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Research Article

Climate Change Adaptation And Performance Of Agriculture Projects In Rwanda A Case Of Kayonza Irrigation And Integrated Watershed Management Project

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ABSTRACT

The general objective of this study was to assess effect of climate change adaptation strategies on performance of KWIIP. Specifically, the study analyzed the effect of water management strategies on performance of KWIIP, ascertain the effect of climate-resilient agriculture on performance of KWIIP and determined the effect of community-based adoption on performance of KWIIP. The research aimed to enroll 151 participants, including 10 health and environment unit heads at the local level, 85 employees at the sector level, 15 administrators from KWIIP, and 41 project workers at the district level. The Slovin formula was used to determine the sample size. When applied to the provided sample, this formula yielded a sample size of 110. Cluster sampling included selecting respondents from pre-existing demographic categories. The research team employed a combination of a questionnaire, in-depth interviews, and document reviews to compile their findings. The Statistical Package for the Social Sciences (SPSS) was used by the researcher to assess the data that had been obtained. This study's methodology used both descriptive and correlational approaches. The results showed that the variables that might be used to forecast how well the KWIIP would do were community-based adoption, climate-resilient agriculture, and water management practices. The correlation coefficient was at 0.495. An R-squared value of 0.245 indicates that the three independent variables (Community-Based Adoption, Climate Resilient Agriculture, and Water Management Strategies) account for about 24.5% of the variation in the dependent variable. With each unit increase in Water Management Strategies, the projected performance of the KWIIP is expected to climb by 0.323 units (β=0.323, t=3.992, p=0.000). In a similar vein, the Performance of the KWIIP (β = 0.304, t = 3.160, p=0.002) is correlated with an increase of 0.304 units in Community-Based Adoption, as shown by a coefficient of 0.304. There seems to be only a minor correlation between Climate Resilient Agriculture and the success of the KWIIP (β=0.009, t =0.117, p=0.907). The dependent variable is significantly impacted by Water Management Strategies and Community-Based Adoption, as shown by their statistical significance (Sig. <0.05). Nevertheless, there is no substantial contribution from Climate Resilient Agriculture (p>0.05) to the prediction of KWIIP Performance. Wastewater recycling, improving water management with tech-driven solutions, and increasing awareness of flood-resistant crop types are all areas where KWIIP could use some work in terms of developing effective communication methods. Drought-resistant crops and other climate-resilient agricultural techniques should be included into KWIIP. To further assure broad adoption of sustainable practices, KWIIP should build feedback systems, engage leaders, conduct training programs, and include community people in decision-making.

Key words: Climate Change Adaptation Strategies, Water Management Strategies, Climate-Resilient Agriculture, Community-Based Adoption, Performance

Introduction

Global warming is caused in part by both natural weather fluctuations and human actions that emit greenhouse gases into the atmosphere. Accelerating global warming affects people's capacity to earn a livelihood in many ways, including the intensification of natural deserts, increases in average temperatures and precipitation, and decreases in the supply of (clean) water. The agricultural industry in Rwanda is threatened by climate change, which has long been recognized as crucial to the country's development. However, the detrimental effects of climate change may be lessened if vulnerabilities are reduced. For this reason, efficient methods of adaptation and mitigation are necessary (Muneza, 2022).

Natural erosion and fragility characterize Rwandan soils. rivers, water reservoirs, and upstream and downstream cultivated fields combined. It also makes crop failure more likely and speeds up the siltation process in plains and marshes. Recent research looked at 25,144 plots throughout the country and found that soil erosion was a problem for 88% of them. Light erosion may be caused by things like splashes and winds, moderate erosion by things like diffuse overland flows, and severe erosion by things like gullies and rills, mass soil movement, and landslides. Persistent agricultural practices, soil erosion and degradation, and an absence of fertilizer treatment that may replenish depleted soil nutrients have depleted a significant section of Rwanda's soils (NISR, 2019).

Furthermore, the Eastern Province was particularly impacted by the drought throughout the main growth seasons (seasons A and B), according to the National Institute of Statistics of Rwanda (2018). Several districts in the Eastern Province, including Kayonza, Gatsibo, Kirehe, Nyagatare, Rwamagana, Ngoma, and Bugesera, have been severely affected by the drought. The number of persons affected ranges from 28,500 to 157,700. Important crops are particularly susceptible to these extreme drought conditions, according to the NISR report. In season A, around 62,000 metric tons of crops are in danger, and in season B, that amount rises to 157,700 metric tons, a considerable increase. Among these crops, the ones most susceptible to the negative consequences of drought are Irish potatoes, bananas, and cassava. The issue underscores the critical need of swift action to tackle the effects of shifting climatic patterns on Rwanda's agricultural sector and food security.

