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Agricultural Community Engagement and Performance of Irrigation Projects in Rwanda: A Case of Irrigation Project in Kirehe District

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Abstract

The primary purpose of this research was to evaluate the impact of agricultural community engagement on the performance of the Irrigation Project in Kirehe. The specific objectives of this research comprised to assess the effect of community participation on performance of Irrigation project in Rwanda, to examine the effect of livelihoods of farmers on performance of Irrigation project in Rwanda, to determine the effect of capacity building on performance of irrigation project in Rwanda. This is descriptive research in terms of its design, which used the quantitative method alone with quantitative data that was collected with the help of a questionnaire and interview guide. For the case of this research, the target population was comprised by 246 registered members of irrigation project stakeholders, giving 148 respondents as sample size as per the attached Krejcie and Morgan (1970) table in the appendices. This study used both simple random and census method to select 148 respondents who had equal chance to participate in this study by providing quantitative data regarding agricultural community engagement and performance of Irrigation project. The collected data was analyzed using SPSS version 22 to perform inferential statistics such as correlation and regression analysis, and descriptive statistics such as SD and mean were used. The findings of this study focused on the effect of community participation, farmer livelihoods, and capacity building on the performance of Rwanda's Irrigation project. Descriptive statistics indicated a positive perception among respondents, with mean scores ranging from 4.417 to 4.637 for capacity building, 4.438 to 4.500 for farmers' livelihoods, and 4.452 to 4.520 for community participation. The correlation analysis showed strong positive relationships between these factors and performance indicators, with correlation coefficients ranging from 0.928 to 0.990. Hence, the study emphasizes the significance of engaging the community, improving farmers' livelihoods, and implementing effective capacity building to enhance food security, market expansion, and profitability in the Kirehe District. Based on the research findings, the investigator recommends strengthening community participation, supporting farmers' livelihoods, enhancing capacity building,

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fostering collaboration, implementing monitoring and evaluation, emphasizing sustainability, encouraging research and innovation, conducting awareness campaigns, addressing challenges promptly, and considering replication and scaling for the successful Irrigation project in Rwanda.

Keywords: *Agricultural Community Engagement, Performance of Irrigation Projects, Irrigation Project, Kirehe District, Rwanda*

1. Introduction

Agricultural community engagement in rural development supported by agriculture is extensively identified as the primary operational precept of rural development because agriculture has contributed 33% on GDP and 70% of job creation in Rwanda (Bayisenge, *et al.*, 2019). Even if the recent agricultural projects do not satisfy the food demand of the general population (Hashim, 2014). The WFP (2012) reported that 21% of Rwandan households have food insecurity issues even if there are very little improvement being done where 81.3% are food secured while 18.7% are food unsecured as per the 2020 statistics of comprehensive food security and vulnerability analysis in Rwanda (UN, 2021).

Rwanda has a rapid population growth of 3.5% per year making it among the highest in Africa even if the country is hilly and the land for agriculture remains constant which implies that to handle these challenges irrigation projects are required to increase productivity on small land to reduce issues of being dependable on unpredictable rainfall (Giertz, *et al.*, 2015). Another challenge is climate change that has negatively changed seasons of rainfall which affect growth of plants used as food and medicine due to poor rainfall and lack of modern irrigation techniques which increase poor performance of agricultural projects (Mupenzi *et al.*, 2011).

Therefore, currently only 60,000 hectares are irrigated compared to the target of 102 thousand of hectares in year 2024 (Mwai, 2019). However, the existence of small land irrigated, issue of understanding the need for land consolidation, the existing irrigation systems are working under their capacity which negatively affects the performance of irrigation project (Uwiragiye, 2015). However, even if there are all those issues there no existing empirical literature conducted to address the issue of irrigation project poor performance and how agricultural community engagement can intervene to handle the issue, even previous researchers who attempted to look at the same issue have looked at irrigation evaluation performance schemes in Rugeramigozi Marshland (Hakuzimana & Masasi, 2020); farmer led irrigation assessment development in Rwanda (Nzeyimana, 2021). It is from these existing challenges and knowledge gap problem of lack of empirical literature, the researcher wants to conduct research on agricultural community engagement and performance irrigation project in Rwanda.

1.2 Research Objectives

1.2.1 General objective

The general objective of this research was to examine the role of Agricultural community engagement on performance of Irrigation Project in Kirehe District, Rwanda.

1.2.2 Specific objectives

The specific objectives of this research comprised:

- (i) To assess the effect of community participation on performance of Irrigation project in Rwanda.
- (ii) To examine the effect of livelihoods of farmers on performance of Irrigation project in Rwanda.
- (iii) To determine the effect of capacity building on performance of irrigation project in Rwanda.

1.3 Research Hypotheses

The Null hypotheses were used as follows:

H₀₁: Community participation does not have a significant effect on performance of Irrigation project in Rwanda.

H₀₂: Livelihoods of farmers does not have a significant effect on performance of Irrigation project in Rwanda.

