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# Farmers Attitude Towards Water Harvesting Technology in Sisena and Girar farmazigba Kebelle, Chaha Woreda, Gurage Zone, Ethiopia

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## ACRONYMS AND ABBREVATIONS

| | |
|---|---|
| ADL | Agricultural Development Led Industrialization |
| CWAO | Cheha woreda Agricultural office |
| FDRE | Federal Democratic Republic of Ethiopia |
| FHH | Farmers Household |
| FWH | Flood water harvesting |
| GOs | Governmental Organization |
| NGOs | Non-Governmental Organizations |
| RWHP | Rain Water Harvesting Practice |
| RWHT | Rain Water Harvesting Technology |
| RWUT | Rain Water Utilization Technology |
| WH | Water Harvesting |
| MOWR | Ministry of water resource |

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## LIST OF TEBLE

**ABSTRACT**

*The southern Ethiopia is characterized by erratic and uneven distribution of rain fall. Annual rainfall is sufficient for crop production but the highly variable distribution in time and space frequently threatens crop production and contribute to food insecurity. Water harvesting for supplemental irrigation is being considered by the Ethiopian government as an alternative and have been implemented throughout the country. Farmers adoption of promising agricultural technologies has been far from universal, and has remained particularly low among the poor. The main factors constraining agriculture and rural development are low productivity and output, the performance of rain-fed agriculture serious by intermittent drought arising from the several of nature. The study is motivated by the belief that the constraints of the low productivity leads to poverty and cannot be overcome by simply concentrating on the rain-fed agriculture. Therefore, the water issue needs to be addressed as well. Identification of factors affecting water harvesting practice is one of the major steps in identifying that increase crop production. In view of this, a study was done in Sisena and Girar farmazigba Kebelle, Chaha woreda gurage zone Ethiopia to assess the public attitude of water harvesting technology and the factor affecting of water harvesting technology. The study was conducted from March to June 2019 on 28 sample size selected from the study area. Structured questionnaire, in addition to physical observation, were developed to collect the required information from the households, development workers, key informants, kebele administrators and agronomy and irrigation experts from district office of agriculture to generate primary and secondary data for the study. Descriptive statistics such as percentage and table were used to describe sampled respondents in terms of some desirable variables. Generally, farmers have showed favorable attitude towards water harvesting practice in the study area. The finding of this study, indicate that the physical, institutional, technical, physiological and economic factors affecting water harvesting practice differ from the catchment situation and farmer to farmers. Moreover, the existence of difference in perception, opinion, attitude and decision are the major finding of this study.*

# 1. INTRODUCTION

## 1.1. Back Ground of the Study

Ethiopia is located in the Horn of Africa with an estimated population of approximately 100million. (Ethiopian population censes 2007) Agriculture is the mainstay of the Ethiopian economy provided 60% of the Gross Domestic Product. It generates about 88% export earnings and provides the majority of the employment (Wagayhu .B, 2003). According to (Temsgen., 2007) Rain-fed agriculture in Ethiopia is suffering from moisture stress, which is a major limiting factor for successful crop production. Many of Ethiopian small holder's depending on rain-fed agriculture are food insecure. In many places, the amount of rainfall and the duration of rainy season are highly variable frequently resulting in low crop yields and associated low incomes (Desta., 2004). Because of large differences in rainfall distribution between years and within years coupled with short rainy seasons, rain-fed agriculture is very susceptible to water shortage (ansen., 2009).

Surprisingly, Ethiopian is well-endowed with water resources (Sileshi.*et al* 2003) The total annual runoff is at 122 billion $m^3$; however, much of which are carried away by trans-boundaries Rivers. Ground water reserves are estimated at 2.6 billion $m^3$. These natural resource bases have a potential for supporting a far great number of people that the current population (Seyoum, 2003). Even though Ethiopia is considered as the "water tower" of Eastern Africa, only about 17% of the population of the country has access to clean and safe water. The potential irrigable land area of the country is estimated at 3.7 million hectares. Despite its abundant water resources and irrigable potential, so far only 300,000 hectares of the potential irrigable land is believed to have been developed. Most of our famers are unable to benefit from the county's water resources. Vast area of potentially agriculture area is not irrigated owing to the unavailable of the necessary infrastructures and facilities for irrigation (MoWR), 2007).

The unstable distribution pattern of rainfall and moisture stress problem from year to years results in uncertain and often uneconomic condition for agricultural production in arid and semi-arid parts of Ethiopia. Each year, drought adversely affects agricultural production somewhere in the country. The region receives lower rainfall than crop water requirements (ACIL.T 2003). In

Ethiopia the government has already taken initiatives towards different types of water harvesting practice

Water harvesting in the world it has very important to the development of the world economy. In the current condition water harvesting is necessarily related to food security. Today the world temperature is abnormal. The water harvesting is very important in the world. And it is also the main issues because it used to reeducate the food insecurity and increased food security. then the government also interacted to the water harvesting technology in ruler area contacted to the farmer in current suction.

Through many kind of interventions which has been exerted to promote water harvesting practice to mitigate the erratic nature of rainfall in the arid and semi-arid parts of the country, a national food security strategy based on the development and implementation of water harvest technologies at a village or household level was adopted (Amha, 2006). Water harvesting technology is used to increased food production or it increased the production of yield in the dray area. And it can improve food security in the world. The main aim of the study is to analysis or to know the attitude of the people to ward water harvesting in the study area.

## 1.2. Statement of the Problem

The mainstay of the livelihood of the people in the study area is mixed agriculture where crop production and animal husbandry plays significant role (main income) for the people. The area faces many problems among which are soil erosion, high population density, and unreliable rainfall. The erratic rainfall nature, together with the recently declining in the length of the rainy period, unpredictable occurrence of dry spells, lack of sufficient water resource has resulted in low agricultural productivity and consequently increased the food insecurity.

To solve the problem to assess the government and the local population attitude to the practices .and to create awareness of the people about the use of water harvesting for the food security and other economic development in the country and in the world. But today the farmer does not use this technology due to many reasons which is the initial and maintenance investment. The government has good intention the water harvesting technology. Mean that the government tray to create awareness for the local population and to fulfill the material to need do the activity.