Most research on the topic of climate change adaptation strategies has focused on Tanzania in East Africa. In Rwanda, studies examining the connection between agricultural project outcomes and adaptation strategies to climate change were few and few between. The impact of climate-resilient agriculture, community-based adoption, and water management measures on the efficiency of the Kayonza irrigation system and the integrated watershed management project needs its own research. The purpose of this study was to fill in some of the blanks in our knowledge in this area.

The general objective of this study was to assess effect of climate change adaptation on performance of KWIIP.

Specific objectives:

i. To analyze the effect of water management strategies on performance of KWIIP.
ii. To ascertain the effect of climate-resilient agriculture on performance of KWIIP.
iii. To determine the effect of community-based adoption on performance of KWIIP.

The study guided by the following null hypotheses;

i. **H_o1:** There is no significant effect of water management strategies on performance of KWIIP.
ii. **Ho2:** There is no significant effect of climate-resilient agriculture on performance of KWIIP.
iii. **Ho3:** There is no significant effect of community-based adoption on performance of KWIIP.

2. Literature review

Water Management Strategies

Jamal (2018) looked at how climate change and water management methods impact performance criteria used to evaluate environmental and agricultural sustainability indices. The Zarrinehrud-and Siminehrud River-basins, two enormous sub-basins of Urmia Lake, are the main focus of this research. Based on three emission-scenarios (A2, A1B, and B1) that span 2015–2040, the study predicts how these basins' hydrologic systems would behave using the WEAP21 model. We take a look at five different scenarios for water management: business as usual, changing crop patterns, increasing distribution and conveyance efficiency, improving both with advanced application techniques, and integrating changes to crop patterns with overall irrigation efficiency. Significantly, the results show that the scenario including overall irrigation efficiency improvements and adaptations to crop patterns under the B1 emission scenario (B1S4) yields the best results in terms of environmental and agricultural sustainability indicators.

Rugiri and Njangiru (2018) investigated the impact of the Constituency Development Fund (CDF) on water project outcomes in Kenya's Nyeri County. The study uses a descriptive research approach to focus on eighty-six water projects that have been recognized as being supported by the Constituency Development Fund Board, an arm of the National Government. Sixty people, including project managers in charge of various water programs, used a stratified sampling method to choose individuals at random. When doing primary research

with questionnaires, the drop-and-pick method is used. A favourable association between project success and resource availability was found in Pearson correlation research. Water project scheduling and approval procedures may be made more efficient according to the report's recommendations, which also urge lawmakers to increase financing for these sectors.\

Climate-Resilient Agriculture

Festus (2021) examined 2016 data to learn how Climate-Resilient Agriculture (CRA) programs impacted soil health and grain output, as well as what variables prompted smallholder farmers in southern-Malawi to join. A control function strategy-based endogenous switching regression was used in the research, which is a unique method. A survey of 808 farm households distributed throughout five WALA regional districts provided the main findings. Endogeneity and selective bias were taken into consideration in the research by taking CRA participation criteria into account. Significantly, the study indicated that active participation in the project resulted in notable improvements. In a dry year, food yields, especially maize, surged by a remarkable 61%. Furthermore, soil organic carbon, nitrogen, potassium, and soil organic matter all showed improvements of 44%, 31%, and 57%, respectively, indicating improved soil health. The significance of CRA programs in enhancing soil quality and agricultural production in arid regions such as southern Malawi is underscored by these findings, and their impact extends beyond the confines of this study. In order to help agricultural systems in Malawi and throughout the globe remain sustainable, this research adds to what is already known by explaining what motivates people to participate in CRA programs and how to make them more attractive.
Udit (2021) found that agricultural systems are quite susceptible to the effects of climate change. This is a result of their susceptibility to a variety of factors, including temperature fluctuations, precipitation changes, and the occurrence of natural disasters such as flooding and droughts. Extreme weather patterns, according to the report, have the ability to cut into agricultural profits by as much as 15–18%. The research recommends improving agricultural production systems' resilience and resource efficiency and strengthening farmers' adaptive ability to lessen the impact of these risks. Farmers, governmental agencies, academic institutions, businesses, and lawmakers all need to work together as part of Climate-Resilient Agriculture (CRA), a comprehensive strategy. This collaboration is structured around three key action areas: identifying threats, implementing adaptation and mitigation processes to address these threats, and ensuring the continuity of adaptive mechanisms over the long term. The study draws attention to the heightened vulnerability resulting from existing challenges such as poverty, malnutrition, and population growth, which exert considerable pressure on finite natural resources critical to agricultural systems, including land, water, and energy.

