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Factors affecting implementation of small-scale irrigation projects: the case of Ada'a district irrigation construction and scheme administration, East Showa, Oromia, Ethiopia

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Abstract

This study aimed to investigate the factors that affect the implementation of small-scale irrigation projects in the Adea district of Ethiopia. The study used a descriptive research design and employed both qualitative and quantitative methods to collect data from employees of ADICSA and other stakeholders. The findings revealed that various factors, including water-related factors, irrigation experts, stakeholders, consultants, contractors, budget/financial, socio-economic, irrigation management system, land topography, and irrigation technologies affect the implementation of small-scale irrigation projects in the study area. These factors negatively impact the effectiveness of irrigation work. The study recommended that Ada'a District Irrigation Construction and Scheme Administration allocate adequate budget, establish a well-structured irrigation management system and structure, regularly monitor and evaluate, attract and involve different stakeholders, hire skilled irrigation manpower, provide regular training for irrigation experts, agriculture and rural development officers, and farmers, use appropriate scheme design, and involve experienced irrigation consultants and scheme construction contractors for effective implementation of small-scale irrigation projects.

Keywords: *Irrigation, Small-scale irrigation, Irrigation projects, irrigation schem*

Introduction

Irrigation has been a critical agricultural practice for thousands of years, particularly in low-rainfall regions. Since World War II, it has driven socio-economic transformation, as evidenced by irrigated land producing 40% of the total grain output from just 20% of global arable land. In contrast, 80% of rain-fed land yields about 60% of grain output. Irrigation not only stabilizes harvest fluctuations but also facilitates multiple cropping and the use of advanced seeds and technologies. The global increase in irrigated land—117% from 1961 to 2009—has significantly contributed to food supply enhancement and poverty reduction. However, many regions, particularly in Africa, still have untapped irrigation potential that must be developed to ensure food security.

In Ethiopia, traditional irrigation has been practiced for centuries, with modern initiatives beginning in the mid-1960s. Despite the positive impacts of irrigation on agricultural productivity and rural income, small-scale irrigation (SSI) projects face mixed success rates. Knowledge sharing among development partners is essential for achieving food security and sustainable development, yet many donor-funded projects in sub-Saharan Africa struggle with financial and administrative challenges. While some SSI projects have improved market participation and asset accumulation for small farmers, others have underperformed, leading to skepticism among investors.A key issue is the imbalance between investments in irrigation infrastructure and the necessary operational and maintenance support. Donors often prioritize physical infrastructure over maintenance budgets, underestimating the limited technical and financial capacities of small farmers. This oversight can result in poorly managed irrigation schemes, leading to water theft, conflicts, and downstream waterlogging.

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Ethiopia's decentralization in the last decade has shifted decision-making in SSI development, but a lack of local capacity remains a barrier to effective implementation. Though the country is rich in water resources, challenges such as inadequate financial resources, inefficient water supply management, and poor governance hinder the realization of its full irrigation potential. In the Ada'a district, where this study focuses, irrigation schemes are poorly managed, contributing to low community livelihoods. The lack of detailed information on factors affecting project implementation complicates efforts to enhance the effectiveness of SSI development in reducing rural poverty. Most studies have overlooked key determinants of project performance, leaving critical gaps in understanding the successful implementation of SSI.

To address these challenges, this research aims to evaluate the factors hindering SSI project implementation in the Ada'a district. The specific objectives include:

- Identifying the basic factors affecting the implementation of small-scale irrigation work in the study area.
- Assessing the negative impacts stemming from unsuccessful SSI project implementation.
- Examining measures required to improve the effective execution of existing small-scale irrigation projects by the Ada'a District Irrigation Construction and Scheme Administration (ADICSA).

Review of Related Literature

Irrigation, an ancient agricultural practice, has been vital for civilization for thousands of years. Egypt, for instance, boasts the construction of the world's oldest dam around 5,000 years ago, facilitating both drinking water supply and agricultural irrigation. Basin irrigation, which originated in regions like the Nile Valley, China, and India, has played a crucial role in agricultural productivity throughout history. The Euphrates and Tigris plains have also been irrigated for millennia, establishing these areas as the breadbasket of the Sumerian Empire. Historically, irrigation development emerged as a response to unfavorable agricultural conditions, particularly in regions with low rainfall. Post-World War II, irrigation was promoted as a means of socio-economic transformation, with global irrigated areas reaching 94 million hectares by the 1950s. From 1950 to 1978, the expansion of irrigated land outpaced population growth, averaging an increase of 2.8% per year.