Then the government has god attitude to water harvesting technology. Therefore, a study on the attitude and different technical, institutional, physical and psychological factors that influences water harvesting practice in general useful for current food insecurity problem of the area.

## 1.3. Objectives of the Study

### 1.3.1. General objective

The main objective of the study is to assess Farmers Attitude Towards Water Harvesting Technology in Sisena and Girar farmazigba Kebelle, Chaha Woreda, Gurage Zone, Ethiopia

#### 1.3.2. Specific objective

- ✓ To assess farmer attitude towards the introduced water harvesting practices in the study area.
- ✓ To assess the government intention towards water harvesting technology currently.
- ✓ To assess factors affecting water harvesting technologies in chaha woreda, gurage zone, Ethiopia.

### 1.3.3 Research question

In order to achieve the study objectives, the study is intended to answer the following questions

1. What is government attitude towards currently about water harvesting technology in the study area?
2. What are the various factors that influence water harvesting practice in the study area?
3. What is the attitude of people for water harvesting technology in the study area?

## 1.4. Significance of the Study

Agriculture, which is the single most important sector of the Ethiopia economy, is mainly dependent on rain-fed farming. In the face of repeated drought phenomena in Ethiopia during recent decades, dependence on rain-fed agriculture has increased vulnerability of farmers to food

shortage, malnutrition and hunger. Water harvesting is take as one of the means to expand small-scale irrigation and to alleviate moisture stress problem there by improving the productivity of agriculture.

Introduction any new technology for beneficiary farmers, basic information about technical, institutional, cultural, socio-economic constraints and opportunities, as well as on farmer's attitude in relation to water harvesting practice, is too important for the success of different GOs and NGOs who are working for the well-being of our farmers. Therefore, the results are expected to be useful for agricultural researchers, extension specialists, policy makers and donors who are involved in the promotion of water harvesting activities and implementing institutions in the region and at national level to take measures to remove or at least to alleviate the constraints and further use of opportunities available. Hence, the outcome of this study may help the farmers to design their best strategies by focusing on resolving their major limiting factors. Furthermore, the study also assists as a base for further study in the area of moisture stress area.

## 1.5. Scope and Limitation of the study

The study is confine in gurage zone chaha woreda of only two kebelles; due to constraints arising from shortage of financial resources, time, vehicles and other logistics relate problems.

**2. LITRATUR REVIEW**

## 2.1 Concept of Water Harvesting

As water harvesting is an ancient tradition and has been used for millennia in most dry lands of the world, many different techniques have been developed. However, the same techniques sometimes have different name in different regions and others have similar names but, in practice are completely different (Oweis, 2004)

"Water harvesting technology package" including household-based rain water harvesting system provides water for humans, livestock and home garden horticultural crops (Desta. 2004). The rain water harvesting techniques most commonly practiced in Ethiopia are run-off irrigation, flood spreading (Spate irrigation), *in-situ* water harvesting (ridges, micro basin), roof water harvesting (Alem, 2006).Birkas in Somalia region and different runoff in Konso (Amha, 2006)shallow wells (Soriano, 2007) Elea and Haffirs (Girma, 2009).

## 2.2 History of Water Harvesting in the World

Water harvesting is an ancient technology practiced in many parts of the world such as North America, Middle East, North Africa, China, and India. Different indigenous rain techniques and systems have been developed and remain an important source of water for agriculture in different parts of the world. The Middle East and North-Africa have a long tradition in water harvesting as one of the methods for survival in the area. Researchers have found signs of early water harvesting structures over 9000 years ago in the Edom Mountains in southern Jordan (Girma, 2009). In Israel complete rain water harvesting systems have been found in the Negev Desert, which were about 4000 years old (Girma, 2009). Remnants of other water harvesting installations have also been discovered in Iraq and in the Arabian Peninsula along the routes used by caravans. The rain water harvesting installations consisted mainly of means to collect rainwater and divert it in to natural and/or artificial ponds and reservoirs.

## 2.3 History of Water Harvesting in Africa

The evidences of rain water harvesting have been found in Afirica specially Morocco, and Egypt. At present all countries in the Africa region practice intensively one or more rain water harvesting technique to collect and store rain water for use in meeting crop, human animal needs (Nigigi,*et al* 2005).The importance of traditional, small-scale systems of rainwater harvesting in sub-Sahara Africa has recently been recognized. Simple stone lines are used, e.g. Burkina Faso and Mali; earth bund systems in eastern Sudan, Kenya and the central rangelands of Somali (Barron.*et al* 2005). Rain water management harvesting, storage and careful use of water are known to be one way of addressing the problems of water shortage in drier areas in Africa. Spate irrigation in northern Ethiopia and Eritrea involves capturing of storm floods from the hilly terrain and diversion into leveled basins in the arid lowlands for crop production (Nigigi,*et al* 2005).

## 2.4 History of Water Harvesting in Ethiopia

In Ethiopia, there is evidence that ancient Churches, Monasteries and Castles used to collect rainwater from roof tops and the history of rainwater have stings by the Axumit Kingdom dates back as early as 560BC (Mitiku,*et al* 2001). During this period rainwater was harvested and stored in ponds for agricultural and domestic water supply purposes. Moreover, remains of water harvesting setups still exist in the oldest places of Axum, Gondar, and Lalibela, which were used for different productive and religious rituals.

In those days, rainwater was harvested and stored in ponds for agriculture and domestic use (Seyoum, 2003). Despite its long history, only a few decades ago water harvest has received renewed attention from policy makers. According to promotion and application of water harvest techniques addressing water scarcity began through the government – initiated soil and water conservation programs as response to the 1971-1974 (during Derg regime) drought in Tigray, Wollo and Harerge (Seyoum, 2003). However, the intervention was limited because of the low level of community participation and declining attention by the government. After the fall of Derg, FDRE established in 1995, adopted the Agricultural Development –Led Industrialization (ADLI) strategy, which emphases improvement in agricultural productivity to achieve food

security and sustainable development (Desta, 2004). The Ethiopian Government has committed financial resources to increase the irrigated area (Soriano, 2007). The Ministry of Agricultural development and respective regional Bureaus planned and implemented aggressive and ambitious water harvesting programs along the country's food security programs (Desta, 2006). Based on this, many different water harvesting technologies have been developed by regional states, NGOs, communities and individual farmers throughout the country. Surface irrigation including river diversions spring development and pond system, is widely used in Tigray to irrigate plots. In the highlands of Tigray, farmers construct ponds for the storage of spring water to irrigate their farms (Mitiku, *et al.*2001).

