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Assessment of Existing Irrigation Practice in Guji Zone of Mid and Low-Land of Southern Oromia, Ethiopia

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Abstract: Irrigation survey was conducted in lowland and midlands of Guji zone of Southern Oromia, to generate information on irrigation activities as a zone in low and mid-land agro ecologies. The studies were conducted in selected representative areas of Adola Rede, Liban, Odo Shakiso, Seba Boru, and Wadera districts. In sampling techniques the cluster sampling techniques was applied, depending on the agro-ecologies of the districts. In two agro-ecologies five districts were selected, three of them were categorized under low-lands and two under mid-lands. From each districts two to three representative PA`s were randomly selected. From each selected PA`s of the district's 30 households were taken as respondents. Among them 15 person were householders used irrigation in each selected PA`s, 15 person were householders not used irrigation are interviewed in doing this survey, 18 person were agricultural and irrigation office expert and thirteen (13) development agents are participated in doing questionnaires (31 key informants). Questionnaire distribution for key informants such as experts and DA's, personal interview for farmers and field visit were used to gather the data. Both primary and secondary data were collected. Soil samples were taken from the representative selected PA's in each districts at the area under irrigation those selected for research and was analyzed in the laboratory to collect parameters such as: - soil ph, soil texture (soil type), soil organic carbon (organic matter), total nitrogen, available p, exchangeable K, Ca, Mg, Na and CEC. The major findings of the research were come up with both opportunities and constraints to expand irrigation farming. And the result shows there were more constraints compared to the opportunities as the study areas. These were more common in lowland than midland.

Keywords: Surface Irrigation, Assessment, Agro-ecologies, Water Bank, Water Sources, Hand-Well, River

1. Introduction

Many countries civilizations have been dependent on irrigation agriculture to provide the basis of their society and enhance the security of their peoples` livelihoods. Some have estimated that as little as 15-20% of the worldwide total cultivated area is irrigated. Comparing yields from some irrigated and none irrigated areas, this relatively small fraction of agriculture may be contributing as much as 30-40% of gross agricultural output [1].

Agriculture is the core driver for Ethiopia`s growth and long term food security. The stakes are high: 15 to 17% of Governments of Ethiopia`s expenditures are committed to the sector, agriculture directly supports 85% of the population`s livelihoods, 43% of gross domestic product (GDP), and over 80% of export value [2] and the country comprises 112 million hectares (mha) of land. Cultivable land area estimates vary between 30 to 70 mha. Currently, high estimates show that only 15 mha of land is under cultivation. For the existing cultivated area, only about 4 to 5% is irrigated, with existing equipped irrigation schemes covering about 640,000 hectares. This means that a significant portion of cultivated land in Ethiopia is currently not irrigated.

According to Haile GG, Kasa AK [3] Quoting Ministry of Agriculture (MoA) [4] the cultivated agricultural land of Ethiopia currently under cultivation is about 12 million ha. Moreover, [5] even if the potential and actual irrigated area are not precisely investigated and [6-9] estimates of irrigable land in Ethiopia vary between 1.5 and 4.3 million hectares (Mha), averaged about 3.5 Mha.

Irrigation is important in sustaining agriculture across the dry belt but it is not the only solution that can solve all the problems of the dry areas. It plays a pivotal role in food security, income generation, employment creation, improved nutrition and rising of the standard living of the farmers. However, some irrigation technology schemes have been found to be non-viable and causing a lot of financial burden on the local farmers [10].

Effective agronomic practices are essential components of irrigation systems. Management of soil fertility, crop selection, rotation and Pest control make as much incremental difference in yield as the irrigation water itself. Irrigation implies drainage, soil reclamation, erosion control and water harvesting refers to making the rain water, underground water and surface run off economically valuable. Therefore, the main attempt of this study was to undertake the assessment of the current irrigation practices in Guji Zone mid and low-land of Oromia Region to identify intervention gaps for effective development of irrigation water management, agronomic and socio-economic aspects of the practice for the problem observed. So, the Objectives of the study were to assess existing irrigation practices and identify problems related to irrigation water management and opportunities for expanding irrigation, and to come out with factors that makes good and poor schemes in the areas and to identify the methods of irrigation water application and water sources used for irrigation and to identify the major crops farmer produce under irrigation and their attitudes towards irrigation practice.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in Guji zone of low-land and mid-land. Guji –zone is one from zones found in oromia. The zone is located at 595 km south of Addis Ababa. It is found between 4°30’-6°25’N latitudes and 38°16’-41° 34’E longitudes. The rain seasons in guji zone in their agro ecologies are: - in low land area: - 1) Spring, Maher (Arfasa) as a main season rainfall from March – May 15 (318.42 mm), 2) Autumn, Belg (Bira) as the second rainfall season: - from September 15- November 15, (225.63.mm) around Negele area and in Midland agro ecology it is the bimodal rainfall the main season rainfall is spring, those months of March to May (508.13 mm) and the second season rainfall is the months of September to October (332.65 mm), and the maximum and minimum average temperature of the midland area agro-ecology was 26.4 and 12.9°C.

The main rainfall season was the months of June to October for most parts of the zone; and the second rain season was the months of March to May. And During summer (Kiremet) season, June-August the rain pattern of Adola Wayu station was lower compared to April, May and October for the reason that Kiremet season is a dry period in the area. While low rainfall was obtained in the months of the winter season.

