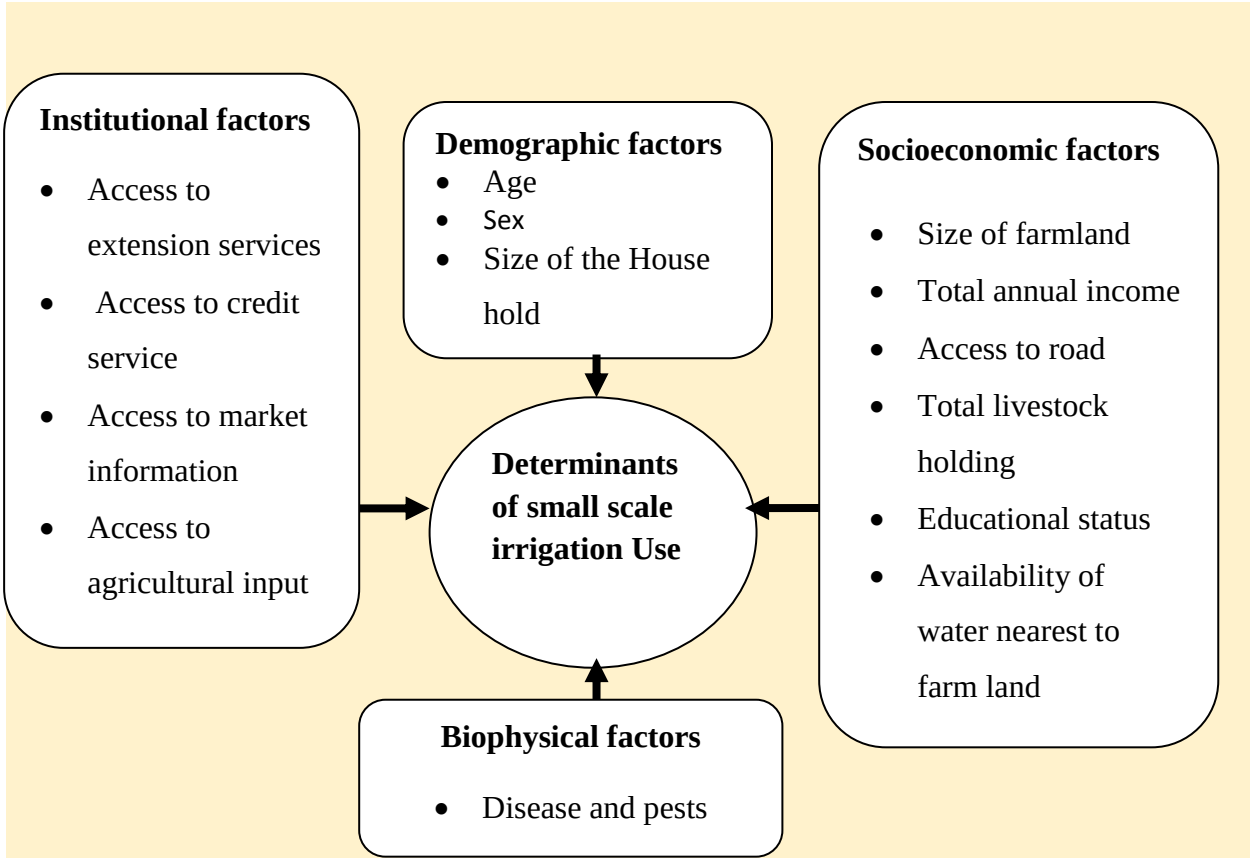

Figure 1: Conceptual frame work of the study

Source: Modified after Seifu (2018).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1 Location of the study area

The relative location of Cheha Woreda is 188km south west of Addis Ababa and 30kms south east of Wolkite city [capital city of Gurage Zone being one of the Woredas in Gurage Zone. The Woreda is bordered by Abeshge Woreda in the North, Geta and Enemor Woreda in the south, Ezha and Gumer Woredas in the East and both Yem especial Woreda and Oromiya region in the west CASCAPE (2015). The absolute location of the Woreda is $7^{0}9^{'}\ 9^{''}$-$8^{0}25^{''}$N and $37^{0}59^{'}$-$38^{0}\ 06^{'}$E.

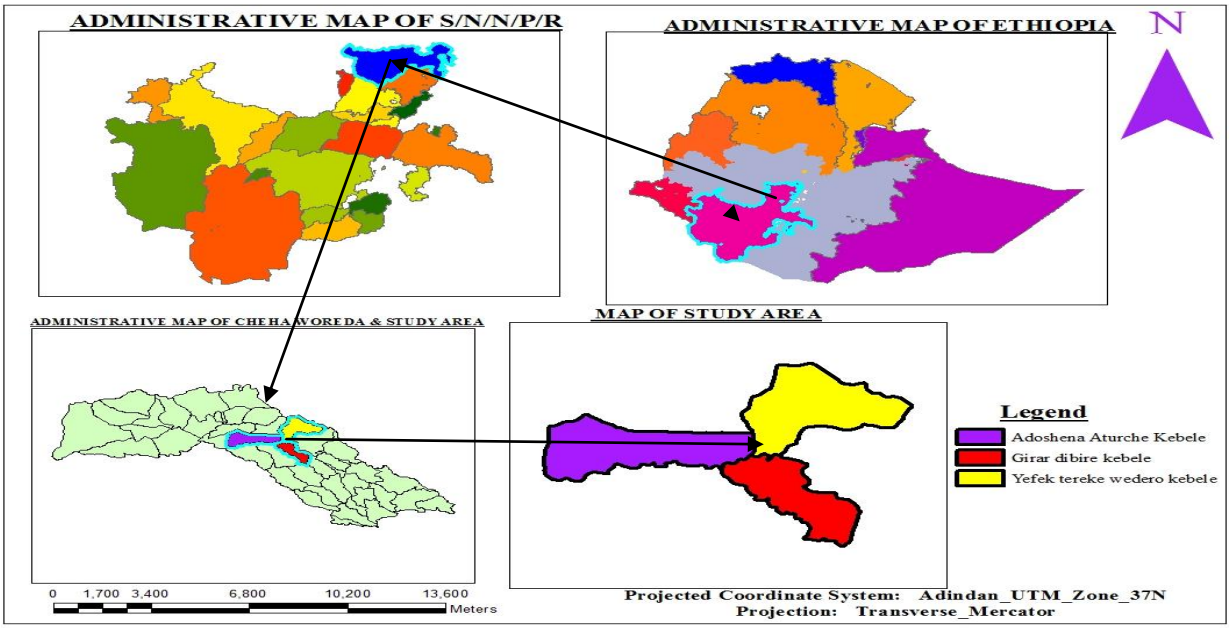

Figure 2: Map of the study area

Source: Ethiopia mapping Agency, Ethiopia Shape files (2017)

3.1.2 Bio-physical conditions

The mean maximum and minimum temperature are 27^{o}c and 18^{o}crespectively. The Woreda receives a rainfall between 900-1500mm, CASCAPE (2015). Elevation in this woreda ranges from 1900 to 3000 masl. There are five [5] permanent rivers in the woreda namely, Gotam ,Gogeb, Megecha, Kecher and Wabe and other seasonal streams. The climatic condition of that area is largely woynadega and some part dega and kolla.

Land degradation is a common feature of the area and it is likely to see marginal lands, Gullies, and sloppy areas which are seriously affected by soil erosion especially in high lands of area. The kiremt rains are more important than the belg rains in this area and are essential for the cultivation of teff, chickpeas, wheat, barley and the oilseed nug (Niger Seed). Belg rainfall is also important for the cultivation of long - cycle crops, of which the most important is maize (Woreda Agricultural Office, 2020).

The total land area of the Woreda is 57693 hectares. The land use in the woreda is 37% for perennial crops 28.2% annual crops 3.55% for grazing land, 15.35% occupied by forest including private forest and the rest is for other purposes.

