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Research Article

# Factors Affecting the Adoption of Micro-Scale Irrigation Program Among Tea Farmers in Burere Sub-County, Buhweju District

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## Abstract

The study assessed the factors influencing the adoption of micro-scale irrigation systems among tea farmers in Burere Sub-County, Buhweju District. It was guided by three objectives which were to; analyze the factors affecting the adoption of micro-scale irrigation programs among tea farmers, establish the effect of micro-scale irrigation programs on tea production among farmers and establish strategies for increasing the adoption of micro-scale irrigation systems to improve tea production and farmer livelihoods. The study employed a descriptive cross-sectional research design and primary data was collected from 300 respondents. The researcher used questionnaire and focus group discussion guide to collect primary data. The data was analysed using SPSS version 22.0. The study concludes that multiple interlinked strategies significantly influence the adoption of micro-scale irrigation systems among tea farmers. Access to extension services, financial support, and training programs were the most influential strategies to adoption. The study recommends that; there is a need to deploy more extension workers and ensure frequent farmer contact to improve awareness and skills, there is a need to partner with microfinance institutions to provide low-interest loans for irrigation equipment, implement public-private partnerships to lower costs through subsidies or bulk purchases, invest in community dams, tanks, or boreholes near tea-growing zones and support the formation and training of farmer cooperatives/farmer groups to promote peer-based irrigation adoption.

## Keywords

Adoption, Micro-Scale Irrigation, Tea Farmers, Burere Sub-County, Buhweju District

## 1. Introduction

On global perspective, the adoption of micro-scale irrigation systems, such as drip and sprinkler irrigation, has gained global importance due to their potential to enhance water-use efficiency, improve crop yields, and ensure food security [15]. These systems are particularly crucial in regions facing water scarcity and unpredictable rainfall patterns. However, the adoption rate varies significantly across the globe, influenced by factors such as cost, access to technology, knowledge, and governmental policies [2].

In the United States, the adoption of micro-scale irrigation has been largely driven by the need to conserve water resources and enhance agricultural efficiency. The United. States Department of Agriculture (USDA) has implemented various programs to support farmers in adopting efficient irrigation

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technologies [21]. For example, the Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to help farmers implement practices that conserve water, including micro-irrigation systems [21]. Despite these efforts, the adoption of micro-scale irrigation systems varies across different states. In arid regions like California, where water scarcity is a significant issue, micro-irrigation is more widely adopted [16]. The state's agricultural sector relies heavily on drip and sprinkler systems to optimize water use for high-value crops, including tea. However, in regions with more abundant water resources, such as the Midwest, the adoption of these systems is less prevalent [16].

In Africa, the adoption of micro-scale irrigation is critical for addressing the challenges posed by climate change, such as erratic rainfall and prolonged droughts [17]. Despite its potential benefits, adoption rates remain low across the continent, primarily due to financial constraints, lack of technical expertise, and inadequate infrastructure [17]. Moreover, the small-scale nature of farming in Africa, coupled with limited access to credit facilities, hampers the widespread use of these irrigation technologies. For example, in Kenya, the adoption of micro-scale irrigation among smallholder farmers has been influenced by factors such as access to markets, the availability of water resources, and the level of farmers' education [11]. Programs such as the Kenya Agricultural Productivity and Sustainable Land Management Project (KAPSLMP) have been instrumental in promoting the adoption of these systems by providing training and financial support to farmers [11]. However, challenges such as the high cost of installation and maintenance continue to limit their uptake.

In Ethiopia, the government has been actively promoting micro-irrigation as part of its strategy to improve agricultural productivity. However, the adoption rate is still low, with studies indicating that only a small percentage of farmers use these technologies. Factors such as the high cost of irrigation equipment, lack of access to credit, and insufficient extension services are significant barriers [1].

In Uganda, agriculture is a key sector, contributing significantly to the country's Gross Domestic Product (GDP) and employing a large portion of the population. However, like many other African countries, Uganda faces challenges such as erratic rainfall, which affects agricultural productivity. The adoption of micro-scale irrigation could be a solution to these challenges, but the uptake has been slow [12].

Factors influencing the adoption of micro-scale irrigation in Uganda include the cost of irrigation systems, access to credit, farmers' knowledge and awareness, and the availability of water resources. A study by Nsubuga et al. highlighted that while there is a growing awareness of the benefits of micro-scale irrigation, the high initial costs and limited access to financial resources are major barriers to adoption [14]. Additionally, the lack of technical expertise and insufficient support from extension services hinder the effective implementation of these systems.

