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Factors Affecting Adoption of Small Scale Irrigation Technology: Insights from Sire Woreda, Oromiya Region, Ethiopia

Dawud Teha[1], Li Jianjun[2]

[1]Agricultural Mechanization Directorate, Ministry of Agriculture, Addis Ababa, Ethiopia
[2]College of Humanity and Development Studies, China Agricultural University, Beijing, China

Email address:
dawud.taha1@gmail.com (D. Teha), dawud.taha1@cau.edu.cn (D. Teha), Lijinajun@cau.edu.cn (Li Jianjun)

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Abstract: Adoption of small scale irrigation technology had unprecedented advantage for smallholder farmer to reduce poverty. It increases use of available water sources to get higher income and improves the livelihood of farmers. Improvement of livelihood of smallholder farmers has ample contribution to the development of the country's economy. With high potential demand to these technologies, still there are number of problems in selection for agricultural production improvements. Therefore, our study with the objective of exploring factors affecting adoption of small scale irrigation technology (SSIT) and existing constraints in the study area had used qualitative and quantitative data analysis. Binary logistic regression model was applied to analyze direct survey of farmers SSIT adoption. Analysis result revealed that six factors were significantly and directionally affects the adoption of small-scale irrigation technology. Age and lack of credit institution are negatively significant whereas awareness, access to water, government promotion, and total income of household affects positively. Qualitative findings show that conflict between members of Farmers Irrigation Water Use Association (FIWUA), unavailability and lack of access to spare parts, topography of the district, irrigation technology technician, and lack of skill were among the constraining factors found to hinder small scale irrigation technology adoption and use. We found the fact that FIWUA act as facilitating medium in adoption and extension of small scale irrigation technology and the presence of association could be taken as opportunities available for small scale irrigation technology adoption enhancement. Overall, our findings revealed that small scale irrigation technologies are highly beneficial, and seen to have impact on the livelihood of farmers, so that the government and partner of the government working on rural livelihood improvement should have to take into account on improving farmers' awareness and education on SSIT adoption through training and promotion in most parts of Ethiopia.

Keywords: Small Scale Irrigation Technology (SSIT), Farmer's Livelihood, Technology Adoption, Extension Service, Logistic Regression

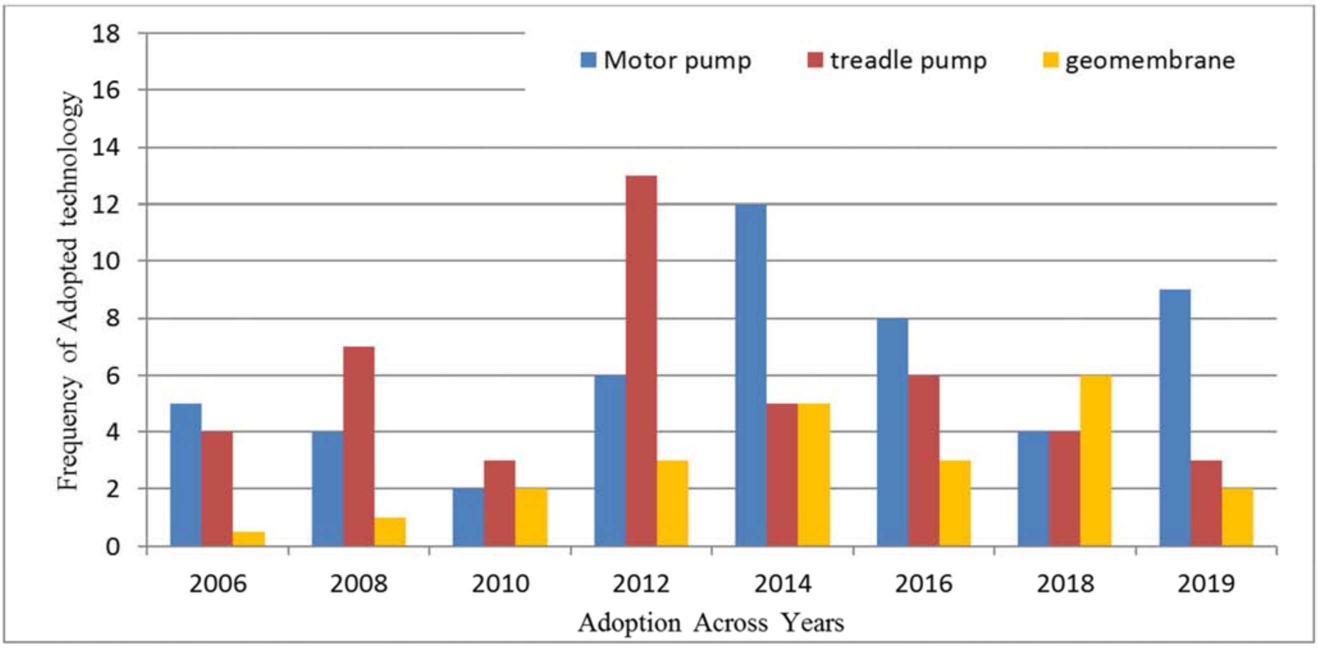
1. Introduction

Agricultural production in Ethiopia mostly depends on inadequate and intermittent rainfall. It is characterized by traditional farming with scarce use of improved irrigation technology. The agricultural sector, on which 75% of the population relies and covered 80% of export is dominated by smallholder households, and shares 40% GDP [49]. According to Bayissa [6] as in many parts of the world, agriculture in Ethiopia is the mainstay of livelihood for the majority of population. It was featured by low agricultural crop and labor productivity with frequent failure in production. Because of its primary source of income for a rural household, the agricultural sector continues to remain the top contributor to the country`s economy and social sector. However, frequently occurring droughts left the rural community vulnerable to extreme poverty [17] leading millions of the rural community to rely on food support [11].

The traditional way of farming that led to low productivity in spite of available natural resources was because of limited technological input for crop production. The food demand of the country`s increase despite crop production correlation with the rainfall pattern is an emerging issue [16]. This resulted in a challenge to meet growing demand with the existing natural resources and changing climatic conditions. Above all, it was worsened by poor technological use, rural feminization, and frequent drought. The major challenge facing smallholder farmers was the efficiency in which scarce water is used. Irrigation water in many parts of Ethiopia is a scarce resource in utilization for the agricultural sector. It was demanded that Ethiopia could not assure self-sufficient food for its population only with rain-fed agriculture without a considerable contribution of irrigation [48]. Irrigation is a means by which farm productivity improved to meet the increasing need for food in Ethiopia [5, 1]. Incorporating irrigation technology in agricultural production stabilizes the surplus created in agriculture due to low yields. From huge agricultural land potential for irrigation, only 5% of agricultural land has been irrigated [7, 49] so very few percent accounts with the support of technologies. Improving agriculture activity ensures food security; in turn, it would improve the livelihood and alleviates the poverty of the rural community. As the mainstay of the rural community of the study area, the agriculture sector plays a vital role in their livelihood.

