

Project Management Practices And Sustainability Of Dam Construction Projects In Kitui County, Kenya

Thomas Makundi, Dr. Lucy Ngugi

(Department Of Management Science, Kenyatta University, Kenya)

(Department Of Management Science, Kenyatta University, Kenya)

Abstract:

Background: This study looks into how project management techniques affect the long-term viability of dam construction projects in Kenya's Kitui County. Due to severe water shortages in Kenya's arid and semi-arid lands (ASALs), the government and development partners have given dam construction first priority in an effort to improve water security. But a sizable fraction of these initiatives has either stopped or fallen short of long-term viability. The purpose of the study is to evaluate the effects of financing sources, stakeholder involvement, and project planning on the long-term viability of dam building projects in the area.

Materials and Methods: In this mixed-methods study combining quantitative and qualitative methodologies, a sample of 269 participants, including project beneficiaries, local leaders, and representatives from pertinent agencies, participated in a cross-sectional survey. Interviews with key informants were also conducted with members of NGOs, water engineers, and government officials. Interview guidelines and structured questionnaires were used to gather data. Descriptive statistics, correlation, and regression analysis were used to analyze quantitative data, while theme analysis was used to qualitative replies.

Results: There is a strong positive relationship between planning practices and sustainability ($r=0.722$, $p=0.000$), a strong positive relationship between funding practices and sustainability ($r=0.642$, $p=0.000$), and a strong positive relationship between stakeholder engagement and sustainability ($r=0.700$, $p=0.000$). All the relationships are statistically significant ($p<0.05$). All the project management practices (planning, funding and stakeholder engagement) have a statistically significant relationship with the sustainability of dams' projects in Kitui County.

Conclusion: This study emphasises that good project management is a governance requirement for sustainable growth rather than merely a technical procedure.

Key Word: Dams planning; Funding practices; Dams sustainability; Project management; Stakeholder engagement.

Date of Submission: 20-04-2026

Date of Acceptance: 30-04-2026

I. Introduction

On a local, national, and international level, the sustainability of dam construction projects is a major concern. To ensure that these projects achieve their goals without a negative impact on the environment, society, or economy, effective project management techniques are essential. The World Commission on Dams (2000) has shown that although dams provide significant economic benefits, ecological and societal well-being are frequently sacrificed in the process. One notable example is the Three Gorges Dam in China, which flooded historical and cultural sites and displaced over 1.3 million people. The dam produces more than 22,500 megawatts of hydroelectric electricity despite these obstacles, greatly lowering reliance on coal (International Commission on Large Dams [ICOLD], 2020). As noted by Mdee et al. (2020), the construction of hydro dams on the Vjosa River in Europe prompted global campaigns to protect biodiversity, underscoring the growing need for ecologically conscious planning procedures. To guarantee that dam projects provide long-term benefits without endangering future generations, these international instances emphasise the critical necessity for strict project management procedures, especially in risk management, stakeholder involvement, and sustainability assessments.

Dam construction is crucial to Kenya's national development plans, particularly those outlined in the Vision 2030 initiative. Dam construction is a national priority in Kenya, where more than 60% of the population still lacks consistent access to water, as noted by the African Development Bank (2022). Yet, issues with governance, poor management, and environmental supervision have raised doubts about the sustainability of many of these initiatives. Consider the Thwake Multipurpose Dam that originally intended to supply water and energy to four counties, it has encountered ongoing delays and upstream pollution issues that have jeopardised its feasibility (Ministry of Water, Sanitation and Irrigation, 2023). Project success is further threatened by non-compliance with environmental management plans and delays in procurement. Participatory planning and

inclusive stakeholder involvement have been regularly highlighted in the Ministry of Water, Sanitation, and Irrigation's (2023) report as essential components of effective project execution.

To address its ongoing water shortages, Kitui County, located in Kenya's arid and semi-arid areas (ASALs), primarily relies on dam development. To combat protracted drought and food shortages, the Kitui County Water and Sanitation Company's (2023) annual report highlights dam construction as a top priority. However, progress has been hampered by subpar project management techniques. A baseline assessment conducted by the Water Sector Trust Fund (2022) showed that shortcomings in planning, procurement, and stakeholder involvement caused more than 35% of Kitui's community water projects to either stall or run below capacity. This deficiency is caused by a lack of organised monitoring frameworks at the county level as well as a lack of technical skills (Muriithi & Kariuki, 2022). As noted by Mwangi and Mutisya's (2022) empirical research, inadequate paperwork, contractor delays, and unfinished feasibility studies plague a large number of local dam projects. In a similar vein, Wambua (2023) contend that community consultation and efficient project risk analysis significantly increase project sustainability and completion rates. The Kitui County Water and Sanitation Department (2023) has attempted to increase transparency utilizing digital project tracking tools; however, due to infrastructure constraints, adoption remains sluggish. As a result, a recurring theme emerges from the local, national, and international contexts where efficient project management is closely linked to project sustainability in dam building.

Problem Statement

In Kenya, water insecurity is still a major problem, especially in dry and semi-arid areas like Kitui County. The national and local governments have made significant investments in building dams and water harvesting systems in response to this problem, working with development partners to guarantee a year-round supply of water for agricultural, livestock, and household usage. These initiatives aim to enhance rural livelihoods, foster socioeconomic growth, and offer long-term solutions to drought. But more and more people are questioning whether these dam projects are sustainable. As per the Ministry of Water, Sanitation, and Irrigation (2023), 38% of Kenya's small and medium-sized dam projects fail or perform poorly during the first five to seven years of operation. Typical problems include rapid siltation, deteriorated spillways, structural leaks, low community ownership, and insufficient maintenance frameworks. This concerning pattern points to a substantial disconnect between project completion and long-term service provision.