In a study by Manasi (2019), an exploration into climate change vulnerability specific to villages in Maharashtra is undertaken, along with strategies for mitigating these vulnerabilities through engineering interventions. The study evaluates the effectiveness of the PoCRA (Protective Cultivation for Resilient Agriculture) project in enhancing climate resilience. The project aims to enhance resilience by facilitating access to protective irrigation, disseminating water availability information before the rabbi season, and implementing watershed initiatives and altered cropping patterns. A mixed-method approach combining bio-physical and socio-economic vulnerability assessment is employed, relying heavily on primary data collected from the field. The study further seeks to refine beneficiary selection by comprehensively understanding the distinct benefits offered by the project and their specific requirements. Notably, the monitoring and evaluation framework goes beyond conventional key performance indicators, aiming to extract richer insights from the Project Development Objectives.

Community Based Adoption

Solomon (2020) examined the socioeconomic factors of beneficiaries who participated in the Community-Based Agricultural and Rural-Development Project (CBARDP) in Kwara State, Nigeria. Agricultural innovations distributed by the initiative are examined in the study. There was a multi-stage sample technique used to choose responders from the LGAs. The majority of the farmers who participated in the study were either married (92.2%) or male (74.1%), and their average age was around 52.1 years old, according to the researchers. The results show that CBARDP has a moderate degree of technology adoption overall, with especially high rates in the areas of orchards, fisheries, poultry, and cattle. However, adoption rates were lower in the following categories: livestock, processing, agricultural production, and agro-processing. The study finds that compatibility, relative advantage, gender, marital status, and social organization participation are all significantly correlated with CBARDP technology adoption. Moreover, correlations were found between farmers' adoption of CBARDP technology and factors such as household size, farm size, and years of employment. The research found that beneficiaries in the study region had a modest degree of technological use within CBARDP. The study's authors suggest getting the word out to the right people, with a focus on getting more women involved in similar initiatives.
Christophe (2018) investigated the impact of beneficiaries' engagement on the God's Way Project in the Ntarama Sector of the Bugesera-District, which is run by ATN-Farming Rwanda. Combining descriptive and correlational research techniques, the study's approach draws relationships between variables. For this poll, we tapped into SPSS v.21, a widely-used statistical program in the social sciences. Positive relationships

between beneficiary participation during planning, implementation, monitoring and evaluation, and other project phases are shown by the data. Project sustainability is improved by involving beneficiaries more actively throughout the project life cycle, according to the research. The most important element of a project is having the beneficiaries involved in the planning process, then coming up with a strategy, and lastly carrying it out.
In Rwanda, Beatrice's (2019) evaluation centered on the importance of community involvement and the longevity of the initiative. With a thorough research method, the study aims to enroll 95 beneficiaries from the welfare program in the Nyarugunga Sector, out of a total population of 1600. The sample was chosen using a straightforward random sampling process. Excel and SPSS are used to handle both quantitative and qualitative data in the study. Tables and graphs display the data, and regression models and correlations are used to investigate the relationship between the independent and dependent variables. Producing high-quality and high-yield crops, particularly fruits, vegetables, and flowers, is made possible by greenhouse technology, according to the research. For this technology to work at its best, it needs state-of-the-art greenhouses constructed from plastic or glass.

3. Research methodology

This chapter lays out the steps used to gather data for the research. This section details the researcher's planned research strategy for accomplishing the research goals and answering the research questions. It also includes information about the study population, sample size and sampling procedure, data collection methods, data analysis, and any ethical considerations that were considered.

Research Design
A combination of descriptive and correlational study was carried out by the investigator. In descriptive survey research, participants are asked to rate a range of topics; in quantitative survey research, respondents are asked to rate their own responses; and in correlational study design, participants are asked to rate the strength of any relationships between the variables being studied.

Study Population and Sample Size
The population is the set of all the things you can create a sum out of. Here are the breakdowns of the 151 people that took part in this study: There are ten district-level project workers, eighty-five sector-level employees, fifteen KWIIP administrative staff, and forty-one health and environment unit local leaders.
The Slovin formula, which offers a straightforward method for doing so, was used to determine the sample size. A total of 110 participants were found to be the sample size.

Data Collection Instruments
Research data and information may be gathered via the use of data collection instruments. Questionnaires and document analysis were among the several methods used to compile data for this research.
Data was collected from participants using a semi-structured questionnaire that they self-administered. Questionnaires are collections of self-administered questions with a predetermined set of answers. To gather data for this research, 110 participants were given questionnaires and asked to reflect on their own knowledge, experiences, and views in answering the questions.
The researcher looked over data, reports, and plans that were pertinent to the project. Background, goals, procedures, and consequences of the project were further illuminated by the papers. The data obtained from the documentary study supplemented the information derived from other sources.