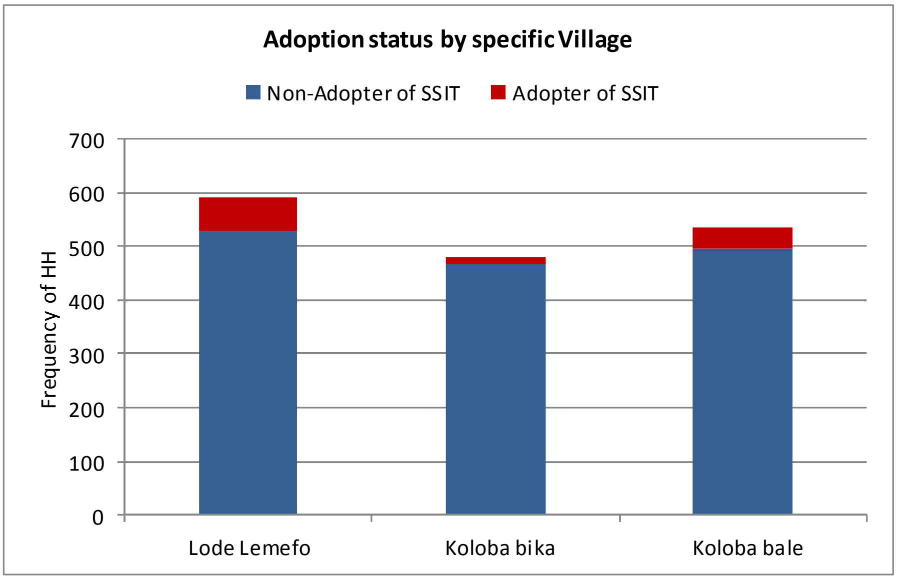
Fulfilling an increasing need for food could be achieved through the introduction of improved modern agricultural technology and its proper practices. This may need better economic incentives, assuring institutional strategy and policy, technological installment, and motive organizational environment of the farming practices. In order to come up with improved and increased production capacity of the smallholder farmer in line with policy, establishing ways for easy use of small scale irrigation technology is important. It indicates that establishing the way a farmer can easily engage in the improved productive way of farming and agricultural activity is recommended for planned growth. The main aim of technological innovation is to improve agricultural productivity, farm output, and income of farming households. Supporting agricultural farming activity with small-scale irrigation technology boosts the income of a rural community. The developing countries' success in irrigation is profoundly affected by the policy and institutional than technical factor issues [20]. Ethiopian irrigation development has little consideration to beneficiary participation, issues of management, and lacks the availability of support with institutional services. Emergence and diffusion of affordable small scale irrigation technology and others that enable farmers to irrigate their small plots has started to improve productivity and family incomes in sub-Saharan Africa and some poverty prone areas in the world in recent years [5]. According to the study carried by [19] irrigation technology installment in agriculture yield production were achieved considerably. Irrigation technologies used for the supply of water to the farmland allow a farmer to bear against drought and problems that existed because of the shortage of rainwater. The design of technologies aimed for smallholder farmers is intended to reduce workloads encountered by the farmer in agricultural activity. Hence, mostly modern method of cultivation profoundly affects farmers' agricultural activity through improving yield and income. The application of appropriate technology for agricultural improvement should have to be developed considerably. Having deficiency problems in suitability, adaptability, capacity, and affordability of available technologies are not mostly compatible with small-scale irrigation requirements. More efficient and smallholder farmer-friendly irrigation technologies allow the improved way of irrigation water use. Farmers can expand their irrigated area of farming and change their intercropping practices towards more water-demanding crops [24]. The decreasing intensity of rainwater and surface water availability direct us to choose improved irrigation technology for an increment in the farm. Combining irrigation technology in agricultural activity both on small-scale and large scale is a decisive step to agricultural change. This has a substantial effect on attainable levels of land profitability and yield [47]. Supporting agricultural production by technology in an irrigation system decreases input cost and improves agricultural farm productivity and income from produces. An irrigation water pump for a smallholder farmer to irrigate agricultural land is essential for additional food production where rainwater was insufficient. This is useful where the topography of the farmland by gravitational or surface irrigation is difficult. Stating about irrigation technology [13, 18] points that downstream users irrigate using furrow irrigation by gravity flow of water and while upstream users motorized system to irrigate their lands. The constraint of water supply to farmland can be minimized by the use of irrigation technologies not only to produce more but also to help keep the farmland productivity for longer. In agriculture, irrigation technologies were the critical option to withstand under productivity resulted because of the shortage in rainfall that faced in the past decades [34]. By allowing more efficient use of farm inputs and practicing different farming systems, and enhancing yields and quality improvements of the smallholder farmer, irrigation technologies help farmers` improve their livelihoods for the better [25]. As of Ethiopian Ministry of Water Resource [35] irrigation sector management and development in the country are classified depending on the size into three that an owner, either investors or farmers, own and manage. These were small-scale irrigation systems (<200 ha), Medium-scale irrigation systems (200-3,000 ha), and Large-scale irrigation systems with a size of more than 3,000 hectares. According to this classification, small-scale irrigations are controlled and owned by the community and are common in the country [21]. Traditional small-scale schemes of up to 100 ha in area, built and operated by farmers in local is below 50ha for small households [21, 35]. As of Usman [50] Small-scale irrigation technologies are those used on a small plot of land under the control of farmers, the technology they can effectively operate and maintain. As explained by [18] irrigation technology adoption-decision mostly condenses on small geographic areas and it has no effect on irrigation technology choice. Small-scale irrigation technology adoption studies conducted in the 1990th was the period when economy of the country declined, and most of the rural farmers suffer the recovery of the 1980s drought. The treadle pump is a simple technology first developed in Bangladesh of South East Asian country to overcome the famine and drought faced in the early 1970s [39] and 1990th in Ethiopia with behind driving force of government and non-governmental organization. In recent years there was an evolving private and smallholder farmer's association interest toward small-scale irrigation technologies. However, low availability and high variability of rainfall additionally with a limited irrigation technology selection characterize the performance of the agricultural activity [43, 1]. The late focus of the government towards irrigation technology made slow rate of irrigation technology adoption in Ethiopia. As a result, in a country with a substantial resource of surface and groundwater resource potential, farmers are constrained to produce adequate food for themselves [19]. The survival of farmers under the pressure of food shortage is the combined effect of frequent failures and underproduction of the agricultural sector. Ethiopia has the potential of underground and surface water that needs to be utilized for irrigation with the support of mechanization technologies [30]. The requirement for farm production during the off-production season demanded this study with the objective to examine the socio-economic profiles of the smallholder farmer and institutional factors regarding the adoption of SSIT. In fact, agricultural activity is full of drudgery and constraints that smallholder farmers especially suffer. Investigating and analyzing key difficulties and minimizing constraining factors for improvement and livelihood enhancement in development are crucial strategies. Therefore, we commenced to study and identify key problems of farmer's low adoption and institutional factors constraining use, adoption, and diffusion of SSIT. Specifically, the study aims to i) describe the socio-economic characteristics of the small-holder farmers, ii) assess the significance of small scale irrigation technology on smallholder farmers' livelihood, iii) identify opportunity and constraints of small-scale irrigation technology user faced in the study area, iv) analyze factors affecting the adoption and extension to deal with small-scale irrigation technology adoption.

In the study area from 2005-2006, there were a severe drought exposing thousands of households to a shortage of food self-sufficient. Subsequently, many people suffer from these droughts and most of them have been affected. So that farmers started to use irrigation technology to make agriculture produces for the use of living. Normally adoption of SSIT starts by the farmer itself with drought-driven power. According to the key informant from the Regional state, farmers were initiated to use irrigation technology because of the drought problem they face (figure 1). But there were few cases that the government has installed technology for farmers as a kind gift for the startup. It was noted that the adoption process was so slow despite its significant impact on the livelihood of farmers (Figure 2).



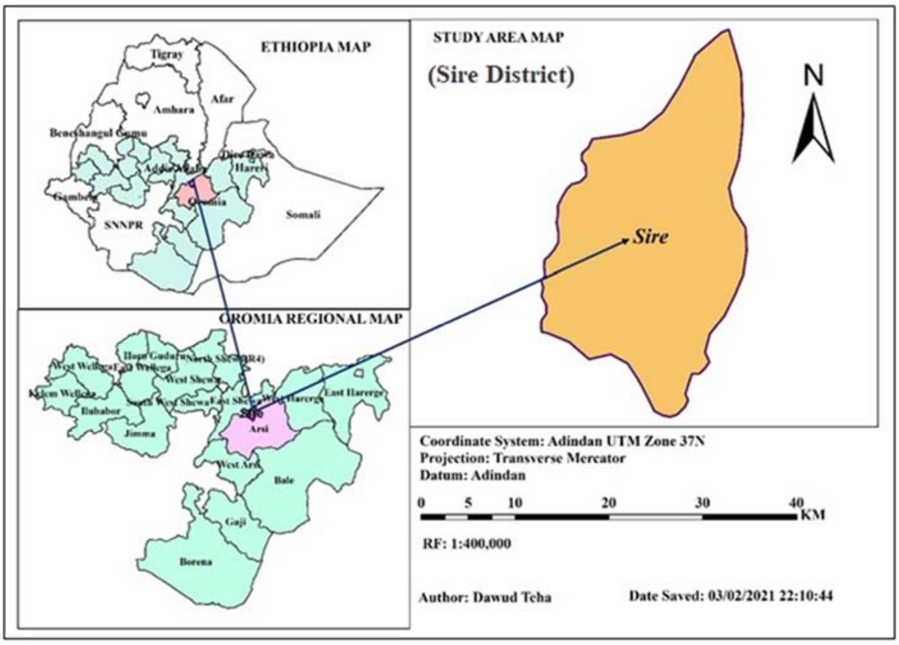
Source: Sire Woreda Irrigation Development Authority

Figure 1. *Small-scale irrigation Adoption Timeline in Sire Woreda.*



Source: - Sire Woreda Irrigation Authority Office

Figure 2. *Rate of Adoption of SSIT by the specific village in the Study Area.*



Source: Field Work

Figure 3. *Study Area Map.*

2. Research Methodology

2.1. Study Area

The State of Oromia region occupies the largest part of the Ethiopia and at present consists of 17 administrative zones and 180 woredas including Sire woreda found in Arsi Zone (figure 3). The location of Sire Woreda[1] Latitude: 8° 19' 0.01" N Longitude: 39° 28' 59.99" lies approximately 144 km from Addis Abeba, capital. The study was conducted from July to September in the year 2019, in three selected kebeles[2] (villages) of the woreda. The Sire woreda has 17 kebeles. The woreda characterizing three different agroecological zones namely, highlands (dega) middleland (woina dega) lowlands (kolla), have a population of 98,786 according to the 2016 census. From 98786 populations 51045 were men and 47741 women and 11.32% of its population was urban dwellers. Sire woreda was selected for study, because it is known to conventional small scale irrigation

1 Woreda is the second lower administrative unit, which is equal to District

2 Kebele is the lowest administrative unit, equal to Village

technology user and still it was noticed that there was a problem of adoption. Its usage was not extended as usual as it has to be. There exists more significant number of non-user compared with users and the researcher anticipated to undertake factors affecting them in adopting Irrigation technology.