In recent years, the Ugandan government, in collaboration with various development partners, has initiated programs to promote the adoption of micro-irrigation systems among smallholder farmers [8]. For instance, the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF) has launched initiatives aimed at increasing the adoption of irrigation technologies to enhance agricultural productivity and ensure food security [8]. However, these efforts need to be scaled up to reach more farmers and address the challenges that limit adoption.

Buhweju District, has a landscape suitable for tea cultivation but faces similar challenges related to rainfall variability and the need for effective water management. Tea farmers in Buhweju are predominantly smallholders who rely heavily on rain-fed agriculture. The introduction of micro-scale irrigation systems has been promoted as a way to enhance tea production and ensure consistent yields [14]. In Buhweju district, tea farmers have been introduced to simple irrigation techniques, such as rainwater harvesting combined with low-cost drip systems. These systems are particularly suited to the hilly terrain and are relatively affordable for smallholder farmers [14]. However, the adoption of these systems is still in the early stages, with only a small percentage of tea farmers currently using them.

The challenges faced by tea farmers in Buhweju are similar to those in Kasese, including the high cost of irrigation equipment, limited access to financial resources, and a lack of technical support. Additionally, the district's remote location and poor infrastructure make it difficult for farmers to access markets, which reduces their income and ability to invest in irrigation systems [10]. The limited availability of water resources during dry periods also poses a challenge, as farmers need to ensure a consistent water supply to make irrigation viable. Programs aimed at promoting micro-scale irrigation among tea farmers in Buhweju have focused on providing training and raising awareness of the benefits of these system [10]. However, the success of these initiatives has been mixed, with some farmers hesitant to adopt new technologies due to the perceived risks and uncertainties involved [10, 11]. More support is needed in the form of subsidies, access to affordable credit, and improved extension services to encourage widespread adoption.

## 2. Problem Statement

In an ideal scenario, tea farmers in Burere Sub-County, Buhweju District, would have access to reliable and efficient micro-scale irrigation systems to ensure consistent tea production throughout the year. These systems would mitigate the impact of rainfall variability, leading to stable tea yields and improved incomes for smallholder farmers. Farmers would be well-trained in using and maintaining irrigation technologies, with access to affordable credit and government support to facilitate the adoption of these systems [10, 14].

The reality in Burere Sub-County is that the adoption of micro-scale irrigation among tea farmers is still limited. The region's hilly terrain and reliance on rain-fed agriculture make tea production vulnerable to erratic rainfall patterns, exacerbated by climate change. Although some tea farmers have been introduced to basic irrigation techniques, such as rainwater harvesting combined with drip irrigation, the high costs of installation and maintenance, limited access to credit, and a lack of technical knowledge hinder widespread adoption [10, 14]. Additionally, underdeveloped infrastructure, poor road networks, and limited market access further constrain the economic viability of investing in irrigation systems [5].

Consequently, tea yields remain inconsistent, leading to fluctuating incomes and increased vulnerability to poverty. Smallholder tea farmers, who make up the majority of the farming population, struggle to secure the necessary resources and support to adopt and sustain these irrigation technologies [19]. If the barriers to adopting micro-scale irrigation systems were addressed, tea farmers in Burere Sub-County could achieve more stable and higher tea yields, leading to increased incomes and improved livelihoods. Widespread adoption of these systems would enhance the resilience of tea farming to climate variability, ensuring that farmers can maintain production during dry spells. With adequate training and support, farmers would efficiently use and maintain irrigation systems, improving their productivity and profitability [10, 14].

Despite the potential benefits of micro-scale irrigation, a significant knowledge gap exists regarding the specific factors that influence adoption among tea farmers in Burere Sub-County. While some research has been conducted on irrigation system adoption in other parts of Uganda, there is limited empirical evidence on the unique challenges and opportunities faced by tea farmers in this sub-county. Understanding the socio-economic, technical, and environmental factors that affect the adoption of micro-scale irrigation in Burere Sub-County, including the roles of local infrastructure, access to credit, extension services, and farmer perceptions, is crucial. Addressing this knowledge gap provided insights to inform targeted interventions and policies, promoting the adoption of micro-scale irrigation systems and ultimately leading to improved tea production and livelihoods in the region [5, 19].