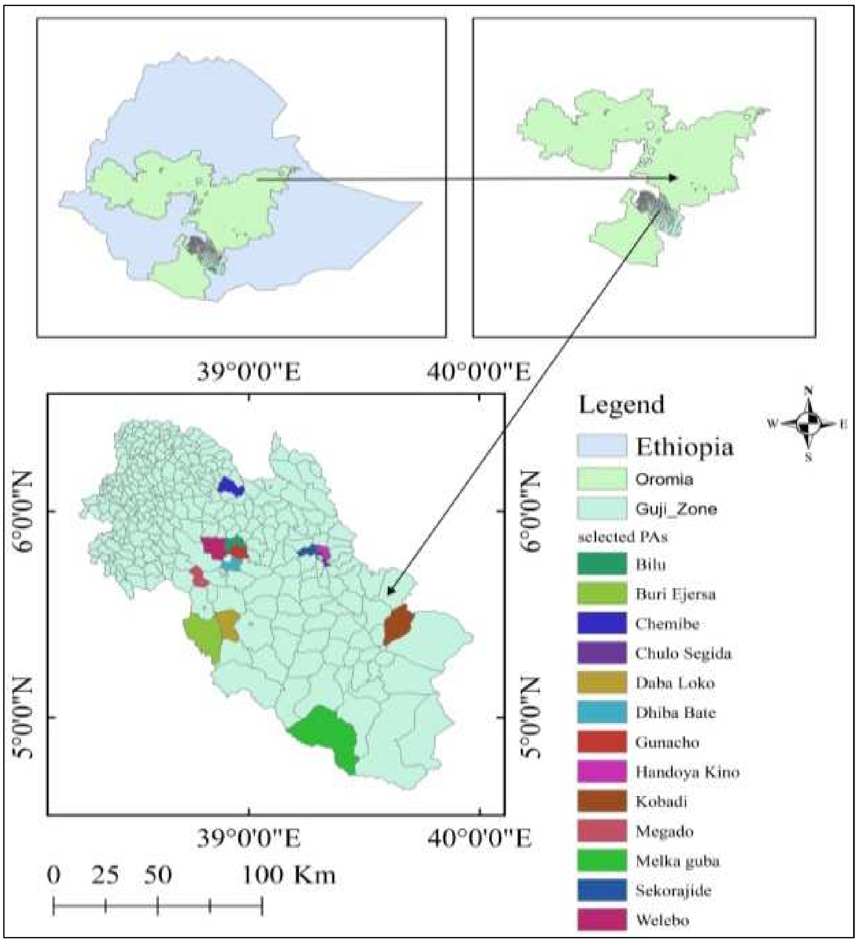

Figure 1. Map of the study area.

The studies were conducted in selected representative areas, Adola Rede, Liban, Odo Shakiso, Saba Boru, and Wadera districts.

2.2. Survey Methodology

2.2.1. Sampling Techniques and Data Collection

In sampling technique the cluster sampling technique was applied, depending on the agro-ecologies of the districts, such as: - mid-land and low-land. In two agro-ecologies five districts were selected, three of them were categorized under low-lands, two under mid-lands. From each districts two to three representative PA`s were selected randomly. From each selected PA`s of the district's 30 households were taken as respondents. Among them 15 person were householders (farmers) used irrigation in each selected PA`s, 15 person were householders not used irrigation, 18 person were agricultural and irrigation office workers and 13 development agents, total (31) key informants were involved.

2.2.2. Method of Data Collection

Questionnaire, personal interview and field visit were used to gather the data. Both primary and secondary data were collected. The questionnaires were distributed to respondents by containing the questions that give answers for the objectives of the study. In questionnaire preparations; the three basic types of questionnaires, such as: - closed ended, open ended and combinations of both were used. The primary data was obtained from questionnaires distributed to respondents and interview conducted and farmers' irrigation field visited. Secondary data was collected from official records. Such as:-zonal and districts agriculture & irrigation office of Guji zone and total 195 farmers are interviewed.

2.2.3. Soil Sampling Methods

The soil samples from irrigation potential area of each individual thirteen kebeles of 20 cm depth were collected and the composite soil samples were taken to Ziway and Beddele soil research center for chemical and physical soil laboratory analysis.

2.2.4. Soil Analysis Methods

PH: in water suspension with soil to water ratio 1:2.5 by PH meter, EC: in water suspension with soil to water ratio 1:2.5 by electro Conductivity meter, Exchangeable Na & K: by flame photometer, Exch. Ca & Mg: by EDTA titration, Av. P by Olsen etal, Texture by Hydometer, CEC (Cation Exchangeable Capacity) by Ammonium Acatate (1M NH4OAC), TN: Kjeldhal Method, Av.K by Ammonium acetate (1MNH4OAC), OC (organic carbon) by Walkley black.

2.3. Data Analysis

The collected data were organized & interpreted by using the statistical package for social science (SPSS version 20) to maintain reliable data base to generate valuable information on existing irrigation practice in Guji Zone.

3. Results and Discussion

3.1. The Existing Irrigation Farming Practice as the Zone

As result obtained from analyzed data, the existing irrigation practiced in Guji zone are: - using motor pump with combination of surface gravity canal and furrows irrigation and watering by hands, surface gravity canal and (furrows) with combination of watering by hands, Watering only by hand and modern concrete canal with furrows irrigation.

Table 1. *Types of irrigation practiced by social.*

	Types of irrigation social practices	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	full irrigation	21	10.8	10.8	10.8
	supplementary irrigation	44	22.6	22.6	33.3
	both	130	66.7	66.7	100.0
	Total	195	100.0	100.0	

As the Table 1, shows the major farmers use both supplementary and fully irrigation and the medium number irrigation users use supplementary irrigation. While the least numbers of farmers use fully irrigation.