H₀₃: Capacity building does not have a significant relationship with performance of irrigation project in Rwanda.

2.1 Empirical Review

2.1.1 Community participation and performance of Irrigation project

The empirical research of Muriithi (2013) was conducted descriptive research on participation of members and irrigation projects performance in Kenya. The results showed that participation of members in selection of management and irrigation projects performance ($r=0.984$), participation of members in designing ($r=0.943$), participation of members in identification ($r=0.762$), participation of members in M&E ($r=0.846$) and participation of members in implementation ($r=0.674$). Based on results, a conclusion was made that identification, implementation, and M&E of project in selection and designing are at 1% and 5% level of significance which gives it above variations of 60.1% of irrigation projects performance in Kenya.

The empirical literature from the research of Bikuba and Kayunze (2019) focused on cross-section research on agricultural communities' engagement and irrigation projects sustainability in Tanzania. The results demonstrated that agricultural community engagement has low level of sustainability <50% in participation in implementation of the project and as well beneficiaries were limited at the same percent in engagement. The participation of women was also low at 37.5%. Engagement of community in agriculture is used as means than the end. Hence, the study concluded that engagement of community in agriculture is required to improve irrigation projects sustainability.

2.1.2 Livelihoods of farmers and performance of Irrigation project

The research of Akudugu, *et al.*, (2021) has concentrated in the impacts of livelihoods in Western African Irrigation with emphasize on Ghana experience. This research has used mixed methods to collect data with the use of individual questionnaires, focus group discussion and interviews. The results of the study revealed that irrigation has a positive and significant effect on employment, farm incomes, food security, consumption, and non-farm businesses. The irrigation has also shown another impact on health and sustainability of environment by providing finance to improve healthcare and negative impact on bringing waterborne outbreak associated with water of irrigation. The results have also demonstrated that irrigation facilities destroy environment even if it improves ecosystem services that can improve farm income and food security.

The previous empirical research of Balarane and Oladele (2014) concentrated on irrigation in farms and livelihood strategies in South Africa. The results showed private owned land

irrigated is 7.6%, owned by chiefs is 92.4%. The government grants is given to 54.5% and other 22.7% are seasonal jobs. The 53% participate in farming irrigation as only source of income and 47% do personal interest in farming irrigation. The significant determinants of livelihood strategies for farming irrigation are marital status with $t=2.43$, household size with $t=5.41$, income with $t=6.59$ and activity of nonfarm with $t=1.73$. Recommendations is made to farmers to access capitals as aspiration of livelihood and training skills helping to access finance in terms of credits from cooperatives and banks.

2.1.3 Capacity building and performance of irrigation project

The research of Tekana and Oladele (2014) concentrated on policies related to empowerment of women and schemes of irrigation in South Africa. The results showed that women empowerment in use of income, disempowered at 53%, 60.2% disempowered in productive capital and credit accessibility, 50% got empowered in decision making and leadership. The determinants of empowerment were expenditure with $t=1.68$ and type of drip irrigation with $t=1.71$. The results showed that empowerment of women has been influence by schemes of irrigation. Hence, participation of women in promotion of decision making for management of water to enhance accessibility to water and improvement equitable development.

The empirical research of Takayama, *et al.*, (2018) conducted on collective action determinants and management of irrigation systems in Japanese rural community. The results found that collective action relationship as inverted on the number of farm households and landholdings of farmers in diversity. The results also demonstrated that irrigation system characteristics and the group of users changed policies related on deterioration of suppression, collective action in management of irrigation to promote ties in the society and promotion of social capital in level of community.

Another research was conducted in Rwanda by Hakuzimana and Masis (2020) focused on schemes of irrigation on evaluation of performance. The results demonstrated that productivity of land in two schemes of irrigation is low with the second Rugeramigozi scheme of irrigation has better performance compared to first Rugeramigozi water productivity with strategies of deficit irrigation promoting conservation of water. The water service delivery performance indicators show that both irrigations are sufficient to meet water requirements irrigation at demand of peak. The results also showed that cost of maintenance and operation affect financial performance, if irrigation scheme is low, it also produces low crop yields which generates low revenue for farmers.

2.2 Research Gap

The research on agricultural community engagement and irrigation project sustainability in various African contexts has led to diverse insights. Bikuba and Kayunze (2019) highlighted the neglect of critical aspects of community engagement in enhancing irrigation project performance. Muriithi's (2013) emphasis on members' participation during the implementation phase underscored the need for more extensive investigation. Contrasting this, the current study places special focus on promoting food security, market expansion, and profitability through enhanced community involvement. In doing so, it contributes unique perspectives to the existing literature.

Akudugu *et al.* (2021) and Balarane and Oladele (2014) primarily focused on the positive impacts of irrigation on income, employment, and food security without delving into the specific role of community participation. Tekana and Oladele (2014) highlighted the challenges faced by women in accessing productive resources, while Takayama *et al.* (2018) emphasized collective action but didn't explore its implications on smallholder farmers' livelihoods extensively. Additionally, Hakuzimana and Masasi (2020) primarily concentrated

on land productivity, neglecting broader socio-economic aspects addressed in the current study.

