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Factors Affecting Rural Households' Participation in Small - Scale Irrigation Scheme: The case of Arba Minch Zuria Woreda, Southern Ethiopia

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Abstract

The development of the agricultural sector in Ethiopia in general and in Arba Minch Zuria Woreda, Southern Ethiopia in particular, is thought to depend on agricultural intensification. To this end, several governmental and non-governmental organizations initiated small-scale irrigation projects all over the nation, including in Southern Ethiopia. Despite these efforts, it is found that smallholder farmers in the study area are reticent to participate in small-scale irrigation schemes. Therefore, the present study is aimed at investigating factors affecting rural households' participation in a small-scale irrigation scheme in Arba Minch Zuria Woreda, Southern Ethiopia. Accordingly, the study employed a multi-stage sampling technique to collect primary data from 379 sample households. Descriptive statistics and binary logistic regression analysis were used to analyze the collected data. The study identified the major problems associated with small-scale irrigation in the study area. Among others, lack of sufficient irrigation water, lack of effective marketing system, lack of input supply and irrigation facilities, presence of pests and diseases, and lack of awareness about irrigation are mentionable for low participation in the scheme in the study area. The econometric model result revealed that the age of the household head and dependency ration has a statistically significant negative effect on rural households' participation in small-scale irrigation while education, adult equivalence, livestock holding, and land size have a positive and statistically significant effect on the variable of interest. Therefore, providing education services for rural households, arranging field training services and experience sharing to farmers is advisable to alleviate these problems and improve small-scale irrigation utilization in the study area.

Keywords: *Small-Scale Irrigation; Smallholder farmer; Binary logit model*

Introduction

Agriculture is the backbone of Ethiopia's economy. It contributes 36.2 percent of the country's gross domestic product (GDP) and 72.7 percent of employment and 70 percent of export earnings. Due to its contribution to the GDP, agriculture highly impacts the performance of the other sectors of the economy (USAID, 2018). However, the sector has remained in its rudimentary stage because of environmental degradation, unchecked population growth (2.4% per annum), small and fragmented landholding, limited access to new agricultural technologies, traditional methods of cultivation, high dependence on natural factors, institutional support services (CSA 2012, MoFED 2012).

Ethiopia, the water tour, having 12 river basins with a combined annual runoff capacity of 124 billion cubic meters and an estimated 2.6 billion to 3 billion cubic meters of groundwater potential (EPCC, 2015) faced food shortage and is a hub of the poor households. Consequently, small-scale irrigation is one of the approaches to boost output levels and help small farmers in Ethiopia fulfill the country's growing food demand (Zekarias et al., 2022).

Different studies have been conducted on small-scale irrigation in Ethiopia. For instance, a study conducted by Gemechu et al. (2018), the assessment of the status of irrigation practice and utilization in the western Hararghe zone, Oromia, Ethiopia. However, his analysis is entirely focused on descriptive statistics. As a result, he did not examine factors affecting rural households' participation in small-scale irrigation. Moreover, studies (Agidew, 2017; Petros and Yishak, 2017; Phogella and Anbaw, 2022) analyzed to study the determinants of small-scale irrigation practice using Binary Logistic Model. But their studies overlooked some relevant demographic, socio-economic, and institutional factors affecting rural households' participation decisions in small-scale irrigation such as dependency ratio and distance from the nearest market in his analysis. Moreover, they did not also; investigate the types of irrigation schemes and their constraints in terms of agro-ecologies.

Arba Minch Zuria Woreda is one of the drought-prone areas in the Southern Region. However, this area has surface and groundwater resources that are not being accessed to their full potential for production purposes. Based on reports from the Woreda food security task force report (2018) showed that about 12,439 households are identified as food insecure, and they are receiving assistance from PSNP and emergency food aid in the form of either food or cash. Therefore, the existence of food insecurity in rural households has been a serious and long-lived problem and the history of the country due to agricultural shocks, disasters, and other internal and external factors.

It is believed that irrigation will increase agricultural production and food security. However, it is not well known the status and to what extent are the households using irrigation better off than those who depend on rainfall in the study area. Therefore, this study is initiated to fill the gaps by analyzing factors affecting rural households' participation in small-scale irrigation across different agro-ecologies of the Woreda, to describe irrigation schemes and their constraints in the study area.

Research methods

Description of the Study Area

Arba Minch Zuria Woreda is one of twelve Woredas found in the Gamo zone of the Southern Nation's Nationalities and Peoples Regional State (SNNPR). The Woreda is located at a distance of 275 and 505 km far from the regional city, and the country capital, Addis Ababa, respectively. The Woreda lies between 5°42 and 6°13 north latitude and 37°19 and 37°41 east longitude. It is bordered on the south by the Dirashe Woreda, on the west by North Bonke, on the north by Dita and Chencha, on the northeast by Mirab Abaya Woreda, and the southeast by the Amaro Woreda. The total area of the Woreda is estimated to be 168,172 hectares. There are three agro-ecologies: Dega, Woynadega, and Kolla which cover the woreda with 14, 53, and 33 percent, respectively. The Woreda has two rainy seasons with rainfall ranging between 800-1200 mm annually, and the minimum and maximum annual mean temperatures are 16°C and 37°C, respectively (Woreda Agriculture and Rural Development Office (WARDO, 2015).