Trends of Irrigation in Ethiopia

Ethiopia's modern irrigation history is relatively brief, with limited research and data available on its development. While irrigation has been practiced for centuries, formal modern irrigation initiatives began in the 1950s through collaboration between the Ethiopian government and foreign investors, focusing on commercial farms in the Awash Valley. Ancient practices of irrigated seed cultivation trace back to the Axum Empire around 1000 BC, highlighting that irrigation is deeply rooted in Ethiopian culture. In the 1970s, the Ethiopian Ministry of Agriculture initiated modern small-scale irrigation (SSI) practices to combat the widespread droughts that led to famine. This period marked a significant effort to enhance irrigation practices and support local farmers.

Modern Irrigation Development and Its Potential

Although irrigation has ancient origins in Ethiopia, modern efforts have only gained traction since the late 20th century. The establishment of irrigation schemes in the Awash Valley and Lower Rift Valley was facilitated by private commercial interests, particularly for cash crops. The Ministry of Agriculture further expanded SSI in response to droughts and food security concerns.

Ethiopia is endowed with substantial water resources, often referred to as Africa's water tower, with 12 river basins holding around 122 billion cubic meters of surface water and 2.6 billion cubic meters of potential groundwater. Despite this, the actual irrigated land remains minimal compared to its irrigation potential, estimated at 3.7 million hectares. Various challenges hinder irrigation development in Ethiopia, including deep river gorges, inadequate capital, uneven water resource distribution, and previously lacking water resource policies. However, recent efforts are underway to strengthen ties with neighboring countries for joint water management.

Irrigation Water Control and Management

Effective water management is essential for optimizing irrigation practices. It encompasses the planning, distribution, and use of irrigation water, focusing on both quantity and quality. Successful irrigation relies on proper operation and maintenance, which are critical for achieving desired agricultural outcomes. Poor water management often leads to inefficiencies, inequitable water distribution, and inadequate cooperation among farmers. The Ethiopian government recognizes the importance of water management in enhancing agricultural productivity. An integrated approach to irrigation management involves not only technical aspects but also social dimensions, such as decision-making and conflict resolution among stakeholders.

Future of Irrigation Programs in Ethiopia

The Ethiopian Irrigation Development Plan emphasizes the development of small-scale irrigation systems, prioritizing capacity building and project implementation. Plans are in place to develop 274,612 hectares of agricultural land under medium and large-scale irrigation schemes, with a target of 5.1 million hectares by the end of the Water Sector Development Program. However, careful consideration is necessary to prevent adverse environmental and public health effects associated with irrigation expansion.

Conceptual Framework of the Study

A conceptual framework serves as a model for understanding the relationships between various factors affecting research outcomes. In this study, the dependent variable is the implementation of small-scale irrigation projects, while the independent variables include environmental factors, technology, irrigation expertise, management practices, stakeholder involvement, socio-economic conditions, and water availability. This framework aims to identify key elements influencing the success of SSI projects in Ethiopia.