Therefore, by addressing these contextual, content, and theoretical gaps, this research provides fresh insights into farmers' livelihoods, emphasizing the importance of comprehensive capacity-building strategies for community engagement, training, and monitoring. It stresses the significance of sustained food security, market expansion, and profitability through effective community involvement and engagement.

2.3 Conceptual Framework

In research, conceptual framework demonstrates the association between independent variable and dependent variable as well as other factors related to the study. For the case of this research, agricultural community engagement is known as IV while performance of irrigation project is known as DV.

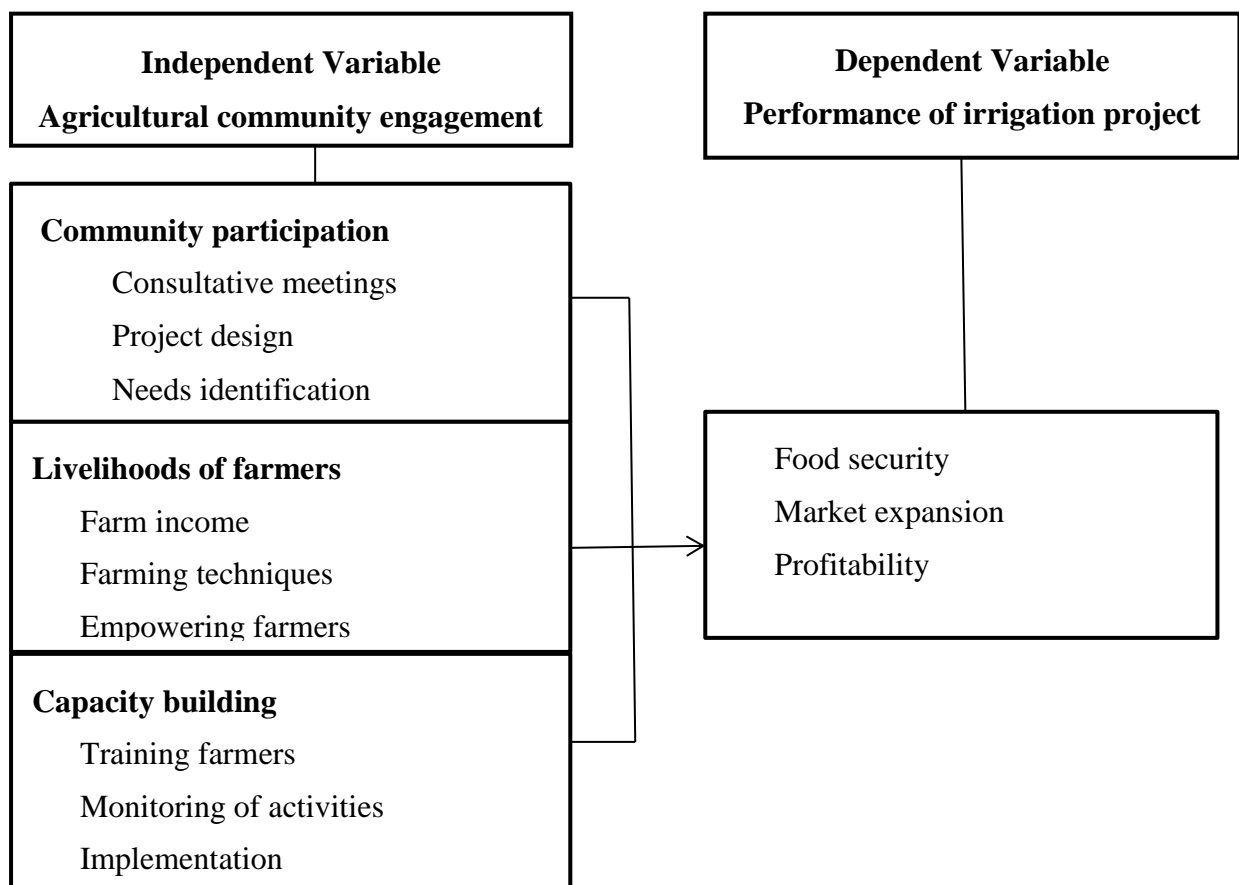


Figure 1: Conceptual framework
 Source: Researcher, 2023

The figure 1 demonstrates the agricultural community engagement as IV while performance of irrigation project is known as DV. The agricultural community engagement is measure by community participation (consultative meeting, project design, needs identification), livelihoods of farmers (farm income, farming techniques and empowering farmers) and capacity building (training farmers, monitoring of activities and implementation of activities) and performance of irrigation project which is measured By food security, market expansion and profitability.