The view is that the adoption of water harvesting technologies, households would be food self-sufficient and the surplus would be generating income. In addition, incomes have been generated through sale of water. In Kobo Ethiopia, the outputs from flood diversion (spate irrigation) are giving confidence to the farming community. Traditional flood harvesting systems in Kobo are that the technique is fully managed by the farmers implemented themselves with their own resources and know-how (Nigigi, 2003, Tesfaye, 2003). Similarly, the people in Konso, Gidole and many other parts of Wolayta & Wollo the southern part region have been exercising the art of conserving soil and water (Tesfaye. 2003).

## 2.5 Water Harvesting Techniques

Before selecting a specific technique, due to consideration must be given to the social and cultural aspect prevailing in the area of concern as they are paramount and will affect the success or failure of the technique implemented. This particularly important in the arid and semi-arid regions of Africa and may help to explain the failure of so many projects that did not take in to account the peoples priorities. In arid and semi-arid Africa most of the population has experienced basic subsistence regimes which resulted over the centuries in setting priorities for survival along with checking the sequence of priorities compared with WH in coast and in the risk involved the comparison must take in to account the water quality required, where alternate water is of better quality, is cheaper to develop, either to obtain or involves less risk, it should be given priority (Palmback, 2003).

### 2.5.1 Flood Water harvesting method

Run-off farming with flood water harvesting comprised with catchment being many square kilometers in size, from which runoff water flow through a major wide bed of on ephemeral system, river, and necessity more complex structure of dams and distribution networks. It is also called large catchments water harvesting system. This technique can be characterized as a size with greater than 20 hectares, channel flow structure need, catchment area to cropping areas100:1 to 10,000:1, the amount of precipitation is 100 to 600 mm per annual, the cropping area are terraced or in flat terrain (PrinzD., 2011).

### 2.5.2. Micro catchments WH

Involves a distinct division of a runoff-generating catchment area, and a cultivated basin where runoff is concentrated and stored in the root zone and productively used by plants (Mbilinyi, *et al* 2010). There are multiple advantages to this RWH system than the others in that the design is simple and cheap, there is higher runoff efficiency than larger scale WH systems. They often prevent or reduce soil erosion and, finally, can be implemented on almost any slope and many level planes Prinz (2011). Micro-catchments vary in size, method and technique from region to region. A micro catchment system in Ethiopia, for example, may be completely different in style and operation from a micro-catchment system found in Western Asia. Although there are little variations, there is a basic principle used within the micro-catchment category, they include; pitting, contour ridges, negarim, semi-circular bunds, contour bench terraces, and eye brow terraces or hill slope micro-catchments Prinz (2011).

### 2.5.3. Macro catchment water harvesting

Macro-Catchments sometimes called medium sized catchments are characterized by large flood zones that are situated outside of the cropping area. Often farmers must use structures such as dams or bunds to divert, transfer, collect and store the runoff. Such systems are often difficult to differentiate from conventional irrigation systems and are considered FWH as long as the harvested water is available year round. Mbilinyi, *et al.*(2010). Examples of macro catchments

include stone dams, large semi-circular hoops, trapezoidal bunds, hillside conduit systems, and cultivated reservoirs, all of which have a scale of between 0.1 ha to 200 ha Prinz (2011).

### 2.5.4. Roof water harvesting

Roof water harvesting, is generally practiced as a way to obtain relatively clean drinking water as well as water for domestic purposes. This method involves a relatively small catchment area, the size of the individual's roof of their house, with gutters and pipes to guide the water into a tank on the ground. Often a tap is attached to the tank for individuals to access this water Mbilinyi *et al.,* (2010. There is concern over whether or not the water is clean enough for drinking, as pollutants in the atmosphere have been known to be present in rainfall. Today water harvesters must be wary of pesticide contamination, high mineral levels, bacteria and other impurities in their runoff water (Palmback, 2008). Most roof catchment systems have screens and purification systems built into the infrastructure to remove leaves and twigs from the water as well as to purify the water prior to use Palmback (2008).

The amount and quality of rainwater collecte from roof catchment depends on the area and type of roofing material. Reasonably pure rainwater can be collecte from roofs constructe with galvanize corrugate iron, aluminum or cement sheets, tiles and slates, although thatched roofs tied with bamboo gutters and laid in proper slopes can produce almost the same amount of runoff less expensively (Gould, 2009).

## 2.6. Factors Affecting WHP

### 2.6.1. Review of Empirical Studies on Factors Affecting WHP in Ethiopia

Most people working in the field of water harvesting argue that most of the constructed water harvest structures do not perform as planned. A number of studies have been constructed by the government and Academia. According to the progressive evaluation report on the implementation of water harvest in Oromiya (Chala.*et al* 2017) 98 % of sampled beneficiaries responding high seepage. The amount of collected water was not sufficient to meet the intended purpose according to 53% of the farmers in East Shoa and 22 % in Welega. The report conclude that the status of the constructed ponds was not good owing to various problems like the

unavailability of plastic sheet to reduce seepage losses, lack of coordination and facilities during implementation, while community and land holding size were not taken in to account during design and implementation. These are related to economic and technical factors. Similarly, conclusion was drawn by (Alamerew, 2015) who summarized the various constraints in implementing the water harvest projects including in adequate public awareness and ownership of local communities, lack of adequate knowledge and skills in management of water harvesting schemes. The cropping pattern in the studied area changed and farm households started to grow cash crops which were not previously grown in the area. However, benefits depend on market and infrastructure access and crop diversification to minimize risk. Despite its potential adoption of rain water harvest practice is slow. Some reasons for the low adoption were poor quality of the construction resulting in cracks in the cemented floor and loss of water, improper site selection and fear of malaria spread. The water harvesting structure in Amhara and Tigray face many problems, many of which originate from the speed and scale of implementation Among the identified problems were poor site selections, leakage due to lack of skilled labor during construction (Rami., 2012)

Temsgen(2007) showed that tied-ridging performed better in retaining water than the local tillage practice providing more water to crop production in a semi-arid region where rainfall erratic. (Kahinda., 2016) list factors that affect water harvesting technology Topography (Slope), crop character, soil, socio-economic (work force, land tenure, accessibility and related costs).