The state of affairs in Kitui County is similar to the national scenario. Over 130 dams and water pans were reportedly built between 2015 and 2022 (Kitui County Water and Sanitation Company, 2023). However, many of these facilities have subsequently dried up, collapsed, or stopped functioning. The Water Sector Trust Fund (2022) notes that more than 40% of Kitui's dams have major maintenance problems and are closed during dry seasons, which negates their primary function. The majority of these projects lacked adequate stakeholder participation, prompt repairs, and sustainable planning processes, as noted in community interviews conducted for the study. Mwangi and Wanyoike (2020) state that poor project management techniques, such as insufficient feasibility studies, a failure to include stakeholders, a lack of monitoring and evaluation systems, and a lack of risk mitigation plans, are frequently the cause of such projects' failure rather than a lack of funds or intention. This brings up a basic question: Why do so many technically feasible and expensive dam projects fail to continue to yield long-term benefits?

The problem is further exacerbated by the scarcity of empirical research that explicitly links project management techniques to the sustainability outcomes of dam projects in Kenya. Wambua (2023) notes that the majority of the literature currently in publication tends to pay little attention to project management issues. Instead, it concentrates on technical engineering aspects or water policy frameworks. The impact of planning, execution, and post-implementation procedures on the long-term success or failure of dam infrastructure is therefore critically understudied. Further, benchmarking and comparative research are made more difficult by the lack of uniform frameworks for evaluating project sustainability across countries. For instance, Kitui currently lacks specific post-construction sustainability standards, which worsens project abandonment, whereas counties like Nyeri and Murang'a have implemented integrated water resource management frameworks (NEMA, 2023).

In light of the foregoing, it is imperative to look at how specific project management techniques affect the sustainability of dam projects, especially in underserved areas like Kitui County. Therefore, by investigating the connection between project planning, stakeholder engagement, monitoring, and assessment, and the overall sustainability of dam projects in Kitui, this research aims to close this crucial gap. The project aims to support more sustainable infrastructure development, enhance the effective use of public resources, and increase community resilience to climate unpredictability by providing evidence-based insights. In the end, project management needs to be refocused as a key factor in the design and execution of dam infrastructure if sustainability is to be attained.

Research Objectives

This research focuses on investigating the extent to which project management practices influence the sustainability of dam projects in Kitui County, Kenya. The objectives have been developed to ensure that the study remains focused, measurable, and relevant to current development challenges in water resource management.

General Objective of the Study

To assess the influence of project management practices on the sustainability of dam projects in Kitui County, Kenya.

Specific Objectives of the Study

1. To examine the effect of project planning on the sustainability of dam projects in Kitui County.
2. To determine the influence of stakeholder engagement on the sustainability of dam projects in Kitui County.
3. To evaluate the role of monitoring and evaluation in enhancing the sustainability of dam projects in Kitui County.
4. To assess the impact of risk management on the sustainability of dam projects in Kitui County.
5. To investigate how funding structures and transparency in financial management practices affect the sustainability of dam projects in Kitui County.

Conceptual Framework

The link between project sustainability (dependent variable) and project management methods (independent variable) is theoretically depicted in Figure 1 below. The likelihood of building sustainable dam infrastructure is significantly increased when these five project management practice characteristics are successfully combined.

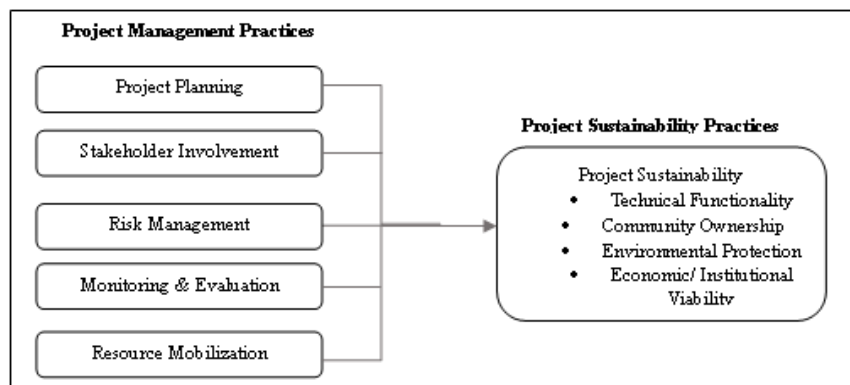


Figure 1: Conceptual Framework

II. Material And Methods

This mixed-methods study combining quantitative and qualitative methodologies investigates the extent to which project management practices influence the sustainability of dam projects in Kitui County, Kenya. The study targeted a total of 286 participants and out of the total target, a total of 269 respondents (both male 55% and females 45%) of age ≥ 18 , completed the questionnaire, giving a response rate of 94.06%.

Study Design: Adopted a descriptive research design with a mixed methods approach.

Study Location: The research focused on Kitui County, Kenya, an arid and semi-arid region heavily reliant on water harvesting projects, particularly dams.

Study Duration: The cross-sectional study in nature, collected data at a single point in time rather than over a prolonged period, aiming to capture the current status and relationships between variables, rather than long-term trends.

Sample size: 269 participants.

Sample size calculation: The sample size for the quantitative component was estimated using Yamane's (1967) formula. The target population size was estimated at 1,000. We assumed that margin of error at 0.05 for 95% confidence level. The actual sample size obtained for this study was 286 participants. Out of the total target, a

total of 269 respondents (both male 55% and females 45%) of age ≥ 18 , completed the questionnaire, giving a response rate of 94.06%.