Table 2. *Irrigation methods of the study areas farmers used.*

	Irrigation methods Farmers used	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.surface gravity	23	11.8	11.8	11.8
	2.motor pump with surface gravity	45	23.1	23.1	34.9
	3. Pressurized irrigation	1	.5	.5	35.4
	4. watering by hand and 1	75	38.5	38.5	73.8
	5. 1 and 2	2	1.0	1.0	74.9
	6. 2 and 5	44	22.6	22.6	97.4
	7. 1 and 5	5	2.6	2.6	100.0
	Total	195	100.0	100.0	

As depicted in Table 2, majority of the farmers watering their lands by hands combination with surface gravity. And others farmers use motor pump and combination of motor pump with surface gravity and watering by hands.

Table 3. *Guji zone irrigation farming practices and the water sources used in mid-land agroecology.*

Name of districts under survey	Name of PA's selected	Irrigation farming they practice	Water sources they use for irrigation
Adola Redde	Cembe	Furrow irrigation and modern concrete channels (lined) and unlined with furrow irrigation	Hila and Abeba Rivers in majority and Ground water hand dug well and deep well rare.
	Gunacho	motor pump with unlined canal and furrow irrigation, watering by hand with combination of furrow and motor pump	Awata River in majority and hand dug well rarely.
	Bilu	furrow irrigation, watering by hand, motor pump with furrow and watering by hands combination with motor pump and furrow irrigation	Ground water shallow hand dug well open to atmosphere, Awata river which flow annually and Obi River which interrupt at winter season in long dry time
Odo shakiso	Megado	Motor pump with furrow irrigation, watering by hand, furrow irrigation and combination of hand irrigate with furrow and motor pump.	Mormora (Camola) River. Camola is another name of mormora river in this kebele.
	welabo	Motor pump with furrow irrigation, watering by hand, furrow irrigation and combination of hand irrigate with furrow and motor pump.	Nyore River, shallow hand dug well and Deep well
	Dhiba Bate	Motor pump with furrow irrigation, watering by hand, furrow irrigation and combination of hand irrigate with furrow and motor pump.	earthen pond surface water harvesting(irrigation water bank, swamp surface water sources)

The modern concrete canals with furrows irrigation were established in Adola Redde woreda (Cembe kebele) and Liban woreda (melka Guba kebele) but in both districts, they stop function.

Table 4. *Guji zone social irrigation farming practices and water sources they use for irrigation in low-land agro-ecology.*

Name of districts under survey	Name of PA's selected	Irrigation farming they practice	Water sources they use for irrigation
Wadera	Celo segda	Watering by hands, furrow irrigation, using motor pump with combination of furrow irrigation and watering by hands	Celo river, surface water harvesting (earthen pond water harvesting) (water bank).
	Sekora jide	Motor pump with furrow irrigation, irrigating by hand and combination of furrow, motor pump and irrigation by hand.	Sokora River and earthen pond surface water harvesting (water bank)
	Handoa kino	Furrow irrigation, watering by hands, and combination of both.	earthen pond surface water harvesting (water bank)
Liban	Melka Guba(know failed under Gumi eldano district)	Modern concrete canal with furrow irrigation, motor pump with furrow irrigation, watering by hand and combination of furrow and motor pump with hand irrigation.	Dawa River
	kobadi	Motor pump with furrow irrigation, watering by hand and combination of furrow and motor pump with hand irrigating.	Genale River
Seba Boru	Buri Ejersa (know failed under Aga Wayu District)	Motor pump with furrow irrigation, watering by hand, furrow irrigation and combination of hand irrigate with furrow and motor pump.	Dawa River
	Deba Loko	Motor pump with furrow irrigation, watering by hand, furrow irrigation and combination of hand irrigate with furrow and motor pump.	Mormora River

Celo Segda PA's farmers use Celo River and Sokora Jide use Sokora River for irrigation purpose. But both rivers interrupt at winter season when the time of rains stop raining for a long time. All districts farmers use fully irrigation for early matured crops and supplementary irrigation for late matured crops.

Irrigation potential Districts were Adola Redde and oddo shakiso those midland agro ecology from five districts surveyed on irrigation in their order. From lowland agro ecology wadera, Seba Boru and Liban districts are irrigation potential districts as result shows. The crops farmer produce under irrigation are horticultural, cereal and pulse crops. From horticultural crop: cabbage, hot pepper, onion, tomato, Garlic, coffee, potato, bet rot, carrot and sugar cane. Chat is also cultivated under irrigation, in wadera District cello segda PA's.

From cereal crops maize is the dominant crop cultivated under irrigation farming in Guji Zone both agro ecologies. While hair cot been are cultivated under irrigation farming in lowland agro ecology. Both maize and hair cot been are cultivated under irrigation in lowland agro ecology. Maize is the dominant crop in this agro ecology while hair cot been is the second one cultivated under irrigation.

Table 5. *Current conditions of irrigation water source.*

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
enough	88	45.1	45.1	45.1
not enough	107	54.9	54.9	100.0
Total	195	100.0	100.0	

As illustrated by table 5, the current condition of irrigation water source is not enough. So, additional irrigation water harvesting and more management for the existing irrigation water are necessary.

***Table 6.** Having motor pump of the farmers for irrigation.*

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
yes	69	35.4	35.4	35.4
no	126	64.6	64.6	100.0
Total	195	100.0	100.0	

As explained by table 6, the majority of the farmers have no motor pump for irrigation. And they rented from motor owners. And expose the farmers for extra expense.