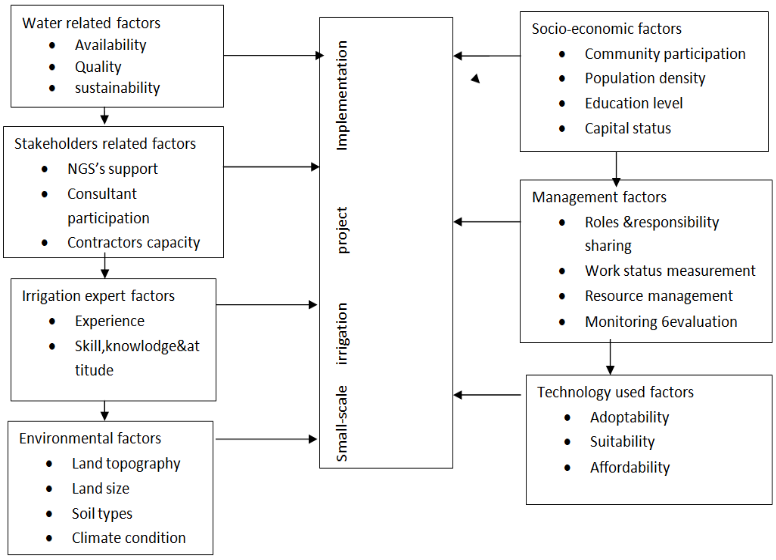

Figure 1. Research Framework, Source: Adopted by researcher, June 2022

Research methodology

Description of the study area

The study was conducted in the Ada'a district, which is situated in the East Tulama Area of the Oromia National Regional State in central Ethiopia. The district is located southeast of Addis Ababa and its capital, Bishoftu, is 47 km and 52 km away from Addis Ababa and Adama, respectively. The district shares borders with Ginbichu, Liban-chuqala, Lume, and Akaki Woredas. The district's geographical coordinates are 56'19"N latitude and 380 48'21"E – 390 11'15"E longitude, with an elevation range of 1,700m – 2,920m.a.s.l. The area receives an average rainfall of 851 mm per year, and the average temperature is around 18˚C. The primary soil type in the area is Pellic Vertisols, according to DARC in 2010. The Ada'a Woreda covers an area of 89,436.6512 ha or 894.3685km2, of which agricultural land accounts for 71,923 ha or 80.42%.

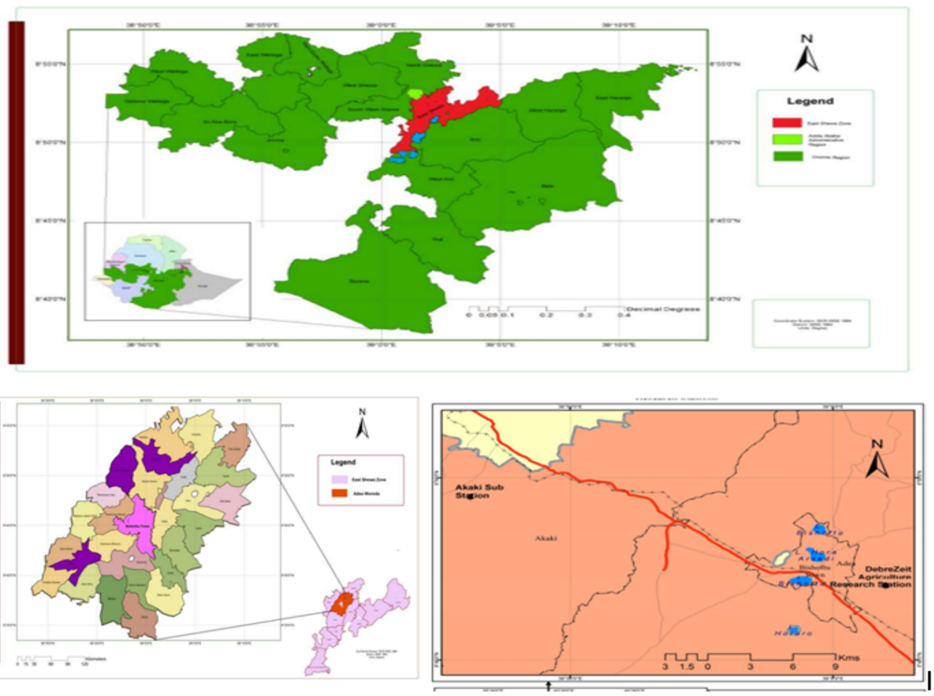

Figure 2. Map of Ada'a Woreda

Research design and approach

The research design refers to the overall plan that a researcher chooses to use to effectively address the research problem by integrating the different components of the study in a coherent and logical manner. In this study, a descriptive research design was adopted, which aims to find out the "what, where, and how" of a phenomenon without interfering with it. The descriptive design was used to describe the selected sample and obtain information on how the data is clustered around a central value, as well as to determine the frequency with which something occurs or the relationship between variables. The descriptive design is a scientific method that involves observing and describing the behavior of a subject without influencing it in any way, and it provides a great amount of description and detail about a particular case. Therefore, the descriptive research design was selected for this study to determine the factors that affect the implementation of small-scale irrigation projects in the study area.

Target population

In this study, the target population was determined based on the availability of data acquired from various sources, such as the Ada'a district Agricultural and Rural Development Office, Ada'a Irrigation Construction and Scheme Management Office, irrigation project contractor and consultant professionals, farmer households participating in irrigation works, and other required governmental institutions and documents such as reports and project documents. The study focused on the Ada'a Woreda irrigation projects, which are located in the Woreda, and the total population of the study area was 95.

Sampling procedures and Techniques

The researchers employed simple random sampling to select respondents from each stratum. They used random sampling techniques to select respondents from representative irrigation projects in order to obtain information from the required target population. The questionnaire was distributed to each irrigation project office, and interviews were conducted with selected members of the Ada'a district Agricultural and Rural Development Office, Ada'a Irrigation Construction and Scheme Management Office, irrigation project contractor professionals, irrigation project consultants, and farmer households at the sites. The responses of the selected participants were collected and analyzed.