3.1.3 Socio-economic conditions

Economic activities in the Woreda were predominantly depends on agriculture. The agricultural cycle lasts for a year beginning with land preparation in January and ending with threshing in December. A root crop the so called Enset, is a staple food for more than 115,000, people in this area (Wergasa, 2006). The subsistence and mixed agriculture in the woreda are primarily based on Enset together with corn [maize], Sorghum chickpea, yams, taro and some other crops. The major cash crops include teff, niger seed, coffee and chat. In addition, Eucalyptus tree have its part in the livelihood of Cheha woreda. The main type of livestock's the area are cattle and goats (Agricultural office the Woreda). The challenges farmers face in the woreda includes seasonal drought, different

pests, water logging during rainy season, shortage of irrigational water, pests and disease and shortage of farming and grazing land.

According to cheha woreda plan commission office the projected 2020 total population of the woreda is 147,715 from this population 72,380 are men and 75,335 are women (Cheha woreda plan commission office, 2020). According to the same source from the total population 9.48 percent lives in urban area and the others 90.52% are rural. The woreda has 191 km of all-weather road and 232km of dry weather road for an average road density of 733.12 km per 1000 square kms (Woreda Administration office, 2020).

3.2 Research Design

In order to achieve the aim of this study across-sectional research design was employed. This approach was chosen because of constraints such as time, financial and logistic supports that would be encountered during data collection. Cross-sectional survey relies on existing differences rather than change following intervention; and, groups are selected based on existing differences and the collection of data is undertaken at one point in time.

3.3 Data Type and Source of Data

Both qualitative and quantitative data were collected from primary and secondary sources. Primary data for the study was collected by household survey. The data was collected from selected sample households by using survey question and additional information from households was collected by focus group discussion by using guiding questions.

The household survey data includes information about socioeconomic, institutional, demographic and biophysical characteristics of the respondents.

For the collection of primary data 7 enumerators, which were selected from kebele development agents were involved, as they are more familiar and have acceptance by local peoples which helps to obtain reliable data and helps to well manage the data collection process. The enumerators had

taken an intensive training on data collection procedures, interviewing techniques and the detailed contents of the questionnaire for two days. Strict supervision was made by the researcher during the course of the survey. In order to get relevant and detailed information about household's irrigation practice and its determinants in the district, focus group discussion was conducted. To generate data, guiding question was administered.

Three focus groups discussions, were held in each selected kebeles having 8 participants, two male household heads and two female household heads consisting users and non-users, one from community elders, one from religious leaders, one from youth's association and one from women's association were purposively selected from the farm households for the discussion. In the discussion both male headed and female headed household heads were participated. In the focus group discussion, the socioeconomic, institutional and biophysical issues that determine the use of small-scale irrigation were stressed and data that could support household survey data was collected.

Secondary data was collected from documents and publications of different organizations, woreda annual reports (Cheha Woreda Agricultural Office, 2020; Cheha Water and Irrigation Office, 2020) and from journals which were relevant to irrigation.

3.4 Sampling Method and Sample Size Determination

In this study a two stage sampling procedure was employed. Cheha woreda was selected purposefully according to its potential for small scale irrigation and the researcher's familiarity to the area that helps to get reliable information about the area and reduces language and other constraints during data collection. Then three rural kebeles namely Girardiber, Adoshe and wedro were selected purposively as the kebeles were among the most potential kebeles where small scale irrigation was used.

The total households in the sample Kebeles were stratified into the two strata (irrigation water user and non-user households) and then simple random sampling technique was applied to select the sample unit from each stratum at each kebele via probability proportionate to size procedure in the respective sample frame. The total number of households in the kebeles was 1364.This number is the sum of the household number for Adoshe, 439; Girardibe*r*, 405 and Wedro, 520.

To determine the sample size, sample size determination formula of Kothary (2004) was used. This formula was used because it is relatively the recent and easy to compute the appropriate sample size. According to him the sample size for finite population could be computed as:

$$\mathbf{n} = \frac{\boldsymbol{z^2 * p * q * N}}{\boldsymbol{e^2 (N-1) + z^2 p * q}}$$ where;

n= sample size

z= the value of standard variant at a given confidence level

p= sample proportion

q= 1-p

e = given precision rate or acceptable error

N = the population size for this study:

-The precision level 0.07 was being used

-The sample proportion of 0.5 and z value 1.96 is used

Then: N=1364, e= 0.07, z= 1.96 p= 0.5 and q= 1-0.5= 0.5

Therefore, the sample size computed as: $\frac{\mathbf{1.96^2 * 0.5 * 0.5 * 1364}}{\mathbf{0.07^2 (1364-1) + (1.96^2 * 0.5 * 0.5)}} = 172$

Therefore, the total sample size for this study is **172.**

Table 1: Proportional Distribution of Sample Households

Name of kebeles	Total number of households	Number of samples selected
Adoshe	439	55
Girardiber	405	51
Wedro	520	66
Total	1364	172

Source: Cheha Woreda Agricultural Office (2020).

3.5 Method of Data Analysis

In this study, descriptive statistic and econometric model were used to analyze the collected data. In addition to these data generated through FGD was analyzed qualitatively and used for triangulation.

3.5.1 Descriptive statistics

After data collection, the data were coded and entered in to SPSS version-16 and STATA software version (14.2). SPSS was used for the econometric analysis and for cross tabulation and STATA was used for multi-co linearity test. Then, the data was analyzed by using descriptive statistics such as frequency, mean and percentage. The statistical significance of the variables in the descriptive part was tested for both dummy and continuous variables using t-test and chi-square test.

3.5.2 Econometric model specification

As indicated by Gujirati, (2003) a model for studies that deal with dichotomous dependent variables the suggested models are: the logit model, Probit model and Tobit model. To select a model different scholars indicate variety of reasons. According to Patnaik (2013) the Logit and Probit models are almost identical and the choice of the model is arbitrary, although logit model has certain advantages (simplicity and ease of interpretation) However, the parameters of the two

models are scaled differently. The parameter estimates in a logistic regression tend to be 1.6 to 1.8 times higher than they are in a corresponding Probit model. The Probit and logit models are estimated by maximum likelihood (ML), assuming independence across observations. The ML estimator of β is consistent and asymptotically normally distributed. The previous studies in determinants small scale irrigation use (utilization) adopt the logit model, for instance (Agidew, 2016; Petros et al., 2017; Mamo, 2018).

In this study to identify the determinants that influence the use of small-scale irrigation water, the binary LOGIT regression analysis was employed. It was selected because it is relevance to deal with dependent variables (user or non-user of SSI) that are dichotomous (Dummy) in nature. The model assists in estimating the probability of irrigation water use status of a household that can take one of the two values, user of irrigation and non-user.

The Binary Logit models

The functional form Logistic Distribution is

Pi= E(Y = 1/xi) = $\frac{\mathbf{1}}{\mathbf{1}+e^{-(\boldsymbol{\beta 0}+\boldsymbol{\beta i xi})}}$ ----------1

or it can be written as pi = $\frac{1}{1+e^{-z}}$

Wherezi = $\beta 0 + \sum_{i=1}^{n} \beta i xi$ ----------2

Pi = the probability of households to be user of small-scale irrigation (SSI)

Xi = the n explanatory variables

$\beta 0$ = is the slop of the function and

βi= the slop parameter that initiates the use of SSI as a unit change in the explanatory variable then similarly the probability of households not to use SSI can be expressed as

1-Pi = $\frac{1}{1+e^{zi}}$ ----------3

By dividing equation – 1 by equation – 3 we can get

Pi/(1-Pi) = $\frac{1+e^{zi}}{1+e^{-zi}} = e^{zi}$ ----------4

Then $Pi/(1-Pi)$ is the odds ratio in favor of using small scale irrigation i.e the probability of households to use SSI to the probability that not to use SSI.

So if we take the natural log of equation 4 we can get,

Li = ln($\frac{Pi}{1-Pi}$) = Zi = $\beta 0 + \sum_{i=1}^{n} \beta i$xi

Therefore, the estimation of the model will be:

Li = ln($\frac{Pi}{1-Pi}$) = Zi = $\beta 0 + \sum_{i=1}^{n} \beta i$xi +ui where:

Li = is the natural logarism of odds ratio

$\beta 0$ = is the intercept

Pi = the probability that the households use SSI that is Y= 1 and

1-Pi = the probability that a household not to use SSI that is Y= 0

3.6 Description of Variables and Hypothesis

3.6.1 The Dependent variable

The dependent variable was the decision of farmers to use small-scale irrigation practice, taking value of 1 if the farmer was user and 0 if the farmer was not user of small-scale irrigation practice. The main intension here is to identify the factors determining the decision of the farmers to use small-scale irrigation.