***Table 7.** Existing problem in water utilization and management for expand irrigation farming.*

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
yes	193	99.0	99.0	99.0
no	2	1.0	1.0	100.0
Total	195	100.0	100.0	

As shown by table 7, there are the problems of water utilization and management such as: - sometimes more water inter the command and water logging, breakage of concrete and surface canal, absence of ground water for lowland area of farmers far from along rivers sides, lack of irrigation water for lower command area after upper scheme farmers used, damage of cultivated crop those late mature by flood for farmers very near to rivers.

***Table 8.** Irrigation Interval farmers used within a week.*

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
twice	78	40.0	40.0	40.0
3 times	7	3.6	3.6	43.6
4 times	6	3.1	3.1	46.7
once in a week	7	3.6	3.6	50.3
daily	45	23.1	23.1	73.3
crop sin to need water	52	26.7	26.7	100.0
Total	195	100.0	100.0	

As explained by table 8, the average irrigation interval farmer's use within a week is twice for major. And another irrigate their crop field depends on weather and crop sin to need water and another irrigate their cultivated area daily.

3.2. Discussions on Soil Results

3.2.1. Soil pH

The soil pH is the negative logarithm of the active hydrogen ion (H^+) concentration in the soil solution. It is the measure of soil sodicity, acidity or neutrality. It is a simple but very important estimation for soils as soil pH has a considerable influence on the availability of nutrients to crops. It also affects microbial population in soils. Most nutrient elements are available in the pH range of 5.5–6.5 [11]. Relating the soil sample laboratory result with the ph range shows the soil sample from Seba boru District: Deba Loko and Buri Ejersa kebele, oddo shakiso: walabo, wadera: handoa kino and Adola Redde: Gunaco kebeles failed under strongly acidic soil reaction rating. While the soil sample result from Adola Redde District: cembe and Bilu, wadera: Celo segda, oddo shakiso: Magado and Dhibba Batte PA's failed under moderately acidic soil rating. While wadera District: Sokora Jide failed under slightly acidic and Liban: Melka Guba and koba Adi failed under moderately alkaline.

The ph controls a wide range of physical, chemical, and biological processes and properties that affect soil fertility and plant growth. Soil pH, which reflects the acidity level in soil, significantly influences the availability of plant nutrients, microbial activity and even the stability of soil aggregates. At low pH, essential plant macronutrients (i.e., N, P, K, Ca, Mg, and S) are less bioavailable than at higher pH values near 7, and certain micronutrients (i.e., Fe, Mn, Zn) tend to become more soluble and potentially toxic to plants at low pH values (5–6) [12]. Aluminum toxicity is also a common problem for crop growth at low pH (<5.5). Typically, soil pH values from 6 to 7.5 are optimal for plant growth; however, there are certain plants species that can tolerate or even prefer more acidic or basic conditions. Maintaining a narrow range in soil pH is beneficial to crop growth. SOM and clay minerals help to buffer soils to maintain a pH range optimal for plant growth [13]. In instances where the pH is outside a desirable range, the soil pH can be altered through amendments such as lime to raise the pH. Ammonium sulfate, iron sulfate, or elemental sulfur can be added to soil to lower pH.

The result shows the higher ph values are obtained from soil sample taken in Liban: Melka Guba and Koba Adi. Their values are 7.64 and 7.84. And the lower ph value in Seba Boru: Buri Ejersa and oddo shakiso: walabo as well as Seba Boru: Deba Loko those have the same ph values. Their values are 5.21 for Buri Ejersa and 5.38 for welabo and Deba Loko. According to Havlin J.L [13], the soil sample result from Seba Boru District: Deba loko and Buri Ejersa, oddo shakiso District: welabo and Megado, Adola redde: Gunaco and Bilu and Wadera: Handoa kino and Celo Segda are failed below 6 ph. on the another hand, the soil sample result from Liban: koba Adi and Melka Guba are failed above 7.5 ph values. But they are very close to 7.5 ph.

Generally all soil sample ph taken from five Districts in thirteen PA's soil ph values result shows, all thirteen soil sample result have no suffer effect on agricultural farming as Guji zone low and mid-land area agroecology.

3.2.2. Soil Electrical Conductivity

Soils with a pH value higher than 8.0–8.5 may have the following special features: Presence of excessive amounts of soluble salts; and Na on the exchange complex. Such soils are generally not considered suitable for growing most crops unless treated with suitable amendment materials. However, there are salt-tolerant crops that can grow on these soils. According to the University of Minnesota Extension [14], to determine the quality of the soils, the following estimations are required: pH; Salt content or EC; Exchangeable Na or gypsum requirement. Comparing with the result the electrical conductivity of the soil sample taken in liban District, melka guba PA's which attain 2.060 mmhos/cm values and failed under very slightly saline salinity level. And the entire rest twelve soil samples are failed under non saline salinity level. In Conclusion the result of all soil sample value shows no salinity problems.

3.2.3. Organic Matter

Organic matter influences physical, chemical, and biological activities in the soil. Organic matter in the soil is plant and animal residue which serves as a reserve for many essential nutrients, especially nitrogen. Determination of organic matter helps to estimate the nitrogen which will be released by bacterial activity for the next season depending on the climatic conditions, soil aeration, pH, type of organic material, and other factors. The majority of the population in the Arid and Semi-arid areas depend on agriculture and pastoralism for subsistence. These activities face many constraints due to predominance of erratic rainfall patterns, torrential rainfall which is majority lost to run-off, high rate of evapotranspiration further reducing yields, weeds growing more vigorously than cultivated crops and competing for scarce reserves of moisture, low organic matter levels and high variables responses to fertilizers [15].