The independent variable which is agricultural community engagement refers to the degree of involvement in community agricultural activities that are done through use of irrigation project. This variable is believed to have effect on dependent variable which is performance of irrigation project. The variable has three sub-variables which are community participation as involvement of local community in decision making process of the irrigation project which include activities like consultative meeting, project design and needs identification. When community participates in the project, they feel sense of ownership and responsibility towards the project which can affect its performance.

The other sub-variables are livelihoods of farmers which has factors like farm income, farming techniques and empowerment of farmers which implies that if these factors work to improve the livelihood of the farmer, there are more likely more investment in farming to ensure project performance. Capacity building deals with training and offering equipment to farmers and these activities are done through training farmers, monitoring, and implementing their activities to enhance project performance. For the case of dependent variable, there are food security, market expansion and profitability to ensure financial sustainability of the project.

3. Materials and Methods

The research design chosen was descriptive, employing a quantitative approach to precisely measure and investigate specific occurrences within a set environment. By utilizing a questionnaire as the primary data collection tool, the study ensured the efficient gathering of information aligned with its objectives. This structured framework enhanced the credibility of the study's outcomes, fostering a comprehensive understanding of the intricacies surrounding the phenomena under investigation.

The target population was 246 registered members of the irrigation project and stakeholders, from whom a sample size of 148 respondents was selected using both simple random and census methods. Questionnaires were distributed to collect data, comprising six parts that covered various aspects of the research objectives, including the performance of the irrigation project in Rwanda. The instruments' validity and reliability were confirmed through two pilot studies, demonstrating consistent high reliability across all variables.

Data analysis involved the use of SPSS version 24.0, integrating descriptive and inferential statistics for questionnaire data, alongside thematic analysis for interview data. Inferential techniques, such as Pearson correlation and multiple linear regression, were applied to explore the relationship between agricultural community engagement and the irrigation project's performance, offering nuanced insights into the effectiveness and factors influencing community involvement.

The regression model presented was $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$, where Y represented the dependent variable, irrigation project performance, and X1, X2, and X3 represented joint consultation, collective planning, and collective empowerment, respectively, as measures of agricultural community engagement. The data collected from semi-structured interviews with four informants underwent thematic analysis, revealing deep insights into agricultural community engagement and the irrigation project in Rwanda.

Ethical considerations were diligently adhered to throughout the research process, with principles of informed consent and confidentiality carefully upheld. The dignity of the informants was respected, and the study's purpose was clearly explained. Letters of introduction from the researcher's institution and acceptance from the irrigation project were provided to the participants, ensuring transparency and trustworthiness.

4.1 Presentation of findings

The study on the Irrigation project in Kirehe District, Rwanda underscored the significance of community participation, livelihood enhancement, and capacity building in driving project performance. Emphasizing community involvement in decision-making and resource provision, the research utilized a 5-point Likert scale, with 'SD' representing standard deviation.

4.1.1 Community participation and performance of Irrigation project in Rwanda

The first objective of this research looked at community participation and performance of Irrigation project. The objective provided insights on project design, consultative meeting, needs identification, financial support, appropriate budget allocation, and determination of project location that affect performance of irrigation project.

Table 1: Community participation and performance of Irrigation project in Rwanda

Statement regarding community participation	Mean	SD
Project design enhances irrigation project performance	4.458	0.955
Consultative meeting promotes project performance of irrigation project	4.500	0.865
Needs identification enhances performance of irrigation project	4.458	0.955
Financial support enhances performance of irrigation project	4.458	0.933
Appropriate budget allocation enhances performance of irrigation project	4.520	0.815
Determination of project location affect performance of irrigation project	4.452	0.954
Overall mean score	4.474	

Source: Field Data, 2023

The results in Table 1 showed that the mean scores for the statements related to project design, consultative meetings, needs identification, financial support, budget allocation, and project location determination range from 4.452 to 4.520, indicating a positive perception. With an overall mean score of 4.474, the study highlights the substantial impact of community participation on the irrigation project's performance. The low standard deviations imply strong consensus among respondents regarding the positive influence of community engagement.

Table 2: Assessment of performance of irrigation project

Indicators of project performance	Mean	SD
Food security	4.500	0.840
Market expansion	4.541	0.788
Profitability	4.527	0.789
Overall mean score	4.522	

Source: Field Data, 2023

The results in Table 2 showed that the assessment of the performance of the Irrigation project in Rwanda is generally positive. This is meant by the mean scores for the indicators such as food security, market expansion and profitability range from 4.500 to 4.542 which indicates agreement and satisfaction with the project's performance. The standard deviations for the

indicators are relatively low which showed high level of agreement regarding project’s performance. The overall mean score is 4.522 which suggests that respondents generally believe that project has been successful in terms of food security, market expansion and profitability of Irrigation project in Kirehe District, Rwanda.