Subjects & selection method: For the qualitative component, the study conducted 20 interviews with key informants, with flexibility based on saturation; the point at which no new insights were emerging.

Inclusion criteria:

1. Individuals who have directly participated in dam project planning, funding, implementation, or monitoring.
2. Residents who have lived near or benefited from dam projects for at least two years.
3. Institutions that have had a documented role in Kitui County's dam-related activities.

Exclusion criteria:

1. Individuals under 18 years of age (except with parental/guardian consent).
2. Stakeholders involved in projects outside the scope of dam construction (e.g., boreholes, piped irrigation schemes).

Procedure Methodology

Sampling procedures upheld ethical standards by ensuring informed consent, voluntary participation, anonymity, and confidentiality. Respondents were briefed about the purpose of the study, their right to withdraw, and how their data would be used. Research permits and ethical clearance were obtained from the National Commission for Science, Technology, and Innovation (NACOSTI) prior to data collection. A multi-method approach combining both quantitative and qualitative instruments was adopted to ensure a comprehensive understanding of the factors influencing the sustainability of dam projects in Kitui County. This mixed-method strategy enhanced triangulation, increased reliability, and ensured deeper contextual insights.

A structured questionnaire was designed and administered to selected respondents involved in dam projects. The questionnaire was divided into six key sections, each reflecting core study variables: (1) Demographic Information – Gender, age, role in the project, organization, years of experience. (2) Planning Aspects – Inquiries into project design, feasibility studies, participatory planning, and timing. (3) Funding Mechanisms – Sources of funds, adequacy, timeliness, transparency, and donor-government relations. (4) Stakeholder Engagement – Community involvement, feedback loops, inclusion of women and marginalized groups. (5) Sustainability Dimensions – Environmental conservation, operation and maintenance, institutional capacity. And (6) Challenges and Recommendations – Respondents' perceptions on barriers and potential solutions.

Likert scales (typically 5-point, from "Strongly Disagree" to "Strongly Agree") were used to measure perceptions, attitudes, and satisfaction. This format allowed for statistical analysis using descriptive and inferential tools. Prior to full-scale data collection, the questionnaire was pilot-tested on 30 respondents in neighbouring Machakos County who had similar dam project experiences. The pilot was meant to assist in refining the language, improve clarity, eliminate ambiguity, and establish reliability (Cronbach's alpha threshold ≥ 0.7) and validity.

To complement the quantitative data, semi-structured interview guides were developed and used to conduct in-depth interviews with purposively selected key informants. The guide included open-ended questions covering: (1) Project lifecycle experiences (planning to post-completion). (2) Coordination and communication among stakeholders. (3) Political and institutional dynamics. (4) Lessons learned from successful and failed dam projects. And (5) perspectives on environmental and social sustainability. These interviews enabled nuanced, experience-rich responses that captured the complexity of issues often overlooked by quantitative tools. Audio recording (with consent) and detailed note-taking was used during interviews to ensure accuracy in data capture.

Secondary data was gathered through a document review checklist covering: (1) Feasibility study reports. (2) County development plans (e.g., CIDP 2023–2027). (3) Environmental Impact Assessments (EIAs). (4) Audit reports and financial statements of donor-funded projects. (5) NGO and government monitoring and evaluation (M&E) reports. And (6) Water Resource Authority (WRA) dam safety reports. This checklist enabled the researchers to extract both quantitative and qualitative indicators related to budget use, stakeholder meeting attendance, implementation timelines, and long-term maintenance records.

Statistical Analysis

Data analysis entailed combining statistical methods with thematic content analysis to provide information on the planning, financing, stakeholder involvement, and sustainability of Kitui County dam projects. Quantitative data collected through structured questionnaires was systematically analysed using the Statistical Package for the Social Sciences (SPSS) version 25.0. The data was cleaned and coded to remove

duplicates, missing replies, and inconsistencies before analysis. Descriptive analysis was employed to distill the essential elements of the data to provide a comprehensive overview of the respondents' characteristics and attitudes toward the main research variables. Qualitative data collected through interviews and document reviews was analyzed thematically. This involved a systematic process of organizing, coding, and interpreting narratives to identify recurring themes, patterns, contradictions, and meaningful insights.

III. Result

The study targeted a total of 286 participants that were drawn from the various stakeholders who are involved in the construction of dams within Kitui County. Out of the total target, 269 respondents completed the questionnaire, giving a response rate of 94.06%, which can be considered an excellent response rate.

Demographic Characteristics of the Respondents

Table 1 below shows the representation of the respondents in terms of their gender. The findings indicate that there were 148 males, representing 55%, while 121 respondents were female, representing 45% of the total respondents. The analysis shows an almost balanced representation of gender among the various identified stakeholders involved in the construction of dams' projects in Kitui County. This enhances the representativeness and inclusivity of the findings of the study.

Table 1: Gender of the Respondents (N=269)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	148	55.0
	Female	121	45.0
Total		269	100.0

The age distribution of the participants is shown in table 2 below. From the results, it is imperative to state that the study has captured the views of both the youthful as well as experienced stakeholders and consequently giving a balanced and multifaceted views of the objectives on dams' construction projects.

Table 2: Age Bracket (N=269)

Variable	Category	Frequency	Percentage (%)
Age Bracket	Below 25 years	59	21.9
	25-34 years	52	19.3
	35-44 years	49	18.2
	45-54 years	60	22.3
	55 and Above Years	49	18.2
Total		269	100.0

The analysis of the highest level of education attained (Table 3 below) revealed that a majority of the respondents had at least a post-secondary education qualification, implying that they have adequate technical know-how as well as the professional capacity to provide well informed responses on construction of dams.