3.2.4. Cation Exchange Capacity

Cation Exchange Capacity is a measure of the amount of cations which the soil can absorb or hold. Soil particles and organic matter are negatively charged, and the cations present as sodium, calcium, magnesium, hydrogen and ammonium are positively charged. This means that the positive charges are attracted and held by the soil particles. The common expression for CEC is in terms of meq/100 g of soil. The CEC on most soils range from 5 to 35 meq/100 g depending upon the soil type, amount or combinations of clay minerals. Soils with high CEC will generally have higher levels of clay and organic matter. Some crops respond to low levels (below 15 meq/100 g) during the season when nutrients are retained in the root zone [16].

When the soil sample under this survey is illustrated relating with the stated reference, the soil sample which is taken from Seba Boru:- Buri Ejersa (1.465 meq/100g) and Deba Loko (6.967 meq/100g) Pa's are failed under low level of CEC below of 15meq/100g. Also the soil sample taken from Liban which in Melka guba that know failed under Gumi Eldano District in new and west Guji Zone formation result of soil is also shows low level of CEC that is below 15 meq/ 100g. The soil sample taken from Adola redde: Cembe and wadera: sokora Jide (15.35 meq/100g) soil sample result shows approach to 15 meq / 100g but more than it. And all the rest eight PA's under this survey shows more than 15meq/ 100g CEC values.

Cation exchange capacity is the capacity of the soil to hold and exchange cations. It provides a buffering effect to changes in pH, available nutrients, calcium levels and soil structural changes. As such it is a major controlling agent of stability of soil structure, nutrient availability for plant growth, soil pH, and the soil's reaction to fertilizers and other ameliorants. A low CEC means the soil has a low resistance to changes in soil chemistry that are caused by land use [17], The Soils with CEC less than three are often low infertility and susceptible to soil acidification. When relating the result of soil samples, the soil sample result from Seba Boru District:- Buri Ejersa (1.465 meq/100g soil is failed under very low rating < 6 cmole(+)/kg CEC. While the soil sample result from Liban: Melka Guba (6.67 meq/100g soil) and from Seba Boru:- Deba Loko (6.967 meq/100g soil) are rested under low rating CEC (6-12 cmole(+)/ kg. the soil sample from Adola Rede: Cembe (15.35 meq/100g soil), Gunaco (24.04 meq/100g soil) are failed under moderate rating (12-25 cmole(+)/kg and from Bilu is failed under high rating (25-40 cmole(+)/kg). while the soil sample result from Wadera:- Celo Segda (22.22 meq/100g soil) and sokora Jide (15.35 meq/100g soil), that from Liban:- Koba adi (16.77 meq/100g soil) and those from Odo shakiso:- Megado (16.398meq/100gsoil), Dhiba Bate(17.416 meq/100gsoil) and Welabo (19.672meq/100gsoil) are failed under moderate rating (12-25cmole(+)/kg of CEC.

The cation exchange capacity (CEC) units are usually expressed as centimoles of positive charge per kg of soil [cmol(+)/kg)], which is numerically equivalent to the unit of milliequivalents per 100 g (me/100 g). CEC is usually estimated by displacing the exchangeable cations (Na, Ca, Mg, and K) with another strongly adsorbed cation, and then determining how much of the strongly adsorbed cation is retained by the soil. The strongly adsorbed cation is supplied by reagents such as ammonium chloride, ammonium acetate, silver thiourea, barium chloride and potassium chloride [18, 19].

3.2.5. Total Nitrogen

As soil sample result shows the rating of total nitrogen values of Adola Rede: from Cembe (0.045%), Liban: Kobadi (0.022%), Seba Boru: Deba loko (0.092%), and Oddo Shakiso from Dbiba Bate (0.096%) are failed under low rating of soil total nitrogen [20]. According to Tekalign Tadese [21]; the soil sample taken from Adola Rede: Cembe kebele (0.045%), Liban: Kobadi (0.022%) failed under very low of rating of soil total nitrogen values and the soil sample result from Seba Boru: Deba Loko (0.092%) and from oddo shakiso: Dhiba bate (0.096%) are failed under low rating of soil total nitrogen values and according to Berhanu Debebe [22] none of the soil samples are very low rating of soil total nitrogen values. The soil from liban: Melka Guba (0.134%), Seba Boru: Buri Ejersa (0.136%) and Oddo shakiso: Megado (0.145%) are failed under medium rating of soil total nitrogen values agreeing with Murphy H. [20].

While the soil sample from Liban: Melka Guba (0.134%), Seba Boru: Buri Ejersa (0.136%) and oddo shakiso: Megado (0.145%) are failed under moderately rating of soil total nitrogen values. And these soil samples are failed under medium rating of soil total nitrogen values Berhanu Debebe [22].

The soil sample taken from Wadera: - Handoa kino (0.157%), Adola Rede:- Gunaco (0.224%) and Bilu (0.202), and oddo Shakiso:- Walabo (0.193%) are failed under high rating of soil total nitrogen values according to Murphy H.F [20]. These soil samples are failed under moderately rating of soil total nitrogen values in line with Tekalign Tadese [21]. According to Berhanu Debele [22], these soil samples results failed under medium rating of soil total nitrogen values, and the soil sample taken from Wadera: - Celo Segda (0.269%)

and Sokora Jide (0.314%) are failed under very high and high rating of soil total nitrogen values [20-22].

3.2.6. Exchangeable Cations

The five most abundant cations in soils are calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), sodium (Na^+) and, in strongly acid soils, aluminium (Al^{3+}). The cations manganese (Mn^{2+}), iron (Fe^{2+}), copper (Cu^{2+}) and zinc (Zn^{2+}) are usually present in amounts that do not contribute significantly to the cation complement. Therefore, it is common practice to measure the concentrations of only the five most abundant cations. These may be summed to give an approximate value of CEC called the Effective CEC. The individual cations may then be expressed as a percentage of the Effective CEC [23].