## 3. Research Objectives

The general objective of the study was to; assess the factors influencing the adoption of micro-scale irrigation systems among tea farmers in Burere Sub-County, Buhweju District. The specific objective was to; establish strategies for increasing the adoption of micro-scale irrigation systems to improve tea production and farmer livelihoods.

## 4. Justification of the Study

Tea production in regions like Burere Sub-County is highly vulnerable to climate variability, with changing rainfall patterns and droughts posing a significant risk [9]. Micro-scale irrigation has been highlighted as a critical approach to mitigate these challenges, improving water use efficiency and ensuring crop sustainability [3]. Understanding the factors that influence the adoption of these irrigation systems is crucial for ensuring long-term agricultural productivity.

The adoption of micro-scale irrigation systems, such as drip irrigation, has been identified as essential for sustainable agriculture, as it significantly reduces water wastage and improves crop yields [18]. However, smallholder tea farmers in Uganda face barriers like high initial costs and limited access to information on these technologies [3]. This study aims to address these barriers by identifying specific factors affecting adoption, which can support targeted interventions. Tea is a major cash crop in Buhweju District, contributing significantly to household incomes. However, inconsistent rainfall has led to fluctuations in yields, impacting the economic stability of farmers. Research indicates that the adoption of micro-scale irrigation can stabilize yields and improve the economic well-being of farmers. Thus, exploring the factors affecting the adoption of these technologies can lead to more stable and improved tea production.

Uganda's National Agriculture Policy aims to enhance agricultural productivity through the adoption of modern and sustainable farming practices, including efficient water management. Micro-scale irrigation aligns with these goals, yet adoption rates remain low among tea farmers. This study will provide data to support policies aimed at increasing the uptake of these systems, contributing to the government's goals of food security and economic development [9].

## 5. Significance of Study

The study will be significant to different stakeholders;

*Tea farmers*

The study is significant for tea farmers in Burere Sub-County as it aims to identify practical solutions to the challenges they face in adopting micro-scale irrigation systems. By understanding the factors that influence adoption, the study can provide recommendations that will help farmers improve their tea yields, stabilize their incomes, and reduce their vulnerability to climate variability.

*Policy Makers/government*

For policymakers, the study will offer insights into the barriers and opportunities associated with the adoption of micro-scale irrigation systems. The findings will help inform the development of policies and programs that support smallholder tea farmers, particularly in hilly and remote regions like Burere Sub-County. This could include policies related to access to credit, infrastructure development, and extension services.

*Community Members*

Community members in Burere Sub-County will benefit from the study as it seeks to improve agricultural productivity and livelihoods in the area. By enhancing tea production through better irrigation practices, the study could contribute to greater food security, economic stability, and overall community well-being.

*Future Researchers*

The study will provide a valuable contribution to the existing body of knowledge on the adoption of micro-scale irrigation systems, particularly in hilly and rural areas of Uganda. Future researchers can build on the findings to conduct further studies in similar contexts or explore additional factors that may influence irrigation adoption. The research could also serve as a baseline for longitudinal studies that track changes in adoption rates and impacts over time.

## 6. Materials and Methods

Buhweju District is situated in the Western Region of Uganda. It lies between the coordinates of approximately 0.3975°S latitude and 30.4175°E longitude. The district neighbors Bushenyi District to the North, Sheema district to the East, Ibanda District to the West, Mitooma District, to the South [20].

Buhweju District experiences a bimodal rainfall pattern, with two main rainy seasons-March to May and September to November. The average annual rainfall ranges from 1,200 millimeters (mm) to 1,800 millimeters (mm), making it one of the wetter regions in Uganda. However, the distribution of rainfall can be erratic, leading to challenges in agricultural planning and production [13].

The district has a moderate climate with average temperatures ranging between 18°C and 25°C. The high-altitude areas tend to be cooler, particularly during the rainy seasons, while the lowland areas can experience slightly warmer temperature.

Buhweju's soils are generally fertile, supporting a variety of crops including tea, bananas, and coffee. However, the hilly terrain makes the area prone to soil erosion, especially during heavy rains. The vegetation is primarily a mix of tropical rainforest in the valleys and savannah grasslands on the higher slopes.