Table 3: Highest Level of Education (N=269)

Variable	Category	Frequency	Percentage (%)
Highest Level of Education	Primary	53	15.2
	Secondary	41	13.8
	Diploma	37	16.4
	Bachelor's Degree	44	22.3
	Master's Degree	60	12.6
	Doctorate Degree	34	19.7
Total		269	100.0

The occupation of the respondents (Table 4 below) reveals that 60 respondents (22.3%) are government officials, 78 respondents (29%) are NGO representatives, 74 respondents (27.5%) are community members while 57 respondents (21.2%) came from the private sector.

Table 4: Occupation of the Respondents (N=269)

Variable	Category	Frequency	Percentage (%)
Occupation	Government official	60	22.3
	NGO representative	78	29.0
	Community member	74	27.5
	Private sector	57	21.2
Total		269	100.0

In terms of years of experience in dams' projects (Table 5 below), 56 respondents (20.8%) have less than 1 year of experience, 49 respondents (18.2%) have experience of between 1-3 years, 58 respondents (21.6%) had experience of between 4-6 years, 50 respondents (18.6%) had experience of between 7-10 years while 56 respondents (20.8%) had experience of 10 years and above. The diversity assisted to enhance the reliability of the findings.

Table 5: Years of Experience in Dam Projects (N=269)

Variable	Category	Frequency	Percentage (%)
Years of Experience in Dam Projects	Less than 1 year	56	20.8
	1-3 years	49	18.2
	4-6 years	58	21.6
	7-10 years	50	18.6
	10 years and above	56	20.8
Total		269	100.0

Descriptive Analysis

The first objective of the study sought to determine the effects of project planning on sustainability of dam projects within Kitui County. The respondents were asked to rate the pre-prepared statements that were relating to the definition of the scope of the project. The statements were as shown in Table 6 below. According to the findings, mean scores range from 2.99 to 3.00. It implies that the respondents generally hold a neutral position on the effectiveness of dams' construction planning processes. The standard deviation (ranging from 1.417 to 1.422) indicates moderate dispersion of responses. The value reveals the existence of mixed opinions among respondents. Although the planning elements are deemed present, there is still room to improve in participatory planning.

Table 6: Descriptive for Project Planning Practices

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	Standard Deviation
The dam project had a clear and documented feasibility study	27	39	75	49	79	3.00	1.418
Risk assessments were thoroughly conducted during planning	14	23	97	61	74	3.00	1.417
Environmental and social impact assessments were effectively integrated thoroughly	51	46	83	58	31	2.99	1.422
Planning timelines and resource needs were realistic	34	43	75	53	64	3.00	1.417
There was an inclusive and participatory planning process	39	63	60	63	44	2.99	1.422

The second objective of the study sought to determine the influence of the stakeholder's engagement on sustainability of dam projects in Kitui county. The results in the table 7 below indicates that the mean scores range from 3.00 to 3.01, which reveals an average engagement of stakeholders. There is still room to improve stakeholder engagement. Additionally, the standard deviation value of approximately 1.42 explains that the respondents gave differing opinions on stakeholder engagement. The results indicate that active stakeholder engagement enhances the ownership of dam projects, minimizes resistance and is likely to improve dam construction sustainability.

Table 7: Descriptive for Stakeholder Engagement Practices

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
Key stakeholders were identified and mapped from the project's inception	44	23	74	63	65	3.01	1.422
Community members were involved in decision-making processes	24	37	64	70	74	3.00	1.418
There was regular communication between the project team and stakeholders	45	41	63	66	54	3.00	1.418
Feedback mechanisms were put in place and utilized	21	54	76	64	54	3.00	1.418
Conflicts and complaints were addressed in a timely and transparent manner	14	74	63	73	45	3.00	1.418

From the table 8 below, the responses of the participants reveal a moderate or average acceptance that funding mechanisms are incorporated fully in the management of dams' projects. The mean score of between 2.99 and 3.00 implies that more efforts can be done to integrate funding mechanisms. A standard deviation of approximately 1.42 indicate that the respondents gave diverse views on funding as a critical component of enhancing dams project sustainability.

Table 8: Descriptive for Funding Mechanisms

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
The project had sufficient initial capital to support major construction phases	47	59	42	67	54	3.00	1.418
There were clear funding structures and transparency in financial management	38	53	71	58	49	2.99	1.422
Delays in funding disbursement affected the project's progress	54	53	54	53	55	3.01	1.422
Public-private partnerships were utilized effectively	41	37	67	53	71	3.00	1.418
Contingency funds were available for unplanned costs	54	45	68	62	40	3.00	1.418

The sustainability of dam construction projects as shown in table 9 below reveals that the mean scores for indicators representing the sustainability perspective range from 3.00 to 3.01. Specifically, participants moderately agreed that the dam projects were anticipated to operate efficiently for at least 20 years (M=3.01, SD =1.422), and that there were structures for regular monitoring and evaluation post-construction (M=3.01, SD =1.422). In addition, there are also moderate agreement on the opinion that maintenance plans and budgets were well-established (M=3.00, SD =1.418), and that community members were empowered to take part in long-term management (M=3.00, SD =1.418) and that the project had contributed to economic and environmental improvements (M=3.00, SD =1.417). The findings suggest that dams in Kitui reveal moderate sustainability.