According to Metson A.J. [17] the exchangeable cation (Na^+) from Adola Rede: - Cembe (0.239), Gunaco (0.348) that moderate exchangeable cation and Bilu (0.870) high exchangeable cation. The soil sample result from Wadera: - Celo Segda (0.348) and Handoa kino (0.522) are failed under moderate exchangeable (Na^+) cation and from sokora Jide (0.130) failed under low exchangeable cation. While the soil sample from Liban: - Melka Guba (0.217) is low in exchangeable cation and from koba adi (2.261) is very high (Na^+) exchangeable cation. The soil sample from Seba Boru: - Buri Ejersa (0.099) is rest under very low (Na^+) exchangeable cation and that from Deba Loko (0.166) is rest under low (Na^+) exchangeable cation. And the soils from Odo SHakiso: Megado (0.269) and from welabo (0.245) are rest under low (Na^+) exchangeable cation and the result from Dhiba Bate (0.313) is rest under moderate (Na+) exchangeable cation. The soil result obtained from Adola Rede: - Cembe (0.256) and Bilu (0.269) are rest under low (k^+) exchangeable cation, while that from Gunaco (0.396) is rest under moderate Soil (k^+) exchangeable cation. That from Wadera: - Cello Segda (0.652) and from sokora Jide (0.512) grouped under moderate (k^+) exchangeable cation and from Handoa kino (1.228) rest under high (k^+) exchangeable cation. The soil result from Liban: Melka Guba (1.036) rest under high (k^+) exchangeable cation and from koba adi (2.110) rest under very high (k^+) exchangeable cation. Those from Seba Boru: - Buri Ejersa (0.4991) and Deba Loko (0.663) are failed under moderate exchangeable cation (k^+). While those from Megado (0.536) categorized under moderate (k^+) exchangeable cation while those from Welabo (1.165) and Dhiba Bate (1.744) are categorized under high exchangeable (k^+) cation.

The soil sample result those taken from Adola Rede: - from Cembe (7.14meq/100gsoil), Gunaco (8.22 meq/100gsoil) and Bilu (7.86) is grouped under moderate exchangeable (Ca^+) Cation. While the soil from Wadera: - Celo Segda (6.43 meq/100gsoil) and sokora Jide (5.650 meq/100gsoil) rest under moderate exchangeable (ca^+) cation [17]. And that from Handoa Kino (12.50) is rest under high exchangeable cation of (Ca^+). The soil from Liban: - Melka Guda (3.21 meq/100g soil) is rest under low exchangeable Cation (ca^+). And that from Koba adi (19.29 meq/100gsoil) is failed under high exchangeable cation (Ca^+). While the result those from Seba Boru: - Buri Ejersa (2.778 meq/100gsoil) is failed under low exchangeable (ca^+) Cation and that from Deba Loko (5.650 meq/100gsoil) failed under moderate exchangeable (ca^+) cation. The Megado (22.237meq/100gsoil) and welabo (21.226 meq/100gsoil) are failed under very high exchangeable cation (ca^+) and that from Dhiba Bate (18.923 meq/100gsoil) is failed under high exchangeable cation (ca^+). The soil sample result from Adola Rede: - Cembe (1.07 meq/100gsoil) is failed under moderate exchangeable cation (Mg^+) and those from Gunaco (3.21 meq/100gsoil) and Bilu (3.57) are failed under High exchangeable cation of (Mg^+). While those from Wadera: - Celo segda (1.07 meq/100gsoil) and Handoa kino (1.43 meq/100g soil are failed under moderate exchangeable cation (Mg^+). And that from Sokora Jide (0.71meq/100gsoil) is failed under low exchangeable cation (Mg^+). That from Liban: - Melka Guba (0.71meq/100g soil) is failed under low exchangeable (Mg^+) cation and that from Koba adi (4.64meq/100gsoil) is failed under High exchangeable (Mg^+) cation. The soil sample from Seba Boru: - Buri Ejersa (12.374meq/100g soil) and Deba Loko (12.149 meq/100gsoil) are failed under very high exchangeable (Mg^+) cation. The soil sample result from Odo shakiso: Megado (25.613meq/100gsoil), Welabo (27.659meq/100gsoil) and Dhiba Bate (27.659 meq/100g soil) are failed under very high exchangeable (Mg^+) cation.

3.2.7. Available Phosphorus

Large quantities of soil P in mineral form are not readily available for absorption by the plant [24]. This phosphorus occurs in numerous combinations with iron, aluminium, calcium, fluorine and other elements. The solubility of these compounds in water varies from sparingly soluble to very insoluble. The phosphorus content in soil solution is low as compared to other nutrients such as nitrogen, potassium, calcium and magnesium [25]. Many soils fix large quantity of phosphorus by converting readily soluble phosphorus to forms less available to plants in the above combinations [26].

The soil sample result from Odo Shakiso: Dhiba Bate (0.320), Megado (1.333), Welabo (3.924), Seba Boru: Deba Loko (0.651), Adola Rede: Chembe (2.640), Gunacho (4.02), and Bilu (4.360) are low rating of available phosphorus and very low, And those from Celo Segda (5.280) and Buri Ejersa (5.939) are medium rating available phosphorus of moderate and low, Kobadi (10.9) and Hando'a Kino (12.5) are adequate, high and medium [27-29].