Due to the geographical orientation of the Gamo Mountains, small rivers drain to Lake Abaya and Lake Chamo. Abaya Lake receives water from the Hare and Baso Rivers, while Lake Chamo receives water from the Kulfo, Sile, and Sego Rivers (Aynalem et al., 2020).

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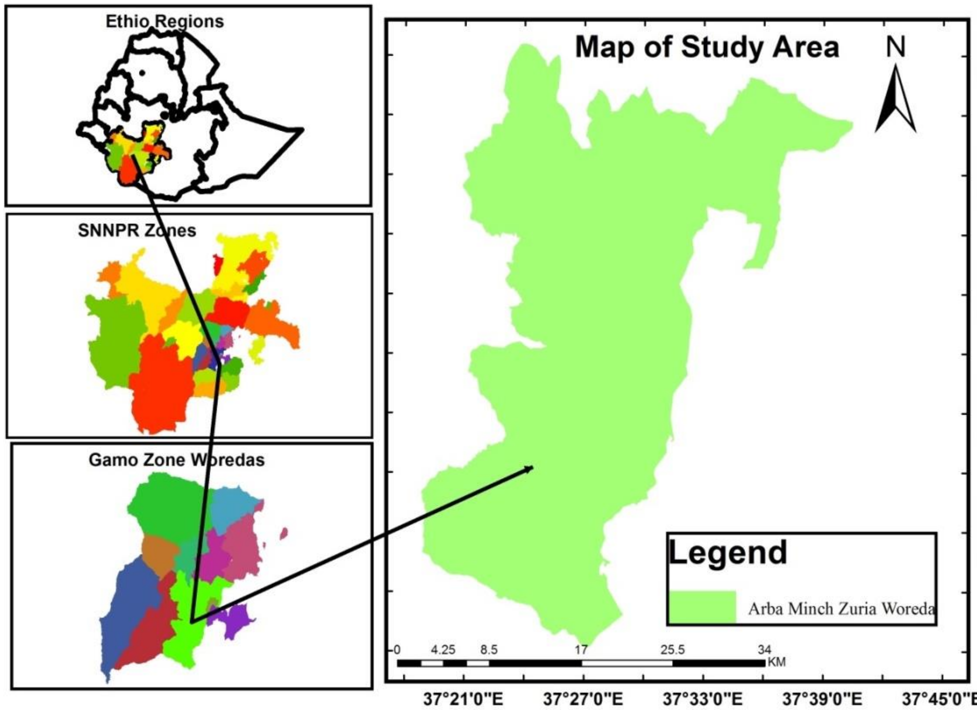

Figure 1: Location Map of Study Area

Source: Own GIS sketch, 2019

Research Design

The study employed a cross-sectional survey research design to examine factors affecting rural households' participation in small-scale irrigation, and to describe irrigation schemes and their constraints in the study area because the researcher only collected data at a single point in time. Furthermore, it enabled the researcher to compare a wide range of factors all at once, and the researcher can utilize it as a starting point for additional investigation.

Data Type and Source

In this study, both qualitative and quantitative data were employed to investigate the social, demographic, economic, and institutional characteristics of rural households in the study area. Both primary and secondary data sources were used to collect qualitative and quantitative data.

Sampling Techniques and Sample Size Determination

As the study population is heterogeneous in terms of both agroecology and participation in irrigation scheme (irrigation users and non-users), 379 sample rural household respondents were selected using the Cochran (1977) formula considering 95 percent of the confidence level (z=1.96), 50 percent estimated proportion of an attribute in the population (p) and 5percent level of precision (e). The formula is:

$$\mathbf{n}=\frac{z^2\dot{P}(1-\dot{P})}{e2+\left(\frac{z^2\dot{P}(1-\dot{P})}{N}\right)}\approx\frac{(1.96)^2(0.5)(0.5)}{(0.05)^2+\left(\frac{(1.96)^2 0.5(0.5)}{27266}\right)}=379 \qquad (1)$$

Where n is the sample size, z is the critical value selected for a desired level of confidence, p is the degree of variability in the population, q =1-p, and e is the desired level of precision. According to Arba Minch Zuria Woreda Agricultural Office (2018) report, the total number of households in the target population was 27,266.

This study used both probability and non-probability sampling techniques. Arba Minch Zuria Woreda was purposively selected as it has a long history of traditional irrigation practices and indigenous knowledge. Multi-stage sampling technique was employed to select the ultimate sample respondents. In the first stage, the cluster random sampling technique was used to divide 29 kebeles into the three agroecological zones, and the proportional to size sampling was implemented to select six sample kebeles. In the second stage, the households in respective kebeles were grouped into users and non-users to analyze factors affecting rural households' participation decisions in small-scale irrigation in the study area using a stratified sampling technique to have a homogenous population within strata. Finally, after stratification, a simple random sampling technique was applied to select a total of **379** were selected by maintaining proportionality to respective users and non-users.

