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Strategic Knowledge Transfer and Climate Programs Implementation: Evaluating Capacity Building in Rural Uganda

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Abstract

Climate change presents escalating risks to rural communities in Uganda, where institutional readiness and adaptive capacity remain uneven. This study examines how capacity building strategies—anchored in knowledge transfer mechanisms—shape the implementation of climate programs in Rukungiri District. Using a mixed-methods design that integrates survey data, key informant interviews, and document analysis, the research evaluates the effectiveness of training initiatives, stakeholder engagement, and localized knowledge dissemination. Findings reveal that while capacity building improves technical competencies and coordination, its impact depends on the relevance, accessibility, and contextual integration of transferred knowledge. The study identifies gaps in strategic alignment between national climate policies and local implementation frameworks. Grounded in Actor-Network Theory and Policy Implementation Theory, the paper offers actionable insights for policymakers and development practitioners seeking to strengthen climate governance in vulnerable rural settings.

Key Words: Knowledge transfer mechanisms, Climate capacity building, Indigenous knowledge systems, Participatory learning, Rural climate adaptation

1.0 Introduction

Global climate governance has evolved through landmark agreements such as the Kyoto Protocol, the Paris Agreement, and the United Nations Framework Convention on Climate Change (UNFCCC), each emphasizing capacity building, technology transfer, and inclusive adaptation as foundational pillars of climate action (Jordan et al., 2018; Bäckstrand & Kuyper, 2017). Advanced economies—including France, the United Kingdom, and Japan—have demonstrated the efficacy of integrating climate policies across sectors, investing in public awareness, and fostering multi-stakeholder networks to accelerate implementation (Meadowcroft, 2009; Adger et al., 2003). In contrast, countries in the Global South such as Bangladesh, Kenya, and Brazil have underscored the critical role of community engagement and localized knowledge systems in building resilience (Tanner et al., 2015; Pelling & High, 2005). These global experiences converge on a central insight: effective climate action requires not only robust policy frameworks but also the strategic transfer of knowledge and capacity to the local level.

Uganda has responded to climate threats with a suite of progressive national frameworks, including the National Climate Change Policy (2015), the Green Growth Development Approach (2015), and its updated Nationally Determined Contributions (2022). Despite these commitments, translating national climate ambitions into effective local action remains a persistent challenge. Rural districts such as Rukungiri—where over 78% of the population depends on climate-sensitive agriculture—face erratic rainfall, prolonged droughts, and soil erosion, which threaten food security and livelihoods (Kato, 2024; Nabalegwa et al., 2020). Implementation efforts are further constrained by limited technical capacity, fragmented coordination, and inadequate funding at the district level (Alinda et al., 2020; Ministry of Water and Environment, 2021).

Rukungiri District presents a compelling case for examining the local dynamics of climate program implementation. Its diverse topography, high climate vulnerability, and active but under-resourced environmental networks reflect broader structural challenges across Uganda. While initiatives such as farmer field schools, reforestation campaigns, and climate-resilient agriculture training have been introduced, their effectiveness hinges on the quality and contextual relevance of knowledge transferred to local actors. The district's experience highlights a critical gap in the literature: how capacity-building strategies can be optimized through knowledge transfer mechanisms to enhance program delivery in climate-vulnerable rural settings (Hatcheu, 2017; Golhasany & Harvey, 2025).

Knowledge transfer, in this context, is not merely a conduit for information dissemination but a transformative process that enables behavioral change, adaptive learning, and institutional strengthening (King et al., 2024; Crawford, 2020). When embedded within capacity building strategies, it has the potential to catalyze climate program implementation and foster sustainable development. However, few empirical studies have systematically examined how these mechanisms interact in rural Ugandan contexts, particularly in districts like Rukungiri where climate vulnerability intersects with governance and resource constraints (Ssekamatte et al., 2020; Nabikolo et al., 2012).