Sampling size

To determine the sample size, the researchers used Slovin's formula, which allows the researcher to sample the population with a desired degree of accuracy. The formula provides an estimate of the sample size (n) needed to ensure a reasonable level of accuracy, using the known population size (N) and the acceptable error value (e). For example, a confidence level of 95 percent (giving a margin error of 0.05) may be accurate enough. Based on Slovin's formula, the total sample size for this study was 76 respondents, which was calculated using the following formula.

$$n = \frac{N}{1+Ne^2}$$

where n = Number of samples, N = Total population (95) and e = Error tolerance at 95% is (0.05).

n= 95/1+95*0.05*0.05=**76** Respondents

Data Types and Sources

In order to investigate the research objectives, both secondary and primary relevant data sources were collected and analyzed. Questionnaires and interviews were used as primary data sources while document review was used as a secondary data source.

Data Instrumentation/Data Collection Techniques

In this study, a questionnaire was used as the research instrument to gather descriptive information from a large sample in a relatively short time. The questionnaire consisted of both open-ended and closed-ended questions. The open-ended questions were designed to encourage respondents to provide detailed and comprehensive responses without feeling limited in their explanation, while the closed-ended questions provided limited response options. The use of questionnaires was intended to save time and money and facilitate easier analysis, as the responses were in an immediately usable form. The questionnaire had two parts: Part one contained demographic information about the respondents, while Part two used Likert scale items to investigate the extent to which each research variable influenced the performance of irrigation projects.

Data analysis techniques

The collected data was analyzed using both quantitative and qualitative analysis methods. Quantitative data was analyzed using descriptive statistics such as frequencies, percentages, mean, and standard deviation. The data was coded and entered into SPSS for easy analysis. Open-ended questions were analyzed using content analysis. Qualitative data analysis was used to see the relationships between variables. Comparative analysis was carried out to determine the factors that influenced the implementation of SSI projects in the study area. The findings were presented in tables and graphs, and conclusions and recommendations were made based on the results of the study.

Results and discussion

Response rate of data gathering basics

In the research process, 76 questionnaires were distributed and all were returned. Additionally, five randomly selected respondents were interviewed from each group of management and irrigation experts. The questionnaire was designed to answer the research questions regarding the factors affecting irrigation implementation, negative impacts of unsuccessful irrigation, and measures for effective irrigation implementation. The Likert scale was used to rate each statement. The questionnaire had two major sections: the first section gathered information about the respondents, while the second section presented the analysis and interpretation of the main data.

Respondents Profile /Demographic data

This section summarizes the collection and analysis of general information from respondents using a structured questionnaire. The questionnaire included five questions about the respondents' sex, age, education qualification, working experience, and position.

Gender of the participants

The participants were asked about their gender in the survey, the result shown in the following table.

Table 1.Gender of respondents

Gender		Frequency	Percent
Valid	Female	23	30.26
	Male	53	69.73
	Total	76	100.0

Source: SPSS Output of the Research Data, August 2022

Table 2 displays the gender distribution of the participants, with 53 male respondents (69.73% of the sample) and 23 female respondents (30.26% of the sample). These results suggest that ADICSA needs to prioritize gender issues in their irrigation activities.

Age of Respondents

The participants were asked about their age in the survey, the result is shown in the following table.

Table 2. Age of respondents

		Frequency	Percent
Valid	Less than 25	9	11.8
	26-35	27	35.5
	36-49	23	30.3
	50 and above	17	22.4
	Total	76	100.0

Source: SPSS Output of the Research Data, August, 2022

AccordingAs seen in the table, the largest group of respondents (35.5%) falls within the age range of 26-35 years, followed by those aged 36-49 years (30.3%). The remaining respondents were under the age of 25 (11.8%) or over 50 years old (22.4%). The fact that the majority of respondents are aged 26-35 indicates that a young population characterizes the sample.

Educational qualification of participants

The participants were asked about their Educational level in the survey, the result was shown in the following table.

Table 3. Education Level of respondents

Education level		Frequency	Percent
Valid	Below diploma	10	13.2
	Diploma	21	27.6
	first degree	31	40.7
	Masters degree and above	14	18.4
	Total	76	100.0

Source: SPSS Output of the Research Data, August 2022

Participants were asked about their highest level of education, and the results show that the majority (40.7%) have a first degree, followed by those with a diploma (27.6%) and those with a master's degree (18.4%). These findings suggest that ADISCA needs to upgrade the educational level of its staff to improve the implementation of their irrigation project activities.

Working years of the participants

The participants were asked about their working experience in the organization under study in the survey, the result is shown in the following table.