2.2. Application of Combined Effect of Two Theories for Better Adoption of SSIT

The decision to innovation is information processing after seeking for activity in which the smallholder household head is strived to reduce uncertainty about the merit and demerit of the innovation process [42]. In general, this theory is about describing how innovation spreads among a social system. Lire et al. [31] stated that because of profitability, resource, and information limits of technology, progressive adoption is central to smallholder farmers` decisions. Diffusion of innovation theory believes that the adoption of new technology is not simultaneous. The spread of SSIT was very slow because of the limited numbers of smallholder farmers` apt to adopt it. These limitations can be reduced through research, laying extension system, and farmers' skill gap enhancement. It can be by targeting the issue with the aim of understanding farmers’ characteristics that will help in the adoption of innovation.

Diffusion of Innovation theory considers technology as one of the most critical attributes for boosting production and improving people’s livelihood status [42]. However, its significance to the community depends on the capacity of producers to adopt and use it for the common good. Technology by itself does not make a change unless producers use it. This is the decision of producers mind work after he/she has awareness about specific technology to decide to use finally. Innovation decision mostly related to an individual [38] because it is a creative approach, it can be used to facilitate innovation of technology adoption between groups such as IWUA.

In Agricultural Knowledge and Innovation System (AKIS) concept farmers` are at the center, all others are outside of farmer`s thinking. Science actors can make an impact and improves farmer`s productivity in combination with practice actors [3]. Through extension, the technology is transferred to the farmer while new technology through research. Upgrading the educational status, training, and demonstration help farmers more productive and continual adoption. Research centers are responsible for producing technologies and facts. It is the mandate of the extension systems to simplify and deliver the knowledge to farmers [36]. This means that shared responsiveness, orientation and upgrading skill of rural people increases the chance of SSIT adoption and extension. Collaboration between agricultural educators, researchers, and extension facilitates communications between decision-makers, both in government’s institution and development organizations. This helps to further support smallholder farmers for more adoption. In contrast, there were limited experts of skilled on technology to reach the farmer [30] that led to slow adoption. Therefore, with the study context, to diffuse technology the farmers there should be awareness creation by extension system and experience sharing. It would be through capacity building and supply of researched new technology to farmers for continual adoption. After this intervention, smallholder farmers in rural areas should be informed about the technology then food self-sufficiency in the households is enhanced with the proper decision on adoption and utilization (Figure 4).

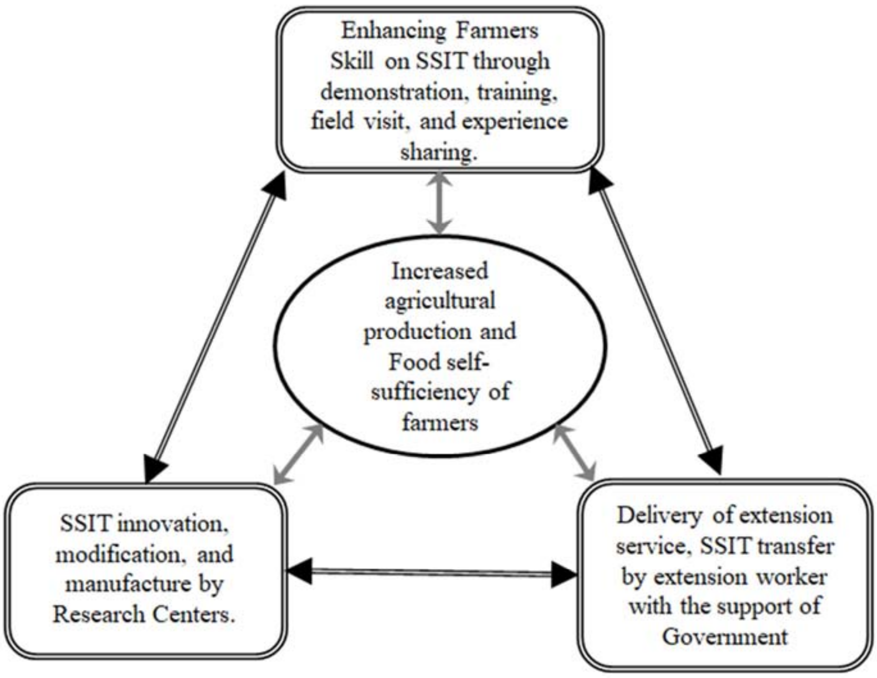


Figure 4. *Modified AKIS framework.*

2.3. Sampling Size, Data Collection and Technique

In order to minimize the deficiencies of individual methodological approach [32] we have introduced quantitative and qualitative approaches. Qualitative method was used to emphasize and capture policy and institutional aspects and quantitative approach for farmers' asset, financial aspects, social and daily activities [41]. We selected farmers in Arsi Province of Sire woreda in south eastern part of Oromiya Regional state of Ethiopia. We select Sire district from Arsi province purposively because of conventional use of SSIT than other available districts and adopter farmers had changed their life standards than their counterparts. Mainly, the research tools were prepared on the basis of the key issues under the objectives of the study. Purposive sampling was carried out to select key informants and focus group discussions. Prepared pre-designed checklist was used to guide the key informants' interviews. Informal discussion is done with one Sire Woreda Rural Peoples Livelihood Improvements (SRPLI) NGO expert working on safety net program of poor people in Sire woreda.

Multi-stage sampling was used to select smallholder farmers as respondents for this study. First, five SSIT conventional users of villages were purposively selected from ten user villages. Second, three villages were randomly selected from the five villages. Then, the actual selection of adopter and non-adopter by stratified sampling technique has been carried out to minimize the errors that occurred in sampling population of adopters. Moreover, the households sample for both adopters and non-adopters are proportional to population sample sizes. We have used two stages purposive and stratified sampling to draw 137 farmers using eqn. (1). Total numbers of farmers were divided into different clusters based on the geographical location of the areas with potential river, pond and well. Three villages, namely; Koloba-balie (30.65%), Koloba-bika (10.22%), and Lode-lemefo (59.13%), were selected randomly from each group.

$$n = \frac{N}{1+N(e)^2} \qquad (1)$$

Where, n=sample size, N=size of households e=error percentage

Data collections were done through face-to-face interviews of SSIT adopter and non-adopter farmers using semi structured questionnaire. To enrich data collected by questionnaire interviews, 15 focus groups (8-10 per group) comprised of adopter and non-adopter was conducted in the places most suitable for farmers. In total 20 key informants from different working offices (federal, regional, province, and district level) those have basic knowledge of irrigation technology were interviewed. Key informants were selected purposively, and prepared pre-designed checklists with content similar to the questionnaire were used to guide the interviews.

Personal interviewing was done in local languages before it was recorded in English. Semi-structured questionnaires with both open and close-ended questions were used to gather raw data from small scale irrigation technology user. Through personal interviewing, the researcher captured detailed information from the respondents and understood the current issues on the ground about the topic of the research. Eight (8) different semi-structured interviews for different level experts and officials containing each (9-17 questions) were carried out for key informants. Thirteen (13) interview guidelines which are probing in nature were used for FGDs. An in-depth interview with selected key informants has enabled the researchers to capture respondents' view in their own words. Additionally, we had collected data through observing different activities carried out by the respondents as an indicator of SSIT situation. The participants' observation allows the researchers to establish a direct affiliation with social actors to better discover the key point of the research. In all activities of data collection the principles and ethics were strictly adhered. The respondents were informed for confidentiality of their responses and if need be their concealment as identification was optional on the questionnaire. Secondary data sources were gathered from relevant relative institutions.