Data Analysis Method
Data analysis entails distilling the collected data into manageable chunks, creating summaries, investigating patterns, and utilizing statistical methods. On the other hand, data preparation entails editing, coding, and data entry, and it ensures the data's accuracy while transforming it from raw to reduced and easier to analyze forms. Data coding is the process of categorizing answers into a small number of predetermined groups by giving them numerical values or other symbols. Information retrieved from secondary or primary sources may be transformed into a format suitable for display and manipulation through data input. Statistical Package for the Social Sciences (SPSS) version 22.0 was used for data analysis. This research made use of SPSS, or the Statistical Package for the Social Sciences, to conduct quantitative analyses.
Information distilled from qualitative sources and summed up for each group. The researcher chose a few quotations that best capture the spirit of each goal. The data was reduced and the key results were summarized using this method.

Ethical Consideration
The researcher contacted the study's stakeholders after submitting a formal request for approval to the individuals in charge of the program. Ethical issues in research mostly revolve upon obtaining informed permission, ensuring voluntary involvement, and maintaining confidentiality or anonymity. The researcher

respected the respondent's right to privacy by meeting them at their preferred location. Respondents were guaranteed anonymity in the research, and their information would be handled professionally. The code number, rather than their identities, would be used for the study's goals. Instead of reflecting names, respondents were assigned codes.

4. Results & Discussions

This chapter focuses on the analysis of the data gathered from 110 participants. The data are presented in tables and then analyzed.

Table 1: Response Rate

Questionnaires	Frequency	Percentage
Filled and returned	110	100.0
Total	**110**	**100.0**

Source: Research findings (2023)

The study found that a perfect 100% response rate was achieved, with all 110 surveys being filled out and returned. While a response rate of 70% or above is ideal for data analysis, Sammut et al. (2021) state that a 100% response rate is sufficient. This response rate was ideal for carrying out a comprehensive analysis of the research objective.

Table 2: Perceptions of respondents on water management strategies

	SD		D		N		A		SA		Mean	Std. Dev.
	Fi	%	fi	%	fi	%	fi	%	fi	%		
KWIIP effectively implements water conservation measures in the watershed area.	0	0.0	1	0.9	3	2.7	50	45.5	56	50.9	4.46	.601
Rainwater harvesting techniques advocated by the project are widely practiced by participants.	0	0.0	1	0.9	9	8.2	53	48.2	47	42.7	4.33	.665
The project successfully promotes efficient irrigation techniques for agriculture.	1	0.9	3	2.7	24	21.8	50	45.5	32	29.1	3.99	.840
Adopted Water conservation measures have led to improved water availability within the project area.	0	0.0	1	0.9	2	1.8	32	29.1	75	68.2	4.65	.568
Wastewater recycling activities of KWIIP are seen as beneficial for both the environment and agriculture.	29	26.4	56	50.9	10	9.1	12	10.9	3	2.7	2.13	1.015
Irrigation techniques used by project have enhanced water use efficiency in agricultural activities.	0	0.0	6	5.5	19	17.3	59	53.6	26	23.6	3.95	.794
Overall											3.91	.747

Source: Research findings (2023)

Table 2 shows the results of an analysis of how different water management tactics affected the KWIIP's efficiency. The statement that KWIIP efficiently executes water conservation measures in the watershed region had a very high mean score of 4.46, showing a very strong positive agreement among respondents, with 50.9% strongly agreeing and 45.5% agreeing. There is heterogeneity in the answers given by the participants, as seen by the standard-deviation of 0.601. Additionally, participants had overwhelmingly favorable reactions to the assertion that the project's recommended rainwater collection methods are widely used. With 48.2% agreeing and 42.7% strongly agreeing, the mean score was 4.3, indicating a very positive agreement. But there is heterogeneity in the answers, as seen by the standard-deviation of 0.665. The initiative effectively promotes efficient irrigation practices for agriculture, according to 45.5% of respondents, with 29.1% strongly agreeing. With a standard-deviation of 0.840 and a mean score of 3.99, the results demonstrate a lot of variation in opinions. With a mean score of 4.65 and a standard-deviation of 0.568, we can see that there is a lot of agreement that the water conservation measures that were implemented have increased the amount of water available in the project area. 68.2% of respondents strongly agreed with this statement, and 29.1% agreed.
In addition, when asked if they thought KWIIP's wastewater recycling efforts were good for the environment and farmers, most respondents gave a negative response (50.9% disagreed, 26.4% strongly disagreed with, 10.9% agreed, and 2.7% very agreed). The low mean score of 2.13 implies that respondents were neither very

in agreement or strongly disagreed, and the standard-deviation of 1.015 shows that there was heterogeneity in the replies. One area where recycling efforts at KWIIP may need some work is evident from the significant discord among responders. Finally, an impressive number of respondents agreed with the assertion that the project's irrigation practices had improved water usage efficiency in agricultural operations. 53.6% of respondents agreed with this statement, and 29.1% strongly agreed. There is heterogeneity in the answers, as shown by the standard-deviation of 0.794 and the high mean score of 3.95, which indicate a significant positive agreement among the respondents.