### 2.6.2. Technical factors

In many cases marginally productive and subsistence farming practices in Ethiopia were linked to a lack of knowledge among individuals. This was attributed to the unavailability of adequate training and support at both an individual and group level within the farming sector. Similarly, poor performance of agriculture in other developing countries associated with the loss of traditional knowledge regarding optimal farming practice has led to a reduction in use of RWHP due to the reluctance of farmers to invest in activities where returns are unreliable. (Jansen, 2013)

### 2.6.3. Economic factors

A lack of resources, including finances, skills, labor and land, was acknowledged within the literature to be a key constraint to the WHP by the poorest farmers and although government schemes in Ethiopia were unsuccessful, the provision of grants and assistance from governments or NGOs has been shown to reduce the barriers to technology uptake (Molla andTefera, 2010). Sampled farmers in our study area explain that, the constraints for implementing the current RWHP structure were finance, Know-how, technical, and labor, respectively. As compared to rain fed agriculture and livestock, respondents believed that RWHP was better in terms of generating income that avoids risk & uncertainties, but rain fed is preferred in terms of labor requirements. Farmers reported a number of problems associated with RWHP activities, lack of capital, technology, lack of skill, labor, and market problem.

### 2.6.4. Psychological factors

### 2.6.4.1. Farmers' Attitude towards Water Harvesting Practice

Apart from bio-physical, institutional, technical and economic factors, farmers' attitude towards the technology is important requirement for technology dissemination and introduction technology. Attitude is a disposition to respond favorably or unfavorably to an object, person or institution or event. The characteristic attribute of attitude is its evaluation that must reflect a positive or genitive evaluation of the attribute object. Accordingly, there are three response categories that help us to infer about attitude. These are cognitive, affective, and co-native responses (Tesfaye, 2003).

According to Abadi T.(2009) attitude is a mental state of readiness, organized through experience, exerting an influence upon an individual's response to an object and the situations with which it is related. Formation and change of attitude are not two separate things, they are interwoven. People are always adopting, modifying and relinquishing attitudes to fit with the ever-changing situation of the attitude object. Attitude cannot be changed by simple education. If the technology is perceived by farmers as incompatible with the resource and other means available to them, then farmers will tend to develop negative attitude towards the object, or at

least show lack of enthusiasm to try the technology despite their knowledge about the importance of the technology. This in turn minimizes the sharing among farmers leading to a very slower rate of diffusion and adoption of technology.

### 2.6.5. Physical factors

#### 2.6.5.1. Topography, Slope and Soil depth

Topography is an important aspect of RWHP as the slope will greatly impact the size and type of catchment area of the RWHP system Prinz and Singh (2011). In addition to the factors of topography and terrain profile, there is an important factor such as soil type and depth that can help judge the potential for runoff and storage potential of water within the soil itself Prinz and Singh (2011).

#### 2.6.5.2. Amount and distribution of rainfall

RWHP depends on limited and uncertain rainfall, and thus understanding the dynamics of precipitation within the environment can influence the method of RWHP that would fit best in each context (Gould, 2009). According to Prinz and Singh (2011), the various factors which should be taken into account include: The number of days in which the rain exceeds the threshold rainfall of the catchment, on a weekly or monthly basis, probability and occurrence (in years) for the mean monthly rainfall, probability and reoccurrence for the minimum and maximum monthly rainfall, and frequency distribution of storms of different specific intensities.

### 2.6.6. Institutional factors affecting WHP

Organizational cultures, hierarchy of decision making which ranges from the lowest level to Woreda and Region. In some situation zonal level also provides technical back stopping. In this connection availability of manpower at each level and work experiences are very crucial for the implementation of RWH Abad (2009).

### 2.6.6.1. Agricultural extension service and mass media.

The agricultural extension service helps famer to be aware and acquire new knowledge and skill to improve the knowledge of water harvesting practice on their farm land. Access to information or extension massage as well as various extension services is one of the intuitional characteristics by influence farmer's decision to adopt new WHP and farmers familiar with mass media there would be a chance of frequent contact that who live at further distance farmers as well as agricultural extension expert, then consume the different experience relate to the water harvesting practice. Mass media plays major role in the diffusion of agricultural technologies in general (Rami H., 2012)

# 3. Materials and methods

During this study different materials would have been used such as note book, pen, paper, and like in addition to these materials important reference books and organization documents which concerned this study will be used

## 3.1. Description of the Study Area

### 3.1.1 Location

The study site locates in SNNP regional state in gurage zone, chaha woreda, chaha woreda found in gurage zone 150km from southern part of Addis Ababa and near to Wolkite town (CWAO;2019)

### 3.1.2 Population

The total population of grara faremazegba is 3540, of which 1940 are male and 1600 are female. And the sesena kebel is 3100 of which 1750 is male and 1350 are famel the total number of Kebele in chaha woreda is 43. They live depend on the agriculture products like livestock, and others depend on the suitable condition of the place. (CWAO 2019)

### 3.1.3 Topography

There is topography variation observed in the woreda. The central part of the woreda is characterized by flat slope and the other part is characterized by medium slope. Generally the topographical characteristics of the study area is ranges between 5 to 9 %.( CWAO 2019)

### 3.1.4 Climate

According to the data obtained from chaha Woreda agricultural offices the average annual rainfall is 1200-1400 mm and the temperature of this area ranges between $14^0$C - $27^0$C. The area is mostly characterized under low land and the altitude ranges from 1350m to 1367m above sea level. The agro ecology of the area is characterized by kola and woyna dega. (CWAO 2019)

### 3.1.4 Soil type

In the study area the major soil type in the area is almost verity soil is endowed with different types of soil texture, such as sandy clay soil and silt soil with different in their color like Black, brown and Red, the most dominant soil color type is black and red. (CWAO 2019)

### 3.1.5. Land use

The land use of the study area is both crop cultivation and Livestock rearing. The most dominant crops in the study area are cereal crops includes Inset, Teff and the local people used different fruit tree in the same way at the sometime in the someplace with in crops. This is the most dominant crops and they grow different fruits like mango, avocado, sugarcane, banana, and orange.