Table 4. Working year of the respondents

Experience		Frequency	Percent
Valid	less than 5 years	16	21.0
	6 -10 years	27	35.5
	11-15 years	23	30.2
	above eleven years	10	13.1
	Total	76	100.0

Source: SPSS Output of the Research Data, August 2022

The study sought to determine the work experience of respondents by asking them to indicate their level of experience in irrigation work. Participants were given five options to choose from. The results showed that the majority of respondents (35.5%) have 6-10 years of work experience in irrigation, followed by those with 11-15 years of experience (30.2%). Participants with less than five years of experience accounted for 21.0% of the total participation, while those with more than 11 years of experience made up 13.1%. These findings suggest that there is a lack of experienced personnel in the field of irrigation project work.

Current Position of Respondents

Table 5. Job position of respondents

Job position		Frequency	Percent
Valid	Irrigation Project Manager	4	5.3
	Irrigation Scheme construction contractor	5	6.6
	Irrigation project consultant	5	6.6
	irrigation expert	23	30.3
	Agricultural &Natural Resource Management Officer	27	35.5
	Irrigation work supporting team, farmers' households, and others	12	15.7
	Total	76	100.0

Source: SPSS Output of the Research Data, August

2022The table above shows the working positions of participants in ADICSA, which include irrigation project managers, irrigation scheme construction contractors, irrigation project consultants, irrigation experts, agricultural and natural resource management officers, irrigation work supporting teams, farmer households, and others. The results indicate that the majority of participants (35.5%) hold the position of agricultural and natural resource management officer, followed by irrigation experts (30.3%). The remaining positions each account for 5.3% or 6.6% of the total participation. These findings suggest that a significant proportion of participants are in management or expert positions related to irrigation and agriculture.

Factors affecting small-scale irrigation project work

In this section, respondents were asked to rate their level of agreement on eleven factors that may affect the implementation of irrigation projects. These factors included the availability and quality of water, the probability of water shortages, the skill and experience of irrigation experts, stakeholder participation, scheme design accuracy, technical advice from irrigation consultants, construction work quality, socio-economic fitness, monitoring and evaluation systems, land topography suitability, and irrigation technology suitability and affordability. The responses to these questions are presented in Table 7.

Table 6. Responses regarding basic factors affecting Small Scale Irrigation Project work

No.	**Items Description**	**Frq.**	**Level of Agreement**					Mean	Std.D
		%	SA	A	U	D	SD		
1.	There is problem regarding sufficient water source availability, water volume and water quality used for small-scale irrigation work under your scheme.	76	20	24	13	16	3	2.26	1.063
		%	26.3	31.6	17.1	21.1	3.9		
2.	There is no probability of irrigation water cut off or water shortage due to different factors.	76	24	15	17	15	5	2.50	1.301
		%	31.6	19.7	22.4	19.7	6.6		
3.	Educational level , skill and experience of the irrigation expert is high to conduct irrigation activities efficiently and effectively	76	3	16	17	23	17	2.54	1.171
		%	3.9	21.1	22.4	30.3	22.4		
4.	There is active participation of different stake holders on Small-scale irrigation projects' for its successful implementation	76	2	7	21	23	23	2.24	1.069
		%	2.6	9.2	27.6	30.3	30.3		
5.	There was appropriate scheme design by considering the environmental context and applied on the ground based on this design.	76	4	12	15	20	25	2.34	1.239
		%	5.3	15.8	19.7	26.3	32.9		

No.	Items Description	Frq.	Level of Agreement					Mean	Std.D
		%	SA	A	U	D	SD		
6.	Irrigation consultants are participating on giving technical advice and follow up accordingly on irrigation implementation activities.	76	4	19	17	20	16	2.67	1.215
		%	5.3	25.0	22.4	26.3	21.1		
7	Contractors are implementing scheme construction work based on the pre-designed design, timely and with high quality work.	76	10	14	19	20	13	2.84	1.286
		%	13.2	18.4	25.0	26.3	17.1		
8	Socio -economy of the communities of the farmers are fit with the irrigation project system being implemented	76	1	25	19	16	15	2.75	1.156
		%	1.3	32.9	25.0	21.1	19.7		
9	There are well structured management system by management team to follow up, monitoring and evaluation of work process toward effective implementation irrigation project scheme	76	3	15	12	25	21	2.39	1.201
		%	3.9	19.7	15.8	32.9	27.6		
10	The land topography of the area is suitable for the scheme construction and SSI implementation	76	4	11	20	22	19	2.46	1.171
		%	5.3	14.5	26.3	28.9	25.0		
11	The new irrigation technologies that are available are suitable, affordable, and easy for the farmers to adopt and implement the irrigation work on their farms.	76	2	10	17	18	29	2.18	1.163
		%	2.6	13.2	22.4	23.7	38.2		
	Aggregate Mean							2.47	1.185