With a mean score of 3.91 and a standard-deviation of 0.747, it is clear that there is heterogeneity in respondents' answers; this highlights the need for KWIIP to focus on improving certain parts of its water management strategies. The results show that water management strategies impact the performance of the KWIIP.

The findings align with the emphasis of Neufeldt (2018) on the nature of water management strategies, encompassing various measures and practices to address water-related issues. The positive agreement among respondents, reflected in high mean scores, indicates the effectiveness of implemented measures. However, the noted heterogeneity in responses, highlighted by standard-deviation s, highlights the need for targeted improvements in specific aspects of water management within KWIIP.

The study utilized the Diffusion of Innovations Theory to further explain how characteristics of water management strategies, such as efficient irrigation and recycling activities, align with the theory's attributes (e.g., relative advantage, compatibility).

Table 3: Perceptions of respondents on climate-resilient agriculture

	SD		D		N		A		SA		Mean	Std. Dev.
	fi	%	fi	%	fi	%	fi	%	fi	%		
KWIIP promotes crop diversification as a climate-resilient agricultural practice.	1	.9	1	.9	7	6.4	62	56.4	39	35.5	4.25	.693
Soil management practices recommended by the project effectively enhance soil resilience.	1	.9	0	0.0	3	2.7	31	28.2	75	68.2	4.63	.633
Participants in the project have experienced benefits from utilizing drought-tolerant crop varieties.	0	0.0	1	.9	10	9.1	64	58.2	35	31.8	4.21	.637
Crop diversification has led to increased resilience against climate-related challenges.	0	0.0	1	.9	10	9.1	71	64.5	28	25.5	4.15	.603
Improved soil management practices have resulted in healthier and more productive soils.	1	.9	1	.9	4	3.6	14	12.7	90	81.8	4.74	.659
The project's promotion of flood-resistant crop varieties has positively impacted agricultural outcomes.	11	10.0	31	28.2	37	33.6	23	20.9	8	7.3	2.87	1.085
Overall											4.14	.718

Source: Research findings (2023)

Table 3 shows the outcomes related to the effect of climate-resilient farming on the KWIIP's performance. In terms of promoting crop diversity as a climate-resilient agricultural approach, the majority of respondents (56.4%) agreed or strongly agreed (35.5%), with a mean score of 4.25 indicating very high positive agreement among respondents. The standard-deviation of 0.693 indicates that the responses are heterogeneous. Similarly, 68.2% of those who took the survey agreed that the soil management strategies suggested by the project made a difference in improving soil resilience, whereas 28.2% strongly agreed. With a mean score of 4.63, this clearly indicates that respondents were in complete agreement. The heterogeneity in answers is shown by the standard-deviation of 0.633.

A member of Health and environment unit stated, KIIWP has provided irrigation facilities for planted fruits under the project and it has also intervened in land husbandry which will prevent soil erosion and increase crop production.

A large majority of respondents (58.2% strongly agreed, with 31.8% agreeing) felt that the use of drought-tolerant crop varieties had a positive impact on the project's participants. The end result was a standard-deviation of 0.637 and an average score of 4.21, both of which point to a high degree of agreement. There was heterogeneity in the answers, as seen by the standard deviation of 0.603 and the mean score of 4.15, it is clear that respondents strongly agree that crop diversification has increased resilience against climate-related challenges. Additionally, 64.5% of respondents strongly agreed and 25.5% agreed, further supporting this

finding. Better soil management practices have resulted in healthier and more productive soils, according to the results, which show a very significant positive agreement among respondents with a mean score of 4.74. While 12.7% of those who took the survey agreed, 81.8% were very much in agreement. A standard-deviation of 0.659 indicates that the responses are heterogeneous. Finally, when asked how the program had an impact on agricultural output, 33.6% were neutral, 28.2% disagreed, and 10% strongly disagreed that the campaign had a positive effect on the promotion of flood-resistant crop kinds. In this respect, there is space for improvement. Only 7.3% of those who took the survey strongly disagreed, while a substantial 20.9% agreed. There is heterogeneity in replies, as seen by the standard-deviation of 1.085 and a lower mean score of 2.87, which imply a significant disagreement or low positive agreement among respondents.

With a mean score of 4.14, there is strong agreement that climate-resilient agriculture improves KWIIP's performance. However, with a standard-deviation of 0.718, there is some heterogeneity in participants' responses, highlighting the need for targeted improvements in specific areas of climate-resilient agriculture within KWIIP.