3.3. Good Social Practice of Study Area

The Morning and night crop watering of some farmers to save water from high evaporation and depercolation. Loading away water from river and storing in concrete reservoirs and watering by hands using materials and using motor pumps of some farmers. (E.g. Shakiso District, Megado farmers' irrigation farm practice is good example). The proper handling of the layflat and motor pump of a few farmers for long life services. Loading away water by motor pump and storing it at specific place through lining earthen pond by plastic material to control water infiltration into the soil and practicing it for the aim of reaching the water source to far irrigation command area. It is good practice for the problem solution for the shorter layfalt to reach irrigation field (Command area) those are far from irrigation water sources. But a few farmers do these mechanisms. Care of some farmers; do for their crops to be harvested, after and before and transport to the market in good way.

Figure 2. *Surface water flood harvesting by earthen pond and water way used for runoff control water diversion to pond in Handoa kino PA's Wadera District.*

Figure 3. *Earthen pond water harvesting for irrigation and stream developed from it in Oddo Shakiso Dhiba Bate PA's.*

3.4. Irrigation Problems in the Study Area

The major factors affecting the development of irrigation activities are climate change that result in erratic rain fall and diminish of amount of rain fall and irrigation water sources. Topography of the area is not appropriate for surface gravity irrigation methods. Water source, quality and crops to be cultivated are not depending on investigation of suitability of water and soil for irrigation purpose. Economic factor and socio cultural aspect that many farmers can't buy motor pump for irrigation purpose and using it by renting from motor owner, due to lack of capital to buy it and exposed for more expenses. Gold mining has negative effect on the irrigation farming as Guji Zone, because, washing the gold take much water, and due to many farmers do this work the rivers become decrease especially at winter season have great effluence on river until it become interrupt. Some farmers dig their cultivated land (their irrigated land) when they see the gold in their cultivated areas and their land is become out of productive, due to when doing that the fertile soil is covered by un fertile soil and it became water logged area. The (Eucalyptus) tree planting of social on productive area for irrigation farming and other agricultural purpose. In Adola Redde and Shakkiso District planting (eucalyptus) tree on productive area goes in alarming rate will create the decrease of land productivity as the Districts and zone, if awareness creation on the sustainable use of the land and its productivity is not given for the societies the more problem will phase the future generation. The problems of capital to afford modern irrigation technologies such as motor, small scale drip irrigation material, micro-sprinkler and water storage technologies such as reservoir from concrete and plastic and metal sheet tankers. As environmental aspect the major problems related to water resources management in the Zone include drought, flood of onset of rainfall season, land degradation and water logging (with small amount of farmers) Adola Redde and Shakkiso District are good example. Water flows in the canal refuse flow in the canal due to termites' attacks and water flow through underground to unknown place. Upstream water users not own the water to the downstream users at the time they want to irrigate their land (Absence of rule concerning water using and canal management). Awareness of societies to manage water, canal and motor pump was low. Low ground water availability for societies those far from river and majority of farmer didn't try to dig ground water hand dug well in mid land. Cleaning surface and concrete canal is very low. Encouraging awareness creation of societies is the solution for those problems. Lack of improved crop Varieties, weed, pest and insect control mechanism and lack of awareness of the farmers to use the technology, and some of them to think for their health problems. Irrigation water source were far from farmers land to use irrigation. This problem was common for majority of the farmers live in both agro-ecologies. But, the farmers' interest to participate in irrigation farming was high.

The farmers plough the mouth of rivers and cultivated land degradation, exposed of lay-flat and hose to sunshine and rain fall.

Figure 4. *Nyore river irrigation water source in odo shakiso district, Welabo PA's land ploughed at the mouth of river and sugarcane cultivated and farm land exposed for degradation.*

Figure 5. *Lay flat and hose exposed to sun and rainfall in Adola Rede, Gunacho PA's.*

Farmers make furrow along the slope of the land,

Figure 6. *Seba Boru, Buri Ejersa PA's (but know under Aga Wayu District), irrigation furrow made down the slope of the land.*

Figure 7. *Modern concrete irrigation canal made in Cembe, Adola Rede District, not cleaned and know stop giving service.*