The district was chosen for this study on micro-scale irrigation because it has significant agricultural potential due to its fertile soils and favorable climate. However, the hilly terrain and the erratic distribution of rainfall pose challenges to consistent agricultural production. These factors made the district an ideal location to study the adoption of micro-scale irrigation program, which helped mitigate water-related challenges and enhance tea productivity.

The study adopted a descriptive cross-sectional survey allowed the researcher to collect data at a single point in time from a sample that represents the entire population of tea farmers in Burere Sub-County. This design was ideal for understanding the current status of micro-scale irrigation adoption and the factors influencing it. The snapshot provided by this approach was valuable for capturing the adoption rates and identifying key barriers.

The descriptive nature of the design enabled the collection of both quantitative and qualitative data. Quantitative data was gathered through structured questionnaires that measure the extent of adoption, the characteristics of the farmers, and the economic, social, and environmental factors influencing their decisions. Qualitative data was obtained through interviews or focus group discussions, which provided deeper insights into the perceptions, attitudes, and experiences of the farmers regarding micro-scale irrigation. The designed was deemed appropriate because given that Burere Sub-County likely had a significant number of tea farmers; the cross-sectional survey design is efficient for studying large populations. It allowed for the collection from a broad range of participants, ensuring that the results were generalizable to the entire population of tea farmers in the sub-county.

A multi-stage stratified random sampling technique was used to select sample smallholder farmers. The two parishes of Rwajere and Rushambya were considered in this study. Within each of these parishes, five (5) villages were randomly. selected. Then the farmers in each selected village were stratified into two groups as participant and non-participant of the agriculture extension training services. The groups were identified from a list agriculture extension worker, and then the information was confirmed by the farmers. Second, the two groups obtained from the first stage sampling was further stratified into male and female headed households to ensure, as much as possible, representation of female-headed households in the sample. Purposive sampling method was used in the selection of key informants. The key informants were considered for their technical knowledge, advisory services, and policy implementation, and provided supplementary information that may not be provided by other respondent categories.

The sample size was determined by Kish & Leslie [4] formula depending on the degree of precision of the general population used.

$$n = pq\,[Z/e]^2$$

Where: n is Sample size; p = population proportion of key informants (30%), q = smallholder tea farmers population proportion (65%); e = marginal error (5%) and Z= Z value of 95% confidence from the Z-table (1.96).

$0.3x\ 0.65\ (1.96/0.05)^2$

n = 300 respondents

A structured questionnaire with both open-ended and closed-ended questions were ideal for gathering a wide range of data from tea farmers in Burere Sub-County. The closed-ended questions allowed for the collection of quantitative data that can be easily analyzed to identify patterns and correlations. These might include questions on the extent of micro-scale irrigation adoption, access to resources, and demographic information.

The open-ended questions enabled farmers to express their views, experiences, and challenges in their own words. This qualitative data provided, uncovered factors that might not be immediately apparent through closed-ended questions.

A semi-structured focus group discussion guide was used as it allowed for in-depth exploration of group dynamics and collective attitudes towards micro-scale irrigation among tea farmers. Focus group discussion were particularly useful in understanding how social, cultural, and communal factors influence the adoption of new technologies like micro-scale irrigation.

This study employed a generalized binary logistic model and specified as;

$$\text{Log (p/1-p)}= a+b_1x_1+b_2x_2+b_3x_3, \ldots .+b_nx_n+e \quad (1)$$

Where; p = is the probability of success, α = is the coefficient on the constant term, $b_i$ = is the coefficient(s) on the independent variable(s), $x_i$ =is the independent variable(s), and *e* = is the error term.

Quantitative data analysis involved the use of statistical techniques to analyze numerical data collected through surveys and group discussion.

Data cleaning was done, checking and correcting errors or inconsistencies in the dataset, such as missing values, outliers, or duplicate entries. This step was crucial to ensure the accuracy of the analysis. Data cleaning was performed using spreadsheet software like Microsoft Excel or statistical software such as Statistical Package for Social Sciences (SPSS) version 22.0 version directly. SPSS was used to analyse quantitative data to generate descriptive statistics which were used to summarize the adoption of micro-scale irrigation program. Inferential statistics were generated to make inferences about a population based on a sample. Techniques such as t-tests, chi-square tests, and regression analysis was used to compare adoption and tea production among farmers.

Qualitative data was analyzed using thematic content analysis where the researcher wrote the responses from key informants basing on the study objectives. The results were presented in form of verbatim statements.