The findings are supported by the emphasis of Festus (2021) on the significant improvements in soil health and grain yields through Climate-Resilient Agriculture (CRA) initiatives. Festus's analysis in southern Malawi aligns with the positive responses regarding crop diversification and soil management practices in the KWIIP, reinforcing the effectiveness of climate-resilient agricultural measures in enhancing agricultural outcomes.

Diffusion of Innovations Theory was used to further examine how specific climate-resilient practices (e.g., drought-resistant crops, soil management) align with it attributes such as relative advantage, compatibility, and complexity to understand the likelihood of adoption and incorporation of these practices.

Table 4: Perceptions of respondents on community-based adoption

	SD		D		N		A		SA		Mean	Std. Dev.
	fi	%	fi	%	fi	%	Fi	%	fi	%		
KWIIP actively engages the community through participatory approaches.	0	0.0	0	0.0	0	0.0	16	14.5	94	85.5	4.85	.354
Knowledge sharing among KWIIP participants is encouraged and facilitated.	0	0.0	0	0.0	1	0.9	34	30.9	75	68.2	4.67	.490
Capacity building activities are effectively enhancing community skills and knowledge.	0	0.0	0	0.0	1	0.9	31	28.2	78	70.9	4.70	.480
Community members feel actively involved in project decision-making processes.	0	0.0	9	8.2	26	23.6	31	28.2	44	40.0	4.00	.986
The project's knowledge-sharing activities have improved community awareness.	0	0.0	0	0.0	2	1.8	29	26.4	79	71.8	4.70	.499
Capacity building efforts have equipped community members with valuable skills.	0	0.0	0	0.0	0	0.0	33	30.0	77	70.0	4.70	.460
Overall											4.60	.544

Source: Research findings (2023)

Presented in Table 4 are the results pertaining to the impact of community-based adoption on the efficiency of the KWIIP. Importantly, 85.5% of respondents strongly agreed and 14.5% agreed that KWIIP actively engages the community via participatory techniques. Respondents strongly agree, as shown by the very high mean score of 4.85, that effective community engagement is taking place. Everyone seems to agree on this issue, because the standard deviation is just 0.354, indicating homogeneity in responses. With 68.2% strongly agreeing and 30.9% agreeing, respondents feel that knowledge sharing among KWIIP members is encouraged and made possible. With a mean score of 4.67, it's clear that respondents were very in agreement. A standard-deviation of 0.490 provides support for the hypothesis of response homogeneity. A mean score of 4.70 indicates that respondents strongly agree, a significant portion of the sample strongly agreed that capacity building activities are effectively improving community skills and knowledge. Specifically, 70.9% of the sample strongly agreed and 28.2% agreed. A very homogeneous set of replies is indicated by a standard-deviation of just 0.480. Additionally, respondents were highly in agreement that community people should feel included in project decision-making processes (40.0% agreeing and 28.2% strongly agreeing), with a mean score of 4.00. There is room for improvement in the success of the KWIIP community-based adoption program, as shown by the rather heterogeneous replies (standard-deviation = 0.986). With a mean score of 4.70 and 71.8% of respondents strongly agreeing, it's clear that the community is very much in agreement that the project's knowledge-sharing initiatives are helping to raise awareness. The homogeneity of responses is emphasized by the standard-deviation of 0.499.

Lastly, capacity development initiatives that provide invaluable skills to community people (with 70% strongly agreeing and 30% agreeing). Respondents strongly agree on this element, as shown by the extremely high mean score of 4.70. The homogeneity of responses is indicated by the standard-deviation of 0.460. .

Respondents' generally good impression of the impact of community-based adoption on KWIIP's performance is strongly supported by the very high mean score of 4.60, while the variability in replies is shown by the standard-deviation of 0.544.

The findings are consistent with the emphasis of Beatrice (2019) on the significance of community participation for project sustainability in Rwanda through participation in decision-making processes, knowledge sharing, and capacity building. The positive responses regarding community engagement, knowledge sharing, and capacity building in the KWIIP align with the emphasis on involving the community, supporting the effectiveness of community-based adoption initiatives highlighted by Beatrice.

Participatory Theory was used to assess how KWIIP empowers communities by focusing on how KWIIP involves key stakeholders, particularly marginalized groups, in decision-making processes, aiming to understand the impact of participatory approaches on sustainability, social justice, and community development.