Table 3: Correlation analysis between community participation and Irrigation project performance

		Food security	Market expansion	Profitability
Community participation	Pearson Correlation	.928**	.944**	.963**
	Sig. (2-tailed)	.000	.000	.000
	N	146	146	146

****.** Correlation is significant at the 0.01 level (2-tailed).

Source: Field Data, 2023

The results in Table 3 showed a positive and significant relationship between community participation and food security ($r=0.928$), market expansion ($r=0.944$), and profitability ($r=0.963$). These correlations (r 's) are statistically significant at the 0.01 level, suggesting that increased community participation is associated with improvements in food security, market expansion, and profitability. Hence, this implies that when community is more involved in the Irrigation project, it tends to have a positive effect on performance of the same project in Kirehe District, Rwanda.

4.1.2 Livelihoods of farmers and performance of Irrigation project in Rwanda

The study delved into the intricate relationship between farmers' livelihoods and the overall effectiveness of the Irrigation project in Rwanda. By analyzing key facets like farm income, agricultural methodologies, and community engagement, it sought to uncover the nuanced dynamics influencing food security, market sustainability, and the project's overall profitability.

Table 4: Livelihoods of farmers and performance of Irrigation project in Rwanda

Statement concerning livelihoods of farmers	Mean	SD
The farm income promotes performance of irrigation project	4.458	0.955
Farming techniques enhance performance of irrigation project	4.458	0.933
Empowering farmers promotes performance of irrigation project	4.479	0.933
Community participated in deciding the priority activities in the project	4.500	0.840
Community provided labor force to the project	4.458	0.933
Community decided for market opportunities of this project	4.438	0.975
Overall mean score	4.465	

Source: Field Data, 2023

The results in Table 4 were assessed using a Likert scale and suggested a positive perception regarding the effect of farmers livelihoods on project performance. The mean scores for the statements related to the promotion of farm income, enhancement of farming techniques, empowerment of farmers, community participation in deciding project activities, providing labor force, and deciding market opportunities range from 4.438 to 4.500. The overall mean score is 4.465 suggesting a positive effect of farmers livelihoods on performance of Irrigation

project. The standard deviations for most of the statements are relatively low, supporting a high level of agreement regarding the effect of farmers livelihoods on performance of Irrigation project in Kirehe District, Rwanda.

Table 5: Correlation analysis between livelihoods of farmers and performance of Irrigation project

		Food security	Market expansion	Profitability
Livelihoods of farmers	Pearson Correlation	.986**	.985**	.974**
	Sig. (2-tailed)	.000	.000	.000
	N	146	146	146

** . Correlation is significant at the 0.01 level (2-tailed).

Source: Field Data, 2023

The results in Table 5 showed a positive and significant relationship between livelihoods of farmers and food security ($r=0.986$), market expansion ($r=0.985$), and profitability ($r=0.974$). These correlations (r 's) are statistically significant at the 0.01 level, suggesting that increased livelihoods of farmers are associated with improvements in food security, market expansion, and profitability. Hence, this implies that when farmers' livelihoods are improved, it tends to have a positive effect on performance of the Irrigation project in Kirehe District, Rwanda.

4.1.3 Capacity building and performance of irrigation project in Rwanda.

The third objective examined various aspects of capacity building, including farmer training, activity monitoring, implementation of farming activities, provision of equipment, and financial support. In addition, the study evaluated the correlation between capacity building and project performance indicators such as food security, market expansion, and profitability, which provided insights into the significance of capacity building on performance of the Irrigation project.

Table 6: Capacity building and performance of irrigation project in Rwanda

Statements related to capacity building	Mean	SD
Training farmers enhance performance of irrigation project	4.417	1.055
Monitoring of activities promote performance of irrigation project	4.637	0.795
The implementation of farming activities promotes performance of this project	4.500	0.865
Community was given equipment to use in plantation	4.500	0.840
Community got money from the project to do other household necessities	4.479	0.933
Community used technology while communicate to other project stakeholders	4.445	0.961
Overall mean score	4.496	

Source: Field Data, 2023

The results in Table 6 showed that capacity building efforts in the Irrigation project in Rwanda have been positively perceived as contributing to its performance. The mean scores for statements related to capacity building range from 4.417 to 4.637. This indicates a general agreement among respondents regarding the effectiveness of capacity building measures.

Specifically, training farmers received a mean score of 4.417, monitoring of activities received 4.637, and the implementation of farming activities received 4.500, suggesting that these activities have a positive effect on project performance.

The provision of equipment to the community, enabling them to engage in plantation activities, and the allocation of project funds for other household necessities also received high mean scores of 4.500 and 4.479 respectively. This indicates that respondents perceive these measures as beneficial for enhancing project performance. Thus, since the overall mean score for capacity building is 4.496, reflecting the positive perception of respondents towards the effectiveness of capacity building efforts in the Irrigation project. The standard deviations for most statements are relatively low, suggesting a level high of agreement among respondents regarding the impact of capacity building on project performance. Hence, this implies that capacity building efforts affect performance of Irrigation project in Kirehe District, Rwanda.