Table 1: Distribution of sample households for each kebele

Agro-Ecological Zone	Number of Kebeles	Sample Kebeles Selected	Total HH	Irrigation users	Sample HH (users)	Non-irrigation Users	Sample HH (Non-users)
Dega	4	Laka	1229	134	9	1095	44
WeynaDega	15	Genta Meyche	642	119	8	523	21
		Zigiti Bakole	1625	64	4	1561	63
		Zigiti Merche	910	45	3	865	35
Kolla	10	Kolla Shelle	1428	1379	90	52	2
		Shara	2105	580	38	1525	62
Total	29	6	7939	2318	152	5621	227

Source: Survey data, 2019

Methods of Data Collection

The data were collected from both primary and secondary data sources. Primary data was collected from sample rural households employing a structured questionnaire and key informant interviews with the help of enumerators. Six experienced enumerators were recruited and trained on the questionnaires. The structured questionnaire was designed and pre-tested on 12 respondents in Arba Minch Zuria woreda kebeles. Feedback from the pre-test was applied to refine and modify the questionnaire, and the final questionnaire was organized. Direct personal observation and focus group discussions were used as additional information sources to gather qualitative primary data.

Moreover, secondary data was also gathered and utilized from various sources, such as reports of the district agricultural bureau, zonal reports, and regional reports on issues associated with rural households' small-scale irrigation practices.

Method of Data Analysis

For analyzing the data, both descriptive and econometric analyses were used. Descriptive statistics such as frequency distribution tables, percentage, mean, standard deviation, chi-square test, and t-test were used to compare the change in a parameter of the treatment and control groups. Further, the binary logistic model was used to identify factors affecting rural households' participation decisions in small-scale irrigation in the study area. The entire analysis was done with the help of (STATA version 14.0 and Excel).

Model Specification

A logit model was used to identify factors affecting rural households' participation decisions in small-scale irrigation in the study area. In estimating the logit model, the dependent variable was irrigation participation which is users of irrigation, which takes the value of 1 and 0 otherwise. Following Gujarati, the mathematical formulation of the logit model is as follows:

$$P_i = E\left(Y_i / X_i\right) = \frac{1}{1+e^{-(\beta_0+\beta_1 x_i)}} \qquad (2)$$

$P_i = E\left(Y_i / X_i\right) = \frac{1}{1+e^{-z}}$ Where Pi is a probability of a i^{th} rural household being use of small-scale irrigation and ranges from 0 to 1; Z_i is a functional form of explanatory variables(X) which is expressed as:

$$z_i = \beta_0 + \sum_{i=1}^{n} \beta_i x_i,\ i = 1,2,3\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots n \qquad (3)$$

Where; β_0 is the intercept and β_i are the slope parameters in the model. The slope tells how the log-odds in favor of a given rural household using small-scale irrigation change as independent variables change. If P_i is the probability of a rural household being the use of small-scale irrigation, then 1- P_i indicates the probability of a given rural household is non-using small– scale irrigation water, which can be given as: $1-P_i = \frac{1}{1+e^{z_i}}$ (4)

Then, equation (2) divided by Equation (4) after simplification results in

$$e^{z_i} = \frac{P_i}{1-P_i} = \frac{1+e^{z_i}}{1+e^{-z_i}} \qquad (5)$$

Equation (5) indicates the odds ratio in favor of a given rural household using small-scale irrigation. It is the ratio of the probability that a rural household will use small-scale irrigation to the probability he/she will not use it. Lastly, the logit model is obtained by taking the natural logarithm of equation (5) as follows:

$$L_i = Ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_i X_i \qquad (6)$$

Where; P_i= the probability that Y=1 (that a given rural household is using small-scale irrigation);

1- P_i = the probability that Y=0 (that a given rural household does not use small-scale irrigation);

L = is represents the natural log of the odds ratio or logit;

β_i = the slope, measures the change in L (logit) for a unit change in explanatory variables (X);

β_0= the intercept. It is the value of the log odd ratio, $\frac{P_i}{1+P_i}$, When X or explanatory variable is zero. Consequently, if the stochastic disturbance term (Ui) is taken into account the logit model becomes $Li = \beta_0+\beta_i X_i + U\ i$