This study investigates how capacity-building strategies, underpinned by knowledge transfer, influence the implementation of climate change programs in Rukungiri District. Guided by Actor-Network Theory (Latour, 2005) and Policy Implementation Theory (Sabatier & Mazmanian, 1980), the research analyzes the interactions among actors, institutions, and learning systems that shape climate governance outcomes. By situating Uganda's local implementation challenges within a global climate governance landscape, the study contributes to ongoing debates on adaptive governance, strategic learning, and inclusive climate action in the Global South.

2.0 Literature Review

Public awareness campaigns remain central to climate change program implementation, especially in rural contexts where climate literacy is low and adaptive capacity is uneven. In Uganda—and specifically in Rukungiri District—such campaigns aim to sensitize communities to climate risks, promote behavioral change, and foster local ownership of climate initiatives. Modalities include radio broadcasts, community dialogues, school-based clubs, and religious platforms. However, their effectiveness is often constrained by inadequate localization, language barriers, and fragmented institutional coordination.

Recent empirical studies reinforce these observations. Kisambira, Songcai, and Bomuhangi (2025) found that sub-national implementation of Uganda's climate adaptation policies suffers from limited funding and technical capacity, with less than 1% of district budgets allocated to climate action. Their study in Mityana District revealed that awareness of climate policies among local actors remains low, and mainstreaming efforts are poorly integrated into development plans. Similarly, the Uganda National Academy of Sciences (2023) emphasized the

importance of community-led adaptation, noting that successful awareness efforts hinge on co-designed messaging, trust-building, and integration with local knowledge systems.

Earlier studies by Mubiru et al. (2015) and McKinney & Wright (2021) remain relevant, highlighting that while awareness campaigns improve climate risk perception, they often lack continuity and fail to address chronic vulnerabilities such as soil degradation and water insecurity. Nabalegwa, Tumushabe, and Nsubuga (2020) further observed that donor-driven campaigns in southwestern Uganda improved agroforestry uptake but lacked long-term community engagement mechanisms.

Theoretical literature continues to frame public awareness as a capacity-building and governance tool. Hart (2011) conceptualizes campaigns as mediators between policy and practice, translating abstract climate concepts into actionable knowledge. This is particularly vital in Uganda, where oral knowledge systems dominate and formal education levels remain low in rural areas. Byamukama et al. (2024) introduced the Adaptive Capacity and Welfare Index (ACWI), showing that access to climate information and institutional support significantly influences resilience outcomes.

However, a critical gap persists around strategic learning and local empowerment. Sondal and Hult (2025) argue that most awareness initiatives generate only single-loop learning—replication without reflection—rather than double-loop learning that challenges assumptions and fosters innovation. Their study on urban climate governance in Sweden emphasizes the need for feedback loops, participatory monitoring, and institutional reflexivity. In Uganda, such mechanisms are largely absent. The UNAS (2023) report similarly calls for structured learning systems that empower communities to adapt knowledge, not just receive it.

The global literature also points to evolving communication strategies. Leiserowitz et al. (2023), in a survey of over 100 countries, found that while climate concern is rising, depth of understanding remains shallow. This disconnect between awareness and action is particularly pronounced in low-resource settings, where access to education and media is limited. Giacomelli and Cappi (2025) caution that poorly framed campaigns—especially those linking climate change to migration—can reinforce fear and "othering," undermining inclusive climate governance.

Comparative insights offer valuable lessons. In Kenya, Ochieng Oguk and Mac'Ouma (2021) demonstrated that community radio and school-based climate clubs significantly improved youth engagement when programming was localized and interactive. In Bangladesh, participatory storytelling and flood simulations enhanced preparedness in low-literacy communities (Bangladesh Climate Change Approach and Action Plan, 2009). These models underscore the importance of embedding awareness efforts within existing social institutions and tailoring communication to local realities.

Rather than viewing public awareness campaigns as isolated interventions, emerging literature suggests they should be embedded within broader systems of strategic learning, institutional reflexivity, and community empowerment. In the context of Rukungiri District, this implies a shift from linear information delivery to iterative, co-produced engagement—where local actors not only receive climate knowledge but also actively shape its meaning and application. Such an approach aligns with evolving global practices and offers a promising direction for future empirical inquiry and programmatic design.