Table 9: Descriptive for Dam Project Sustainability

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
The dam project is expected to operate efficiently for at least 20 years	39	53	69	47	61	3.01	1.422
There are structures for regular monitoring and evaluation post-construction	41	33	74	53	68	3.01	1.422
Maintenance plans and budgets are well-established	43	53	65	41	67	3.00	1.418
Community members are empowered to take part in long-term management	54	23	84	44	64	3.00	1.418
The project has contributed to economic and environmental improvements	35	53	74	43	64	3.00	1.417

Correlation Analysis for Project Management Practices and Sustainability

Table 10 below shows the pearson correlation analysis done on the various project management practices (planning, stakeholder engagement and funding practices) and sustainability of dam construction projects. The results of the analysis reveal that there is a strong positive relationship between planning practices and sustainability (r=0.722, p=0.000), a strong positive relationship between funding practices and sustainability (r=0.642, p=0.000), and a strong positive relationship between stakeholder engagement and sustainability (r=0.700, p=0.000). All the relationships are statistically significant at the 0.05 level. This implies that all the project management practices (planning, funding and stakeholder engagement) have a statistically significant relationship with the sustainability of dams' projects in Kitui County.

Table 10: Correlation Analysis

		Correlations			
		Planning Practices	Funding Practices	Stakeholder Engagement Practices	Sustainability Practices
Planning Practices	Pearson Correlation	1	.529**	.518**	.722**
	Sig. (2-Tailed)		.000	.000	.000
	N	269	269	269	269
Funding Practices	Pearson Correlation	.529**	1	.426**	.642**
	Sig. (2-Tailed)	.000		.000	.000
	N	269	269	269	269
Stakeholder Engagement Practices	Pearson Correlation	.518**	.426**	1	.700**
	Sig. (2-Tailed)	.000	.000		.000
	N	269	269	269	269
Sustainability Practices	Pearson Correlation	.722**	.642**	.700**	1
	Sig. (2-Tailed)	.000	.000	.000	
	N	269	269	269	269

** . Correlation Is Significant At The 0.01 Level (2-Tailed).

The third objective of the study sought to evaluate the role played by monitoring and evaluation towards enhancing the sustainability of dam construction projects in Kitui County. According to the findings in the table 11 below, there is a strong positive correlation between Monitoring & Evaluation and the sustainability of dams' projects ($r= 0.892$, $p= 0.00$). This implies that consistent monitoring and evaluation practices are critical in improving the performance and sustainability of dam construction projects in Kitui county.

Table 11: Correlation between Monitoring & Evaluation and Sustainability

Correlations			
		There are structures for regular monitoring and evaluation post-construction	SUSTAINABILITY PRACTICES
There are structures for regular monitoring and evaluation post-construction	Pearson Correlation	1	.892**
	Sig. (2-tailed)		.000
	N	269	269
SUSTAINABILITY_PRACTICES	Pearson Correlation	.892**	1
	Sig. (2-tailed)	.000	
	N	269	269

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

The fourth objective of the study assessed the impact of risk management on the sustainability of dams' projects within Kitui County. A correlation analysis was carried out between the risk management and the sustainability of the dams' projects. The results of the analysis are as shown in table 12 below. The results of the analysis indicate that there is a moderately strong relationship ($r=0.647$, $p<0.01$) between the risk management practices and sustainability of dams' projects in Kitui County. This implies that effective risk management increases the sustainability of dams' projects.

Table 12: Correlation between risk management and the sustainability of dams' projects

Correlations			
		SUSTAINABILITY PRACTICES	Risk assessments were thoroughly conducted during planning
SUSTAINABILITY PRACTICES	Pearson Correlation	1	.647**
	Sig. (2-tailed)		.000
	N	269	269
Risk assessments were thoroughly conducted during planning	Pearson Correlation	.647**	1
	Sig. (2-tailed)	.000	
	N	269	269

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

The fifth objective of the study investigated how funding structures and transparency in financial management practices affect the sustainability of dams' construction projects in Kitui County. The findings shown in table 13 below indicate that there is a moderately strong correlation between the funding structures and transparency in financial management practices and the sustainability of dams' projects ($r=0.529$, $p<0.01$) in Kitui County. The relationship is statistically significant at 0.05 level.

Table 13: Correlation between funding structures and transparency in financial management practices and the Sustainability of Dams' projects in Kitui County

Correlations			
		SUSTAINABILITY PRACTICES	There were clear funding structures and transparency in financial management
SUSTAINABILITY_PRACTICES	Pearson Correlation	1	.529**
	Sig. (2-tailed)		.000
	N	269	269
There were clear funding structures and transparency in financial management	Pearson Correlation	.529**	1
	Sig. (2-tailed)	.000	
	N	269	269

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

Regression Analysis

Multiple regression analysis was conducted with an aim of determining the combined effects of the independent variables (planning, funding and stakeholder engagement) on the sustainability of dam construction projects. According to table 14 below, the model summary indicates R value of 0.849 and an R^2 value of 0.721, implying that the combined independent variables explained 72.1 % of the variation in the sustainability of dam construction projects. The other external factors explain just 27.9 % of the variation in the dependent variable (sustainability). The adjusted R^2 was 0.717, which suggests a strong explanatory power of the model.

Table 14: Regression Analysis; Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.849 ^a	.721	.717	.67370
a. Predictors: (Constant), STAKEHOLDER ENGAGEMENT PRACTICES, FUNDING PRACTICES, PLANNING PRACTICES				

The ANOVA results shown in table 15 below reveal that the regression model was statistically significant (F=227.757, p=0.000), and this indicates that the combined predictors significantly explain the variations in sustainability of dams' construction projects.