3.6.2 Independent (Explanatory) Variables

Sex of the respondent (SEXR): This variable is dummy variable taking value of 1 if the sex of the household head is female or 0 if the sex of the household head is male. This variable is found that as the probability of using irrigation practice and irrigated area will be higher for male headed household as compared to female headed households. As evidence (Mamo, 2018; Agidew, 2016;

Agerie, 2016; kinfe et al., 2012; Muez, 2014; Seifu , 2018) have gotten the same result. The cultural restrictions and double responsibilities of females make it hard to engage in irrigation activities.

Age of household head (AGEHH): This variable is continuous measured in years. From the findings of different studies age of household head is found negatively affected the using of irrigation practice by farmers and its intensity. This is because as the age of household's head increase and farmers are being out of productive age the power and creativity decreases then the probability of farmers to be nonuser increases.

Educational status of the households (EDUCHH): This variable is dummy variable measured in terms of school attendance, taking zero if the farmer is illiterate and some value greater than zero if the farmer is literate. This variable is found by different researchers that literate farmers are probably more users of small-scale irrigation practice than illiterate counterparts (Agidew, 2016; Muez, 2014; kinfe et al., 2012) from the evidences it was hypothesized that education level has positive relation with irrigation use.

Total Land holding size (TLAN SZ): This variable is continuous variable measured in terms of hectare. Those farmers having larger area of cultivable land were found to use irrigation more than the farmers who have smaller land as the evidences indicate (Abebaw et al, 2015; Muez, 2014; Petros, 2017). By this there is positive relationship between total land size and irrigation use. i.e. farmers which have more hectare of land are better use irrigable land.

Total annual income of the household (TINC): This variable is continuous variable, which is the total annual income measured in Ethiopian Birr. It is hypothesized that farmers which have more income are more users of small-scale irrigation. i.e. there is positive relationship between income and irrigation use. From the empirical review (Kinfe et al., 2012; Abebaw et al., 2015; seifu, 2018) show this result.

Market information (MKT INFO): This variable is dummy variable taking value of 1 if the farmers have information on the market concerning the demand and price issue of the product, or 0 if the farmers does not have an access to market information and undertake every production without market information. This variable is found positively and significantly affected the using decision of the farmers by several studies (Abebaw et al., 2015; Kinfe et al., 2012; Temesgen, 2017; Woldegebrel et al., 2017). From the evidences it is hypothesized that market information and the use of irrigation by farmers have positive relationship.

Access to credit service (ACC Credit): This variable is dummy variable taking on 1 if the farmer has access to credit or 0 if the farmer did not used credit. Previous studies found that Access to credit (use) has positive effect on the irrigation practice decision of the farmers (AgerieNega, 2016; MuezHaileleul, 2014; knife et al., 2012; Temesgen , 2017; Mamo , 2018).

The farmers having access to credit are able to buy irrigated farming inputs required on time than those who do not have credit access. Therefore, this variable was hypothesized to have positive effect on irrigation use and intensity of use by the respondents.

Availability of water nearest to farm land (AVWNFL): This variable is Dummy variable, which takes '1' if water is available in a distance about 400m or less than 400m around farm land and '0' otherwise. It is found by different scholars as when the distance between farmland and the water source increases the probability of farmers to utilize irrigation decreases that is it has negative impact on irrigation use (Petros , 2017; Tizita, 2017 ; Mamo , 2018; Agidew, 2016; Temesgen, 2017; Agerie , 2016; Niguse, 2013; Kinfe et al., 2012). However, when farmers have available water nearest to their farm, they were more likely to use small scale irrigation. Therefore, this variable is hypothesized to influence the use of small-scale irrigation positively.

House hold size (HH size): Family size is a quantitative continuous variable measured in numbers of house hold members in adult equivalent. Evidences show that the farmers with higher house hold

size are more users of small-scale irrigation than their counter parts (Woldegebrel et al., 2017; Agerie, 2016). This may be the case when the family members are used as the labor force in irrigated farming. This will reduce the cost incurred in hiring external labor. So, this variable is hypothesized as to have positive relationship with irrigation use.

Total livestock owned (Livestock): This is a continuous variable measured in Tropical Livestock Unit (TLU). In Ethiopia livestock including oxen were important source of income, food, manure and draught power for crop cultivation in agriculture. The evidences show that the higher the total livestock owned by the respondent the higher the probability of participation in small-scale irrigation practice (Agerie, 2016).This result could be related with the possibility of using the livestock sale at the time of irrigated farming as a source of income that can be used for expending on irrigated farming. On the other hand, farmers use oxen as a power to cultivate their land. This variable hypothesized as to have a positive effect on the use of small-scale irrigation.

Access to extension service (ACEXTEN): This refers to an access for extension services from development agents or not. This is a dummy variable with values of 1 if the household head has access to extension service and 0 otherwise. The previous studies indicated that it has positive effect on irrigation use (Woldegebrel et al., 2017; Muez, 2014; Agerie , 2016; Seifu ,2018).

Extension service provides the necessary information to acquire new skills and knowledge to farmers to improve agricultural production including small scale irrigation. It was; therefore, this variable was hypothesized to positively influence utilization of small-scale irrigation.

Access to all weather roads (ACCRD): this is a dummy variable which takes 1 if there is access 0 otherwise. According previous studies this variable has positive effect on irrigation use (Woldegebrel et al., 2017; Niguse, 2013). This may be irrigation products such as vegetables and fruits are usually perishable and bulky to transport, so if there aren't all weather road farmers may discourage for risk of transport access. Therefore, this variable is hypothesized positively related with irrigation use.

Access to agricultural inputs (ACC AGRII): this refers to availability of variable agricultural inputs such as fertilizer, pesticides and irrigation tools, which were frequently used in irrigated farming. Regarding to this there were evidences which has been indicating the positive relation between availability such agricultural inputs and irrigation use by farm households such as (Dereje, 2016; Tizita, 2017).If the farmers have got sufficient amount and type of agricultural inputs they were more likely to use and produce irrigated agricultural products by utilizing small scale irrigation practices. By depending on these evidences this variable hypothesized to have positive relationship with the use of small-scale irrigation.

Pests and disease: this variable is a dummy variable which takes '1' if there is occurrence of pests and disease including crop raider animals and '0' otherwise. Occurrence of disease and pests discourage farmers to cultivate crops including irrigation crops because sometimes they occur suddenly and can have unexpected damage. On the other hand, crop raider animals which are part of pests for agricultural crops, such as Grivet monkeys, crested porcupines, baboons, antelopes, warthogs, and wild pigs were the major crop raiders in the area (Dagne, 2003). Therefore, this variable hypothesized as negatively related with irrigation use.

Table 2 :Summary of the variable types, codes, hypothesis and description of explanatory variables.

NO.	Variable cod	Variable description	Variable type	Hypothesis
1	SEXR	Sex of the respondents	Dummy	+/-
2	AGEHH	Age of household head	Continuous	-
3	EDUCHH	Educational status of the hhs	Dummy	+
4	TLAN SZ	Total Land holding size	Continuous	+
5	TINC	Total annual income of the hhs	Continuous	+
6	MKT INFO	Market information	Dummy	+
7	ACC Credit	Access to credit service	Dummy	+
8	AVWNFL	Availability of water nearest to farm	Continuous	+
9	HH size	House hold size	Continuous	+
10	Livestock	Total livestock owned	Continuous	+
11	ACEXTEN	Access to extension service	Dummy	+
12	ACCRD	Access to all weather road	Dummy	+
13	ACC AGRII	Access to agricultural inputs	Dummy	+
14	PEST DSE	Pests and disease	Dummy	-

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Descriptive Statistics Results

In this section, the demographic, socioeconomic and institutional factors that determine the use of small-scale irrigation were discussed. In this paper user refers to those smallholder farmers who used small scale irrigation over the past five consecutive years while non-users implied those who were not utilized in the past five years in the study areas respectively. In this study primary data was collected from 172 sample households. From the total sample households 97(56.4%) were user of small-scale irrigation and 75(43.6%) were non users.