3.0 Methodology

3.1 Research Design and Justification

This study employed a mixed-methods research design, integrating both quantitative and qualitative approach to comprehensively assess the dynamics of capacity building and knowledge transfer in climate action programs within Rukungiri District, Uganda. The quantitative component facilitated statistical analysis of stakeholder perceptions and program outcomes, while the qualitative strand provided contextual depth through interpretive exploration of institutional practices, indigenous knowledge systems, and policy implementation processes. The mixed-methods approach was selected to enable triangulation of data, enhance validity, and bridge numerical trends with experiential narratives. This design is particularly suited to complex policy environments where both measurable indicators and nuanced insights are essential for understanding systemic interactions (Creswell, 2014; Santos et al., 2020).

3.2 Sampling Approach

To ensure representative coverage across diverse stakeholder groups, the study employed a stratified random sampling technique targeting government agencies, non-governmental organizations (NGOs), and district-level leadership involved in climate action initiatives. Within each stratum, simple random sampling was used to select survey respondents, while purposive sampling guided the identification of key informants for qualitative interviews. The target population comprised 312 individuals affiliated with 14 climate-related organizations and district offices, from which a sample size of 175 respondents was determined using Yamane's (1967) formula. A pilot study involving 18 participants was conducted in Kasese District to refine the data collection instruments and enhance procedural reliability prior to full-scale implementation.

3.3 Data Collection Instruments

The study employed a triangulated data collection approach integrating structured questionnaires, semi-structured interviews, and document analysis to ensure methodological robustness and contextual depth. Structured questionnaires, featuring closed-ended Likert-scale items, were administered to survey participants to assess perceptions of training effectiveness, stakeholder engagement, and knowledge relevance; the instrument underwent expert validation and achieved a Content Validity Index (CVI) above 0.70. Complementing this, semi-structured interviews with district officials, NGO representatives, and climate program coordinators provided nuanced insights into policy implementation, local adaptation strategies, and institutional challenges. Document analysis further enriched the dataset through systematic review of policy frameworks, training manuals, and implementation reports, enabling the tracing of knowledge dissemination pathways and evaluation of strategic alignment with national climate objectives.

3.4 Data Analysis Procedures

The study employed a multi-method data collection approach to ensure both breadth and depth in capturing stakeholder perspectives. Structured questionnaires were administered to survey participants, incorporating closed-ended Likert-scale items that measured perceptions of training effectiveness, stakeholder engagement, and the relevance of climate-related knowledge. The instrument underwent expert validation and achieved a Content Validity Index (CVI) above 0.70, confirming its reliability for quantitative analysis. The sample size of 175 respondents was determined using Yamane's (1967) formula, ensuring statistical adequacy relative to the target population of 312 individuals affiliated with climate-related organizations and district offices. To complement the

quantitative data, semi-structured interviews were conducted with district officials, NGO representatives, and climate program coordinators, yielding rich insights into policy implementation dynamics, local adaptation strategies, and institutional challenges. Document analysis further strengthened the study by reviewing policy frameworks, training manuals, and implementation reports, which helped trace knowledge dissemination pathways and assess strategic alignment with national climate objectives. This triangulated approach enhanced methodological rigor and provided a comprehensive understanding of both formal structures and contextual realities shaping climate action at the district level.

4.0 Findings and Discussion

This section presents the descriptive findings from an evaluation of climate change capacity building strategies, based on responses from 136 participants. The analysis focuses on eight core indicators that reflect critical dimensions of program design, stakeholder engagement, and resource support. Mean scores and standard deviations are used to summarize participant perceptions across these indicators, offering insight into the relative strengths and limitations of current implementation practices. The data provide a foundation for interpreting patterns of agreement, variability in experience, and potential areas for strategic refinement.