Source: SPSS Output of the Research Data, August 2022

Table 7 shows the responses of participants regarding the availability, volume, and quality of water for irrigation. Of the respondents, 20 (26.3%) strongly agreed and 24 (31.6%) agreed that water source, volume, and quality were adequate. 13 (17.1%) were neutral, while 16 (21.1%) disagreed and 3 (3.9%) strongly disagreed. The mean rating was 2.26, with a standard deviation of 1.063. Based on these responses, 44 (57.9%) of participants perceived water availability positively, 13 (17.1%) had a moderate perception, and 19 (25.0%) perceived water availability negatively. These findings suggest that the problem of water availability, volume, and quality affects the implementation of small-scale irrigation projects in the study area.

The table shows the responses of participants to eleven statements related to factors affecting the implementation of small-scale irrigation projects. The statements included water availability, probability of water cut-offs, skill and experience of irrigation experts, stakeholder participation, scheme design accuracy, technical advice from irrigation consultants, construction work quality, socio-economic factors, management system, land topography suitability, and irrigation technology suitability. Participants rated their level of agreement on a Likert scale, with mean ratings ranging from 2.18 to 2.84. The majority of respondents perceived water availability, stakeholder participation, and socio-economic factors negatively, while irrigation technology and land topography suitability were perceived negatively by over 50% of participants. The skill and experience of irrigation experts, scheme design accuracy, technical advice from irrigation consultants, construction work quality, and management systems were also identified as problematic. Overall, the findings suggest that these factors affect the implementation of small-scale irrigation projects in the study area.

The table shows that respondents generally disagree with the statements related to water availability, water cut-offs, educational level and skill of irrigation experts, stakeholder participation, scheme design accuracy, technical advice from irrigation consultants and contractors, socio-economic factors, management systems, land topography, and irrigation technologies. The mean score of 2.47 indicates an overall negative perception of these factors and their impact on the implementation of small-scale irrigation projects in the study area. The lowest and highest mean scores of 2.24 and 2.84, respectively, reveal the statements with the least and most agreement. The interviews with the respondents further revealed that there were various challenges affecting the implementation of SSIP, such as lack of collaboration among stakeholders, poor quality of construction materials, conflicts among users over water schedules, sedimentation of soil in reservoirs, lack of skills in operation and maintenance of schemes, insufficient inputs for scheme construction, absence of electric power, expensive fuel costs, and inadequate farming practices under irrigation conditions.

Negative impacts created due to ineffective irrigation implementation at ADICSA

Table 8 presents the responses of respondents to statements related to the negative impacts of the unsuccessful implementation of SSIP at ADICSA. Participants rated their level of agreement on a Likert scale regarding the following issues: decreased production and increased food security problems, deterioration of water quality leading to soil fertility pollution, lack of balanced diet causing health problems, decreased feed for animals and reduced animal rearing, wastage of resources required for irrigation work, loss of economic returns, and a decrease in the life expectancy and sustainability of the irrigation system.

Table 7 -Responses regarding Negative impacts being created due to the unsuccessful implementation SSIP work

No.	Items Description	Frq.	Level of Agreement					Mean	Std.D
		%	SA	A	U	D	SD		
1.	Production and productivity decreased and caused household status of food security problem as well as poverty increased	76	20	13	23	11	9	2.58	1.359
		100	26.3	17.1	30.3	14.5	11.8		
2.	Water quality is became deteriorate and create water logging which may pollutes the soil fertility	76	24	34	12	4	2	2.03	1.966
		100	31.6	44.7	15.8	5.3	2.6		
3.	Creates food shortage which causes lack of balanced diet and health status of the communities exposed to risk.	76	30	17	1	20	8	2.08	1.080
		100	39.5	22.4	1.3	26.3	10.5		
4.	Animal raising and feeds that used for them became minimized.	76	20	24	13	16	3	2.66	1.281
		100	26.3	31.6	17.1	21.1	3.9		
5.	There is Wastage of natural resources such as fresh water, soil fertility, and the energy required because of scheme systems are not properly implemented	76	24	20	21	8	3	2.43	1.289
		100	31.6	26.3	27.6	10.5	3.9		
6.	There is Loss of economic growth return from irrigation activities on livelihood of farmers and communities of the area	76	27	12	25	10	2	2.17	1.159
		100	35.5	15.8	32.9	13.2	2.6		
7	Irrigation expenditure cost increases for its amendments including maintenance and corrective action of.	76	24	18	12	14	8		
		100	31.6	23.7	15.8	18.4	10.5	2.63	1.413
8	Reduces irrigation system life expectancy and sustainability of irrigation project activities in the area.	76	23	21	18	9	6		
		100	30.3	27.6	23.7	11.8	6.6	2.37	1.220
	Aggregate mean							2.37	1.346