## 3.2 Methods of study

### 3.2.1 Data collection method

All data concerning the study was collected from both primary and secondary source, primary data was collected through personal interviews with respondent using questionnaire and direct observation. The secondary data have been collected from various published and unpublished material such as, research paper, reports and relevant document of government office of the study area.

### 3.2.2 Sampling techniques and sample size

Different approaches were used to determine the sample size in research. This study applied a simplified formula provided by Israel (2009), to determine the required sample size at 95% confidence level with degree of variability =0.5 and level of precision (e)=5%. Where n is the sample size, N is the population size (total household size), and e- is the level of precision. Based on this formula and to make use of the opportunity of large sample size this study when N=180, e=0.05, the formal is $n= N/1+N*e^2$ is 124 sample sizes. However, due to various limitations (time and money) only 28 sample size were used. In the study purposive stratified simple random

sampling techniques was employed. Sesena and Grara farmazgba kebeles were selected with farmers‟ households in the kebele are stratified according to their participation in the water harvesting practices. Then from the kebele both adopted and non-adopted farmers group were again selected using stratified simple random sampling technique. Those who use harvested water are designated as Adopters or Users whereas those who don't use any improved water harvesting practices are categorized as non-adopters or non-users. Using the household list of the sampled kebele respondents was selected from adopted farmer and from non-adopted farmers by random table. During the selection process, irrigation and agronomy department heads of the district of agriculture were participated. In addition to the selected farmer households, development workers, kebele administration and agronomy and irrigation experts from district office of agriculture was interviewed to acquire the government intention towards the technology.

## 3.3. Data Collection

Both primary and secondary types of data as well as quantitative and qualitative data was collected from different sources at different levels to fulfill the research questions and objectives of the study. All information about water harvesting practice, socio economic and institutional factors and other relevant to the study was gather from primary and secondary sources such as documents, study reports, district office and from resource centers. And governmental attitude farmer attitude also collected from the information collected from the chaha woreda administration and agricultural office from woreda to kebele levels. The data was collected on socio-economic aspects of the household such as farmers sex, age, education level, livestock number, off-farm income, institutional factors on government attitude such as training on WH practice, extension service on WH practice

### 3.4. Data analysis

Data was analyzed using descriptive statistics. Qualitative data was used to specify contexts of the study and enrich information that is generated from quantitative data analysis. Moreover, tables and percent were used to describe the result.

## 4. RESULT AND DISCUSSION

This section focuses on attitude of water harvesting technology of the study area. Specifically, the government and farmer attitude towards water harvesting technology. And factor that affect water harvesting technology in the study area.

## 4.1. Results of Descriptive Analysis

The descriptive statistics was run to observe the distribution of the independent variables. The most common household characteristics that are frequently influencing farmer's decision on adoption of water harvest practice include: social, economic, physical and institutional characteristics of the users and non-users of water harvest practice are analyzed.

### 4.1.1. Socio economic characteristics of sampled households

### 4.1.1.1. Age, sex, marital and education status of sampled household heads

Table 1. Age of sampled household heads

| **Age Group** | **Users** | **Non users** |
|---|---|---|
| Age 16-19 | 5 | 2 |
| Age 20-49 | 9 | 4 |
| Age 50-75 | 7 | 1 |

Source; from our field survey, 2019

The result of the survey indicates that out of the total sampled household heads of users and non-users were 64.3% and 35.7% respectively. This result indicates that in the study area the users were higher than that of non-users, thus the farmers attitude towards water harvesting practice increases, this may due to the awareness of water harvesting, it used for food security.

Table 2:Educational Status, sex and marital status

| Characteristics | Users | Non users |
|---|---|---|
| Sex | | |
| Male | 13 | 5 |
| Female | 8 | 2 |
| Marital Status | | |
| Married | 17 | 3 |
| Single | 0 | 3 |
| Widowed | 4 | 1 |
| Divorced | 0 | 0 |
| Education | | |
| Informal education | 4 | 3 |
| Elementary | 11 | 4 |
| High school | 2 | 0 |
| Collage | 1 | 0 |
| University | 3 | 0 |

Source; from our field survey, 2019

**Educational Status:** from the table above (Table 2), the sample household head shows various levels of education. It revealed that the younger generations have better education opportunity than the older farmers. Empirical evidences indicate that the higher the level of education, the greater is the possibility for farmers to become aware of the uses of better agricultural practices for securing food self-sufficiency. It is expected that those farmers with increased formal education be disposed to decide to participate in water harvesting works. Generally, it is believed that exposure to education increases the farmer's management capacity and reflect a better understanding of the benefits of better management practices and improved technologies.

## 4.2 Factor Affecting water harvesting technology during the use of pounding

### 4.2.1. Physical factors

#### 4.2.1.1. Type of soil of the sampled households

Land varies in its use of agricultural production. Soil type in the study area was verity and the texture is sand and clay CWAO (2019). Most farmers said these soil types are best crop to grow tiff, enset for food consuming and fruit like avocado, orange, banana, and mango. The severity of soil erosion is evident in the kebele by the common occurrence of spectacular deep and wide gullies that are extreme forms of soil erosion. The total numbers of farm plots users and for non-users of were classified as black, red and brown soil respectively. Soil type categories suitability of sampled households farm as perceived by farmers, Joe membrane and ponds are usually constructed on black color clay soils. Therefore, it is more suitable to construct water harvesting practice on suitable soil type, which is consistent with the farmer's decision criteria.