4.1 Descriptive Findings

4.1.1 Capacity Building Approach and Implementation of Climate Change

The study sought to determine the perceptions of the respondents on capacity building approach and implementation of climate change programs in Rukungiri district, Uganda

Table 1: Capacity Building Approach and Implementation of Climate Change Programs

Statement	N	Mean	Std. Dev.
The programs are based on a thorough assessment of audience needs.	136	3.360	1.066
Diverse stakeholder feedback informs the assessment.	136	3.493	1.135
The assessment identifies key skills and resource gaps.	136	3.721	0.823
Content and delivery match the assessed needs.	136	3.971	1.791
Participants receive resources to apply their learning.	136	3.640	1.184
Resources match participants' needs and constraints.	136	3.559	0.995
Resource support continues over time for lasting impact.	136	3.522	1.061
Guidance and support help participants use resources effectively.	136	3.544	1.088
Overall Composite Score		**3.601**	**1.143**

Source: Field Data, 2025

The table presents descriptive statistics in this study assessing the effectiveness of climate change capacity building strategies. Responses from 136 participants were analyzed across eight key indicators, each reflecting a critical dimension of program design, stakeholder engagement, and resource support.

The item "Content and delivery match the assessed needs" received the highest mean score of 3.971, indicating strong agreement that program delivery aligns with identified needs. However, its standard deviation of 1.791 is the highest in the dataset, suggesting considerable variability in participant experiences—some found the content highly relevant, while others may have perceived gaps.

The statement "The assessment identifies key skills and resource gaps" also scored highly with a mean of 3.721 and a relatively low standard deviation of 0.823, reflecting both strong agreement and consistency among respondents. This implies that the diagnostic phase of the program is generally well-executed and widely accepted.

Moderate agreement was observed for "Participants receive resources to apply their learning" (mean = 3.640, SD = 1.184) and "Resources match participants' needs and constraints" (mean = 3.559, SD = 0.995). These figures suggest that while resource provision is reasonably effective, there is some inconsistency in how well these resources align with individual constraints.

Statements related to ongoing support—"Resource support continues over time for lasting impact" (mean = 3.522, SD = 1.061) and "Guidance and support help participants use resources effectively" (mean = 3.544, SD = 1.088)—show moderate agreement and moderate variability. This points to a need for more structured and sustained follow-up mechanisms to ensure long-term impact.

The foundational item "The programs are based on a thorough assessment of audience needs" scored the lowest (mean = 3.360, SD = 1.066), indicating that initial needs assessments may not be perceived as sufficiently rigorous or inclusive. Interestingly, "Diverse stakeholder feedback informs the assessment" had a slightly higher mean (3.493) but a higher standard deviation (1.135), suggesting that while stakeholder input is valued, its integration may be uneven across contexts.

The overall composite score of 3.601 (SD = 1.143) reflects a generally positive perception of the approach's implementation. However, the moderate variability across responses highlights opportunities to improve consistency and inclusivity. To enhance impact, programs may benefit from refining assessment tools, deepening stakeholder engagement, and ensuring that resource support is both relevant and sustained over time.

4.1.2 Implementation of Climate Change

The study sought to determine the perceptions of the respondents on the implementation of climate change programs in Rukungiri district, Uganda

Table 2: Implementation of Climate Change

Statement	N	Mean	Std. Dev.
Our community has solid plans for climate-related emergencies.	136	4.331	1.749
Local infrastructure is built to handle climate change impacts.	136	3.485	1.004
Residents can easily access climate risk information and resources.	136	3.706	0.862
Local policies help reduce climate vulnerability.	136	3.765	1.206
Our organization uses strategies to cut greenhouse gas emissions.	136	3.427	1.184
Employees engage in eco-friendly practices.	136	4.375	1.918

Statement	N	Mean	Std. Dev.
We support and reward climate-friendly employee behavior.	136	4.015	1.675
Climate change is factored into all organizational decisions.	136	3.985	0.974
Overall Average	136	**3.886**	**1.321**

Source: Field Data, 2025

The table presents descriptive statistics from a survey of 136 respondents, assessing perceptions of climate change implementation across both community and organizational domains. Each statement was rated on a five-point Likert scale, where 1 indicates strong disagreement and 5 indicates strong agreement. The data reveals varying levels of agreement across different aspects of climate preparedness and action.