Table 2: Summary of the definition and hypothesis of explanatory variables

List of explanatory variables	Nature and measurement units of variables	Hypothesized direction of significance	Some of the supporting evidences
Age of a household Head (Agehh)	Continuous (years)	Negative	Getaneh (2011); Temesgen (2017)
Sex of household head (Sexhh)	Dummy (1 if male, 0 otherwise)	Positive	Jema *et al*. (2013); Hadush (2014)
Education Level of the household head (Eduhh)	Continuous (class year)	Positive	Muez (2014); Adem (2016)
Family size of a household per adult equivalent (Famsize)	Continuous (AE)	Positive	Hadush (2014); Sikhulumile (2013)
Total livestock owned(Tlu*)*	Continuous (TLU)	Positive	Abonesh *etal*., (2011); Getaneh (2011)
Dependency ratio (Depr)	Continuous (number)	Negative	Abera et al. (2021); Adem (2016)
Cultivated land size (Landsize)	Continuous (hectare)	Positive/ Negative	Sithole *et al*.,(2014); Abebaw *et al*.,(2015)
Distance from irrigation water source (Distws)	Continuous (km)	Negative	Sikhulumile (2013)
Frequency of extension contact (Freqext)	Continuous (year)	Positive	Sinyolo *et al*., (2014); Adem (2016)
Access to Credit (Act)	Dummy (1 if used, 0 if not)	Positive	Temesgen (2017)
Distance from the nearest market (Distmkt)	Continuous (km)	Negative	Muez (2014); Temesgen (2017)

Source; Own definition, 2019

Results and Discussion

Types of Small-Scale Irrigation used in the Study Area

From the total participant sample households, the majority (68 percent) use the traditional river diversion (figure2). Twenty-two percent of the participants used Concrete canal river diversion. River diversion irrigation and Motorized pump systems are widely practiced in the Kolla agro-ecology part of the study area. There was about six percent of the participants use motor pump irrigation. The rest four percent of the participant households use the Hand pump.

Additional information gathered from the key informant's interview and focus group discussion participants revealed that Traditional River diversion is the dominant method used by farmers in the study area. This irrigation system is simple for farmers to practice by inheriting knowledge from grandparents, but the amount of water and seasonality of rivers are the major problems. Many farmers use traditional irrigation to complement other irrigation systems like modern river diversion and motor pump irrigation.

Concrete canal river diversion was the other irrigation type used by the farmers in the study area. River diversion irrigation and Motorized pump systems are widely practiced in the Kolla agro ecology part of the study area. Sile, Sego, Hare Rivers, and Lake Abaya are the main sources of water for the modern irrigation system in Kolla agroecology. The river is diverted through the cement concrete canal for irrigation purposes.

The motor pump was the other irrigation type used by the farmers in the study area. Motorized pumps are widely used irrigation systems, especially in the lowland part of the study area. The greatest of the farmers bought them as part of a group. Other households gain admission to the pumps through renting from the owners. The other irrigation type used by the farmers in the study area was the Hund pump. This is a type of small-scale irrigation with a pumping arrangement for lifting water mainly from surface sources where diversion by gravity may not be feasible. As the operation and maintenance of these schemes are costly, they are successful mainly in areas with good market access, better service delivery, and the growing of high-value crops. Based on the size of the pump they can be privately owned or communal.