Table 3: Summary of Demographic, Socioeconomic and institutional characteristics of the Respondents

Variables		Households category						Chi^2-Value
		Users		Non-users		Total		
		Freq	Percent	Freq	Percent	freq	Percent	
Sex	Male	88	90.7%	59	78.7%	147	85.5%	4.9*
	Female	9	9.3	16	21.3%	25	14.5%	
Access to all weather road	Have access	64	66%	30	40%	94	54.7%	11.5**
	Haven't access	33	34%	45	60%	78	45.3%	
Availability of water	Available	95	97.9%	50	66.7%	120	69.8%	83.7**
	Not available	2	2.1%	25	33.3%	52	30.2%	
Educational status	Read & write	86	86.7%	55	73.3%	141	82.%	6.7*
	Can't read &write	11	11.3%	20	26.7%	31	18%	
Access to agricultural inputs	Have access	86	86.7%	15	20%	101	58.7%	82.3**
	Haven't access	11	11.3%	60	80%	71	41.3%	
Market information	Have access	84	86.6%	30	40%	114	66.3%	41.1**
	Haven't access	13	13.4%	45	60%	58	33.7%	
Access to extension service	Have access	88	90.7%	34	45.3%	122	70.9%	42.3**
	Haven't access	9	9.3%	41	54.7%	50	29.1%	
Access to credit service	Have access	84	86.6	12	16%	96	55.8%S	85.5**
	Haven't access	13	13.4%	63	84%	76	44.2%	
Pests and disease	Occurred	66	68%	75	100%	141	82%	29.2**
	Didn't occur	31	32%	0	0	31	18%	

*, ** significant at 5% and 1% significant level respectively

Source: Own survey computation

4.1.1 Demographic Results

4.1.1.1. Sex of the respondent

From 172 totals sample households 147(85.46%) were male headed and 25(14.53%) were female headed households. On the other hand, Table-3above shows that from 97user sample households, 88(90.7%) were male headed and the other 9(9.3%) were female headed. From 75 non user households 59(78.7%) were male headed and 16(21.3%) were female headed households. Similarly, the chi-square test indicates that there is significant relationship between sex of the household heads and being user or nonuser of small- scale irrigation at 5% significant level. Therefore, from the survey result it can be stated that male headed households are more likely to be user of small-scale irrigation than female headed households.

4.1.1.2. Age of household head

In the study area the average age of sample households was 41.1 years and the minimum and maximum age sample households in the study area was 21 and 60 respectively. Likewise, average age of user household's was 41.8 and the maximum and minimum age of user households was 60 and 21 respectively. On the other hand, the average age of non-users was 40.2 and the maximum and minimum age size of non-user households was 60 and 25 respectively (see table 4). However, the result of the independent sample t-test indicates that the relationship between age and being user or nonuser of small-scale irrigation is not significant.

4.1.1.3. Household size of the respondent

According to survey result the average household size of sample household in adult equivalent were 3.92 and the minimum and maximum size of households in adult equivalent in the study area was 1.8 and 7 respectively. Likewise, from the table below the average household size of user households were 4.61 and the maximum and minimum household size of user households was 7 and 2.6 respectively in adult equivalent. On the other hand, the average household size of nonusers

was 3.04 and the maximum and minimum household size of non-user households in adult equivalent was 6 and 1.8 respectively (see Table 4). Similarly, the result of the independent sample t-test indicates that there is a significant relationship between household size and being user or nonuser of small-scale irrigation at 1% significance level. Therefore, from the survey result it can be concluded that households that have a greater number of household members in adult equivalent were more user of small-scale irrigation than households which have a smaller number of household size in adult equivalent.

Table 4: Summary of continuous demographic variables

	Households category									
	Users			Non users			Total			t-value
Variables	Mean	Max	Min	Mean	Max	Min	Mean	max	Min	
Household size (AE)	4.61	7	2.6	3.04	6	1.8	3.91	7	1.8	11.20*
Age (Years)	41.8	60	21	40.2	60	25	41.1	60	21	1.5

*, significant at 5% significance level

Source: Own survey computation.

4.1.2. Socioeconomic results

4.1.2.1. Educational status of the households

The survey shows that from 172 total sample households, 142(82.6%) of the household heads can read and write. The rest 30(17.4%) cannot read and write. from 97 irrigation user sample households, 86(88.7%) of household heads can read and write showing that they attend some level of formal or informal education. Whereas the other 11(11.3%) cannot read and write. From 75 non user households, 55(73.3%) household heads can read and write and 20(26.7%) cannot read and write (see Table-5). Similarly, the chi-square test indicates that there is significant relationship between access to education level and being user or nonuser of small- scale irrigation at 5%

significant level. Therefore, from the survey result it can be stated that as the educational level of household heads increases the probability of households to use small scale irrigation increases.

4.1.2.2. Access to all weather road

The survey results show that from 172 total sample households, 94(54.7%) have access to all weather road and the other 78(45.3%) were without access to all weather road. From 97 user sample households, 64(66.0%) have access to all weather road and the other 33(34.0%) haven't access to all weather road. From 75 non user households 30(40%) have access to all weather road and 45(60%) haven't access to all weather road (see Table 5). Similarly, the chi-square test indicates that there is significant relationship between access to all weather road and being user or nonuser of small- scale irrigation at 1% significant level. Therefore, from the survey result it can be stated that households that have access to all weather road are more likely to be user of small-scale irrigation than their counter households.

4.1.2.3. Access to Agricultural Inputs

Agricultural inputs, such as motor pumps, fertilizer, pesticides and insecticides, improved seeds and other types of such imputes which facilitates production in small-scale irrigation are very important for farmer's decision to utilize small-scale irrigation. The survey data shows that from 172 total sample households, 101(59.7%) have access to at least the basic agricultural inputs for their small-scale irrigation farm and the other 71(41.3%) haven't access to such agricultural inputs. On the other hand, from 97 user sample households 86(88.7%) have an access to at least the basic agricultural inputs which are used in small-scale irrigation and 11(11.3%) doesn't have access. From 79 non user households 15(20%) have access to agricultural inputs for small-scale irrigation and the other 60(80%) haven't access (see table-5). Similarly, the chi-square test indicates that there is significant relationship between access to agricultural inputs and being user or nonuser of small-

scale irrigation at 1% significant level. Therefore, from the survey result it can be stated that households that have access to agricultural inputs for their small-scale irrigation are more likely to be user of small-scale irrigation than their counter households.

4.1.2.4. Availability of water nearest to farm land

From 172 total sample households, water is available for 120(69.8%) of sample farm households nearest to their farm land and the rest 52(30.2%) of sample farm households haven't available water nearest to their farm land. from 97 user sample households, 95(97.9%) have available water nearest to their farm land and for 2(2.1%) haven't water nearest to their farm land. From 75 non user households 25(33.3%) have available water for small-scale irrigation and 50(66.7%) did not have available water for small scale irrigation nearest to their farm land (see table-5). Similarly, the chi-square test indicates that there is significant relationship between availability of water nearest to farm land and being user or nonuser of small- scale irrigation at 1% significant level. Therefore, from the survey result it can be stated that households that have available water nearest to their farm land are more likely to be user of small-scale irrigation than their counter households.

4.1.2.5. Pests and disease

This variable is the only biophysical variable included in this study. From 172 total sample households, 141(82%) have encountered diseases and pests last year on their farm and the other 31(18%) hadn't the case. On the other hand, from 97 user sample households 66(68%) have encountered diseases and pests and 31(32%) hadn't the case. from 75 non user households 75(100%) have encountered diseases and pests on their farm. Similarly, the chi-square test indicates that there is significant relationship between occurrence of Pests and disease and being user or nonuser of small- scale irrigation at 1% significant level (Table 3). Therefore, from the survey result it can be stated that households that have access to agricultural inputs for their small-scale irrigation are more likely to be user of small-scale irrigation than their counter households.