Table 15: Regression Analysis; ANOVA

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	310.118	3	103.373	227.757	.000 ^b
	Residual	120.276	265	.454		
	Total	430.395	268			
a. Dependent Variable: SUSTAINABILITY PRACTICES						
b. Predictors: (Constant), STAKEHOLDER ENGAGEMENT PRACTICES, FUNDING PRACTICES, PLANNING PRACTICES						

The coefficients of the regression analysis shown in table 16 below reveal that project planning ($\beta = 0.375$, $p = 0.000$), funding practices ($\beta = 0.279$, $p = 0.000$), and stakeholder engagement ($\beta = 0.387$, $p = 0.000$), have a statistically significant effect on the sustainability of dam construction projects. This indicates that these factors play a great combined role in influencing the sustainability of dams' projects in Kitui County. Other external factors such as environmental, political, among others play a minor role in influencing the sustainability.

Regression Equation: Sustainability = (-0.237) + 0.383 (Planning) + 0.295 (Funding) + 0.403 (Stakeholder Engagement)

Table 16: Regression Analysis; Coefficients

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.237	.132		-1.801	.073
	PLANNING PRACTICES	.383	.042	.375	9.051	.000
	FUNDING PRACTICES	.295	.041	.279	7.122	.000
	STAKEHOLDER ENGAGEMENT PRACTICES	.403	.040	.387	9.971	.000
a. Dependent Variable: SUSTAINABILITY PRACTICES						

From the multiple regression equation above, effective project management practices (planning, stakeholder engagement and funding) positively and significantly influence the sustainability of dam construction projects in Kitui County. The analysis also reveals that stakeholder engagement is the greatest predictor of variation in sustainability, followed by planning and then funding.

Qualitative Data Analysis

Qualitative data obtained from Focus Group Discussions (FGD) and Key Informant Interviews (KII) were analysed thematically to explore how project management practices influence the sustainability of dam construction projects in Kitui County. Analysis followed Braun and Clarke's (2006) six-step thematic framework, allowing patterns, meanings, and variations within participants' narratives to be systematically identified. The findings are organized into key themes that emerged consistently across respondent categories. Verbatim statements are included to preserve participants' voices and enhance trustworthiness of the findings.

1. Stakeholder Participation and Project Ownership

Participants across FGDs indicated that although community members are invited to meetings, their involvement in decision-making remains limited. Most respondents described their participation as largely consultative, particularly during planning and implementation stages. This limited involvement was frequently associated with weak project ownership and reduced commitment to long-term sustainability. One participant explained: "We attend meetings when we are called, but most of the decisions are already made by the leaders and engineers." Another FGD participant noted: "When people feel the dam is not really theirs, they don't take responsibility when something goes wrong." Similarly, a government official acknowledged: "Community participation is encouraged, but in practice, technical and financial decisions are often handled at higher levels."

These responses suggest that insufficient inclusion of local stakeholders in critical decisions undermines community ownership and, consequently, the sustainability of dam projects.

2. Financing and Use of Project Funds

Financing emerged as a central concern affecting sustainability. Participants reported that most dam projects depend heavily on government or donor funding, with minimal local financial contribution. While construction funding was generally available, respondents expressed concern over delayed disbursements and lack of dedicated funds for operation and maintenance. One FGD participant stated: “The dam is built using donor money, but after that, there is no clear money set aside for repairs.” Another participant observed: “Sometimes funds come late, and by the time repairs are done, the damage has already increased.” A government official echoed similar concerns: “Budgeting focuses more on construction than on long-term maintenance, which affects sustainability.” The findings indicate that weak financial planning beyond the construction phase poses a significant risk to the continued functionality of dam projects.

3. Governance and Institutional Management Structures

Respondents described the existence of dam management committees, though their effectiveness was often questioned. FGDs revealed concerns regarding elite capture, political influence, and lack of transparency in committee operations. In some cases, leadership roles within committees were said to be dominated by a few individuals. One participant noted: “The committee exists, but it is controlled by a few people who decide everything.” Another added: “Politics sometimes interfere, especially when leaders want to be seen as the ones in charge.” A government respondent explained: “There are structures in place, but coordination between agencies and committees is not always clear.” These findings suggest that governance challenges, particularly weak accountability and political interference, negatively affect dam management and sustainability.

4. Management Practices and Sustainability Planning

Participants expressed mixed views regarding the adequacy of management practices currently in place. While basic operational arrangements existed, structured maintenance plans and regular monitoring were largely absent. Many respondents indicated that repairs were conducted only after major breakdowns occurred. One FGD participant remarked: “We only fix the dam when it is already damaged; there is no regular checking.” Another stated: “There is no clear plan on who should do what when problems arise.” A government official confirmed: “Monitoring is done occasionally, but consistent follow-up is limited due to resource constraints.” These responses suggest that reactive rather than preventive management practices are common, which compromises long-term sustainability.

5. Technical Capacity and Training

Limited technical skills among local operators emerged as a key challenge. Most communities relied on external technicians for maintenance and repairs, leading to delays and increased costs. Participants reported that training opportunities were either insufficient or offered only during the initial stages of project implementation. One FGD participant stated: “We were shown how to use the dam when it was completed, but not how to repair it.” Another added: “When something breaks, we have to wait for experts from outside.” A government official noted: “Capacity building is provided, but it is not continuous, and many operators still lack technical skills.” The findings highlight the need for sustained training and capacity development to enable communities to manage dam projects independently.

6. Government Policy and Institutional Support

Participants acknowledged that government policies play an important role in promoting sustainability. However, both FGDs and KIIs revealed gaps between policy formulation and implementation at the community level. Limited information dissemination and weak enforcement were frequently mentioned. One government official observed: “Policies exist, but implementing them consistently on the ground remains a challenge.” An FGD participant commented: “We hear about policies, but they are not well explained to the community.” Another participant added: “Support is there, but follow-up after construction is not strong.” These findings suggest that stronger institutional support and clearer communication are necessary to translate policy intentions into sustainable outcomes.