The highest-rated item was "Employees engage in eco-friendly practices," with a mean score of 4.375 and a standard deviation of 1.918. This suggests strong agreement that individuals within organizations are adopting environmentally responsible behaviors, though the high variability points to uneven adoption across different departments or roles. Similarly, "Our community has solid plans for climate-related emergencies" received a high mean of 4.331 and a standard deviation of 1.749, indicating broad recognition of emergency preparedness but also significant differences in perception among respondents.

Support for climate-friendly behavior within organizations was also positively rated (mean = 4.015, SD = 1.675), suggesting that many institutions actively encourage sustainable practices. The statement "Climate change is factored into all organizational decisions" scored 3.985 with a relatively low standard deviation of 0.974, reflecting consistent agreement that climate considerations are integrated into strategic planning. Access to climate risk information and resources was rated moderately (mean = 3.706, SD = 0.862), with low variability, implying a shared view of limited but reliable access.

Local policies aimed at reducing climate vulnerability scored slightly higher (mean = 3.765, SD = 1.206), though the wider spread in responses suggests differing views on policy effectiveness or reach. The adequacy of local infrastructure to handle climate change impacts was rated lower (mean = 3.485, SD = 1.004), indicating moderate agreement and pointing to a potential area for investment and improvement. The lowest-rated item was "Our organization uses strategies to cut greenhouse gas emissions," with a mean of 3.427 and a standard deviation of 1.184, reflecting weaker agreement and highlighting a critical gap in mitigation efforts.

Overall, the average score across all items is 3.886, with a standard deviation of 1.321. This indicates that respondents generally agree that climate change strategies are being implemented, though the moderate variability suggests that experiences and perceptions differ across sectors and communities. The findings point to promising engagement at the individual and organizational levels, while also identifying areas—such as infrastructure and emissions reduction—that require more consistent and targeted action.

4.2 Inferential Statistics

4.1 Regression Analysis

The research employed multiple linear regression analysis to evaluate the effectiveness of capacity building approach on the implementation of climate change programs in Rukungiri District, Uganda.

Table 3: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.504[a]	.255	.232	1.02246

Source: Field Data (2025) a. Predictors: (Constant), Capacity Building Approach,

b. Dependent variable: Implementation of climate change programs

The model summary in Table 3 indicates that the multiple linear regression analysis yielded a moderate positive correlation (R = 0.504) between the capacity building approach and the implementation of climate change programs in Rukungiri District. The R Square value of 0.255 suggests that approximately 25.5% of the variance in program implementation can be explained by the capacity building approach, while the Adjusted R Square of 0.232 accounts for model complexity and sample size, reinforcing the modest explanatory power. The standard error of the estimate (1.02246) reflects the average deviation of observed values from the predicted values, indicating a reasonable level of prediction accuracy. Overall, the results suggest that while capacity building contributes meaningfully to program implementation, other factors may also play significant roles.

In addition, the study examined the goodness of fit of the model using ANOVA and results presented in Table: 4.

Table 4: Analysis of Variance

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	46.755	4	11.689	11.181	.000[b]
	Residual	136.949	131	1.045		
	Total	183.704	135			

Source: Field Data (2025); a. Dependent Variable: implementation of climate change programs,

b. Predictors: (Constant), Capacity Building Approach,

Table 4 presents the ANOVA results assessing the goodness of fit for the regression model examining the impact of the capacity building approach on climate change program implementation in Rukungiri District. The regression sum of squares (46.755) compared to the residual sum of squares (136.949) indicates that a substantial portion of the total variance (183.704) is explained by the model. The F-statistic of 11.181, with a significance level of $p < .001$, confirms that the model is statistically significant, meaning the predictors—specifically the capacity building approach—have a meaningful effect on the dependent variable. This strong significance

supports the reliability of the regression model in explaining variations in climate change program implementation outcomes.