Table-5 Summary of socioeconomic dummy variables

Variables		Households category						Chi^2-Value
		Users		Non-users		Total		
		Freq	Percent	Freq	percent	Freq	Percent	
Access to all weather road	Have access	64	66%	30	40%	94	54.7%	11.5**
	Haven't access	33	34%	45	60%	78	45.3%	
Availability of water	Available	95	97.9%	50	66.7%	120	69.8%	83.7**
	Not available	2	2.1%	25	33.3%	52	30.2%	
Access to agricultural inputs	Have access	86	86.7%	15	20%	101	58.7%	82.3**
	Haven't access	11	11.3%	60	80%	71	41.3%	
Educational status	Read & write	86	86.7%	55	73.3%	141	82.%	6.7*
	Can't read &write	11	11.3%	20	26.7%	31	18%	

*, **,significant at 5% and 1% significance level respectively.

Source: Own survey computation.

4.1.2.6 .Total land holding size of the respondents

In the study area the average landholding size of sample households were 1.34 ha and the minimum and maximum landholding size of sample households in the study area was 0.25 ha and 4ha respectively. Likewise, from the table below the average landholding size of user households were 1.68 ha and the maximum and minimum landholding size of user households was 4 hr. and 0.5 hr. respectively. On the other hand, the average landholding size of nonusers was 0.90 ha and the maximum and minimum landholding size of non-user households was 2.5 hr. and 0.25 hr. respectively (see table 6). Similarly, the result of the independent sample t-test indicates that there is a significant relationship between landholding size and being user or non-user of small-scale irrigation at 1% significance level. Therefore, from the survey result it can be concluded that households that have more size of farm land were more likely to use small-scale irrigation than households which have less area of landholding size.

4.1.2.7. Total annual income of the household

In the study area the average annual income of sample households was 21876.24 ETB and the minimum and maximum annual income of sample households in the study area were 2200ETB and 75345 ETB respectively. Likewise, from the table below the average annual income of user households were 29807.56 ETB and the maximum and minimum annual income of user households was 75345 ETB and 2500 ETB respectively. On the other hand, the average annual income of nonusers was 11618.40 ETB and the maximum and minimum annual income of non-user households was 23600 ETB and 2200 ETB respectively (see table-6). Similarly, the result of the independent sample t-test indicates that there is a significant relationship between annual income and being user or nonuser of small-scale irrigation at 1% significance level. Therefore, from the survey result it can be concluded that households that have more amount of annual income were more likely to use small-scale irrigation than households which have less amount of annual income.

4.1.2.8. Total livestock owned

In the study area the average total livestock owned by sample households were 4.55 TLU and the minimum and maximum total livestock owned by sample households in the study area were 0 and 9.58 TLU respectively. Likewise, from the table below the average number of livestock owned by user households were 5.13 TLU and the maximum and minimum number of livestock owned by user households was 9.58 TLU and 0 respectively. On the other hand, the average number of livestock owned by nonusers was 3.80 TLU and the maximum and minimum number of livestock owned by non-user households was 7 TLU and 0 respectively (see table 6). Similarly, the result of the independent sample t-test indicates that there is a significant relationship between total livestock owned by the households and being user or nonuser of small-scale irrigation at 1% significance level. Therefore, from the survey result it can be concluded that households that have a greater number of livestock were more likely to use small-scale irrigation than households which have a smaller number of livestock in TLU.

Table 6: Summary of socioeconomic continuous independent variables

Variables	Households category									t-value
	Users			Non users			Total			
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	
land size(ha)	1.68	4	.50	.90	2.5	.25	1.34	4	.25	8.83**
annual income (ETB)	2981 8.9	75345	2500	1181 8.40	2360 0	220 0	2188 2.63	7534 5	220 0	11.67**
Total livestock (TLU)	5.13	9.58	0	3.80	7	0	4.55	9.58	0	6.38**

**, significant at 1% significance level.

Source: Own survey computation.

4.1.3 Institutional results

4.1.3.1. Access to extension service:

From 172 total sample households, 122(70.9%) reported that they have access to extension services the remaining 50(29.1%) doesn't haven access to extension services regarding small scale irrigation. From 97 user sample households, 88(90.7%) have access to extension services about small-scale irrigation and the rest 9(9.3%) haven't access. From 79 non user households 34(45.3%) have access to extension service and 41(54.7%) doesn't have access to extension services regarding to small scale irrigation (see table-7). Similarly, the chi-square test indicates that there is significant relationship between access to extension services and being user or nonuser of small- scale irrigation at 1% significant level. Therefore, from the survey result it can be stated that households that have access to extension services concerning small-scale irrigation are more likely to be user of small-scale irrigation than their counter households.

4.1.3.2. Market information

From 172 total sample households, 114(66.3%) have access to market information and the other 58(33.7%) haven't access to market information. from 97 user sample households, 84(86.6%) have

access to market information and the other 13(13.4%) doesn't have access. From 75 non user households 30(40%) have access to market information and 45(60%) haven't access (see table 7. Similarly, the chi-square test indicates that there is significant relationship between access to market information and being user or nonuser of small- scale irrigation at 1% significant level. Therefore, from the survey result it can be stated that households that have access to market information are more likely to be user of small-scale irrigation than their counter households.

4.1.3. 3. Access to credit service

Results by the conducted survey show that from 172 total sample households, 96(55.8%) have access to credit service and the other 76(44.2%) doesn't have access to credit service. From 97 user sample households, 84(86.6%) have access to credit service and the other 13(13.6%) haven't access. From 75 non user households 12(16%) have access to credit service and 63(84%) haven't access (see table 7). Similarly, the chi-square test indicates that there is significant relationship between access to credit and being user or nonuser of small- scale irrigation at 1% significant level. Therefore, from the survey result it can be stated that households that have access to credit are more likely to be user of small-scale irrigation than their counter households.

Table 7: Summary of institutional independent dummy variables

Variables		Households category						Chi^2-Value
		Users		Non-users		Total		
		Freq	Percent	Freq	Percent	Freq	Percent	
Access to extension ser.	Have access	88	90.7%	34	45.3%	122	70.9%	42.3**
	Haven't access	9	9.3%	41	54.7%	50	29.1%	
Market information	Have access	84	86.6%	30	40%	114	66.3%	41.1**
	Haven't access	13	13.4%	45	60%	58	33.7%	
Access to credit service	Have access	84	86.6	12	16%	96	55.8%S	85.5**
	Haven't access	13	13.4%	63	84%	76	44.2%	

**, significant at1% significance level.

Source: Own survey computation.

4.2. Discussion of the Econometric Model Results

In this section the statistically significant variables in the model will be discussed. To examine for the existence of serious multi-co-linearity problem, the explanatory variables were diagnosed by multi co-linearity test. For this case, the VIF were used to test the association between continuous explanatory variables. To avoid serious problem of Multi-co-linearity, it is quite essential to omit the variable with the VIF value exceeds 10 from the Logit analysis. Likewise, the degree of association among discrete variables was measured with contingency coefficient test based on chi-square. The values of contingency coefficient ranges between 0 and 1, with zero indicating no association between the variables and values close to 1 indicating high degree of association. The result from the diagnosis indicated that there was no problem of multi co-linearity in the explanatory variables. Finally, a set of 14 explanatory variables (5 continuous and 9 discrete) were included in the logistic analysis in SPSS version-16. The model explained about 98.8% of the total variation in the sample for use of irrigation. The Correctly predicted figures for users were about 99%; while correctly predicted sample size for nonusers were 98.7%.

Table 8: The Binary Logistic Regression results of independent variables

Variables	Coefficient	Sig.	Odds ratio
SEXR	-7.197	.087*	.001
HH size	2.957	.026**	19.234
TLANSZ	-1.089	.552	.336
ACCRD	-.480	.764	.619
AVWNFL	3.62	.093*	37.16
ACEXTEN	-4.026	.198	.018
ACCAGRII	7.528	.040**	1859.995
AGEHH	.278	.047**	1.321
EDUCHH	-4.497	.152	.011
TINC	.000	.308	1.000
MKTINFO	-.573	.738	.564
ACCCredit	5.508	.054*	246.665
Livestock	.059	.937	1.061
PESTDSE	-26.066	.995	.000
Constant	-1.662	1.000	.190

Variable(s) entered on step 1: SEXR, HH size, TLANSZ, ACCRD, AVWNFL, ACEXTEN, ACCAGRII, AGEHH, EDUCHH, TINC, MKTINFO, ACCCredit, Livestock, PESTDSE.