Overall, the qualitative analysis reveals that sustainability of dam construction projects in Kitui County is shaped by the interaction of stakeholder participation, financing mechanisms, governance structures, management practices, technical capacity, and government support. Limited community involvement in decision-making, inadequate maintenance financing, weak governance, and insufficient technical capacity emerged as key constraints. Addressing these challenges requires a more inclusive, well-resourced, and capacity-oriented approach to dam project management.

IV. Discussion

The study targeted a total of 286 respondents. The respondents were drawn from various stakeholders involved in dam construction projects in Kitui County. These included government officials, NGO representatives, private sector actors, and community members. Out of this target population, 269 respondents successfully completed the questionnaires. This translates a response rate of 94.06%. Such a response rate is exceptionally high based on social science research standards. According to Holtom, Baruch, Aguinis, and Ballinger (2022), a response rate above 70% is generally considered good. The rates exceed 90% significantly which reduces the likelihood of non-response bias. As stated by Holtom et al. (2022), high response rates enhance confidence in the survey findings validity, representativeness, and generalisability. Beyond methodological testing, the demographic characteristics of respondents further enhance the trustworthiness of the findings. Gender representation was nearly balanced, with 148 male respondents (55%) and 121 female respondents (45%). This distribution reflects a commendable level of inclusivity. Also, the age distribution of respondents contributed to the depth and balance of the findings. The study captured views across all major age brackets. Respondents below 25 years accounted for 21.9%. Those aged 25–34 years accounted for 19.3% while respondents aged 35–44 years accounted for 18.2%. In the same manner, respondents aged 45–54 years accounted for 22.3%, while those aged 55 years and above accounted for 18.2%. This distribution demonstrates that both younger and older stakeholders were adequately represented.

Further, educational attainment among respondents supports the quality of the data collected. The study revealed that 15.2% of respondents had primary education, 13.8% had secondary education, and 16.4% held diplomas. Also, 22.3% of the respondents revealed to have attained bachelor's degrees, with 12.6% having master's degrees, as 19.7% of the respondents possessed doctoral degrees. This indicates that a substantial proportion of respondents had attained post-secondary education with professional training. The occupational profile of respondents further reinforces the representativeness of the study. Government officials constituted 22.3% of respondents while NGO representatives were 29.0%. Also, the community members represented 27.5% as private sector actors were 21.2%. This distribution aligns closely with the principles of stakeholder theory articulated by Freeman (1984). Moreover, experience levels among the respondents enriched the study. The respondents with less than one year of experience accounted for 20.8%. Those respondents with 1–3 years accounted for 18.2% while those with 4–6 years accounted for 21.6%. Also, there were those respondents with 7–10 years who accounted for 18.6%. Lastly, the respondents with over 10 years of experience accounted for 20.8%. This balanced distribution captures both emerging and seasoned perspectives.

The findings show that respondents expressed neutral to moderate views on the effectiveness of project planning practices in dam construction projects in Kitui County. The mean scores for planning-related statements ranged narrowly between 2.99 and 3.00, with standard deviation values ranging from 1.417 to 1.422. These statistics suggest that planning practices exist, but their effectiveness is neither convincing nor fully trusted by stakeholders. On feasibility studies, respondents were divided. 79 respondents strongly agreed and 49 agreed that dam projects had clear and documented feasibility studies. However, a notable number either disagreed (39) or strongly disagreed (27), with 75 respondents remaining neutral. This resulted in a mean score of 3.00. The neutral clustering is significant. It suggests that feasibility studies may have been conducted as formal requirements. But, their depth, transparency, and visibility to stakeholders was questionable. The findings reported that several dam projects in Kitui County commenced without comprehensive feasibility assessments. This led to stalled works and underperforming infrastructure. Risk assessment during planning also attracted neutral perceptions. Although 74 respondents strongly agreed and 61 agreed that risks were thoroughly assessed, 97 respondents remained neutral. Still, 37 either disagreed or strongly disagreed, which resulted in a mean score of 3.00. Risk in dam projects is not theoretical. It includes geological instability, climate variability, community resistance, and funding uncertainty. According to Kinyua (2021), failure to proactively manage these risks compromises long-term sustainability.

Environmental and social impact assessments recorded a slightly lower mean score of 2.99. Of these, 51 respondents strongly disagreed and 46 disagreed that such assessments were effectively integrated. This finding is critical. Environmental neglect undermines dam longevity. Social exclusion fuels resistance. As noted by Kimeu and Musau (2022), dam projects in Kitui West that ignored environmental considerations experienced sedimentation, water contamination, and reduced usability over time. This reinforces the argument that sustainability is inseparable from environmental stewardship. Planning timelines and resource realism also produced a mean score of 3.00. This had mixed opinions reflecting in a standard deviation of 1.417. Unrealistic timelines are common in publicly funded projects. As per the Office of the Auditor-General (2021), rushed planning in government infrastructure projects often results in delayed completion and inflated costs. This pattern appears consistent with stakeholder perceptions in Kitui County.