Table 7: Correlation analysis between capacity building and performance of Irrigation project

		Food security	Market expansion	Profitability
Capacity building	Pearson Correlation	.930**	.958**	.990**
	Sig. (2-tailed)	.000	.000	.000
	N	146	146	146

** . Correlation is significant at the 0.01 level (2-tailed).

Source: Field Data, 2023

The results in Table 7 showed a positive and significant relationship between capacity building and food security ($r=0.930$), market expansion ($r=0.958$), and profitability ($r=0.990$). These correlations (r 's) are statistically significant at the 0.01 level, suggesting that increased capacity building is associated with improvements in food security, market expansion, and profitability. Hence, this implies that when capacity of community is built, it tends to have a positive effect on performance of Irrigation project in Kirehe District, Rwanda.

4.1.4 Regression analysis

Table 4. 8: Model summary of agricultural community engagement and food security in Rwanda

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.992	.984	.984	.10764

a. Predictors: (Constant), Capacity building, Livelihoods of farmers, Community participation

Source: Field Data, 2023

The results in Table 8 showed that agricultural community engagement factors including capacity building, livelihoods of farmers and community participation have a strong positive relationship with food security in Rwanda. The model has a high R-squared value of 0.989 indicating that 98.9% of variation in food security can be explained by the factors.

Table 9: Analysis of variance (ANOVA) of agricultural community engagement and food security in Rwanda

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Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	100.855	3	33.618	2901.380	.000
Residual	1.645	142	.012		
Total	102.500	145			

a. Dependent Variable: Food security

b. Predictors: (Constant), Capacity building, Livelihoods of farmers, Community participation

Source: Field Data, 2023

The results in Table 9 showed that revealed a significant relationship between the predictor of community agricultural engagement (capacity building, livelihoods of farmers, and community participation) and the dependent variable (food security). The regression model accounts for a substantial amount of the variation in food security, as evidenced by the high F-value of 2901.380 and a significant p-value of .000 <0.05 level of significance. These statistics suggested that the predictors included in the model are strongly associated with food security outcomes in Rwanda.

Table 10: Regression coefficients of agricultural community engagement and food security in Rwanda

Model	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Std. Error	Beta	t	
(Constant)	.136	.051		2.651	.009
Community participation	.422	.040	.410	10.457	.000
Livelihoods of farmers	.705	.044	.684	16.111	.000
Capacity building	.101	.035	.097	2.903	.004

a. Dependent Variable: Food security

Source: Field Data, 2023

The results in Table 10 showed a positive and significant relationship between community agricultural engagement factors (community participation, livelihoods of farmers, and capacity building) and food security in Rwanda. The equation model became food security = 0.132 + 0.422× (Community participation) + 0.705 × (Livelihoods of farmers) + 0.101 × (Capacity building). The results show that community participation and livelihoods of farmers have positive and significant standardized coefficients (Beta) of 0.410 and 0.684 respectively.

Therefore, this indicates that an increase in community participation and improvement in farmers' livelihoods are associated with higher levels of food security in Rwanda. On the other hand, capacity building has a positive and significant standardized coefficient (Beta) of 0.097. This suggests that an increase in capacity building is associated with an increase in food security. Hence, these results highlight the positive and significant effect of community participation, capacity building and livelihood improvement on food security in Rwanda.

Table 11: Model summary of agricultural community engagement and market expansion in Rwanda

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.994 ^a	.987	.987	.08957

a. Predictors: (Constant), Capacity building, Livelihoods of farmers, Community participation

Source: Field Data, 2023

The results in Table 11 showed that agricultural community engagement factors including capacity building, livelihoods of farmers and community participation have a strong positive relationship with market expansion in Rwanda. The model has a high R-squared value of 0.989 indicating that 98.9% of variation in market expansion can be explained by the factors.

Table 12: Analysis of variance (ANOVA) of agricultural community engagement and market expansion in Rwanda

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	89.114	3	29.705	3702.384	.000 ^b
Residual	1.139	142	.008		
Total	90.253	145			

a. Dependent Variable: Market expansion

b. Predictors: (Constant), Capacity building, Livelihoods of farmers, Community participation

Source: Field Data, 2023

The results in Table 12 showed that revealed a significant relationship between the predictor of community agricultural engagement (capacity building, livelihoods of farmers, and community participation) and the dependent variable (market expansion). The regression model accounts for a substantial amount of the variation in market expansion, as evidenced by the high F-value of 3702.384 and a significant p-value of .000 < 0.05 level of significance. These statistics suggested that the predictors included in the model are strongly associated with market expansion outcomes in Rwanda.