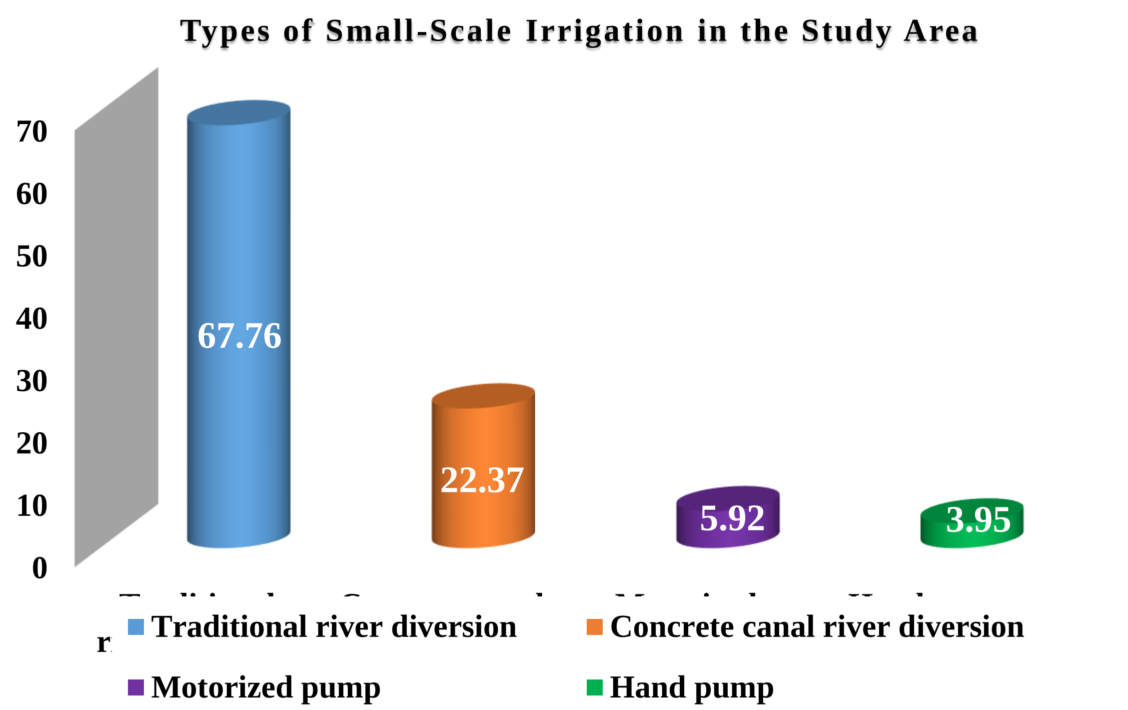

Figure 2: Types of Small-Scale Irrigation in the Study Area

Sources: own survey result, 2019

Problems encountered in small-scale irrigation development in the Study Area

The survey results indicate that small-scale irrigation can be a valuable tool in improving the incomes of poor rural households. Using small-scale irrigation participants in the study area, this study identified several irrigation constraints. According to figure 3, 54.6% of irrigation users reported a lack of irrigation water as a major problem, while a lack of a marketing system, a lack of input supply, an absence of irrigation facilities, pests, and diseases, and a lack of irrigation awareness were among the treatment respondents at 26.32 percent, 9.87 percent, 5.26 percent, and 3.95 percent, respectively.

The key informant interview and focus group discussion participants also revealed that the major problems associated with small-scale irrigation in the study area were the lack of sufficient irrigation water, the lack of an effective marketing system, the lack of input supply and irrigation facilities, pest and disease infestations, and the lack of irrigation awareness. There has been a significant increase in the importance of irrigated agriculture in the Woreda.

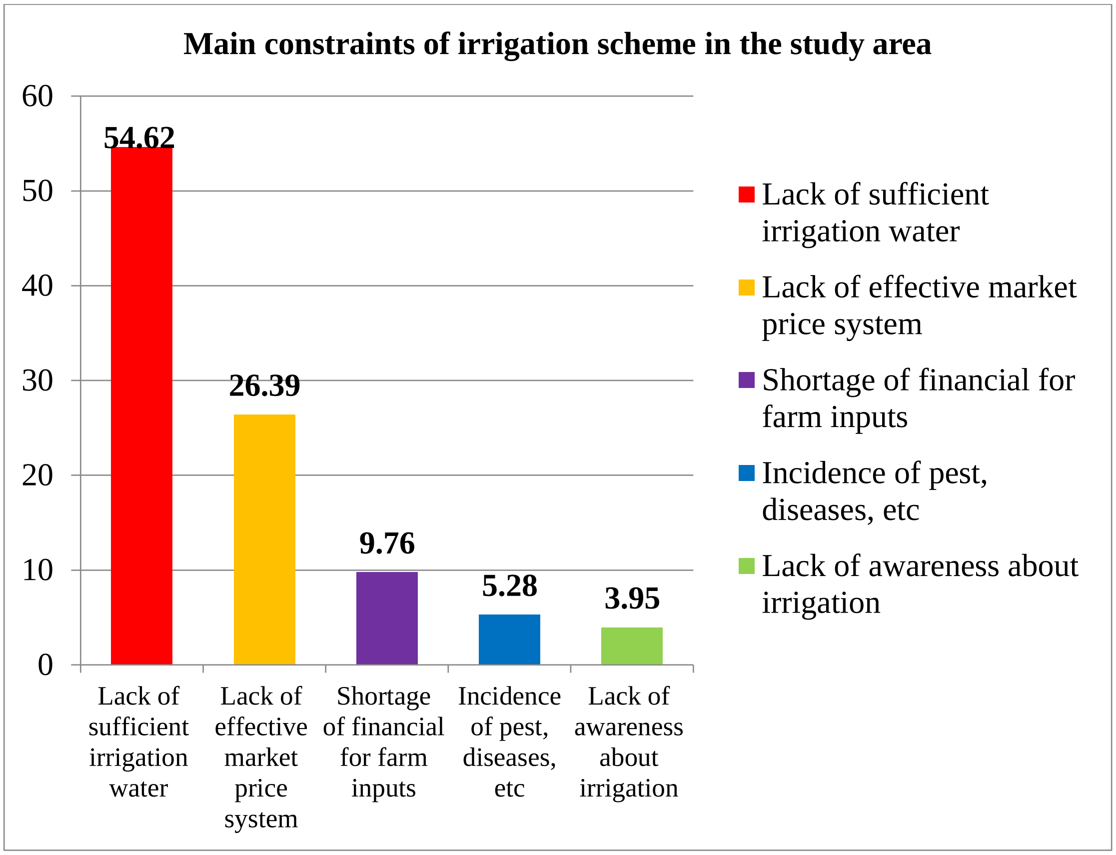

Figure 3: Main constraints of irrigation scheme in the Study Area

Source: own survey result, 2019

Econometric Result of factors affecting rural household's participation decision in Small-Scale Irrigation Scheme

In this study, a logistic regression model was used to estimate factors that influence rural households' participation decisions in small-scale irrigation schemes. Out of the 11 explanatory variables included in the logistic regression model, seven of them have shown statistical significance in determining a rural household's participation in the small-scale irrigation scheme. Thus, the marginal effect and interpretation of significant variables were presented below.