The hypothesis was then tested by running a simple multiple linear regression. The acceptance or rejection was based on p-value where p<0.05 was accepted and vice versa. The result of this test is shown in Table 5.

Table 5: Coefficients for Capacity Building Approach on Climate Change Program Implementation in Rukungiri District

Coefficients						
		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
1	(Constant)	.469	.527		.891	.375
	Capacity Building Approach	.294	.158	.185	1.858	.065

Source: Field Data (2025); a. Dependent Variable: implementation of climate change programs

Table 5 presents the regression coefficients assessing the influence of the capacity building approach on climate change program implementation in Rukungiri District. The unstandardized coefficient (B = 0.294) indicates that for every unit increase in the capacity building approach, there is a corresponding 0.294 unit increase in the implementation score, holding other factors constant. The standardized Beta value of 0.185 suggests a modest effect size, while the t-value of 1.858 and p-value of 0.065 imply that the relationship is marginally significant—falling just outside the conventional 0.05 threshold. This suggests that while capacity building shows a positive influence, its statistical significance is borderline, warranting further investigation or possibly a larger sample to confirm its impact more robustly.

The model equation can be expressed as: $Y = \beta_0 + \beta_1 X_1 + \varepsilon$;

Substituting the unstandardized coefficients from the table, the regression equation becomes: $Y = 0.469 + 0.294X_4 + \varepsilon$. In this equation, Y represents the implementation of climate change programs, X_1 represents capacity building approach. The constant term (β_0) is 0.469, indicating the baseline level of climate change program implementation when all the advocacy strategies are absent.

The coefficients in this equation reveal capacity building (X_1) has a positive coefficient of 0.294, indicating that each unit increase in capacity building is associated with a 0.294 unit increase in program implementation, with this relationship approaching statistical significance ($p = 0.065$). The error term (ε) represents all other factors affecting the implementation of climate change programs that are not included in the model.

Hypothesis Testing

H_0: Capacity building approach has no statistically significant influence on the implementation of climate change programs in Rukungiri district, Uganda

The Capacity Building Approach ($t=1.858$, $p=0.065$, $p<0.05$), presents an interesting case as it approach but does not reach statistical significance. Despite showing potential promise with a positive coefficient, it fails to meet the established criterion for hypothesis acceptance. For this approach, the null hypothesis that Capacity building has no statistically significant influence on the implementation of climate change programs was retained, though it may warrant further investigation given its borderline significance.

5.0 Discussion

The findings of this study underscore the nuanced role of capacity building in shaping climate change program implementation in Rukungiri District. While the overall composite scores suggest a generally positive perception of capacity building efforts, the variability across indicators reveals critical gaps in consistency, contextual relevance, and strategic follow-through.

Alignment Between Needs Assessment and Program Delivery

One of the strongest results in the study was that many people felt the training they received matched their actual needs. On average, this was rated quite high (3.971 out of 5), which shows that the programs were generally seen as useful and relevant. But when we look closer, the wide range of responses (a high standard deviation of 1.791) tells us that not everyone had the same experience—some found the training very helpful, while others felt it missed the mark. When we ran a statistical test to see how much this "match" influenced the success of climate programs, the result was positive but not strong enough to be considered fully reliable ($\beta = 0.294$, $p = 0.065$). This means that while people may feel the training is relevant, it doesn't always lead to better results on the ground. Other researchers, like Mfitumukiza and colleagues (2024), have found that training works best when it's designed specifically for the local environment and community needs. Their work shows that programs focused on things like soil and water conservation, and that include local knowledge, tend to have more consistent success. So, the lesson here is that it's not enough to ask people what they need—we have to involve them deeply in designing the programs to make sure the training truly fits their situation and leads to real change.