We introduced theory triangulation to analyze and interpret the study output. Innovation diffusion theory and Agricultural Knowledge and Innovation System were used to in analysis for the study analysis. Data triangulation was presented for qualitative data analysis. Qualitative data after triangulation were analyzed using thematic and content analysis. A Binary logistic regression model was used to identify significant factors affecting the adoption of small scale irrigation technologies. We employed Logistic regression to determine dichotomous outcome variable that takes the value of 1 if smallholder household head farmer was adopter and 0 if smallholder household head farmer is non-adopter of small scale irrigation technology.

$$\log\left(\frac{p}{1-p}\right) = Logit\ (p) = \beta 0 + \beta 1X1 + \beta 2X2 + \cdots \beta 12X12 \qquad (2)$$

Where the probability of adopting SSIT (p), intercept (β_0), independent variable coefficients ($\beta_1 \ldots \beta_{12}$), independent variables ($X_1 \ldots\ldots X_{12}$), and probability of adopting SSIT (P); probability that a farmer does not adopt SSIT (*1—P*)

$$\text{odd Y} = \frac{p}{1-p} = \frac{probability\ of\ Adopting\ SSIT}{probability\ not\ adopting\ SSIT} \qquad (3)$$

$$logit\ (p) = ln\frac{p}{1-p} \qquad (4)$$

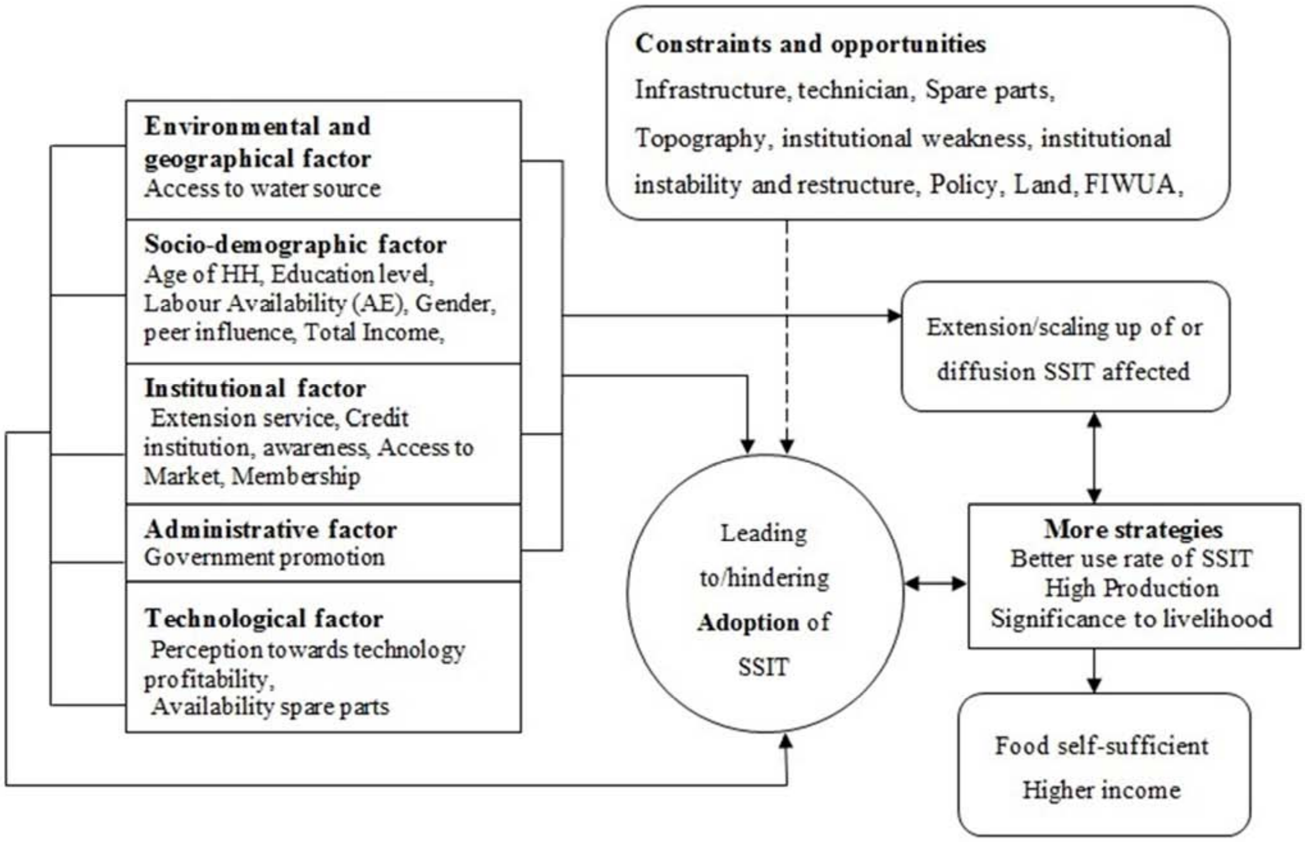
$$ln\left(\frac{p(Yi=1)}{(1-p(Yi=1))}\right) = \log odds = \log(Y), \qquad (5)$$

Where: *ln*=natural logarithm.

Parameters that tend to maximize the likelihood of observed sample values rather than those maximize the sum of squared errors were chosen by logistic regression. Log of likelihood was used to assess the overall significance of the binary logit regression model. Furthermore Hosmer–Lemeshow [22] test was used in the analysis to see statistical goodness fit of logistic regression model showing higher than 0.05.

2.4. Research Framework

The conceptual framework is developed depending on the diffusion of innovation theory and agricultural knowledge and innovation system (AKIS) concept. It is regarded as the purposeful linkage of research centers, government extension services, as well as farmers on innovations of technology for agricultural production improvement [15]. According to [29] the concept is extensively useful for policymaking in rural development strategy. In this process, the stage by which a person adopts an innovation through diffusion is realized. We believe through the rural development policy of the agricultural sector, farmers are supported in their efforts of competitiveness in economic change. Thus, the framework clearly shows the association between knowledge of small irrigation technology and research-farmer–extension concept of technology (Figure 5). The framework provides a compound relationship among the farmers, extension workers, economic institutions, and technological opportunities. This assumes that proper knowledge and awareness about technology creates favorable condition for adoption of SSIT and hence enables small holder farmers to choose the appropriate technology in production. Agriculture production practice is characterized with constraining and enhancing conditions. Influencing circumstances can be impacted with the use of SSIT to catalyze the utilization of enhancing conditions on the income of smallholder farmers and its significance on livelihood. Some factors that may constrain SSIT adoption and use of SSIT also affect its extension as well. This finally affects the strategy of food self-sufficiency that this sector can contribute.