Table 12: Regression coefficients of agricultural community engagement and market expansion in Rwanda

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
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	B	Std. Error	Beta		
(Constant)	.132	.043		3.097	.002
Community participation	.414	.039	.428	10.506	.000
Livelihoods of farmers	.414	.039	.428	10.506	.000
Capacity building	.147	.029	.151	4.997	.000

a. Dependent Variable: Market expansion

Source: Field Data, 2023

The results in Table 12 showed a positive and significant relationship between community agricultural engagement factors (community participation, livelihoods of farmers, and capacity building) and market expansion in Rwanda. The equation model became market expansion = 0.132 + 0.414 × (Community participation) + 0.414 × (Livelihoods of farmers) + 0.147 × (Capacity building). The results show that community participation, capacity building and livelihoods of farmers have positive and significant standardized coefficients (Beta) of 0.428, 0.151 and 0.428 respectively. This indicates that an increase in community participation, capacity building and improvement in farmers' livelihoods are associated with higher levels of market expansion in Rwanda. Hence, these results highlight the positive and significant effect of community participation, capacity building and livelihood improvement on market expansion in Rwanda.

Table 13: Model summary of agricultural community engagement and profitability in Rwanda

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.998 ^a	.997	.997	.04479

a. Predictors: (Constant), Capacity building, Livelihoods of farmers, Community participation

Source: Field Data, 2023

The data analysis in Table 13 highlighted a strong positive relationship between critical agricultural community engagement factors, such as capacity building, farmers' livelihoods, and community participation, and the project's overall profitability in Rwanda. A high R-squared value of 0.989 emphasized the significant influence of these factors on economic sustainability.

Table 14: Analysis of variance (ANOVA) of agricultural community engagement and profitability in Rwanda

Model	Sum of Squares	df	Mean Square	F	Sig.
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Regression	90.106	3	30.035	14974.300	.000 ^b
Residual	.285	14	.002		
		2			
Total	90.390	14			
		5			

a. Dependent Variable: Profitability

b. Predictors: (Constant), Capacity building, Livelihoods of farmers, Community participation

Source: Field Data, 2023

The results in Table 15 showed that revealed a significant relationship between the predictor of community agricultural engagement (capacity building, livelihoods of farmers, and community participation) and the dependent variable (profitability). The regression model accounts for a substantial amount of the variation in profitability as evidenced by the high F-value of 14974.300 and a significant p-value of .000 <0.05 level of significance. These statistics suggested that the predictors included in the model are strongly associated with profitability outcomes in Rwanda.

Table 15: Regression coefficients of agricultural community engagement and profitability in Rwanda

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	.066	.021		3.097	.002
Community participation	.207	.020	.214	10.506	.000
Livelihoods of farmers	.207	.020	.214	10.506	.000
Capacity building	.574	.015	.586	38.919	.000

a. Dependent Variable: Profitability

Source: Field Data, 2023

The results in Table 15 showed a positive and significant relationship between community agricultural engagement factors (community participation, livelihoods of farmers, and capacity building) and profitability in Rwanda. The equation model became profitability = 0.066 + 0.207 × (Community participation) + 0.207 × (Livelihoods of farmers) + 0.574 × (Capacity building). The results show that community participation, capacity building and livelihoods of farmers have positive and significant standardized coefficients (Beta) of 0.214, 0.586 and 0.214 respectively. This indicates that an increase in community participation, capacity building and improvement in farmers' livelihoods are associated with higher levels of profitability in Rwanda. Hence, these results highlight the positive and significant effect of community participation, capacity building and livelihood improvement on profitability in Rwanda.

4.2 Discussion of findings

The current research emphasized the pivotal significance of community participation in shaping the effectiveness of the Irrigation project in Rwanda, corroborated by the work of Muriithi (2013) in Kenya. Muriithi's study highlighted the strong positive association between members' engagement and the performance of irrigation initiatives, stressing the importance of involvement across various project stages. This emphasis on inclusive decision-making processes and community involvement resonates with the current findings, underscoring the importance of fostering a sense of ownership and active participation for enhanced project outcomes.

Furthermore, the research shed light on the substantial influence of farmers' livelihood factors, including farm income, agricultural practices, empowerment, and market opportunities, on the project's overall performance. These results align with the findings of Akudugu et al. (2021) in Western Africa, emphasizing the transformative impact of irrigation on employment, income generation, food security, and diversified business activities. Akudugu et al.'s study highlighted the broad-ranging benefits of irrigation, emphasizing its role in bolstering livelihoods, health, and sustainable environmental practices. Thus, the study emphasized the critical need for continued support and effective interventions in the realm of irrigation to bolster the project's sustainability and positive impact on local livelihoods.

Additionally, the research highlighted the positive contributions of capacity building programs, encompassing farmer training, monitoring initiatives, and the provision of resources, to the overall success of the Irrigation project. This finding aligns with the research by Tekana and Oladele (2014) in South Africa, emphasizing the central role of empowerment and well-structured irrigation schemes in driving successful project outcomes. Notably, Tekana and Oladele's study emphasized the positive influence of women's empowerment in decision-making and leadership, reflecting the transformative potential of capacity building initiatives. These insights collectively underscore the critical role of capacity building strategies in bolstering the effectiveness and sustainability of irrigation projects, promoting increased agricultural productivity, and fostering community well-being.