#### 4.2.1.2. Slope of sampled farmers farm

Slope refers to the steepness of the place; erosion is more serious on steeper farm than on flat plots farm. Erosion potential is determined by the slope of the household's farms and other factors such as, soil type and land use practices. Farmers who have farms in areas which are more prone to soil erosion such as steep and very steep slopes, are expected to experience more soil erosion and therefore recognize the impact of top soil loss due to erosion more easily than farmers with farms located on flat areas. Since farm plots are located on sloppy areas were less productive and need different types of conservation measures. In Grarafarmazgba kebelle especially in around Gotam watershed the slop is above 25% then it is not applied or constructed water harvesting structure (i.e., not suitable to water harvesting technology construction). The result implies that slope is an important factor in the selection and use of water harvesting structures. For the use of pond in that area it is very difficult because steeply slope is not suitable for preparing of water harvesting structures.

### 4.2.1.3. Amount and distribution of rainfall

Interviewed farmers and the meteorological data indicate that rainfall of the cropping season started very late and cease early than the average onset and offset of the rains during the normal cropping season CWAO (2019). Accordingly, the duration of the effective rainy season, in other words the length of growing period, of the cropping season was only two months and three weeks which is very short for long season crops. The total rainfall recorded over period of the cropping season is low and the distribution of rainy days with in the duration of the cropping season was not uniform. Considering, the rainy months of the cropping season, cumulative average rainfall amount for ten years recorded data showed in June (27.2 mm), July (35.6 mm) and August (36.8 mm). From the figure: highest rainfall recorded was during August, followed by July and the least is June. The rainfall data recorded for the cropping season revealed that the crop production in the study area is heavily constrained by sever soil moisture stress caused by the problem of shortage of water. On the other hand, shortage of water is caused by low total seasonal rainfall, very short duration (Length) of crop growing period and especially by uneven distribution of rainfall both in intensity of rainfall event and infrequency of rainfall occurrence among the months and within the days in a month over the crop season. Thus, erratic and insufficient rainfall and the resultant limited availability of soil moisture coupled with the exceptional risks of prolonged dry spells are the major constrain of crop production in the study area. Therefore, WHP can be reducing these all problems that related amount and distribution of rain fall on Agricultural production.

### 4.2.1.4 Location of water harvesting structure

Location of water harvesting Structure can affect utilization of WHT. The Site of steep slopes is not economically suitable for construction of WH structures because Water harvesting practice is not recommended for area where slops are greater than 5% due to absence of water collection catchment, gentle topography is suitable for construction and harvesting water harvesting structure. Location of water harvesting structure categories as perceived by sampled respondents should positive influence to adoption of water harvesting practice.

Table 3: physical factor of the farmer

| **physical factor of the respondent** | | | | | |
|---|---|---|---|---|---|
| Respondents | | User | | Non user | |
| | | Frequency | Percent | Frequency | Percent |
| parameters | Location of WHT | 3 | 14.3 | 1 | 14.3 |
| | soil types | 7 | 33.3 | 2 | 28.6 |
| | (slope) topography | 6 | 28.6 | 1 | 14.3 |
| | Rainfall | 5 | 23.8 | 3 | 42.8 |
| | Total | 21 | 100 | 7 | 100 |

Source CWAO.2019

## 4.3. Economic Factors

### 4.3.1 Land size of the farmer

In our study area the size of land can affected the use of water harvesting, the size of the land increased when the farmer construct water harvesting structure but the land size is small the farmer has the shortage of the land then they do not constructed water harvesting structure because the people has among that get from their lands then they can constructed water harvesting structure but the people that has small land they can't construct water harvesting structure due to shortage of money. And. The number of owned farm plots range from one to three farms for total sample households. The survey result indicates that some farmers have more than two plots of the lands. As the number of plots of the lands increases, it may help the households to allocate a given plot of land for construction of Water harvesting structures.

## 4.3.2. Vegetable production

In our study area most of the farmers produce different fruit like avocado, mango, bandana, and Orange using water harvesting structure in addition to vegetables like carrot, cabbage, onion, tomato and potato by using the water harvesting structures like pond produce more production than the farmers cannot be used water harvesting structures to produce the agricultural crops. Generally, the result indicates that the farmers that adopted water harvesting practice attain more crop yield than that of the farmers cannot be adopt water harvesting practice.

Table 4:Comparison of vegetable production between users and non-users of WHP.

| | | Vegetable(quintal) | |
|---|---|---|---|
| **S/N** | **vegetable types** | **Users** | **Non users** |
| 1 | Carrot | 18 | 6 |
| 2 | Cabbage | 23 | 4 |
| 5 | Onion | 50 | 6 |
| 4 | Tomato | 25 | 15 |
| 5 | Potato | 30 | 9 |

Sour; CWAO 2019

## 4.3.3. Livestock production

Livestock play a significant role in the mixed farming system of the area. Livestock holding size is also one of the indicators of wealth of the household in the study area. Their main contribution; oxen kept to providing draft power, income generation, cows to provide farm households with milk and better for consumption and sale, whilst sheep, goats and poultry are mainly kept for sale as well as for their meat. As it confirmed in many studies farmers who have relatively better livestock ownership status are likely to adopt improved agricultural technologies like water harvesting practice because of, livestock can provide cash through sale of products which enables farmers to purchase different agricultural inputs. The livestock holding size varied between farmers' categories. This means that water harvest technology users have relatively medium livestock size than non-users.

Table 5:economical factor of water harvesting technology

| economical factor of the respondents | | | | |
|---|---|---|---|---|
| Validity | | Frequency | Percent | Valid Percent | Cumulative Percent |
| | lack of money | 9 | 32.2 | 32.2 | 32.2 |
| | lack of market | 6 | 21.4 | 21.4 | 53.6 |
| | lack of infrastructure | 7 | 25.0 | 25.0 | 78.6 |
| | Other | 6 | 21.4 | 21.4 | 100.0 |
| | Total | 28 | 100.0 | 100.0 | |

Source; CWAO ;( 2019)

According to the (Table 5) indicted that our field observation in the study area the main factors that affected or limited the use of water harvesting practices is the shortage of money, lack of infrastructure availability of market, and other factors like human labor it represents in present 32.2,21.4,25 and 21.4 respectively.