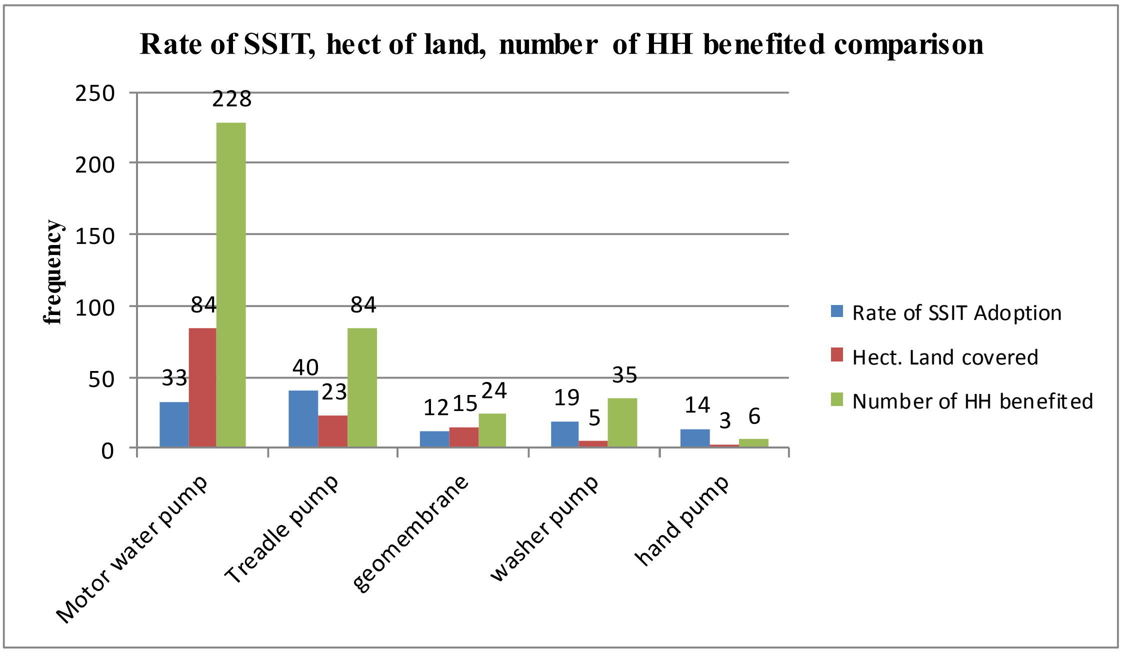
Source: Personal Conceptualization

Figure 5. *Research Conceptual Framework.*

3. Result

3.1. Rate of Adoption, Household and Hectare of Land Covered

Smallholder farmers use small-scale irrigation technologies either individually or participating in irrigation water use associations. The number of smallholder farmers who use small-scale irrigation technology for their livelihood improvement was considerably smaller than non-user. As it was indicated in figure (6) the hectare of land covered and the number of households benefited was higher for motor water pump than others. It is because the motorized water pump is efficient to supply water to the farmland than treadle and hand pumps. Geomembranes coverage was found limited because of its high initial capital to own, the difficulty of preparing a pond. There were no other methods of irrigation system practices in the study area other than SSIT indicating significance of its adoption.



Source: Sire Woreda irrigation development Authority

Figure 6. *Rate of Adoption and Household and hectare of land covered in Sire woreda.*

3.2. Farmers Irrigation Water Use Association

Irrigation water use associations are group members of smallholder farmers those practice irrigation farming either on irrigation scheme or technology-supported irrigation system. We have found that association on irrigation water use promotes the adoption of irrigation technologies. According to IWUA proclamation 841 of 2014, the allowable minimum member of the association forming was five whereas, in the study area it is seven. According to the working document of "Farmers Irrigation Water Use Association," the number of member starts from seven and have no maximum limit on gender, age and education. After they form an association, they buy motor water pumps. If it is not sufficient to use at a time for all members of association, they use the available pumps turn by turn (table 1). Those farmers who have a chance of visiting these associations surely got some insights. They bought agricultural product of the associations and got information through discussion with members. Number of farmers got experience from FIWUA. These associations have a high influence on adoption of irrigation technology. They give their small-scale irrigation technology to the other farmers as a rental, hire and use permission. As it is indicated in the table 1 a number of farmers were adopted, rented, and motivated after visit of Farmers irrigation water use association (FIWUA). According to [51] irrigation water use association improved adaptation of irrigation water saving technology.

Table 1. *Role of FIWUA in the adoption of small-scale irrigation technology.*

FIWUA	No. of Farmers those adopted after visiting Association in past 2 yrs.	No. of farmers rented SSIT from association in past 2 yrs.	motivated
Jitu Hawaas	3	5	
Amola Tabo	2	2	
Burka wererso	-	3	All who have visited association
Burka Bakkie	1	2	
Horoffe Kalata	1	-	
Arda Oda	2	4	

Source: Field Survey. Note: This survey is independent of respondents; it is gained from the association directly.

3.3. Demographic and Socio-economic Characteristics of Respondents

As the findings of socioeconomic characteristics summarized (Table 2) indicated that, in Sire Woreda there are more male-headed households than female-headed households. Results showed that 90% of adopters were males and 10% are females. On the same way, 84% Non-adapters were males, and 16% are females. This finding revealed that women headed households failed to adopt small scale irrigation technologies because of technological characteristics and its labor intensiveness. According to [4] female farmer lacks access to adequate productive resources such as land, extension services and agricultural inputs despite their immense contributions to agriculture. This finding is consistent with [28] revealed existence of difference between male and female in adoption of irrigation technology.

Most smallholder farmers' are aged between 30-45 while minorities are aged above 55 and less than 30. This proves that most of the smallholder farmers in the study area are within the productive age and thus capable of adopting small-scale irrigation technologies for the production of horticultural and cereal crops for more improvement of their livelihoods.

The findings revealed that, with the comparison, most of the smallholder farmer in the study area has attained primary education but still followed by uneducated smallholder farmers of 26% and 30% of adopters and non-adopters respectively. This indicates that education is not the foremost obligatory criteria for adopting SSIT in case of other facilitating factors are fulfilled. This result contradicted with the findings that education was the underlying factors for adopting technologies [20]. As of results from key informants, according to study area attributing factors for adoption of SSIT is access to the water source, and farmers who had access to irrigation water source has higher chances to adopt SSIT (Table 2).

Table 2. *Socio-economic and demographic characteristics of respondents.*

Characteristics		Adopter of SSIT (n=30)		Non-adopter of SSIT (n=107)	
		Freq.	(%)	Freq.	(%)
Age	15-29	2	6.67	14	13.08
	30-45	21	70.0	47	43.93
	46-60	7	23.33	35	32.71
	>60	-	-	11	10.28
Gender	Male	27	90.0	90	84.11
	Female	3	10.0	17	15.89
Religion	Muslim	15	50.0	46	42.99
	Christian	12	40.0	56	52.34
	Others	3	10.0	7	6.54
Education	Uneducated (0)	8	26.0	33	30.84
	Elementary (1-5)	14	46.67	52	48.6
	Junior primary (6-8)	7	23.33	20	19.08
	Secondary (9-12)	1	3.33	3	2.80
	Tertiary	-	-	1	0.93
Family Size	1-5	11	36.66	45	42.08
	6-10	18	60.0	48	44.86
	>10	1	3.33	14	13.08
Access to Market (Adama)	Lode Lemefo	68	n.a	67	n.a
(Average distance of market	Koloba Bika	71	n.a	73	n.a
from villages in KM)	Koloba Bale	74	n.a	69	n.a
Extension Service	Accessed	22	73	36	34
	Not accessed	6	27	71	66
Accessed to irrig. water source	River	21	70.0	12	11.21
	Pond water	5	16.66	-	-
	Well and others	4	13.33	1	0.93
Off-farm Income	Off-farm activity	2	6.67	9	8.41
Income	0-3,000ETB	-	-	28	26.17
	3,001-12,000	-	-	42	39.25
	12,001-24,000	4	13.33	23	21.49
	25,001-40,000	16	53.34	6	5.60
	40001-60,000	7	23.33	-	-
	>60,000	3	10.0	1	0.93
Farmingsystem of HH (Household)					
Rain fed	Crops	-	-	103	98.9
	Vegetables and fruits	-	-	4	1.01
	Others	-	-	-	-
Irrigation system	Crops	1	3.33	-	-
	Vegetables and fruits	9	30.0	-	-
	Others	13	43.3	-	-
Mixed Farming	Crops	21	70.0	-	-
	Vegetables and fruits	21	70.0	-	-
	Others	1	3.33	-	-

Source: Field Survey

The findings from respondents indicated that 36.66% of adopter and 42.08% of non-adopter smallholder farmers have less than six household members and 60% adopter and 44% non-adopter smallholder household farmers possess six to ten family members.

Access to the market is one of the crucial factors to access technological input for agricultural production and productivity. According to the finding from Sire Woreda revealed that the average distance from far and big market is nearly equal indicating all of the adopter and non-adopter were affected equally. The big market found cloth to Sire woreda is Adama city which around 70KM from the stud area. As a result this variable is dropped for further analysis for its equal influence on the smallholder farmers.

On its essential primary factor to use SSIT, it is unimaginable for farmers to adopt water dependent agricultural technology. Farmer were accessed to three different water sources i.e., river, pond, and natural wells. Results show that, 70% of adopter respondents had access of river water and 16.66% had access of natural well and ponds. Some of the adopter smallholder farmers those have no access to either river or well water, they had prepared ponds for cultivating cash crops and vegetables in addition to regular farming. They used SSIT for suctioning of water from the water source to farm land for watering plants. Minorities of non-adopter smallholder farmers only accessed to river water sources whereas the majority of them has no access to water sources for irrigation water. Results from key informants argued that the problem of water access in Sire woreda is common and a major constraining factor for development.

Additionally, the result indicates that smallholder farmers had practiced three different kinds of farming systems, i.e. rain fed, irrigation, and mixed farming practices depending on whether they had adopted SSIT or not. As specified herein, classification of the farming systems has been based on critical factors such as availability natural resource base and the dominant pattern of farm activities. These classification criteria were applied to most regions of the Country [40]. Most of the adopter farmers were practicing a mixed farming system while minorities had practiced only irrigation. In other ways, findings show that adopter farmers who adopted SSIT cultivate crops, vegetables, and fruits and have a much higher income than non-adopters smallholder farmers.