Source: SPSS Output of the Research Data, August, 2022

Table 8 shows that for the variable related to production and food security, 20 (26.3%) respondents strongly agreed, 13 (17.1%) agreed, 23 (30.3%) neither agreed nor disagreed, 11 (14.5%) disagreed, and the remaining 9 (11.8%) strongly disagreed, with a mean score of 2.58 and a standard deviation of 1.359. Based on these results, 33 (43.4%) respondents perceived the impact of unsuccessful implementation of SSIP on production and food security positively, 23 (30.3%) perceived it moderately, and 20 (26.3%) perceived it negatively. This indicates that unsuccessful implementation of SSIP leads to a decrease in yield food production and creates food insecurity among some farmers' households in the community.

Table 8 shows respondents' level of agreement on the negative impacts of the unsuccessful implementation of SSIP. The results indicate that a majority of respondents perceived the impact of unsuccessful implementation negatively for all variables. Specifically, the unsuccessful implementation of SSIP led to a decrease in yield food production and food insecurity for some farmers' households, water quality deterioration and soil fertility pollution, lack of balanced diet and health problems, decreased feed for animals and reduced animal rearing, wastage of resources required for irrigation work, loss of economic returns, irrigation cost expenditure for maintenance and corrective action, and a decrease in the life expectancy and sustainability of the irrigation system. Overall, the results suggest that the implementation of SSIP faced significant challenges, which had negative impacts on the community.

The results from the Likert scale responses in Table 8 indicate that, on average, respondents strongly agreed that unsuccessful implementation of SSIP had negative impacts on production yield, water quality, health of farmers and communities, animal raising, natural resources, economic growth return, irrigation cost, and sustainability of small-scale irrigation at ADCSA. The mean score of 2.37 suggests an overall negative perception of the impacts of unsuccessful implementation. The range of mean scores, from 2.03 to 2.66, represents the items with the least and most agreements, respectively. Additionally, interviews with participants revealed that ineffective SSIP had negative impacts such as total project failure, an increase in farmers' household poverty, a decrease in country economic development, an increase in yield cost price due to yield decrease, and the creation of conflicts and lack of acceptance between farmers and irrigation experts.

Measures required to improve implementation of SSIP at ADICSA

In Table 9, respondents' level of agreement regarding measures required to improve the implementation of irrigation projects is presented. Participants were asked to rate their level of agreement on a Likert scale for various statements, including conducting water quality tests, follow-up and monitoring capacity development, training and capacity building for concerned bodies, mobilizing farmers' community members, providing adequate input supply resources needed for irrigation, participating skilled manpower, allocating adequate budget, and attracting different stakeholders for effective small-scale irrigation projects.Table 8. Responses regarding measures required improving the implementation of existing small scale irrigation project schemes by ADICSA

Table 8. Responses regarding measures required improving the implementation of existing small scale irrigation project schemes by ADICSA

No.	**Items Description**	Frq.	**Level of Agreement**					**Mean**	**Std.D**
		%	**SA**	**A**	**U**	D	SD		
1.	Conducting water quality test for each water source for production as well as successful implementation of small scale irrigation project	76	28	21	3	10	14	2.00	1.095
		100	36.8	27.63	3.9	13.16	18.4		
2.	Follow up and monitoring capacity development of districts' irrigation scheme office.	76	24	19	16	13	4	2.70	1.178
		100	31.6	25.0	21.1	17.1	5.3		
3.	Skill capacity training for districts Agricultural and Rural development office as well as irrigation staffs on the supporting of software and hardware aspects of scheme management.	76	21	19	16	15	5	2.78	1.218
		100	27.6	25.0	21.1	19.7	6.6		
4.	Mobilizing and giving training for Farmers Community members are and on how to participate on irrigation project activities and manage schemes as their own responsibilities.	76	27	20	10	10	9	3.14	1.197
		100	35.5	26.3	13.2	13.2	11.8		
5.	Adequate irrigation resources input supply are given and managed accordingly and timely for the implementation of irrigation project	76	20	18	14	14	10	3.08	1.334
		100	26.3	23.7	18.4	18.4	13.2		
6.	Recruiting and participating educated and skilled man power on planning, designing ,consulting and managing , on SSIP implementation activities	76	24	21	21	7	3	2.59	1.387
		100	31.6	27.6	27.6	9.2	3.9		
7	Allocating adequate budget for initial project scheme construction	76	32	21	14	6	3	2.93	1.087
		100	42.1	27.6	18.4	7.9	3.9		
8	Initiating and attracting different stake holders to participate on SSIP for successful implementation of irrigation project.	76	21	22	14	11	8		
		100	27.6	28.9	18.4	14.5	10.5	2.78	1.256
	Aggregate mean							3.42	1.219