## 7. Study Results

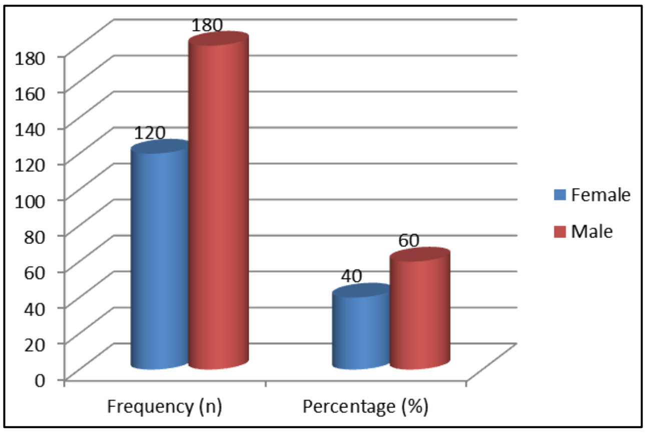


*Figure 1. Sex of respondents.*

The majority of respondents were male 60% and female 40%. This implies that tea farming in the study area is more male-dominated, potentially due to land ownership patterns or labor intensity associated with the practice.

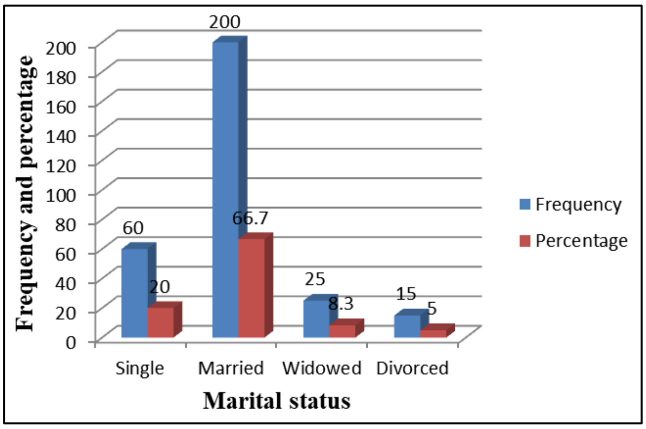


*Figure 2. Marital status.*

Most respondents (66.7%) are married, suggesting family involvement in tea farming. The presence of widowed (8.3%) and divorced (5%) farmers may indicate generational continuity or dependency on tea for livelihood across diverse household structures. Married farmers may be more committed to long-term farming improvements, including irrigation, for family welfare.

The results imply that married farmers are likely to lead in early adoption due to resource stability, widowed/divorced farmers need targeted support to bridge adoption gaps and single farmers may benefit from mentorship and linkage to input/credit providers. Therefore marital status is a critical social factor influencing capacity, willingness, and equity in small-scale irrigation adoption in Burere Sub-county, Buhweju District.

*Table 1. Descriptive statistics for age, education and farming experience.*

| Variable | Mean | Std Dev | Minimum | Maximum |
|---|---|---|---|---|
| Age | 35.5 | 6.7 | 25 | 75 |
| Years in School | 11.3 | 2.2 | 7 | 16 |
| Farming Experience | 10.0 | 2.7 | 5 | 15 |

*Age*

Mean of 35.5 years shows that the average respondent is in their early middle age, typically characterized by energy, maturity, and openness to change.

Standard deviation of 6.7 indicates moderate variation, meaning most farmers are relatively close in age and belong to a productive generation.

Minimum age of 25 and maximum of 50 shows that all respondents are within an age bracket likely to be physically active and mentally alert, critical traits for adopting irrigation technology. This implies that farmers in this age range are more likely to adopt small-scale irrigation systems due to their flexibility, willingness to innovate, and concern for sustainability.

*Education level*

Mean of 11.3 years reflects an average education level of lower to upper secondary school. Standard deviation of 2.2 implies a fairly tight distribution, with most farmers having similar educational backgrounds.

Minimum of 7 years (likely P.7 level) and maximum of 16 years (bachelors) demonstrates that nearly all farmers have basic literacy skills.

The results imply that education level is sufficient to understand technical information, calculate input/output benefits, and follow usage guidelines for irrigation tools. Educated farmers are more likely to access and interpret extension messages, manuals, mobile apps, or training materials related to irrigation. Educated tea farmers are also more likely to participate in capacity building programs promoting smart water use, boosting adoption chances.