The study findings indicate average stakeholder engagement. This is shown by mean scores ranging from 3.00 to 3.01 and standard deviation values of approximately 1.42 across all engagement indicators. This consistency suggests uniformity in perception. Engagement happens but not deeply. Stakeholder identification

and mapping from project inception recorded a mean score of 3.01. Indeed, 65 respondents strongly agreed while 63 agreed, but 44 strongly disagreed and 23 disagreed. This polarisation indicates inconsistency in stakeholder analysis across projects. As indicated by Mwangi and Mutuku (2023), weak stakeholder mapping leads to governance gaps, with duplicated roles and conflict escalation during project implementation. Community involvement in decision-making scored a mean of 3.00. Although 74 respondents strongly agreed and 70 agreed, 61 respondents either disagreed or strongly disagreed, and 64 remained neutral. This confirms partial inclusion. Juma and Githinji (2021) state that meaningful community participation in water governance enhances equity, gender responsiveness, and sustainability. However, token consultation produces neutral perceptions and weak ownership. Communication between project teams and stakeholders also recorded a mean score of 3.00. Regular communication is essential.

The descriptive analysis of funding mechanisms reveals moderate acceptance. This is supported by a mean score ranging from 2.99 to 3.01 and standard deviations of approximately 1.42. This indicates variability in funding experiences across projects. Sufficiency of initial capital scored a mean of 3.00. 67 respondents agreed and 54 strongly agreed, but 106 respondents disagreed or strongly disagreed. This reflects uneven funding adequacy. Kinyuira (2018) indicates that undercapitalisation at project start often leads to stalled construction and contractor withdrawal. Transparency in financial management recorded a mean of 2.99. This data had 38 participants strongly disagreeing and 53 disagreeing. Financial opacity undermines accountability. Public-private partnerships recorded a mean of 3.00, which suggests limited but emerging use. As per Mwangi and Wanyoike (2020), diversified funding sources enhance sustainability thereby reducing reliance on single donors. Contingency funding also scored a mean of 3.00, which indicates limited preparedness for unforeseen costs.

The findings reveal moderate sustainability, with mean scores ranging from 3.00 to 3.01. Respondents moderately agreed that dam projects were expected to operate efficiently for at least 20 years ($M = 3.01$, $SD = 1.422$). Long-term operation is hopeful but not guaranteed. Monitoring and evaluation structures also scored $M = 3.01$, which suggests partial institutionalisation. Maintenance plans and budgets scored $M = 3.00$, which reflects weak preparedness for long-term upkeep. KITWASCO (2023) notes that inadequate maintenance budgets remain a key challenge in sustaining water infrastructure. Community empowerment for long-term management scored $M = 3.00$. This reinforces earlier findings on limited participation. Economic and environmental benefits also scored $M = 3.00$, which indicates moderate impact. These findings echo the Walter and Oyaya (2017) conclusion that many dam projects in ASALs regions operate below optimal capacity. This is due to planning, funding, and governance weaknesses.

Project planning emerged as the strongest predictor of sustainability among the core practices examined. The Pearson correlation coefficient between planning practices and sustainability was $r = 0.722$, with a p-value of 0.000. This indicates a strong positive and statistically significant relationship. In Kitui County, poor planning has historically resulted in dams drying prematurely, silting rapidly, or becoming inaccessible to communities. The strong correlation of $r = 0.722$ suggests that when feasibility studies are thorough, environmental assessments are conducted properly. Also, technical designs reflect local ecological realities, where dam projects are more likely to endure. This aligns with Sharma et al. (2010), who argue that inadequate environmental planning in dam projects leads to long-term ecological stress and reduced functional life. Stakeholder engagement also showed a strong positive relationship with sustainability. It had a Pearson correlation coefficient of $r = 0.700$ and a p-value of 0.000. This finding confirms that community participation is not symbolic but functional. As argued by Saba et al. (2019), stakeholder involvement improves ownership, reduces conflict, and enhances long-term project use.

The Pearson correlation coefficient between post-construction monitoring and sustainability was an exceptionally high [$r = 0.892$], with a p-value of 0.000. This result sends a clear message. Sustainability lives beyond project closure. PMI (2023) clarifies that projects without post-implementation reviews and performance monitoring often deteriorate unnoticed. In Kitui County, dams with regular inspection, maintenance schedules, and performance evaluations remained functional longer. Risk management also showed a statistically significant and moderately strong relationship with sustainability, given by $r = 0.647$ and $p < 0.01$. This finding highlights the importance of proactive rather than reactive project management. Risk assessments conducted during planning helped identify threats such as flooding, siltation, contractor failure, and social resistance. As per Saunders et al. (2019), projects that systematically identify and mitigate risks perform better under uncertainty.

Generally, the regression and qualitative findings converge on one conclusion. Sustainability is a system outcome. It emerges from the interaction of planning quality, funding reliability, stakeholder ownership, governance strength, technical capacity, and institutional support. As emphasised by Tashakkori and Teddlie (2010), mixed-methods research strengthens interpretation by linking numbers to lived experiences. In Kitui County, the numbers speak loudly, and the voices explain why. Thus, these findings demonstrate that dam

sustainability is not primarily constrained by climate or geography but by management choices and the voices from FGDs and KIIs explain why the numbers look the way they do.

V. Conclusion

The central role of project planning in determining dam sustainability. The study established that feasibility studies, environmental and social impact assessments, risk assessments, and realistic timelines were only moderately applied. Stakeholder engagement is the most influential predictor of sustainability. This finding is both statistically powerful and socially revealing. The correlation between stakeholder engagement and sustainability was strong ($r = 0.700$, $p < 0.001$). More importantly, stakeholder engagement recorded the highest standardised regression coefficient ($\beta = 0.387$). Risk management must be continuous and not ceremonial. When risks are identified early and revisited regularly, project lifespan improves. Institutional governance and technical capacity are weak links in sustainability chains. Management committees, policies, and frameworks existed, yet sustainability remained fragile. Elite capture, political interference, weak transparency, and poor coordination undermined governance structures while technical skills among local operators were limited. This increased reliance on external experts, delaying repairs as costs rose.

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