* and ** represents variables significant at 10% and 5% respectively.

From Table 8 above six (6) explanatory variables significantly determine the use of small-scale irrigation. These variables were; sex of the respondents(SEXR), household size(HH size), availability of water nearest to farm land(AVWNFL), access to agricultural inputs (ACCAGRII), age of the household heads(AGEHH) and access to credit services(ACCCredit).These significant explanatory variables were discussed in detail bellow.

4.2.1. Sex of the Respondent (SEXR)

In the model, this variable coded by 1 if the household head was female and 0 for male. The variable, in this case (being female) was significantly and negatively determined the use of small-scale irrigation at 10% significant level. That means when the household heads are female it is unlikely to utilize small-scale irrigation. Similarly, the odds ratio disfavors the use of small-scale irrigation by a factor of 0.001. This may be due to socially defined triple roll of females such as; reproductive, productive, community services and other economic and social factors which exerts additional burden on female headed households in the study area. On the other hand, male headed households are more likely to utilize small-scale irrigation than female headed households.

4.2.2. Household size of the respondents (HH size)

This variable had significant and positive effect on the use of irrigation water at 5% significance level. The odds ratio favors the use of irrigation by a factorof19.23. If the household size increased by 1 adult equivalent which increases the household labor force, the probability to use irrigation increase by a factor of 19.23. Therefore, the households who have larger household size were more likely to use small-scale irrigation. The information gathered from FGD participants in the study area revealed that, “irrigation is labor intensive practice and it needs high labor for construction of canals, diversion of water from rivers, application of water on the farm and for other cultural management practices.”

4.2.3. Availability of Water Nearest to Farm Land

The variable had significant positive effect on small-scale irrigation use at10% significance level and for households which have agricultural water nearest to farm land the odds ratio favors use of small-scale irrigation by a factor of 37.16. Therefore, households which have irrigation water nearest to their farm land were more likely to use small-scale irrigation than households which haven't agricultural water nearest to farm land.

4.2.4. Access to Agricultural Inputs

This variable had significant and positive effect on small-scale irrigation use at 5% significance level. Similarly, for households which have access to agricultural inputs, the odds ratio favors by a factor of 1860to be user of small-scale irrigation. Therefore, households which have an access to agricultural inputs were more likely to use small-scale irrigation than households which haven't agricultural inputs. However, respondents which were participated in FGD reported that, "sometimes farm households encountered a problem of timeless and poor quality of agricultural input delivery'' in the study area.

4.2.5. Age of Household Head

In the study area age of households has significant and positive effect on small-scale irrigation use by farm households at 5% significance level and the odds ratio favors small-scale irrigation use by a factor of 1.32 as age of the household head increased by one year. This might be relatively older famers have more experiences, more accumulation of wealth and more matured household members which increases household labor capacity in adult-equivalent that may encourage households to use small-scale irrigation. Therefore, households which have relatively older household heads were more likely to use small-scale irrigation than their counter parts.

4.2.6. Access to Credit Service

This variable had significant and positive effect on small-scale irrigation use at 10% significance level and the odds ratio favors small-scale use by factor of 246.66 for households which have access to credit services. Therefore, households which have access to credit service were more likely to use small-scale irrigation than their counter parts. However, farmers which were participated in FGD reported that with respect to credit service, they encountered problem of collateral, high amount interest rate and religious factors which hindered farm households from using credit services.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

The performance of the Ethiopian economy as a whole is highly correlated with the Agricultural sector and the performance of Agriculture highly depend on availability of Agricultural water. Ethiopia is endowed with sufficient amount of surface water and groundwater systems to meet most domestic and irrigation purposes. But the lack of installed water infrastructure provides a serious constraint to irrigation development in the country.

The aim of this study was to assess the determinants of small-scale irrigation use by smallholder farmers in Cheha woreda, Southern Ethiopia. For this purpose, a total of 172 households were selected by using two stage sampling technique. In order to achieve the aim of this study across-sectional research design that involved quantitative approach was employed. Descriptive statics and the Binary logit model were employed to analyze the data collected from the sample households. The descriptive statistics results showed that 56.4% of the total sample households were user of small-scale irrigation and the other 43.6% were nonusers. In addition to this, the descriptive statistics also revealed that there was statistically significant difference between users and non-users in, land holding size, household size, amount of total annual income, number of livestock owned, gender characteristics, availability of all-weather road, availability of agricultural water, access to agricultural inputs, educational status, access to credit services, access to extension services, access to market information of sample households. Furthermore, the descriptive result of perceived responses by sample households for perception questions indicated that there was some relationship between perception and being user or nonuser of small-scale scale irrigation. Likewise, a set of 14 explanatory variables (5 continuous and 9 discrete) were included in the logistic analysis and from 14 explanatory variables used in binary logit model six variables, (sex of respondents, household

size, availability of water nearest to farm land, access to agricultural inputs, age of respondents and access to credit services) significantly influenced the use of small-scale irrigation in the study area.

5.2 RECOMMENDATIONS

Promoting agricultural productivity through irrigation, specifically by small-scale irrigation is unquestionable. This could reduce; food security problem, rural unemployment rate and it has a potential to support the overall economic development of the country. Based on the major findings of this study the following recommendations are suggested.

- From econometric results access to agricultural inputs has significant and positive effect on the use of small-scale irrigation. Agricultural inputs such as fertilizers, pesticides and insecticides, improved seeds, water pumps and other machineries that facilitate irrigated farming are very important to promote small-scale irrigation. Therefore, the government, nongovernmental organizations and other entitled stakeholders should work hard to ensure the accessibility of such inputs in order to sustain and increase the productivity of small-holder farmers through small-scale irrigation.
- Econometric results also indicated that the household size has a significant and positive effect on the use of small-scale irrigation. This mainly related with availability of household labor. Households which have greater number of household members in adult equivalent were more likely to use small-scale irrigation. In order to address such type of labor problems promotion of cooperative working between households and mechanization of the sector is very important.
- In this study availability of water nearest to farm land is one of significant and positive determinants of small-scale irrigation use by farm households in the study area. Farm households which have agricultural water nearest to their farm land were more likely to use irrigated farming. So, the government and non-governmental organizations should actively participate in the installation, management and sustaining of water infrastructures for the local

farming households. In addition, it is important to improve the skill and knowledge of the local farm households about proper utilization, the management and sustainable use of irrigation water.

- Another variable significantly and positively influences the use of small-scale irrigation in this study is access to credit. Farm households in the study area reported that they encountered problem of collateral, religious sanctions that deny interest and the financial institutions were far from their residence. Therefore, government and nongovernmental institutions should work hard to ensure the accessibility of consistent financial institutions with the demand of the local farm households. In order to solve problem of collateral, group lending approach is a good way but it needs strong awareness creation and solidarity of the group members is very important.
- Sex of household head (being female) had a negative and significant effect on the use of small-scale irrigation. The negative relationship indicates that women have not benefited much from small scale irrigation. But for sustainable and progressive impacts by small scale irrigation, it should be given more attention to female headed households. Therefore, polices and strategies should provide solution to increase female headed household participation on small scale irrigation through capacity building and by training the community in the way of minimizing the triple role burden and social sanctions that were discouraging women participating in small-scale irrigation.
- Furthermore, results from the descriptive analysis showed that, access to extension services, access to market information, access to all weather road, total annual income and livestock ownership were important variables that influences small-scale irrigation. So, improving the road access for the rural households, addressing quality extension services, diversifying and improving income of rural households and market infrastructures and market information system is very important.