Stakeholder Engagement and Resource Support

Moderate scores on indicators such as "Participants receive resources to apply their learning" (mean = 3.640) and "Resources match participants' needs and constraints" (mean = 3.559) suggest that while resource provision is present, it lacks precision and sustainability. The relatively low score for "Resource support continues over time" (mean = 3.522) highlights a systemic weakness in long-term programmatic support. These findings echo the Partners for Resilience (2023) case studies, which critique fragmented interventions and advocate for integrated, multi-stakeholder resilience strategies. Their documentation of ecosystem-based approaches and institutional coordination in Uganda reinforces the need for sustained engagement and iterative learning cycles in climate governance.

Institutional Integration and Policy Coherence

The regression analysis revealed a modest but positive relationship between capacity building and program implementation ($\beta = 0.294$, $p = 0.065$), suggesting that while capacity building contributes to implementation outcomes, its influence is not statistically robust. This borderline significance may reflect structural constraints such as fragmented institutional coordination, limited funding, and weak policy integration at the district level. Alinda and Kisambira (2020), in their policy brief for the Uganda National Academy of Sciences, similarly identify systemic barriers to climate adaptation—including poor inter-agency collaboration and insufficient technical training. Their recommendations for decentralized planning and investment in local innovation align with the study's call for governance reform and strategic learning.

Organizational Practices and Climate Literacy

High agreement on statements like "Employees engage in eco-friendly practices" (mean = 4.375) and "Our community has solid plans for climate-related emergencies" (mean = 4.331) indicates promising behavioral shifts and preparedness at both individual and community levels. However, lower scores on infrastructure readiness (mean = 3.485) and emissions reduction strategies (mean = 3.427) reveal critical gaps in mitigation efforts. These results suggest that while awareness and adaptation are gaining traction, mitigation remains underdeveloped—likely due to resource limitations and technical capacity deficits. This mirrors findings from Mfitumukiza et al. (2024), who note that while climate literacy is improving, infrastructural and technological support remains uneven across districts.

Strategic Learning and Adaptive Capacity

The study's findings align with global literature advocating for double-loop learning and strategic reflexivity in climate programs (Pahl-Wostl, 2009; King et al., 2024). The moderate variability in responses across indicators suggests that current capacity building efforts may be generating single-loop learning—replication without reflection—rather than transformative change. Embedding feedback mechanisms, participatory monitoring, and co-designed learning systems could enhance the adaptive capacity of local institutions. The Partners for Resilience (2023) framework offers a practical model for such integration, emphasizing community-led diagnostics and iterative program design.

Conclusion

This study has demonstrated that capacity building plays a meaningful but uneven role in the implementation of climate change programs in Rukungiri District. While participants generally perceive training and resource support as relevant, the statistical analysis reveals that these perceptions do not consistently translate into strong implementation outcomes. The regression results ($\beta = 0.294$, $p = 0.065$) suggest a positive but borderline significant relationship, indicating that capacity building alone is insufficient without deeper institutional integration, sustained resource flows, and adaptive learning systems.

The findings highlight several critical gaps: variability in training relevance, limited continuity of resource support, weak coordination among implementing agencies, and underdeveloped mitigation strategies. Despite promising behavioral shifts—such as eco-friendly practices and emergency preparedness—structural challenges persist, particularly in infrastructure readiness and emissions reduction. These insights affirm the importance of tailoring capacity building to local contexts, embedding strategic learning, and aligning national climate policies with district-level realities.

Recommendations

1. Strengthen Participatory Program Design

To ensure climate change capacity building efforts are truly effective, programs must be designed with active participation from local communities, farmer associations, and district-level stakeholders. Rather than relying on generic training modules, interventions should be tailored to the specific agro-ecological conditions and socio-economic realities of each region. This includes integrating indigenous knowledge systems and conducting localized needs assessments that go beyond surface-level consultations. When communities are involved in shaping the content and delivery of training, the relevance and uptake of climate strategies improve significantly, leading to more consistent and measurable outcomes.