*Farming experience*

Mean of 10 years indicates that most respondents have a decade of farming experience, suggesting strong familiarity with local climatic conditions and farming cycles.

Standard deviation of 2.7 shows slight variability; most farmers have a consistent level of experience.

Minimum of 5 years and maximum of 15 years indicates that no respondent is new to farming, with even the least experienced farmer having a good foundation. The results imply that experienced farmers are more likely to recognize the effects of drought, erratic rainfall, or climate stress, which are key motivators for adopting irrigation system. This experience increases the likelihood of strategic adoption of micro-scale irrigation as a coping or yield-stabilization measure.

***Table 2.*** *Regression output on strategies for increasing the adoption of micro-scale irrigation systems to improve tea production.*

| **Predictors** | **Coefficient (β)** | **Std. Error** | **t-Statistic** | **p-value** |
|---|---|---|---|---|
| Constant ($\beta_0$) | 0.45 | 0.09 | 5.00 | 0.000 |
| Access to extension services | 0.32 | 0.08 | 4.00 | 0.001 |
| Financial support/subsidies | 0.28 | 0.07 | 4.00 | 0.000 |
| Training & farmer demonstrations | 0.25 | 0.06 | 4.17 | 0.002 |
| Access to equipment suppliers | 0.15 | 0.07 | 2.14 | 0.033 |
| Community group participation | 0.12 | 0.06 | 2.00 | 0.046 |
| Awareness through media | 0.10 | 0.05 | 2.00 | 0.048 |

*Constant ($\beta_0 = 0.45$, $p < 0.000$).*

When none of the strategies are implemented, the base level of adoption is 0.45 units. Standard error = 0.09: The variability in this estimate is small, so we can be confident in its accuracy.

p-value = 0.000: This is statistically significant, confirming the model's base level is meaningful.

*Access to extension services.*

Coefficient ($\beta_1 = 0.32$): For farmers who have access to extension services, adoption increases by 0.32 units, holding other variables constant.

p-value = 0.000: Highly significant ($p < 0.001$), confirming extension services have a strong and reliable influence on adoption.

*Financial Support/Subsidies*

($\beta_2 = 0.28$): Availability of financial support is associated with a 0.28 unit increase in adoption.

p-value = 0.000: Statistically significant. This confirms that subsidies or financial aid play a crucial role in helping farmers adopt irrigation technologies.

*Training and farmer demonstrations*

($\beta_3 = 0.25$): Farmers who receive training are expected to have 0.25 units higher adoption level.

p-value = 0.002: Very significant, meaning training is consistently effective in promoting adoption.

*Access to irrigation equipment suppliers*

($\beta_4 = 0.15$): Proximity or access to suppliers increases adoption by 0.15 units.

p-value = 0.033: Statistically significant ($p < 0.05$). This suggests that while access to inputs matters, it may not be the most decisive factor alone.

*Community group participation*

($\beta_5 = 0.12$): Participation in farmer groups leads to a 0.12 unit increase in adoption.

p-value = 0.046: Just below the 0.05 threshold for significance. This indicates that group activities help, but their effect is not very strong individually.

*Awareness through media*

($\beta_6$ = 0.10): Media awareness campaigns lead to a 0.10 unit increase in adoption.

Standard Error = 0.05: Small variability.

p-value = 0.048: Statistically significant, but weakly so. This implies that media alone is not enough, though it can contribute when combined with other strategies.

In focus group discussion held with respondents on what changes or improvements they think could make micro-scale irrigation systems more accessible and practical for tea farmers, it was reported that *"Government or Non-governmental organizations should provide subsidies or loans to farmers. Also, we need local technicians who can install and repair the systems at a low cost. Group training would also help us understand how to use and maintain the systems properly."*

In another group discussion conducted with respondents on what ways have micro-scale irrigation influenced the overall health and growth of their tea plants, it was also said that, *"The plants look greener and healthier. There's less leaf drying and wilting. They mature faster, and pest attacks also seem lower due to better tea plant vigor."*

In another discussion conducted on they would recommend micro-scale irrigation to other tea farmers who have not adopted, it was also reported that *"Yes, we would recommend it. It helps improve yields and reduce the stress of relying on rainfall. But we also need support to access and manage it. But still without financial and technical help, it would still remain out of reach for majority of tea farmers who have not adopted."*