Source: SPSS Output of the Research Data, August, 2022

Table 9 presents the respondents' level of agreement on various measures required to improve the implementation of SSIP by ADICSA. The first variable in the table concerns irrigation water quality testing. Results show that 64.4% of respondents perceived positively, 3.9% were neutral, and 32% perceived negatively regarding the importance of irrigation water quality testing that fits the production. Specifically, 36.8% of respondents strongly agreed and 27.6% agreed that irrigation water quality testing is required to improve the implementation of SSIP by ADICSA, while 18.4% strongly disagreed and 13.16% disagreed. The mean score for this variable was 2.00, indicating an overall agreement that irrigation water quality testing is necessary for SSIP implementation.

Table 9 presents the respondents' level of agreement on various measures required to improve the implementation of SSIP by

ADICSA. The measures include conducting water quality tests, follow-up and monitoring, skill capacity training, mobilizing communities, providing adequate input supply resources, recruiting educated and skilled manpower, allocating adequate budget, and initiating stakeholders. The responses were rated on a Likert scale. Results show that follow-up and monitoring, skill capacity training, mobilizing communities, adequate input supply resources, recruiting educated and skilled manpower, allocating adequate budget, and initiating stakeholders are required to improve the implementation of SSIP by ADICSA, as evidenced by the positive perception rates. However, there were still some respondents who perceived the measures negatively or were neutral about them. Overall, the measures highlighted in Table 9 represent important steps for improving the implementation of SSIP by ADICSA.

The results presented in Table 9 indicate that respondents strongly agreed and agreed with various measures required to improve the implementation of irrigation projects at the study area. These measures include conducting water quality testing, follow-up and monitoring, skill capacity training, mobilizing and giving training to farmers, providing adequate irrigation resources input supply, recruiting and participating educated and skilled manpower, allocating adequate budget, and initiating and attracting different stakeholders. The aggregate mean score for these measures was 3.42 with a standard deviation of 1.219, indicating a high level of agreement among the respondents. Additionally, interviews with employees of ADICSA and other respondents revealed that other measures required for the improvement of SSIP implementation include providing a full irrigation package system for farmers, adequate budget allocation, hiring the right personnel, regular maintenance of scheme canals, good management system, participatory approach, using cropping calendar, seed selection, timely supplying of agro-inputs, and conducting prior research in the project implementation area.

In conclusion, the study highlighted a range of critical factors influencing the effective implementation of small-scale irrigation projects (SSIP) in the study area. These factors encompassed water-related issues, expertise of irrigation professionals, stakeholder engagement, scheme design, consultancy services, contractor performance, socio-economic conditions, management systems, land availability, and irrigation technology. The research also underscored the adverse consequences of unsuccessful SSIP implementation, which included compromised water quality, reduced agricultural yields, disrupted animal feed production, resource wastage, diminished economic returns, increased irrigation costs, and weakened irrigation sustainability and expectancy. To address these challenges and enhance SSIP implementation, the study recommends that ADICSA prioritize measures such as conducting irrigation water quality assessments, implementing consistent follow-up and monitoring, providing skill development training, mobilizing community participation, ensuring sufficient irrigation resource inputs, recruiting qualified and skilled personnel, allocating adequate budgets, and fostering stakeholder engagement.

Recommendations

To enhance small-scale irrigation project (SSIP) implementation, stakeholders should collaborate to address key challenges, improve project performance, and strengthen cooperation. The government and ADICSA should prioritize farmer training, enhance input supply and credit services, and establish output marketing institutions. Continuous monitoring and evaluation of irrigation schemes are essential for effective planning and maintenance. Capacity building for staff and farmers, alongside empowering farmers with technical irrigation skills and providing infrastructure like water reservoirs and solar pumps, is crucial for sustainability. Further studies on irrigation structure rehabilitation and maintenance are recommended.

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