## 4.4. Institutional factors affecting WHP during the use of pounding

### 4.4.1. Agricultural extension service and mass media.

The agricultural extension service helps famer to be aware and acquire new knowledge and skill to improve the knowledge of water harvesting practice on their farm land. Access to information or extension massage as well as various extension services was one of the intuitional characteristics by influence farmer's decision to WHP. A farmer can gain access information about new technologies though various means such as attending field days, visiting demonstration fields, participating, training, listening to agricultural program though media. In this study the average number of extension contact for the users of the water harvesting practice, was 2 days per month. The result is consistent with prior extension in that the frequent access of extension service is potential force which accelerates the effective dissemination of agricultural information to the farmers. As farmers familiar with mass media there would be a chance of frequent contact that who live at further distance farmers as well as agricultural extension expert, then consume the different experience related to the water harvesting practice.

## 4.5. Psychological factors affecting WHT

### 4.5.1 Farmer attitude towards WHT

In the study area the water harvesting practice started at decently as agricultural expert said that at that time the farmer attitudes towards the WHP is very low, now a day through gradually the farmers' awareness increase year to year by the help of the government. Water harvesting practice can improve agricultural productivity of the land. In 2019/20 almost all farmers can be participating on water harvesting practice and increase their attitude towards WHP and the farmers can grow different agricultural and domestic using water harvesting structures.

### 4.5.2 Government attitude

In the study area the water harvesting practice start in 2017 as agricultural expert said that at that time the government attitudes towards the water harvesting technology is high, during the year 2001-2004 during the period of this four year the water harvesting attitude of the government is very high, that help the people by creating awareness and constructing the pond for each individual farmers who have interest to the technology in many kebeles, but 2005-2014 the government motive and intention towards WHT is decreased due the poor farmers perception and motive to the constructed technology. However, the knowledge and attitude of farmer increased and the government attitude increased year to year after the of 2015 because water harvesting can have increased the productivity of all products or it can have increased food security. The government create awareness for the local people about the use of water harvesting and it can help the farmers by full filling their need and want to help the introduced water technology in the local area. The government provide materials like black plastic, ploughing tractor facilitation to promote irrigation utilization) and money as incentive to the people in addition to awareness creation about water harvesting practices

## 5. COCLUSION AND RECOMMENDATION

## 5.1. Conclusion

In spite of being the dominant sector of the Ethiopian economy, Agriculture in the country is characterized by low productivity in and low yield per unit area in particular. More recently, Ethiopia is trying to expand Water harvesting practice especially those that can be constructed and managed at individual resource poor farm household levels. Identification of factors that affect water harvesting practice like economic, social and physical is one the important factors that affect water harvesting technology in the study area. Steps in identifying sustainable management options. The study area is one of the densely populated farmers where crop failure due to inadequate moisture from rainfall is common physical factors in the study area. Due to this and other poor agronomic practices, the crop productivity in the area is generally low and the people were under Aid for a long period. Some farmers have devised a coping mechanism through Water harvesting practice to supplement the moisture from rainfall. However, the majority of the farmers are not capable of doing so as it involves some initial and maintenance investment. On the other hand, the area has a good potential for development of water resources, improving water use efficiency and crop productivity if proper interventions are made.

The study revealed that farmers who used water harvesting practice than non-users able to diversify their income. Income from using water harvesting practice implies a positive correlation and influences of this income towards the utilization of the water harvest practice. Availability of cash is a way, which bridges the gap of dawn payment in the utilization of the water harvesting practice. This helps farmers to use more inputs to exploit harvested water. The extension contact has influences utilization of the water harvest practice, as the technology requires knowledge and skill. Farmers can develop positive attitude through frequent contact with the development worker as well as attending field day and field visits in the locality. This variable has a positive correlation and it affect water-harvesting suitability, as the technology is suitable to the decision of farmers to have water harvesting practice structures.

Labor availability is the other key factor affecting the decision of farmers to participate in water harvesting activities, which indicated that economy is one of the essential factors that limited or

affected water harvesting technology in the study area. Availability of labor is an essential element to implement water harvesting activities. The government and farmer attitude is the main important factors that affect water harvesting technology. When the attitude of government or farmer is low to water harvesting technology or practice that affect the development of water harvesting technology negatively.

## 5.2 Recommendation

The importance of expanding water harvesting practice for sustained development of the agricultural sector becomes growing especially at the benefited farmers, experts and political leaders' level. Based on the major findings of the study, the following recommendations are forward;

- Farmers' performance regarding water harvesting practice varies from site to site and from one crop to another crop. Most of the smallholder farmers could not afford the cost of recommended agricultural technologies due to shortage of capital. Though the overall water use efficiency as defined in this study was generally low, there was still great potential for improvement to save substantial amounts of water that could be used to expand water harvesting structures. Thus, there was a need to provide revolving funds which can facilitate both upgrading of agriculture and diversification into new activities. Therefore, use of revolving funds can play a significant role in increasing agricultural productivity.
- Farming experiences were associated with water harvesting practice positively. Farmers with longer farming experience have wide knowledge and skills, which enables them to perceive risks and constraints related to effective transfer of new technologies. Development agents in the kebele should arrange periodic experience sharing sessions among young and old age group of farmers to enhance community's member participation in water harvesting practice in addition to their current contact 2 days/month. This can improve farmer-to-farmer learning on agricultural practices.

- And also the government can have increased the awareness of the farmer in the importance of water harvesting technology. Then the government has good attitude about water

harvesting technology. The government attitude or government interference about water harvesting technology is recommended.

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## 7 APENDIXE

WOLKITE UNIVERSITY

COLLAGE OF AGRICALTUR AND NATURAL RESOURECE

Part one

A USERS QUESTIONARIES

This questionnaire is prepared by prospective graduating student from Wolkite University to identify the challenge and prospects of attitudes of water harvesting technology. the outcome of the study will help to suggest possible solutions from the observed you are kindly requested to response the questions as responsible as possible. The researcher assures you that the response it kept confidential and for academic purpose only.