Age of the Household Head (Agehh): The age of the household head was associated with the rural household's participation in small-scale irrigation negatively and significantly at a 1 percent level of significance. The resultant marginal effect shows that a one-year increase in the age of the household head decreases the likelihood of the household's irrigation participation by 1.05 percent, keeping other variables constant. This is in line with the fact that young household heads are more likely to participate in irrigation than the seiner one due to their better capability of working things with strong capacity. Moreover, the farmers who lived long have more wealth than younger farmers do, and hence they may not want to exert more effort for their livelihood. The other reason for this finding could be related to the reason that seiner farmers do not have long-term planning they do not worry about the development of the long term, and they do not want to invest their time and energy in a tiresome job that will bring the long-term benefit and improvement in the productivity of their production. The result conforms to the findings of Getaneh (2011) and Temesgen (2017) revealed that seiner-aged household heads are more reluctant to accept new technology and agricultural production styles than younger household heads.

Education Level of the Household Head (Eduhh): This vital human capital was expectedly to have a strong positive relationship with the probability of rural households' participation in small-scale irrigation, and the variable is significant to determine rural households' participation in small-scale irrigation at a 1 percent probability level. It is expected that one additional year of schooling of the household, keeping all other variables constant, increases the probability of the household to be participating in small-scale irrigation by about 5.34 percent. This variable as hypothesized affects the household's participation decision in irrigation in such a way those households who are educated better chance to adopt small-scale irrigation. The possible justification for this positive relationship is that literacy promotes households' awareness and use of new agricultural technologies, and inputs and they are keener to diversify their income sources to escape from unforeseen risks of food insecurity and rural poverty. This result is in line with the study of Muez (2014) and Adem (2016) emphasizing that promoting the education level of rural households enables them to increase the probability of participation in small-scale irrigation practice.

Family Size of a Household in Adult Equivalent (Famsizeiae): Family size was associated with rural households' participation decision in small-scale irrigation positively and significantly at a 1 percent level of significance. The probability of participating in a household increase by 7.9 percent when family size increases by 1 member in terms of adult equivalent. This implies that having a large family size in adult equivalent will have more labor for agricultural production. The same finding was reported by scholars such as Hadush (2014) found that there was a significant difference in the availability of adult labor between irrigation users and non-user households, with irrigation, have owned better labor input than non-irrigating households. Sikhulumile (2013) also found that irrigators were found to have bigger families (both in numbers and adult equivalents) compared to non-irrigators, indicating a high labor demand for irrigation farming.

The Number of Livestock Owned in TLU (Tlu): The number of livestock is also another determinant factor for the household to be irrigation users or not. The variable has statistically significant (at a 1 percent level of significance) and has a positive marginal effect coefficient. The magnitude and sign of the marginal effect show that one unit (in TTLU) increase in the number of tropical livestock units of a household increases the irrigation participation of the household by 3.85 percent, holding other variables constant. The possible justification for this positive relationship is that households with larger livestock holdings may have money to spend on any possible costs to use irrigation. The study result was consistent with the work of Abonesh et al. (2006) and Hadush (2014) also reported livestock holding had an appositive and significant influence on participating in micro-irrigation.

Dependency ratio of household (Depr): This variable affects participation in irrigation negatively, as expected. It significantly affects participation in irrigation at a 5% probability level. This negative relationship shows that the probability of participating in irrigation decreases as the dependency ratio increases. Other things remain constant if the dependency ratio increases by one unit, the probability of participating in irrigation decrease by 7.7 percent. This is probably because the dependency ratio reflects the pressure and responsibility of household members in the labor force. This finding was in agreement with the work of scholars such as Abera et al. (2021) and Adem (2016) who found that household members of holdings with high dependency ratios might not be able to participate in programs due to time, labor, and/or financial constraints.

Cultivated land size (Landsize): This variable positively affects participation in irrigation in line with the previous hypothesis at a 5 percent level of significance. The resultant marginal effect shows that one hectare of land increment of a household increases the likelihood of the household's irrigation participation by 11.59 percent, keeping other variables constant. The possible explanation is that, as the cultivated land size increases, a household can increase and diversify the quantity and type of crop produced, which may, in turn, lead to more participation in, increased consumption and household food security. The result of the finding of Sithole et al., (2014); Abebaw et al., (2015) found that those farmers having a larger area of cultivable land were found to participate more in irrigation practice than their counterparts.