Other Activities and Occupations of Smallholder Farmers

Agriculture farming is the dominant daily activity and source of income for farmers in the study area. The farmers were practicing other activities off farm activities. The study found that a limited number of farmers, besides relying on farming as a means of income generation for the households, had engaged in other minor non-farm occupations and activities to supplement their primary source of income. As the study shows that, 8.03% of smallholder household farmers` were reported to have off-farm activities like trading, shopkeeping, and merchant in addition to agricultural farming. The remaining 5.7% of farmers` were supported by the government for their living. In terms of the annual income for the farmers, the study found that for non-adopter farmers their average income was 11711.92 which is about three and half times lower than that of adopter counterparts and briefly summarized in table 2. This finding was consistent with that of [10] indicating adoption of agricultural technology by farmer increases income by approximately 15% higher than non-adopters.

3.4. Significance of Small-scale Irrigation Technology Adoption to the Livelihoods of Smallholder Farmer

The potential of irrigated smallholder technology-supported agriculture to enhance food security and improve livelihoods has a significant impact on the agricultural sector development. According to the investigation on the impact of small-scale irrigation on households' livelihood, findings confirm that there were significant differences in income, overall expenditure, asset accumulation, and expenditures on agricultural inputs between the adopter and non-adopter smallholder farmers. The net income from the integrated farming systems varied widely between ETB 11712 (non-adopter) and 38,161 (adopter) on average (table 3). The gap was significant indicating three times more than the average income they can get before the adoption. Crop and vegetable farming in the uplands and intensive cultivation around the embankments of the ponds were found to be effective in increasing the net return from the technology supported agricultural irrigation activity. Access to irrigation water is a separating line between poverty and prosperity for smallholder farmers [46]. Increasing accessibility of smallholder poor farmer to agricultural water source in semi-arid and drought-prone areas is key strategy that could contribute to the alleviation of poverty and improvement in food security. If substantial unrealized gain exists to smallholder farmer it can be considered as under-adoption of SSIT. Smallholder farmers usually use their own method finance to obtain irrigation technology and irrigate their farmland to produce horticultural and cash crops.

Table 3. *Income before and after the adoption of SSIT.*

Before Adoption			After Adoption		
Farming Category	**Cost**	**Amount in TB**	**Farming Category**	**Cost**	**Amount (ETB)**
Rainfed	Average income from produce	11711.92	Irrigation tech.	Average income	38,160.67
	Labor cost	3,000		Labor cost	5,000
	Input cost	2,500		Maintenance and repair cost (2X/year)	4,000
	---	---		Fuel cost	1000
	---	---		input cost	2,200
	---	---		Transport cost	550
	Total cost	5,500		Total cost	12750
	Net profit	6,212		Net profit	25419

Source: Field Survey, Note: - other costs kept constant. 1ETB equals to 0.36 USD, at the time of study.

The economic situation of the household has high influence on adoption of technologies. In another way, if the technology minimizes the output variability of the smallholder farmers` economy, then it would be more increasingly confirmed among risk-fearing smallholder farmers. The farmer who increases yield variability to raise production does not take the technological risk to adopt irrigation technologies. In contrast, if the adopted irrigation technology has high probability to decrease there would be high variability in production, and then it would not rapidly adopted by smallholder farmers. The study revealed that small-scale irrigation technology increases income, and improves the livelihood of smallholder farmers in advance. Adopter farmers practice number of agricultural practices like rainfed agriculture, irrigation and mixed farming to earn more incomes (table 4). Adopter farmers almost change their livelihood and start to engage additional income generation activities.

Table 4. *Income of Household vs. SSIT Adoption.*

Variable	Income level	Adopter of SSIT (n=30)	Non-adopter of SSIT (n=107)
Income	0-3,000ETB	-	28 (26.17)
	3,001-12,000	-	42 (39.25)
	12,001-24,000	4 (13.33)	23 (21.49)
	25,001-40,000	16 (53.34)	6 (5.60)*
	40001-60,000	7 (23.33)	-------
	>60,000	3 (10.0)	1 (0.93)*

Source: Field Survey, * Farmers who have off-farm activities

The agriculture sector has no much reward because of a shortage of rainfall and other farm activities. Despite poor saving habits and low involvement in off-farm activities, farmers face a shortage of capital to access improved technologies. Those SSIT adopting farmers can able to grow cereals, vegetables, and fruits. They have higher income, whereas non-adopters grow mostly cereal crops. Still, there was a perception barrier to use SSIT even on adopters side, as that they work with irrigation technology only after harvest of agricultural products of regular farming. Concentrated awareness and supply of new technology is needed to intensify the technology use and eradicate farmers` perception of longtime dependence on rainfall. If not, the shift of agricultural farming becomes laggard adoption and time consuming. Otherwise dissemination of improved agricultural technologies for the increment of agricultural farm productivity level at different agricultural activity becomes low. *"In our village rainfall fall was fluctuating. Sometimes it is not available. It is difficult to produce crops those need more water specially vegetables. We had started using irrigation technology two years ago. We have three motor pumps today. We work together to change our life. My living standard has changed after I became a member of this association because we produce more than before. I know most of my colleagues, who bought land in the town to build house, those who do have nothing before"* a farmer from a village. Higher incomes always help to withstand shocks and take risks related to agriculture technology. Adopter smallholder farmers practice mixed farming and they gain higher agricultural output and indicated in (figure 7).

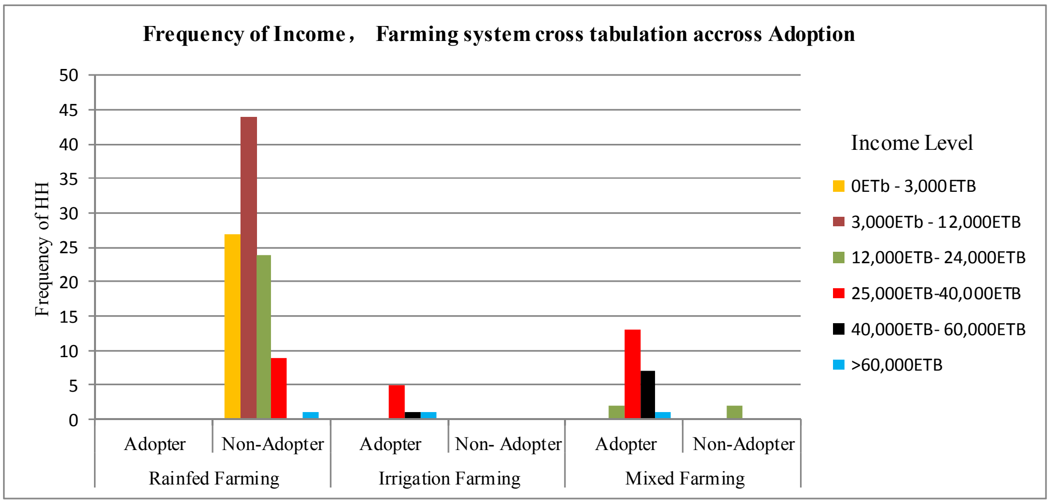


Figure 7. *Income, Farming system and Adoption cross tabulation.*

Source: Field work, *Note that: Non-adopter farmer who has higher income has off-farm Activity. Very few of smallholder farmer have engaged in irrigation farming with limited dependence on rainfed agricultural practices.

3.5. Empirical Analysis

3.5.1. Test for Association Between Outcome and Explanatory Variables

The variables theoretical expectations about the sign, direction and analysis of independent variables on the adoption and extension of small scale irrigation technologies is more particularly about motor water pump, treadle pump, hand pump, and geomembrane (table 5). These variables are selected for study based on the reviewed available literatures and arranged based on the pretest survey done on randomly selected households. Thus, effects of many of these factors on adoption were examined in the subsequent sections using econometric method. However, education and distance to the SSIT input and output market dropped from the model distance of small scale irrigation technology input and output market was almost the same for all villages which is 70KM. With respect education equal percent of adopter and non-adopter was seen along all levels. Thus, analysis of the determinants on the choice decisions is meaningless when the entities are similar across the entire households. Therefore, both of these variables are dropped from the model while the rest twelve explanatory variables tracked against the outcome variables in the in econometrics model.