4. Conclusion and Recommendation

The major finding of the research came up with many outputs. Those are the Interest of farmers to use irrigation farming is high. But the awareness of them to handle, operate and manage of irrigation and water saving irrigation technologies are low. Due to this the modern irrigation scheme done by government and different non-government are not on function. Majority of irrigation motor pump within farmers are not functioning. These is created due to farmers didn't aware properly how to operate their motor pump before start to use the technology. Some farmers make irrigation furrow down the slope of their land. So the water they use for irrigating their crop makes erosion rather than feeding their crops under irrigation for good yield attaining. For the farmers use river water source for irrigation, their crop cultivated was taken away by flood at the time rain starts before they harvest their production. This problem is more common for late matured crops. Majority of farmers use river water sources for irrigation. But harvesting surface flood run off, ground water and roof top rain water by using tank such as pvc plastic tanker and supper fiver, concrete ponds, earthen ponds, concrete tank are low and the systems of farmers' uses to harvest ground and surface water expose their water for seepage, siltation and evaporation loss. Poor market linkage and transportation enforce farmers to use motor to transport their production to the market and expose them for extra expense. Farmers stay their irrigation layfat (shara) in the sun for a long time and pull up it when they rolling after irrigating their land standing only one place. These increase the damage of lay flat in a short period of time. The spare parts of the motor pumps can't available at zonal and Districts level and experts have logistic problems for timely guidance of farmers' irrigation work and giving professional support for the users. The farmers at the boundary of the region with neighboring region have grievances on the government as they seen partially treated with comparing other region because the neighboring region farmers can get big motor through support of NGO and their regional government. Liban (know Gumi Eldano) District, Melka Guba PA's farmers which have boundary with Ethio Somale regional government is good example for raising this ideas. They also have the fair of war rising with neighboring region societies. The farmers of this zone need good motor pump for irrigation farming, but the way they can get it is not facilitated for them. Modern irrigation water harvesting system and water saver irrigation methods like Drip and micro-sprinkler irrigation practice are not known as the Zone. Scarcity of high value crop investigated under research for suitability as zonal agro ecology and soil type. The drought prone areas of the zone, Liban, Seba Boru and some parts of Wadera Districts, people travel long distance to get water for their live and other purposes, for them irrigation practice is difficult due to lack of water, even if they have more interest to practice irrigation farming. From this research the following recommendation was drawn, to have sustainable development of irrigation as the zone. These are: Modern water saving irrigation methods like Drip and micro-sprinkler has to be introduced to users. Awareness creations on modern irrigation technology operation such as motor pump have to give for the farmers. Roof top rain water harvesting should have to practice, especially for lowland area societies for irrigation farming and other purposes. Constructions of water harvesting structures through controlling evaporation are necessary to supplement irrigation and other use. Classify and identify target groups based on the scope of their assets and livelihoods and provide development assistance that enables them to protect and improve these assets and livelihoods through various combinations of interventions through conserving natural resources such as water, soil and natural vegetation to manage water for more production and more benefit from irrigation farming. The farmers have to make their irrigation furrow across the slope of their lands to control erosion and appropriate watering and feed of their irrigated crops to maximize their production from irrigation farming. And they have to roll the layflat (shara) moving by themselves rather than pulling the layflat standing only one place to minimize the damage of their layflat. Manage the water properly and avail water to overcome dry spells & provide supplementary irrigation through rain water harvesting, in-situ soil moisture maximization, ponds, shallow wells, treadle pumps, hand pumps, micro pumps, and whenever water resource availability permits, development of small scale irrigation diversions, storage dams and Involve intensive consultation with beneficiaries, preceded by base line study and accompanied by action research to achieve greater food security and sustainable irrigation farming as the Zone is necessary. Giving priority to the societies those live at the boundary within another districts and regional states are better due to they compete with neighboring societies. Proper use of natural resource such as water, mining, land and vegetation is very important for the productivity of their land for long term benefit and to maintain best benefit of the future generation.

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Appendix

Table 9. *Chemical Properties of five Districts from thirteens PA's in Guji Zone soil laboratory result.*

No	Name of Districts	Name of PA's	Soil sampling depth(cm)	Date of sampling	EC mmhos/cm at 25°C	pH H_2O	% T.N	Av.p ppm	CECmeq/ 100g soil	% OC
1	Adola Redde	Cembe	20	16/04/2015	0.299	6.410	0.045	2.640	15.35	3.26
2	>>	Gunaco	20	17/04/2015	0.157	5.490	0.224	4.020	24.04	3.56
3	>>	Bilu	20	18/04/2015	0.168	5.850	0.202	4.360	25.05	5.06
4	Wadera	cello segda	20	03/05/ 2015	0.455	5.840	0.269	5.280	22.22	3.86
5	>>	Handoa kino	20	03/05/2015	0.112	5.5	0.157	12.500	32.32	6.67
6	>>	Sokora Jide	20	04/05/2015	0.079	6.95	0.314	4.580	15.35	3.26
7	Liban	Melka Guba	20	09/11/2015	2.060	7.64	0.134	8.040	6.67	0.45
8	>>	Koba Adi	20	10/11/2015	0.313	7.84	0.022	10.900	16.77	1.65
9	Seba Boru (Aga wayu)	Buri Ejersa	20	14/04/2016	0.047	5.38	0.136	5.939	1.465	1.740
10	Seba Boru	Deba Loko	20	16/04/2016	0.143	5.21	0.092	0.651	6.967	2.663
11	Oddo Shakiso	Megado	20	18/04/2016	0.140	5.62	0.145	1.333	16.398	5.482
12	>>	Welabo	20	27/05/2016	0.148	5.38	0.193	3.924	19.672	6.943
13	>>	Dhiba Batte	20	28/05/2016	0.091	6.2	0.096	0.320	17.416	4.624

Table 9. *Continued.*

No	Name of Districts	Ca meq/ 100gsoil	Mg meq/100 g soil	exch.Na meq/ 100g soil	exch.K meq/ 100g soil	Texture			class
						% sand	% silt	% clay	
1	Adola Redde	7.14	1.07	0.239	0.256	36	34	30	Clay loam
2	>>	8.22	3.21	0.348	0.396	44	30	26	Loam
3	>>	7.86	3.57	0.870	0.269	44	36	20	Loam
4	Wadera	6.43	1.07	0.348	0.652	54	26	20	Sandy clay loam
5	>>	12.50	1.43	0.522	1.228	52	28	20	Loam
6	>>	5.00	0.71	0.130	0.512	64	18	18	Sandy loam
7	Liban	3.21	0.71	0.217	1.036	66	14	20	Sandy clay loam
8	>>	19.29	4.64	2.261	2.110	42	38	20	Loam
9	Seba Boru (Aga wayu)	2.778	12.374	0.099	0.491	96	2	2	Sand
10	Seba Boru	5.650	12.149	0.166	0.663	84	6	10	Sand
11	Oddo Shakiso	22.237	25.613	0.269	0.536	68	18	14	Sandy loam
12	>>	21.226	27.659	0.245	1.165	72	20	8	Loamsand
13	>>	18.923	18.039	0.313	1.744	66	18	16	Sandy loam

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