Frequency of extension contract (Freqext): The model result shows that the variable was statistically significant at the 5 percent probability level and positively affects participation in irrigation as hypothesized. The regression result revealed as a one-unit increase in extension visits by a development/agricultural agent increases participation in irrigation by 1.99 percent, holding other variables constant. This is in line with the fact that irrigation participation provides technical support or advice from the extension worker. This result is consistent with the finding of Sinyolo et al., (2014) and Adem (2016) founds that farmers who have direct contact with extension agents more participating in irrigating than those who do not in contact.

Table 3: Logistic estimation and Marginal effect results

Variable	Coefficient	Std. Err.	Z	P-value	Marginal effect (dy/dx)
Agehh	-0.0447633	0.0122888	-3.64	0.000***	-0.0104846
Sexhh	-0.1524677	0.3162179	-0.48	0.630	-0.0361078 ^
Eduhh	0.2281115	0.0354528	6.43	0.000***	0.0534293
Ae	0.3372357	0.0840105	4.01	0.000***	0.0789889
Tlu	0.1645055	0.0345106	4.77	0.000***	0.0385312
Depr	-0.3292645	0.1616876	-2.04	0.042**	-0.0771218
Landsize	0.4949291	0.2328727	2.13	0.034**	0.1159245
Distws	0.0055882	0.0454962	0.12	0.902	0.0013089
Freqext	0.084934	0.0399775	2.12	0.034**	0.0198936
Act	-0.0920262	0.2547197	-0.36	0.718	-0.021511 ^
Distmkt	0.0214199	0.0410886	0.52	0.602	0.0050171
Number of observations	379	Pseudo R2	0.2204		
LR chi2(11)	112.52	Log likelihood	-198.97488		
Prob> chi2	0.0000***				

***, ** and * represent significance at 1, 5 and 10% level respectively.

Source; Own Survey result, 2019

Conclusions and Recommendations

This study has investigated influential factors that determine rural households' participation in a small-scale irrigation scheme in Arba Minch Zuria Woreda, Ethiopia. To achieve the objectives of the study, various data analysis methods were employed. Descriptive results indicated that irrigation user and non-user households showed a statistically significant mean difference in terms of age of household heads, education level, family size in adult equivalent, livestock holding, cultivated land size, and extension contrast, the negative significant effect of the dependency ratio has an adverse implication, while a positively significant effect of land size has a multiplier effect on irrigation scheme participation. Therefore, awareness creations on family planning and strengthening crop-livestock production have a comparative advantage to harvest the fruits of the small-scale irrigation scheme. In general, providing education services for rural households, arranging training services, and experience sharing to seiner farmers is advisable to alleviate these problems and improve small-scale irrigation utilization in the study area.

This study was primarily focused on cross-sectional data which infers the results of one-time data that challenged to investigate the real picture of analyzing factors determining farm households' participation in small-scale irrigation across different agro-ecologies of the Woreda. Therefore, it has paramount importance to organize stakeholders (researchers, practitioners, NGOs, government, the society) to conduct detailed studies on the problem using panel data and continuous household surveys to have comprehensive productivity and food security status of the area for better intervention.

Conflict of interest

We declare that we have no conflict of interests.

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References

Agidew Abebe. (2017). The determinants of small-scale irrigation practice and its contribution on household farm income: The case of Arba Minch Zuria Woreda, Southern Ethiopia. *African Journal of Agricultural Research*, *12*(13), 1136-1143. https://doi.org/10.5897/AJAR2016.11739

Abebaw Abiyu, Mesfin Tebeje and Ermias Mekonnen. (2015). Determinants of small-scale irrigation utilization by smallholder farmers' in rift valley basin, Wolaita zone, Ethiopia. *Journal of Natural Sciences Research*, *5*(21), 1-6.

Abonesh Tesfaye, Ayalneh Bogale, Regassa E. Namara & Dereje Bacha (2011). The impact of small-scale irrigation on household food security: The case of Filtino and Godino irrigation schemes in Ethiopia. *Irrigation and Drainage Systems*, *22*(2), 145-158.

Gamachu Ayala, Beyisa Muleta and Tadele Geremu. (2018). Assessment of status of irrigation practice and utilization in western Hararghe zone, Oromia, Ethiopia. *Journal of Civil and Environmental Research*, *10*(5), 1-9.

Getaneh Kebede Ayele. (2011). *The impact of selected small-scale irrigation schemes on household income and the likelihood of poverty in the Lake Tana Basin of Ethiopia* (Doctoral dissertation, Cornell University).

Cochran, W. G. (1977). *Sampling techniques* John Wiley & Sons.

CSA (Central Statistical Authority) (2012). *Agricultural Sample Survey for Strategic Planning: Annual Report.* Federal Democratic Republic of Ethiopia Central Statistical Authority of Ethiopia: Annual Report, Addis Ababa, Ethiopia.

EPCC (Ethiopian Panel on Climate Change).(2015). *First Assessment Report, Working Group II; Climate Change Impact, Vulnerability, Adaptation and Mitigation IV.*

Gebrehaweria Gebregziabher, Gardiano, M. A., Simon Langan, J., &Namara, R. (2014). Economic analysis of factors affecting motor pump irrigation adoption in Ethiopia. *Academic Journal, Journal Of Development and Agricultural Economics*, *4*(3), 257-266.