Table 5: Perceptions of respondents on Performance

	SD		D		N		A		SA		Mean	Std. Dev.
	fi	%	fi	%	fi	%	fi	%	fi	%		
The project consistently achieves high crop productivity.	0	0.0	1	.9	7	6.4	40	36.4	62	56.4	4.48	.660
The project contributes significantly to local food security.	0	0.0	2	1.8	5	4.5	51	46.4	52	47.3	4.39	.665
The project has created job opportunities in the region.	0	0.0	1	.9	6	5.5	39	35.5	64	58.2	4.51	.646
The project provides income opportunities for local farmers.	0	0.0	1	.9	2	1.8	30	27.3	77	70.0	4.66	.563
KWIIP meets its objectives and targets.	0	0.0	14	12.7	50	45.5	33	30.0	13	11.8	3.41	.860
KWIIP demonstrates a positive impact on the local economy.	0	0.0	0	0.0	1	0.9	55	50.0	54	49.1	4.48	.520
Overall											4.32	.652

Source: Research findings (2023)

Table 5 shows the results of the KWIIP, for several metrics. With 56.4% strongly agreeing and 36.4% agreeing, the assertion that the initiative routinely delivers high crop yield is regarded in a good light. A standard-deviation of 0.660 indicates that there is some heterogeneity in the replies, and the very high mean score of 4.48 indicates that the respondents are in great agreement with this element.

With a standard-deviation of 0.665 highlighting response heterogeneity and a very high mean score of 4.39 indicating very strong positive agreement among respondents. Additionally, the project's contribution to local food security is well-regarded, with 46.4% strongly agreeing and 47.3% agreeing. Similarly, when asked if the project has increased employment prospects in the area, 58.2% of respondents gave a strong agreement and 35.5% gave an agree. A relatively high mean score of 4.51 and a standard-deviation of 0.646 indicate that responses to this aspect are heterogeneous. In addition, 27.3% of people think the initiative is helping local farmers make money, and 70.0% of those who took the survey really agree with that. This results in a mean score of 4.66, which indicates a high level of agreement among respondents. The response was also quite heterogeneous, with a standard-deviation of 0.563. While 30.0% agree and 11.8% strongly agree, 12.7% disagree and 45.5% are indifferent when asked whether KWIIP routinely achieves its aims and targets. There is considerable response variability, as shown by a mean score of 3.41 and a standard-deviation of 0.860. The agreement level is moderate to high. Respondents seem to lack understanding or confidence on whether KWIIP achieves its goals and aims, as seen by the large percentage of participants who were indifferent or disagreed. This indicates a potential area for development. With a standard-deviation of 0.520 indicating significant heterogeneity in replies, and a very high mean score of 4.48 indicating a very strong positive agreement. Finally, 50.0% of respondents strongly agree and 49.1% agree that KWIIP demonstrates a positive impact on the local economy.

While the overall extremely high mean score of 4.32 indicates a very strong favourable general assessment of KWIIP's performance, the standard-deviation of 0.652 suggests that respondents' views are heterogeneous.

The findings are supported by the emphasis of Ojiako *et al.* (2021) on assessing and managing project performance, including measuring objectives, constraints, and continuous improvement. The very strong positive general perception of KWIIP's performance, along with the acknowledgment of areas for improvement, aligns with Ojiako *et al.* focus on effective project management principles and ongoing enhancement for successful outcomes.

The Theory of Change guided the assessment of KWIIP's ambitions, essential steps, and progress toward desired performance in the context of integrated watershed management.

Table 6: Model Summary on climate change adaptation and performance of agriculture projects

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.495[a]	.245	.223	.30189

a. Predictors: (Constant), community-based adoption, climate resilient agriculture, water management strategies

Source: Research findings (2023)

According to Table 6, which summarizes the results of a regression model, there is a moderate positive-correlation (R = 0.495) among the variables that were used to predict the performance of KWIIP, as well as climate resilient agriculture and water management procedures. The predictors (Community-Based Adoption, Climate Resilient Agriculture, and Water Management Strategies) explain around 24.5% of the variability in the dependent variable, according to the R Square value of 0.245. The model shows a reasonable degree of fit, with an Adjusted R Square of 0.223 after accounting for the number of predictors. This indicates that 22.3% of the variability remains explained.

The results are in line with what Filomena (2018) stressed: that a holistic, multi-angle strategy is necessary to combat climate change. The moderate positive correlation between the project's performance and the predictors (community-based adoption, climate resilient agriculture, and water management strategies) lends credence to the idea that successful adaptation strategies to climate change play a substantial role in the project's final results.

Table 7: ANOVA[a] on climate change adaptation and performance of agriculture projects

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.132	3	1.044	11.457	.000[b]
	Residual	9.661	106	.091		
	Total	12.793	109			

a. Dependent Variable: Performance of agriculture project

b. Predictors: (Constant), community-based adoption, climate resilient agriculture, water management strategies

Source: Research findings (2023)

Table 7 shows the results of an ANOVA for the provided regression model. The regression model, which incorporates variables including Community-Based Adoption, Climate Resilient Agriculture, and Water Management Strategies, is statistically significant with an F-statistic of 11.457 and a p-value of 0.000. This proves that these factors significantly affect the success of the KWIIP when taken as a whole.