- Finally, based on the results of this research, some suggestions for future research can be inferred. First the study is confined to few variables, lack of data on biophysical and technological factors. Secondly, the method of data collection was based on only structured questionnaire and FGD since other method like key informant interview are important to get more information and hidden aspects information. Hence there is a scope for further studies including those factors and other data collection and analysis methods listed above at woreda, zonal, regional and national level.

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APPENDICES

APPENDIX I Questionnaire

WOLKITE UNIVERSITY

COLLEGE OF SOCIAL SCIENCE AND HUMANITIES

Department of Governance and Development Studies

Dear respondent,

The purpose of this interview guide is to collect data for the study on the title "Determinants of Small Scale Irrigation Use by Smallholder Farmers: A case study in Cheha Woreda in Gurage Zone". The researcher is going to conduct this study for academic purpose i.e. for a partial fulfillment of MA degree in Development Planning and Management. The result of this study will help different stakeholders and policy makers to make appropriate measures on irrigation development in the future. The researcher would like to assure you that your response will be kept confidential. Truthfully, feel free and try to answer the questions honestly and accurately. You are not required to write your name.

General Instructions

- For the questions you are asked to choose among the alternatives, please choose and encircle the letter of your choice.
- For the open ended type questions, try to put your answers on the space provided in a neat and readable hand writings.
- Please try to answer all questions correctly.

1. Name of kebele _____

2. Category of the household 1.Irrigation user 2.Non-user

3. Household Composition and characteristics

General Background of Respondents

Sex (codes A) 1.Female 0.Male
Relation to household head (codes B) 1. Household head 2. Spouse 3. Son/daughter 4. Parent 5. Son/daughter in law 6. Grandchild 7. Other relative 8. Hired worker 9. Other(specify)……
Marital status (codes C) 1.Single 2.Married 3.Divorced/separated 4. Widow/widower 5. Other(specify)……
Education (codes D) 0. None/ Unable to read and write 1.Adult education 2. Religious education 3.First cycle (grades 1-4) 4 .Second cycle (grades 5-8) 5.Secondary (grades 9-10) 6.Preparatory (grades11-12) 7.Tertiary 8. Others (specify)……..
Occupation (codes F) 1.Work on the family farm 2.Salaried 3.Casual labor 4.Self-employed in business (other than the farm) 5.Student 6.Not employed 7.Housekeeping and child care 8. Livestock herding 9.Other (specify): ……

Member Code	(start with respondent and make a complete list)	Sex(Codes A)	Age (years)	Relation to HH head (CodesB)	Marital status(Codes C)	Education level (code D)	Occupation (Codes F)
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							

4. Land and Crop Production

4.1. Do you possess your own land? 1. Yes 2. No

4.2 If yes, its total area in hectare _____Area under irrigation _____Area under rain fed_____

No	Land Type	Size in time
1	Own(currently cultivated land)	
2	Rented in	
3	Rented out	
4	Shared cropped in	
5	Others (Grazing land Wood lot /forest, Fallow land)	

4.3. How do you perceive the condition of your land?

1. Fertile 2. Moderately fertile

3. Less fertile 4. Infertile

4.4. How did you get your land?

1. Inherited from family 2. Gift from relatives/on kinship basis

3. Bought 4.Government redistribution 5. Others (specify) __

4.5. Have you rented out your irrigable land?

1. Yes 2. No

4.6. If yes, Area rented out (out of the total plot) _____ (in hectare)

4.7. The answer is if no/yes, what is the reason?

1. Shortage of seed 2. Shortage of oxen

3. Disabled 4. Others (specify) _____

5. Infrastructure/access to road and irrigation water

5.1. Distance from the main all weather road (in km) _____

5.2. Do you have any access to irrigation water? 1 yes 2 no

5.3.If your answer is **yes** for question 5.2 above, what is source of the water ?

1. Rivers 2. Springs 3. Ponds

4. Well 5. Other, specify_____

5.4. What is the distance between the sources of water to your farm land (in km)? _____

5.5. Are you irrigation user ? 1 yes 2 no

5.6. If the answer is No in question 5.4 above, what is the reason for not utilization of irrigation?

1. No farmland with water access 2. There is enough rain and moisture

3. No information about irrigation 4. Others (specify) _____

5.7. How do you transport agricultural produce to the market place?

1. On back 2. Horse/donkey cart

3. Vehicle 4. Other (specify) _____

5.8. How many times do you using irrigation within a year?

1. Once in a year 2. Twice in a year 3.Three times in a year 4. Four times in a year

5.9. Have you cultivated the total of your irrigable land? 1. Yes 2.No

5.10. If No what is the reason?

1. Shortage of family labor 2. Lack of seed

3. Lack of oxen 4. Enough rain for cultivation

5.Lack of credit 6 .Others (specify) _____

6. Household net income

6.1 Meher Crop production: List all plot crops planted in Meher last year (2011/2012 E.C) and If a plot is Inter-cropped write all the crops intercropped.

Codes A: 1=Teff 2=wheat 3=Maize 4= Barley 5=Chickpea 7=fababean 8=field pea 9= Haricot Bean 10=oil seeds (Lin seed Niger seed) 11=vegetables12=others,_____

No.	Type of Crop Planted (code A)	Size of plot in hectare	Mode of Production (code B)	Fertilizer used in kg	Did you use improved seeds √ = yes, × =no	Total Harvested in quintal	Total Sold last year(qt)	Total net price received

Code B: 1= Rain fed, 2=Irrigated

6.2 Belg Crop production: list all plots and identify crops planted in belg last year (2012E.C)

No.	Type of Crop Planted (code A)	Size of plot in hectare	Mode of Production (code B)	Fertilizer used in kg	Did you use improved seeds √ = yes, × =no	Total Harvested in quintal	Total Sold last year(qt)	Total net price received

Use the codes in 6.1 above

6.3 Income from perennial crop production in (2012 E.C.):

No.	Type of Crop Planted (code A)	Unit	Size of plot in hectare	Mode of Production (code B)	Fertilizer used in kg	Did you use improved seeds √ = yes, × =no	Total Harvested/unit	Total Sold last year/ unit	Total price received

Code-A :1= coffee 2= chat 3= fruits 4= enset products 5= equilaptus tree 6= other specify____

Cod-B :1= irrigated 2= rain fed

7. Livestock Production

7.1. Livestock: Please describe your household's livestock assets:

No.	Animal Type	Number owned Now	Household Income from sales of livestock in 2012 E.C			
			Number sold last year	Total price received	Sale of animal product	
					Product	Amount in birr
1	Ox					
2	Cow					
3	Bull					
4	Heifer					
5	Calf					
6	Goat					
7	Sheep					
8	Donkey					
9	Mule					
10	Horse					
11	Poultry					
12	Others					

7.2. If you did not have enough oxen what do you use for your farm operation?

1. Exchange with labor 2. Exchange (by grass or hay)

3. Hire oxen (rent) 4. Others (specify) _____

8. Non-farm Income and Household expenditures

8.1 Household non/off- farm income in 2012 E.C

No.	**Income sources**	**Have you generated any income from the following sources last year (2012E.C) √ = yes, × =no**	**Total amount your family generated last year in ETB**
1	**Trade**		
2	**Remittance**		

3	**Salary**		
4	**Handy crafts**		
5	**Casual labor**		
6	**Aid(cash/in kind)**		
7	**Others--**		

Cash expenditures

No.	**Item Name**	**In the past 12 months, did your household spend money on this item? √ = yes, × =no**	**How much did the household spend on the item in the last 12 months? (ETB)**
1	**Food and drinks**		
2	**Clothing (dress and foot wear)**		
3	**Education**		
4	**Water expense**		
5	**House rent**		
6	**transport and communication**		
7	**Health care**		
8	**Entertainment (visit of relatives)**		
9	**Religious& cultural expense**		
10	**Gas and Other fuel**		
11	**Animal health expense**		
12	**Government tax**		
13	**Agricultural inputs**		
14	**Others--**		