Aynalem Gochera, Simon Shibru and Yisehak Kechero. (2020). Woody fodder species in three agro-ecological Parklands of Arba Minch Zuria Woreda, Gamo Gofa Zone, Southern Ethiopia. *International Journal of Biodiversity and Conservation*, *12*(1), 38-47. https://doi.org/10.5897/IJBC2019.1305

Gujirati, D. N., 1995. *Basic Econometrics. 3rd ed.* McGraw - Hill Co. New York

Hadush, Hailu. (2014). *Adoption and impact of micro irrigation on household income: the case of Eastern Tigray* (Doctoral dissertation, Mekelle University).

Jema Haji, Mohammed Aman and Tewodros Hailu. (2013). Impact analysis of Mede Telila small scale irrigation scheme on house poverty alleviation: Case of Gorogutu District in Eastern Haratghe Oromia National Regional State of Ethiopia. *International Journal of Development and Economic Sustainability*, *1*(1), 15-30.

Abera Ifa , Jema Haji, Jemal Yusuf. (2021). Determinants of use of small-scale irrigation and its effects on household food security: The case of Bako Tibe District, West Shoa, Ethiopia.

Adem Kedir. (2016). *Impact of Small-Scale Irrigation on household's food security in Fentale district east Showa zone of Oromia National Regional State, Ethiopia* (Doctoral dissertation, Haramayauniversity).

Temesgen Hirko Lebeta. (2017). *Participation in and Impact of Small-Scale Irrigation Practice on Household Income: The Case of Abay Chomen District of Oromia National Regional State, Ethiopia* (No. 634-2018-5524).

MoFED (Ministry of Finance and Economic Development) (2012). *Performance and Challenges on the Five Year Strategic Plan of Growth and Transformation:* Annual Report of MoFED, Addis Ababa, Ethiopia.

Muez, H. A. (2014). *The Impact of Small-Scale Irrigation on Rural household Food Security: The case of EmbaAlajeworeda* (Doctoral dissertation, Mekelle University).

Nhundu, K., Mushunje, A., Zhou, L., &Aghdasi, F. (2015).Institutional determinants of farmer participation in irrigation development post" fast-track" land reform program in Zimbabwe.*Journal of Agricultural Biotechnology and Sustainable Development*, *7*(2), 9.

Phogella, M. G., & Anbaw, W. S. (2022). Smallholder Farmers Participation in Small-Scale Irrigation: The Case of Emba Alaje District, Tigray regional state, Ethiopia.

Pokhrel, B. K., Paudel, K. P., &Segarra, E. (2018). Factors affecting the choice, intensity, and allocation of irrigation technologies by US cotton farmers. *Water*, *10*(6), 706.

Sinyolo, S. (2013).*The impact of smallholder irrigation and water security on household welfare: the case of Tugela Ferry irrigation scheme in KwaZulu-Natal, South Africa* (Doctoral dissertation).

Sinyolo, S., Mudhara, M., & Wale, E. (2014). The impact of smallholder irrigation on household welfare: The case of Tugela Ferry irrigation scheme in KwaZulu-Natal, South Africa. *Water SA*, *40*(1), 145-156.

Sithole, N. L., Lagat, J. K., &Masuku, M. B. (2014). Factors influencing farmers participation in smallholder irrigation schemes: The case of ntfonjeni rural development area. *Journal of Economics and Sustainable Development*, *5*(22), 157-167.

Abonesh Tesfaye, Ayalneh Bogale, Regassa E. Namara & Dereje Bacha. (2008). The impact of small-scale irrigation on household food security: The case of Filtino and Godino irrigation schemes in Ethiopia. *Irrigation and Drainage Systems*, *22*(2), 145-158.

USAID (United States Agency International Development). (2018). *Crop Availability and Market Study in Ethiopia*: Getachew, O., Nuri K., N., Raya, A., Basab, D., Worku, A., Francis, O. & Mildred, M. (2018).

Wang, J., Klein, K. K., Bjornlund, H., Zhang, L., & Zhang, W. (2015). Adoption of improved irrigation scheduling methods in Alberta: An empirical analysis. *Canadian Water Resources Journal/Revue canadienne des ressourceshydriques*, *40*(1), 47-61.

Petros Woldemariam, Yishak Gecho. (2017). Determinants of small-scale irrigation use: the case of Boloso Sore District, Wolaita Zone, Southern Ethiopia. *American Journal of Agriculture and Forestry*, *5*(3), 49-59.

Zekarias Zemarku, Mulumels Abrham, Elias Bojago and Tsegeye Bojago Dado**.** (2022). Determinants of Small-Scale Irrigation Use for Poverty Reduction: The Case of Offa Woreda, Wolaita Zone, Southern Ethiopia. *Advances in Agriculture*, *2022*.