Table 5. *Correlation matrix of explanatory variables with dependent Variable.*

S/N	Variables	Type of test	correlation test statistics	P- value
1	Gender	Phi	φ=-0.425**	0.042
2	Access to water	Phi	φ=0.872***	0.000
3	Membership	Phi	φ=0.181*	0.034
4	Access to market	Phi	φ=0.032^{NS}	0.674
5	Go support	Phi	φ=0.345***	0.000
6	Access to credit	Phi	φ=-0.213***	0.002
7	Awareness	Phi	φ=0.401***	0.001
8	Extension service	Phi	φ=0.295***	0.001
9	Age	Pearson correlation	r=-0.421***	0.000
10	Education	Pearson correlation	r=0.054^{NS}	0.455
11	Peer influence	Pearson correlation	r=0.359***	0.000
12	Perception	Pearson correlation	r=0.194*	0.094
13	Total Income	Pearson correlation	r=0.562***	0.000
14	Labor availability	Pearson correlation	r=0.083*	0.064
	NS=Not statistically significant, *=significant at 10%, **=significant at 5%, ***=significant at 1% level. Note: Phi test was used for Nominal Data and Pearson correlation for others			

Source: Field survey

3.5.2. Empirical Factors Affecting Adoption of Small Scale Irrigation Technology

We employed Binary logistic regression to see the relative influence of different demographic, socio-economic situational, environmental, and institutional variables and adoption of small-scale irrigation technology on one another. Selection of these variables depends on the literature review covered and pretest survey questionnaire collected before data collection. The regression result indicates that Age, access to water, lack of access to credit, government promotion, are the six strongest determinants identified to affect adoption of small-scale irrigation technology (table 6). It was concluded that most of the affecting factors need the focus of the government to take into account as they cannot be managed by smallholder farmer. The maximum likelihood estimation the model produced (R^2) which is 74.1% and test for fitness of the model p=0.527 are considerably exciting result describing model fitness to the data.

Table 6. *Working Variables Definition and Description.*

SN	Variables	Definition	direction of influence
1	Adoption	Adoption of SSIT, dummy Variable, 1=Adopter SSIT and 0=non-Adopter of SSIT	±
2	Age	Exact age of smallholder farmer household head, continuous, scale variable,	-
3	Gender	Gender of respondents, independent dummy variable, 1=male, 0=female	±
4	Access to Credit	Access to Credit institution, Dummy Variable, 1=if accessed, 0=other wise	+
5	Perception	Perception towards SSIT, 5 point likert scale, from strongly agree to strongly disagree	±
6	Access to water	Access to Irrigation water source, dummy variable, 1=accessed, 0=not accessed	+
7	Total Income*	Estimated total household annual income, continuous variable	±
8	peer influence	Influence of Peers towards SSIT adoption (5 levels likert scale, strongly agree to strongly disagree	±
9	Extension service	Utilization of Extension worker and Experts, Dummy, 1=utilized, 0=otherwise	+
10	Labor Availability	Labor Availability in the family member. Continuous variable, Adult Equivalent unit (AE)	+
11	Awareness (demonstration and field day)	Awareness about SSIT, dummy variable 1=have awareness 0=otherwise	+
12	Membership	Membership in the social organization, Dummy variable 1=member of social association, 0=not member in social association	+
13	Government promotion	Government promotion in the form of incentive and training, Dummy variable 1=accessed 0=not accessed	+

Source: Field Survey, *HH income is taken as total income the household earn in yr and it includes off-farm and on-farm incomes.

The hypothesized independent explanatory variables have been checked for the presence of multi-collinearity problem, before running by the model. VIF (variance inflation factor) was used for testing the association between the hypothesized continuous variables using the following formula.

$$VIF\ (X_i) = \frac{1}{1-R^2} \quad (6)$$

Where R^2 is squared multiple correlation coefficients existed between X_i and other explanatory variables in a statistical package (SPSS) were employed to compute the Variance Influence Factor (VIF) values.

A Binary logistic regression model (Table 7) was used to come across the factors affecting the adoption of small scale irrigation technology by small holder farmers in Sire Woreda central part Oromiya regional State. The logistic regression results of Adoption and identified predictor variables indicated that the model interestingly fits the data. The goodness of fit [22] was checked against adequacy of model fit and thus, it indicates that the model adequately fits the data as the output result was above the cut of value.

Table 7. *Maximum Likelihood estimates of logistic regression function for factors affecting the adoption of SSIT.*

	B	S. E.	Wald	df	Sig.	Exp (B)
Age	-0.933	0.449	4.325	1	0.038**	0.393
Gender	-0.077	0.205	0.142	1	0.706^{NS}	0.926
Labor Availability (AE)	0.300	0.925	0.105	1	0.746^{NS}	1.350
Total Income	0.000	0.000	9.154	1	0.002***	1.000
Access To Water	1.608	0.650	6.127	1	0.013**	4.991
Perception Towards SSIT	0.363	0.756	0.230	1	0.631^{NS}	1.437
Membership	0.785	0.753	1.086	1	0.297^{NS}	2.191
Extension Service	1.020	0.833	1.500	1	0.221^{NS}	2.773
Peer Influence	-0.122	0.392	0.097	1	0.756^{NS}	0.885
Government Promotion	1.761	1.003	3.083	1	0.079*	5.819
Access to Credit	-1.906	0.973	3.838	1	0.050**	0.149
Awareness	0.000	0.000	6.445	1	0.011**	1.000
Constant	-5.212	2.058	6.413	1	0.011**	0.005
Model chi-square=90.052, p=0.000						
-2log likelihood Function=53.966						
Cox & Snell R Square=0.482, Nagelkerke R Square=0.741						
Hosmer and Lemeshow of χ^2=7.086, p=0.527						
NS=Not statistically significant						
*=significant at 10%, confidence, **=significant at 5% confidence ***=significant at 1% confidence						

Source: Field Survey

The regression result indicates that Age, access to water, lack of access to credit, government promotion, are the six strongest determinants identified to affect adoption of small scale irrigation technology. The maximum likelihood estimation of the model produced (R^2=74.1%) and the test for fitness with significance of the model (p=0.527) are considerably exciting result describing model fitness to the data.

3.5.3. Non-significant Variables Explanation

The other non-significant variables such as gender, perception towards small-scale irrigation technology, extension service, peer influence, and labor availability influence the adoption of small-scale irrigation technology. The utilization of extension service and access to training are positive as in [18] but it was not significant statistically in regression analysis. However, it indirectly affects significant predictor variables and contributes to outcome variables. All of them indirectly affect other adoption as their share. Membership in social association has no significant relationship on the adoption of small-scale irrigation technology. A membership in association was hypothesized to have significant positive relationship with adoption categories of small holder farmers. However, it has no significance relationship as a membership in association could not help small holder farmer to access capital credit for technology adoption. This was because of the gender and peer influence indirect effect on the adoption of small-scale irrigation technology. The negative sign of peer influence indicates that if he/she has no interest in technology and peers influences his relatives in a way that his/her motivation towards adoption diminishes.

For Gender negative influence means being female decreases adoption of small scale irrigation technology. It was because of technological characteristics and unsuitability for women. The intent to adopt agricultural technology is a function of positive or negative value individuals toward technology, and perceived easiness or difficultness of value towards technology. The finding of peers influence was consistent with [43] that peer impact on technology usage and adoption describes a low impact of peers on the individual decision and inconsistent [33].

4. Discussions

The potential of irrigated smallholder technology-supported farms to improve food security and increase income has a significant impact on the agricultural sector development. The study found that there was a significant difference between adoption categories in income and livelihood improvement (table 4). The findings of the study confirm that there was a significant difference in income between the adopter and non-adopter of smallholder farmers. The finding assured that through the adoption of small-scale irrigation technology livelihood of adopter smallholder farmer have been changed, income increased and food self-sufficiency achieved opposite to their counterpart. The net income farmers get from the integrated farming systems varied widely depending on the agricultural farm he/she practices. Intensive agricultural farming around the embankments of the rivers, ponds, and other water source was found to be effective in return for the small-scale irrigation technology-supported agricultural activity. Participation in agricultural activity through the use of small-scale irrigation technology has strong and significant effect on the livelihood improvement and use of small sale technology for irrigation is a good strategy in the water-scarce and drought-prone as well as semi-arid parts Ethiopia

The study found that considerable constraints were hindering adoption and extension of small scale irrigation technology. Most of these were geographical institutional and personal affecting factors. After failure of these technology; farmers can`t repair because of absence of accessories and spare parts on the near market. Among these constraints topography, unavailability of spare parts, lack of technician and experts, poor infrastructure, poor skill of farmers, absence of policy, and institutional weaknesses are key factors constraining small-scale irrigation technology adoption and use in the Sire district. Topography and Lack of availability of spare parts has considerable effect on use of these technologies. The opportunities known to exist in adoption and extension of small scale irrigation technology were farmers' irrigation water use association (FIWUA), working labour availability, potential land, unaccessed source of water was found as major opportunities that existed for better adoption and extension of SSIT. As [30] found that the land holding sizes have effect on utilization of technology meaning higher probability of using technology on larger land.