The findings are supported by the emphasis of Torikul & Melissa (2017) that acknowledges the importance of formal institutions in contributing to local agricultural mitigation and adaptation capacities. The statistically significant impact of predictors (Community-Based Adoption, Climate Resilient Agriculture, and Water Management Strategies) on the project's performance aligns with the need for localized initiatives strengthening resilience as highlighted by Torikul and Melissa.

Table 8: Coefficients on climate change adaptation and performance of agriculture projects

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.618	.562		2.877	.005
	Water management strategies	.323	.081	.371	3.992	.000
	Climate resilient agriculture	.009	.079	.011	.117	.907
	Community based adoption	.304	.096	.274	3.160	.002

a. Dependent Variable: Performance of agriculture project

Source: Research findings (2023)

In a linear regression model, the equation took the form of:

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3$

Where:

Y is the dependent variable (Performance of agriculture project), X_1: water management strategies, X_2: climate resilient agriculture, X_3: community-based adoption, β_0 is the intercept or constant term, β_1, β_2 and β_3 are the coefficients or slopes associated with each independent variable.

Performance of KWIIP = 1.618 + 0.323 (Water Management Strategies) + 0.009 (Climate Resilient Agriculture) + 0.304 (Community-Based Adoption).

Table 8 illustrates the regression coefficients for the model that forecasts the performance of the KWIIP. Assuming that all predictor variables are set to zero, the constant term (1.618) represents the dependent variable's predicted value. An increase of one unit in Water Management Strategies is anticipated to result in a

0.323-unit improvement in the Performance of the KWIIP. The same holds true for Community-Based Adoption; a coefficient of 0.304 suggests that for every one unit rise in this variable, the Performance of the KWIIP goes up by another 0.304 units. With a coefficient of 0.009, Climate Resilient Agriculture has a small but favourable effect on the Performance of KWIIP. Water Management Strategies (p=0.000) and Community-Based Adoption (p=0.002) have a substantial influence on the dependent variable, as shown by their statistical significance (Sig. < 0.05). When it comes to forecasting KWIIP performance, however, Climate Resilient Agriculture is insignificant (p=0.907>0.05).

The results are in line with what Williams et al. (2019) found: that farming households in sub-Saharan Africa use a variety of adaptation strategies, including planting crops that mature early and are drought tolerant, diversifying their crops, and changing their land management techniques, to lessen the impact of climate change. The regression model's ability to forecast the Kayonza irrigation project's success is heavily dependent on Water Management Strategies and Community-Based Adoption.

5. Conclusion

The primary objective of this study was to assess effect of climate change adaptation on performance of KWIIP. Specifically, the study guided by objectives of analyzing the effect of water management strategies on performance of KWIIP, ascertain the effect of climate-resilient agriculture on performance of KWIIP, and determine the effect of community-based adoption on performance of KWIIP.

The evaluation of KWIIP shows positive perceptions across its water management strategies, climate-resilient agriculture, and community-based adoption initiatives. Particularly, initiatives to recycle wastewater and promote agricultural types that are more resistant to flooding need more focus. These findings highlight the need to improve some parts of KWIIP's strategy to make sure the project's many activities provide consistent and even better results.

The results indicate that water management strategies significantly affect the project's performance, as evidenced by the rejection of Null Hypothesis 1 (H01) with a p-value less than 0.05. Also, Null Hypothesis 3 (H03) concerning the impact of community-based adoption is rejected, with a p-value less than 0.05, indicating a significant effect of community-based adoption on the project's performance. Conversely, for Null Hypothesis 2 (H02) related to the influence of climate-resilient agriculture, the p-value exceeds 0.05, confirming insufficient evidence to establish a significant effect.

6. Recommendations

KWIIP should develop and implement comprehensive communication strategies specifically focused on wastewater recycling activities and provide clear, accessible information about the positive environmental and agricultural impacts of the recycling initiatives. KWIIP should implement efficient water management strategies, such as optimizing irrigation schedules, technology-driven solutions and reducing water wastage, is crucial for enhancing the overall performance of the Kayonza irrigation project. Moreover, KWIIP should consider enhancing its promotion and communication strategies related to flood-resistant crop varieties by providing clearer information, conducting awareness campaigns, and actively involving the community in understanding the benefits of flood-resistant crops.

KWIIP is recommended to prioritize the integration of climate-resilient agricultural practices within the Kayonza project by promoting drought-resistant crops, improving soil moisture retention, and incorporating climate-smart technologies. Furthermore, KWIIP is recommended to enhance the effectiveness of community-based adoption initiatives by improving community members' active involvement in project decision-making through regular community consultations, feedback sessions, or participatory forums. Finally, KWIIP should strengthen community-based adoption by strengthening active participation and awareness among the local community by implementing training programs, engage community leaders, and establish a feedback mechanism to ensure widespread adoption of sustainable practices.

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