5.1 Conclusion

In conclusion, the first objective related to community participation its results demonstrated the substantial impact of community participation on the Irrigation project's performance in Rwanda. The mean scores, ranging from 4.452 to 4.520, underscored the vital role of various aspects, including project design, consultative meetings, needs identification, financial support, budget allocation, and project location determination. These high mean scores suggested the importance of inclusive decision-making and community engagement in driving project success. The strong correlation coefficients of 0.975, 0.975, and 0.963 further supported the significant influence of community participation on critical performance indicators, namely food security, market expansion, and profitability.

The second objective about farmer's livelihoods findings highlighted the instrumental role of farmers' livelihoods in shaping the performance of the Irrigation project. The mean scores, ranging from 4.438 to 4.500, emphasized the positive influence of farm income, farming techniques, empowerment, community participation, labor provision, and market opportunities. These aspects were crucial in enhancing agricultural productivity and overall project efficacy. The substantial correlation coefficients of 0.986, 0.985, and 0.974 reinforced the significant relationship between farmers' livelihoods and key performance indicators, including food security, market expansion, and profitability.

The third objective about capacity building emphasized the critical role of capacity building initiatives in bolstering the Irrigation project's effectiveness. The mean scores, ranging from 4.417 to 4.637, highlighted the efficacy of measures such as farmer training, activity monitoring, and the provision of equipment and financial support. These capacity building strategies played a vital role in enhancing agricultural practices and improving project outcomes. The notable correlation coefficients of 0.930, 0.958, and 0.990 further underlined the substantial influence of capacity building on critical performance indicators, such as food security, market expansion, and profitability.

Therefore, the study underscored the critical significance of community participation, farmers' livelihoods, and capacity-building initiatives in fostering the overall success and sustainability of the Irrigation Project in Rwanda. The findings highlighted the need for inclusive community engagement and targeted interventions to support local farmers, ultimately contributing to the advancement of food security, market expansion, and overall profitability within the agricultural landscape of the Kirehe District.

5.2 Recommendations

Based on the research findings, key recommendations include strengthening community participation through active engagement in decision-making processes, supporting farmers' livelihoods by providing training and resources, enhancing capacity building initiatives, fostering collaboration among stakeholders, implementing a robust monitoring and evaluation system, prioritizing sustainability in long-term planning, promoting research and innovation, conducting awareness campaigns, addressing challenges promptly, and considering replication and scaling in similar areas. These actions will ensure the success and sustainable impact of the Irrigation project while benefiting the broader community.

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References

- Akudugu, M.A., Millar, K.K. & Akuriba, M.A. (2021). The Livelihoods Impacts of Irrigation in Western Africa: The Ghana Experience. *Sustainability*, 13 (6), 56-77. <https://doi.org/10.3390/su13105677>.
- Balarane, A. & Oladele, I.O. (2014). The impact of irrigation farming on livelihood strategies among smallholder farmers in the Morth West Province, South Africa. *Sustainable irrigation and drainage*, 185(12), 223-234. DOI 10.2495/SI140201.
- Bikuba, J.R & Kayunze, A.K. (2019). Enhancing agricultural community engagement to improve sustainability of irrigation projects in Geita District, Tanzania. *Journal of Agricultural Extension and Rural Development*, 11(10), 169-175, doi: 10.5897/jaerd2019.1066
- Hakuzimana, J. & Masasi, B. (2020). Performance Evaluation of Irrigation Schemes In Rugeramigozi Marshland, Rwanda. *Water Conservation and Management*, 4(1): 15-19.
- Muriithi, J. L. (2013). *Influence of members participation on performance of irrigation projects in Meru Central District, Kenya*. Unpublished master thesis at University of Nairobi, Nairobi, Kenya.
- Odongo, J. and Ma, D. (2021). Perspectives in Urban Planning Research: Methods and Tools. *Current Urban Studies*, 9, 759-778. doi: [10.4236/cus.2021.94045](https://doi.org/10.4236/cus.2021.94045).
- Rashied, Masudur & Begum, Halima. (2016). Community Participation in Development Projects in a Low-Income Community. 65-76. 10.13140/RG.2.2.28120.32008.
- Takayama, T., Matsuda, T., Nakatani, T. (2018). The determinants of collective action in irrigation management systems: Evidence from rural communities in Japan, *Agricultural Water Management*, 206 (10), 113-123. DOI: <https://doi.org/10.1016/j.agwat.2018.04.031>.
- Wanjala, A.W., Csorba, A. & Attila, J.T. (2020). Integration of Manure and Mineral Fertilizers among Smallholder Farmers in Kenya: A Pathway to Sustainable Soil Fertility Management and Agricultural Intensification. *International Journal of Agricultural Extension and Rural Development Studies*, 7(2), 1-20.
- Yami, M. (2013). Sustaining participation in irrigation systems of Ethiopia: what have we learned about water user associations? *Water Policy* 15(6): 961-984.