Because of the characteristics of technology, higher age farmers' adoption of irrigation technology diminishes. It was revealed that an increase in the probability of younger farmer's irrigation technology adoption. The probability of being young increases adoption of SSIT by a factor of 0.0776 (table 7) and younger household heard more likely to adopt SSIT and decrease for every additional increase in age. However, according to the study result adult smallholder household head farmers are more inclined than their older non-adopter to use their technological skills in an innovation of agricultural technology. This was because of the awareness and exposure of young generations to the technology than others. Farmers who adopted modern irrigation technologies were younger than their non-adopting counterparts [41, 37] and inconsistent with [26] who found technology adoption with age growth.

According to the result, farmers are more persuaded to adopt technology as their asset increases because they assume withstanding technology related risk would be with initial higher saving. This implies that higher-income enables smallholder farmers' capacity to try new technology and finally adopt earlier than those who have lower income status. Wealthier smallholder farmers' can withstand the risks of new technologies and try them for later adoption or rejection than their counterparts to improve agricultural practices for increasing productivity and warranting food security. This study was consistent with [14] that stated income as a crucial element for young farmers for adoption agricultural product-related technologies. It was found that relatively middle and higher-income farmers usually were those who use motorized pumps while the low-income farmers are mostly using rainfed farming. Gebregziabher [19] stated that poor farmers of inadequate incomes were unwilling to adopt new agricultural inputs.

Awareness of farmers on technology influences their decision towards adoption as it was a barrier between the two categories. For additional point increase in awareness scale, there was a doubling of the odds that the small holder farmers would increase in adoption of small-scale irrigation technology. It was hypothesized that farmers who had participated in demonstration and field visits about small-scale irrigation technology were more likely to adopt small-scale irrigation technology than those have not participated. "*I have no full information; there is no training or demonstration, of field visit done in our village about this technology. Even don`t know whether it is profitable or not, a farmer from K/Bale village."* Having awareness was seen as a having higher chance in adoption of irrigation technology. This indicates that smallholder farmers who have an awareness of small-scale irrigation technology are more likely to adopt SSIT than those who are not accessed to awareness of small scale irrigation technology. According to [45] finding lack of awareness was an obstacle for accessing technological benefit.

We had found that the absence of financial service has a negative effect on the adoption of small irrigation technology. The absences of financial service institutions those works on financing agricultural technology directly affect the adoption of small scale irrigation technology because credit institutions assumed to be the second source of capital for farmers. As access to reasonable credits has a positive influence on adoption of small scale irrigation technology, absence credit institution has a negative effect on the adoption of small-scale irrigation technology.

Lack of access to credit institutions hinders smallholder farmers' decision to adopt small-scale irrigation technology. Availability of credit institution does not mean that farmers can access credits for irrigation technology purchase. One of the main weaknesses of credit institutions was the lack of taking responsibility for farmers seeking to adopt irrigation technologies. Lack of access to credit hinders the adoption of risky small-scale irrigation technology by diminishing relaxation of farmer's risk-bearing ability especially at the startup of the work since it needs capital installment. As [44] explains the effect of uncertainty and risk in agriculture production, credit supply determines the adoption rate of new technology in as its absence affects farmer's willingness to adopt technology well. A farmer from Koloba Balei Village states the problem of credit institutions as, "*When I went to the credit institution and asked to lend me money to buy water pump they asked me to bring three farmers for referee as a guarantor. I went to ask more of my friend to help me as* *a referee and tell them that I am going to buy technology; no one would be volunteer to be a referee because they think that the technology would be loss if failed suddenly and result in deficit. I got no farmers as guarantor for referee. What I frankly can tell you is that even the institution has no willingness to borrow for technology adoption. As of the rules of the instruction you have to return borrowed money in a year. If you fail to return back they will took any other of your social or natural capital. To return money back it may take two or three years. This was problem. To buy by myself I have no initial capital"* (Farmer from Koloba Balei Village).

This indicates that there were a need for targeting credit for credit constrained smallholder farmer to improve access to credit and agricultural technology adoption.

The result revealed that access to irrigation water source increases the likelihood of adopting small-scale irrigation technology. It increases farmers' option to use a number of agricultural production systems through a flexible adoption of small-scale irrigation technologies. Smallholder farmers who have access to water source can efficiently manage the adoption of small scale irrigation technology. The problem of water resource was common in developing country not because of its absence but because of the fact that smallholder farmers` potential to access available water resource. Similar findings are reported by [9, 41] that key determinants of small scale irrigation technology adoption include access to irrigation water. Chinese agriculture was also faced problem of availability of water [8] however; they overcome this constrained with critical promotion and innovation of water saving technology.

Government promotion of small-scale irrigation technology in the form of incentive or kind gift was among positively significant predictors of the outcome variable. This result implies that smallholder farmer who had access to government promoted SSIT is more likely to adopt than who has not accessed support. Government promotion might be in kind as incentives or as a discount to motivate and encourage smallholder farmer as its direct impact on the adoption of small-scale irrigation technology. "*... We want support on how to explore our agriculture farmland to feed ourselves and to change undermining livelihood. For example our partner who has access of water source has used technology to cultivate crops and vegetables in shortage of water. Others those received kind gifts from the woreda have also used the technology for their agricultural practices. They used to produce vegetables like onions and chili. They got the technology as gift from the government. We need a government to give as technology and water source rather sending us supplement of food easily support ourselves".*

Knowledge by itself does not guarantee definite adoption on bare land unless the technologies are easily accessible to the farmers and developing institutional support system [37]. Lack of support for specialized technical advice reduces overall smallholder farmers' productivity. Incentives for water market from the government lead to additional technology adoption with gains to both parties [12]. Consistency of irrigation water source and institutional promotion of irrigation technology had positive and significant associations with adoption decision [2, 27].

5. Conclusion

Besides its reliance on intermittent and often inadequate rainfall patterns smallholder farmers are primarily dependent on traditional farming systems lacking the use of improved technology. Frequently occurring droughts highly affect the livelihood of agriculture and livestock-dependent households and made most households to rely on food support. Irrigation technologies used for supply of water to the farmland allows a farmer to bear against drought and problems existed because of the shortage of rainwater. Our finding concluded that irrigation is a key in transformation of agriculture sectors and realizing yield increment without increasing farm size. In this study, we have analyzed a number of factors affecting the use and adoption of small scale irrigation technology. We employed an econometric method to analyze the quantitative factors affecting adoption and in-depth analysis of constraining factors. It was found that a number of factors had significantly affected and constrained the adoption and extension of small scale irrigation technology. Some of the significant factors are institutional to mitigate as they need policy consideration while others can be mitigated with the cooperation of the end user. We found that irrigation technologies catalyze the shift from rain-fed to irrigation system. Emergence and diffusion of affordable small scale irrigation technology has started to improve productivity and family income in semi-arid parts of Ethiopia. Integration of small scale irrigation technology into agricultural technology for semi-arid and drought prone areas of the country is extremely important to improve the economic status of rural people. Our finding also showed that FIWUA facilitates adoption so they need to be supported and promoted. This reveals that to establish reliable adoption of small scale irrigation technology their promotion would be more promising to facilitate a decision to adopt for smallholder farmers.

6. Recommendation

Practicing technological use is also not a simple and easy task for farmers as it needs knowledge, skill, and frequently experience. With the absence of spare parts and technicians, it would be more difficult for most farmers to adopt small scale technology. To overcome this issue government with responsible sectors such as extension sectors, research, and service providers has to facilitate for easy access of SSIT. Farmers' field day/visit on technology demonstration and experience sharing can provide information to help guide farmers. This allows the farmers' smooth transition to new agricultural technology. Debating farmers can better be persuaded by demonstration, field day, targeted training, and neighboring farmers who had already adopted irrigation technology.

The administrative institution should facilitate and improve access of credit and promote irrigation technologies. These are more critical for technology adoption for a resource-poor rural farmer. Policy and institutional intervention for an increment of irrigation technology impact on the agricultural produce need to be based on the main objective of enhancing efficient irrigation technology adoption for farmers.

Conflict of Interest

The authors declare that they have no competing interests.

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