Attitude of water harvesting technology

GENERAL CHARACTERS OF THE FARMER

1 Name of interview _____

2 Sex [2] Male [0] Female

3 Age _____

4 Marital statuses of the household head [a] Married [b Unmarried [c] Divorced [d] Widowed

5 HH Level of education [a] informal education [b] Elementary [c] Junior [d) High school [e] college[f] University

6 Category [a] Users [b) Non Users

7 Households Farm Experience _____ Years

8 Household Irrigation farm Experience _____ Years

9) Total Cultivated area (in ha) _____ [a] Irrigated _____ (b] unirrigated: _____ c) Chat Land _____ (d] Fallow Land _____ [e] Grazing Land _____ [f] Forest Land _____ [g] others _____

(11) Are you dealing with RWHT? A yes b. No

(12) If yes what is your source of information?

(1) Extension agents (DAs) (2) Neighboring farmers. (3) Government. (4) Mass Media. (5) Others

(13) Does Water harvesting technology used for economic development? (1) Yes. (2) No

(14)) what is the use of RWHT in this area?

(a) Irrigation. (b) Domestic utilization. (c) Cattle drinking (d) others

(15) Do you have your own farm land? [a] Yes [b] No

16] Is the land you have enough to produce for your household consumption? [1] Yes [0) No

[18] Have you taken some land on rent or some other terms taken from other farmers for cultivation? [a] Yes [b] No

(19) If you yes what is the reasons

[1] Have extra labor [2] to help the owner of the land. [3] Shortage of his lands [4] others

(20) How many livestock do you have_____ (a) ox_____ (b) sheep _____(c) goat_____ (d) camel_____(e) cow_____(f)others_____

(21) Which RWHT is most commonly practice in this area?

(1) Half-moon. (2) Bench terrace. (3) Trench (4) Percolation pit. (5) Eye brow basin (6) pond. (7) Others

(22)Do you know pounding? (a)Yes. (b) No

(23) How Mach the pond is effective in this area? (a) Very high (b) high. (c) Median (d) low

(24) Which is the most dominated material you will use/ used to function the pond?

(a) Jeo membrane. (b) Stone (c) concrete. (d) Others

(25) The government can support to facilities during construction of pond? a Yes b No

(26) If the answer is yes from 17 how to support?

(a) Providing knowledge. b) Provision of material. (C) Provision of money (d) others

(27) Do you think that water harvesting technology has change for the local community?

(a) Yes. (b) No

(28) If the answer YES from 19 what is the change of water harvesting technology

(a) Economic. (b) Social (c) physical. (d) Others

(29) Which stakeholders are more benefit from water harvesting?

(a) Government body. (b) Local people. (c) Others

(30) The government can help continuously the work start to the end? (a) Yes. (b) No

(31) Which physical factors that affect water harvesting technology?

(a) Soil structure. (b) Topography. (c) Rainfall. (d) Others

(32) Which social factors have impacts in this area?

(a) Social relationship in working group. (b) Family member

(C) Precipitation water harvesting technology. (d) Others

(33) Which type of economic factor have impacts water harvesting technology in this area? (a) Lack of money. (b) Lack of marketing availability(c) lack of infrastructure availability. (d) Others

(34) Which types of institutional factors are having affected water harvesting technology in this? (a) Farmer attitudes. (b) Government attitude. (c) Mass Media (d) other

(35) What is your suggestion on RWHT? _____

WOLKITE UNIVERSITY

COLLAGE OF AGRICALTURE AND NATURAL RESOURECE

Part two

B QUESTIONNARY ABOUT GOVERNMENT BODY

This questionnaire is prepared by prospective graduating student from Wolkite University to identify the challenges and prospect of attitude water harvesting technology .The outcome of the study will help to the suggest possible solution from the problems observed you are kindly requested to response the questions are reasonable as possible .the researcher assures you that the response it kept confidential and for academic purpose only.

1 Name of interview _____

2 Sex [2] Male [0] Female

3 Age _____

4 Marital statuses of the household head [1] Married [2] Unmarried [3] Divorced [4] Widowed

5 HH Level of education [1] informal education [2] Elementary [3] Junior [4] High school [4] college [5] University

(6) Do you have enough information the attitude of farmer about water harvesting?

(1) Yes. (2) No

(7) Have you learned by the government about water harvesting technology?

(1) Yes. (2)No

(8) What is the degree or level of RWHT in this area?

a very high. b high. c medium. d low. e very low

(9) Which RWHT is most commonly practice in this area?

(1) Half-moon. . (2)Percolation pit (3) pond (4) others

(10) Do you know pounding? (a)Yes. (b) No

(11) How Mach the pond is effective in this area?

(a) Very high. (b) High. (c) Median. (d) Low

(12) Which is the most dominated material you will use/ used to function the pond?

(a) Jeo membrane. (b) Stone (c) concrete. (d) Others

(13) The government can support to facilities during construction of pond?

a Yes. b No

(14) If the answer is Yes from 17 how to support?

(a) Providing knowledge (b) provision of material (C) provision of money (d) others

(15) Do you think that water harvesting technology has change for the local community?

(a) Yes. (b) No

(16) Which stakeholders are more benefit from water harvesting?

(a) Government body. (b) Local people. (c) Others

(17) The government can help continuously the work start to the end? (a) Yes. (b) No

(18) Which physical factors that affect water harvesting technology?

(a) Soil structure. (b) Topography. (c) Rainfall. (d) Others

(19) Which social factors have impacts in this area?

(a) Social relationship in working group (b) family member

(C) Precipitation water harvesting technology. (d) Others

(20) Which type of economic factor have impacts water harvesting technology in this area?

(a) Lack of money. (b) Lack of marketing availability

(c) Lack of infrastructure availability (d) others

(21) Which types of institutional factors are have affected water harvesting technogy in this?

(a) Farmer attitudes (b) government attitude (c) Mass Media (d) others