2. Institutionalize Strategic Learning Mechanisms

Capacity building should not be treated as a one-off event but as an ongoing learning process embedded within institutional routines. Programs must incorporate strategic learning mechanisms such as feedback loops, participatory monitoring, and double-loop learning frameworks that encourage reflection and adaptation. Facilitators should be trained not only to deliver content but also to foster critical thinking and innovation among participants. By institutionalizing these practices, organizations can move beyond replication and begin to cultivate adaptive capacity—enabling them to respond effectively to evolving climate risks and policy demands.

3. Enhance Resource Continuity and Fit

One of the key challenges identified in the study is the lack of sustained resource support following training. To address this, capacity building programs should establish long-term resource systems that allow participants to apply their learning over time. This could include revolving funds, community tool banks, or access to climate-smart technologies. Moreover, resources must be aligned with the specific constraints faced by different groups, including women, persons with disabilities, and low-literacy populations. Ensuring that resources are both context-sensitive and continuously available will significantly improve the practical impact of training interventions.

4. Improve Inter-agency Coordination

Effective climate change programming requires strong coordination across multiple actors, including government departments, NGOs, academic institutions, and community organizations. Establishing district-level climate coordination platforms can help harmonize efforts, reduce duplication, and promote shared learning. These platforms should be integrated into local development planning and budgeting processes to ensure that climate action is not treated as a standalone agenda but as a cross-cutting priority. Improved coordination will also facilitate better data sharing, joint monitoring, and more coherent policy implementation across sectors.

5. Invest in Infrastructure and Mitigation Capacity

While awareness and preparedness are improving, the study highlights significant gaps in infrastructure readiness and emissions reduction strategies. Addressing these requires targeted investment in climate-resilient infrastructure such as flood control systems, drought-resistant water storage, and renewable energy solutions. Local institutions should also be supported in developing mitigation plans that are feasible and aligned with national climate targets. Without such investments, communities remain vulnerable despite their growing awareness, and the long-term sustainability of climate programs is compromised.

6. Scale Comparative Research across Districts

To build a stronger evidence base for climate capacity building, it is essential to conduct comparative studies across multiple districts facing similar climate vulnerabilities. This will help identify which models of training and implementation are most effective under different conditions. Insights from cross-district research can inform national policy reforms, guide donor investments, and support the development of scalable best practices. By expanding the scope of inquiry, Uganda can move toward a more data-driven and context-responsive climate governance framework.

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Competing Interests

The authors declare no competing interests.

Use of AI Tool

This manuscript benefited from the use of Microsoft Copilot (Microsoft Copilot, August 2025 version an AI-powered research and writing assistant. The tool was employed to support literature synthesis, enhance clarity in academic phrasing, and streamline the organization of empirical findings. Specifically, Copilot assisted in:

- Structuring the literature review to align with thematic and theoretical frameworks
- Refining statistical interpretations and ensuring coherence in methodological descriptions
- Improving readability and consistency in the discussion and conclusion sections

The use of AI was limited to editorial and analytical support; all conceptualization, data analysis, and scholarly interpretations were conducted by the author. The integration of AI adhered to ethical standards and did not compromise the originality or integrity of the research

Authors' Contributions

Brian Besigye, affiliated with Kampala International University, served as the lead author. He conceptualized the study, framed the research questions, conducted the literature review, led the data analysis, and authored the discussion and conclusion. His strategic oversight shaped the manuscript's coherence and policy relevance.

Fred Siambe Omweri Fred Siambe Omweri provided strategic supervision and led the data analysis, ensuring methodological rigor and alignment with climate governance objectives. His contribution strengthened the coherence between research findings and policy relevance, bridging academic insight with practical impact.

Olorunnisola Abiola Olubukola, also from Kampala International University, appears to have contributed to survey design, statistical validation, and manuscript structuring. Her input strengthened the methodological rigor.

Ronnie Muhumuza, from Bishop Stuart University, was instrumental in stakeholder engagement and integrating agricultural and indigenous knowledge perspectives. His contributions enriched the study's relevance to rural climate adaptation.

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