## 8. Discussion of Results

The results revealed that financial support and subsidies were the most influential factor. The coefficient indicates that provision of subsidies and affordable credit for purchasing irrigation equipment strongly encourages adoption. High initial investment costs are a major barrier to adoption of irrigation systems. Therefore, policy interventions in the form of subsidies or low-interest loans can serve as important enablers and that government intervention that offer financial incentives significantly boost farmer interest in adopting to water-saving technologies. This aligns with the findings of [21] whose report explained that government interventions such as subsidies and tax breaks play a critical role in encouraging farmers to adopt micro-scale irrigation systems. [21] revealed that such incentives lower the financial burden and make advanced irrigation systems more accessible to small-scale farmers.

Access to agricultural extension services emerged as the strongest predictor among all variables, indicating that tea farmers who regularly interact with extension agents are more likely to adopt micro-irrigation systems. Access to extension services significantly increases the likelihood of adopting irrigation technologies in Burere subcounty. Extension workers often act as a bridge between research institutions and farmers, helping them understand the technical and economic benefits of micro-scale irrigation. This is consistent with findings by Nimusiima et al., who reported that capacity building through extension services is vital in rural areas of developing countries where literacy levels may be low, and access to information is limited [13]. Nimusiima et al., argued that programs focusing on practical demonstrations and local language training have shown success in regions like Uganda, where government extension workers collaborate with Non-Governmental Organizations (NGOs) to educate farmers on the benefits and operation of micro-scale irrigation systems [13].

The results showed that media awareness remains a significant factor, although with the smallest coefficient among the predictors. Access to information through radio programs, television, and social media platforms appears to positively influence adoption. Media can raise awareness about the benefits of micro-scale irrigation and publicize successful farmer stories. This is in line with studies by [7] who emphasized that rural radio and television programs are crucial for disseminating agricultural innovations in Africa. [7] further explained that media campaigns by organizations such as National Agricultural Research Organization (NARO) and National Agriculture Advisory Services (NAADS) have played an increasing role in promoting modern farming practices.

The results also established that participation in community groups such as farmer cooperatives or water user associations can boost the adoption rate. Group settings often facilitate the sharing of knowledge, collective decision-making, and pooling of resources, all of which are beneficial in promoting adoption. Collective action is essential in the successful management and adoption of shared agricultural technologies, particularly in water-scarce areas. This finding can be compared with [6] who in their study noted that in regions of Uganda, Buhweju district, collective action through farmer cooperatives has been an effective strategy. [6] emphasized that this approach not only reduces individual costs but also fosters a sense of ownership and mutual support among community members.

## 9. Conclusion

The study concludes that multiple interlinked strategies significantly influence the adoption of micro-scale irrigation systems among tea farmers. Access to extension services, financial support, and training programs were the most influential strategies to adoption.

## 10. Study Recommendations

Based on study results in relation to objectives the study recommends the following;

1) Enhance extension services: Deploy more extension workers and ensure frequent farmer contact to improve awareness and skills.
2) Provide credit facilities: Partner with microfinance institutions to provide low-interest loans for irrigation equipment.
3) Subsidize or reduce costs: Implement public-private partnerships to lower costs through subsidies or bulk purchases.
4) Expand water infrastructure: Invest in community dams, tanks, or boreholes near tea-growing zones.
5) Strengthen farmer groups: Support the formation and training of farmer cooperatives/farmer groups to promote peer-based irrigation adoption.
6) Target youth engagement: Encourage younger farmers to adopt technology through digital platforms and incentive programs.
7) Leverage mass media: Design targeted agricultural radio and television programs to raise awareness and provide success stories related to micro-irrigation use.

## Abbreviations

| | |
|---|---|
| SPSS | Statistical Package for Social Sciences |
| NAADS | National Agriculture Advisory Services |
| NGOs | Non-Governmental Organizations |
| NARO | National Agricultural Research Organization |
| mm | Millimeters |
| GDP | Gross Domestic Product |
| MAAIF | Ministry of Agriculture, Animal Industry, and Fisheries |
| KAPSLMP | Kenya Agricultural Productivity and Sustainable Land Management Project |
| EQIP | Environmental Quality Incentives Program |
| USDA | United. States Department of Agriculture |

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## Conflicts of Interest

The authors declare no conflicts of interest.

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