9. Access to market information

9.1. Do you have access to market? 1. Yes 2. No

9.2. Distance from the market place (in km) _____

9.3. What are the problems in marketing your produce?

1. Transportation problem 2. Low price of agricultural produce

3. Low bargaining power 4. Too far from market place 5. Others (specify) __

9.4. Where do you sell your farm products?

1. On farm (local assembler) 2. Taking to the local market

3. Through service cooperatives 4. Other (specify) _____

9.5. Do you get reasonable price for your produce in 2011/12 E.C.? 1. Yes 2. No

9.6. If no, what are the reasons?

1. No demand for the produce 2. More supply of the produce

3. Others (specify) _____

9.7. Do you get market information about prices and demand conditions of agricultural inputs and out puts? 1. Yes 2.No

9.8. Do you have Mobile and/or Radio? 1. Yes 2. No

9.9. Do you listen to agricultural program on Radio? 1. Yes 2. No

10. Extension issues

10.1. Do you receive any sort of extension services available in your locality? 1. Yes 2. No

10.2. If yes, what are the supports given?

1. Advice 2. Training 3. Demonstration

4. Controlling water distribution 5. Conflict resolution 6. Other (specify) _____

10.3. How many days do you contact the DA's per month? _____

11. Access to credit and Agricultural inputs

11.1. Did you need credit for the production of your agricultural products? 1. Yes 2. No

11.2. Do you have access to credit for your agricultural activities? 1. Yes 2. No

11.3. If yes what are the sources?

1. Cooperatives 2. Local lenders 3. Neighbors and relatives

4. Micro finance institutes 5. Irrigation office 6. Other (specify) _____

11.4. If no why? 1. No collateral 2. No Access to credit supply 3. No need

4. High interest rate 5.Not available on time

6. Religiously forbidden 7.Other, specify_____

11.5. Do you have an access to Agricultural inputs, such as, fertilizer, herbicides and insecticides and irrigation technologies? 1 Yes 2 No

11.6. If yes what are the sources?

1. Cooperatives 2.Irrigation office 3.Agricultural office 4. Other……

12. Diseases and pests

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

1. Yes 2. No

12.2. If your answer for question number 9.1 is yes, what were the possible causes for this problem of crop failure last year? 1. Water shortage

2. Damaged by disease and pests 3.Poor adaptation of varieties used

4. Poor administration of water distribution 5.Others, specify

12.3. Is there any crop raider animal that may destruct your crop? 1. Yes 2.No

12.4. If your answer is 'Yes' for question 12.3 above what do you think about their counter impact on your decision to use irrigation water?

1. Extremely high 2.Very high 3.High 4.Somewhat 5. No impact

APPENDIX II: Guiding Question for Focused Group Discussion

Dear respondent,

The purpose of this guiding question is to collect data for the study on the title "Determinants of Small Scale Irrigation Use by Smallholder Farmers: A case study in Cheha Woreda in Gurage Zone". The researcher is going to conduct this study for academic purpose i.e. for a partial fulfillment of MA degree in Development Planning and Management. The result of this study will help different stakeholders and policy makers to make appropriate measures on irrigation development in the future. The researcher would like to assure you that your response will be kept confidential. Truthfully, feel free and try to answer the questions honestly and accurately. You are not required to write your name.

General Instructions

- Try to put your answers on the space provided in a neat and readable hand writings.
- It would be advisable if you answer all questions
- Honestly be aware that this investigation has nothing to with religious and political stand

Guiding Question for Focused Group Discussion

1. What are the major opportunities in your local area to utilize small-scale irrigation water?

2. What are the main constraints you face during utilization of small-scale irrigation water in your local area?

3. How do you view the role played by the government in irrigation development in the area?

4. What are important strategies for irrigation development in the area? What type of irrigation water source do you think is more advantageous for the community in the area?

5. What are the major social organizations in the area and what their roles are in irrigated farming?

6. What do you think are the major environmental problems in the area related with irrigation?

APPENDIX III: Conversion Factors Used To Compute Tropical Livestock Units (TLU)

No.	Animal Type	Conversion factor in (TAU)
1	Ox	1.42
2	Cow	1
3	Bull	1.2
4	Heifer	0.78
5	Calf	0.43
6	Goat	0.2
7	Sheep	0.2
8	Donkey	0.8
9	Mule	0.8
10	Horse	0.8
11	Poultry	0.04

Source: Jemimah Njuki et al(2011).

APPENDIX IV: Conversion Factors Used To Compute Adult Equivalent

Age group	Male	Female
<10 years	0	0
10-14 years	0.35	0.35
15-50 years	1	0.8
>50 years	0.55	0.5

Source: Strock et al. (1991) as sited by Seifu, 2018

APPENDIX V: The Binary Logistic Regression results of independent variables

	B	S.E.	Wald	df	Sig.	Odds ratio	95% C.I.for EXP(B)	
							Lower	Upper
SEXR	-7.197	4.208	2.926	1	.087	.001	.000	2.856
HHsize	2.957	1.331	4.937	1	.026	19.234	1.417	261.082
TLANSZ	-1.089	1.831	.354	1	.552	.336	.009	12.184
ACCRD	-.480	1.601	.090	1	.764	.619	.027	14.270
AVWNFL	3.62	2.331	2.210	1	.093	37.16	.332	3082.815
ACEXTEN	-4.026	3.130	1.655	1	.198	.018	.000	8.232
ACCAGRII	7.528	3.672	4.203	1	.040	1859.995	1.392	2485045.263
AGEHH	.278	.140	3.940	1	.047	1.321	1.004	1.739
EDUCHH	-4.497	3.143	2.047	1	.152	.011	.000	5.275
TINC	.000	.000	1.041	1	.308	1.000	1.000	1.000
MKTINFO	-.573	1.712	.112	1	.738	.564	.020	16.166
ACCCredit	5.508	2.860	3.710	1	.054	246.665	.908	67009.038
Livestock	.059	.757	.006	1	.937	1.061	.241	4.677
PESTDSE	-26.066	4418.847	.000	1	.995	.000	.000	
Constant	-1.662	4418.850	.000	1	1.000	.190		

APPENDIX VI: VIF Value for Independent Continues Variables

Model	Collinearity Statistics	
	Tolerance	VIF
number of households in adult equivalent	.487	2.051
total land size in hecktar	.440	2.273
age in years	.976	1.025
total annual income	.438	2.283
total livestoke	.739	1.354

a. Dependent Variable: households category

APPENDIX VII: Contingency coefficient for dummy/discrete variables

obs=172)

	HHscat~y	SEXR	ACCRD	AVWNFL	ACEXTEN	ACCAGRII	EDUCHH	MKTINFO	ACCCre~t	PES
HHscatagory	.247348									
SEXR	-.029818	.124949								
ACCRD	.066809	-.028118	.248708							
AVWNFL	.159799	-.01428	.045152	.212158						
ACEXTEN	.112267	-.010132	.038692	.092887	.207398					
ACCAGRII	.169829	-.021522	.042194	.114239	.101523	.243812				
EDUCHH	.03791	-.03213	.04165	.044608	.03502	.05967	.148613			
MKTINFO	.115259	-.00918	.052836	.090439	.106079	.105603	.038284	.224806		
ACCCredit	.174623	-.017272	.070039	.117095	.104719	.132327	.042704	.113287	.248062	
PESTDSE	-.079049	-.00289	-.010982	-.054808	-.035156	-.039746	-.003434	-.020196	-.039168	.14

APPENDIX VIII: BIOGRAPHICAL SKETCH

The author was born in Gurage Zone of SNNPR, Cheha woreda, in November 1983. He attended his elementary (1-8) at Gura-Awuyate primary school and he completed his high school studies in Emdibir city, at Emdibir Secondary and Preparatory School in 2002. He joined Bonga Teachers Training College in September 2003 and successfully completed his Diploma of Social Science and again he joined Dilla University in June 2009 and successfully completed his Bachelor Degree in Civics ans Ethical Studies in August 2012.

Immediately after graduation, the author was employed in Cheha District Educational Office as a teacher, served as a teacher in different schools and land use and management expert in Cheha district's Agricutural and Natural Resource Office, Chief Councilor in Cheha District Administrative office and served at the District's Transport and Road Development Unit as Vice head of the Unit until May 2019.

Then, he joined Wolkite University for his postgraduate study in October 2019 to pursue post Graduate studies for Masters of Arts in the field of Development Planning and Management.