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Participatory Project Implementation and Sustainability of Hydroelectric Power Projects in Kenya: A case of Mwea Hydroelectric Power Project, Kirinyaga County, Kenya

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Abstract: Hydroelectric power projects are facing myriads of implementation challenges that pose threats to attaining sustainable impacts. Participatory decision making is one of such constraints. The study examined how participatory implementation influences sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya. Both stakeholder and sustainability theories guided the study. Descriptive survey research design was adopted. The target population was 207 consisting of 187 members of Kiuria Community Micro-Hydropower Scheme and 20 project implementation officers. Krejcie and Morgan table of sample tabulation was sued to obtain a sample size of 134. Proportionate stratified random sampling technique was utilized in drawing samples from each sub-population. 5-point Likert questionnaire, interview guide and focused group discussion were data collection tools. Reliability was tested using split-half technique subject to Cronbach's method and the value were α=0.81. The results revealed that there was very strong positive relationship between participatory project (r for =0.86). Thus, the null hypothesis was rejected as there was valid evidence to conclude that participatory project implementation has significant influence on sustainability of Mwea Hydroelectric power project. Recommendation was made to project managers to adopt participatory decision making during project implementation in order promote sustainable results. Government should institute guideline for promoting participatory decision making during project implementation so as to increase chance of impactful outcomes. Government can also apply the findings from this study to develop a criteria or standard for appraising future projects based on the level participation. Future scholars can explore can explore how participatory decision making interacts with risk management to inform sustainability.

Key words: participatory, project implementation, sustainability, Mwea Hydroelectric power project in Kirinyaga County.

1.0 Introduction

Energy is critical resource for socioeconomic development of nations. Energy exists in different form including but not limited to chemical, electrical, mechanical, thermal, nuclear and gravitational. The increasing demand for clean energy and the need to promoted environment sustainability is forcing countries to shift from the fossil energy to renewable energy like wind, solar, hydroelectric, geothermal etc. (United Nations, 2015). As a result, Hydroelectric power projects are receiving great attention in resolving energy challenge. However, sustainability of hydroelectric power projects is raising professional and scholarly issues (Ritchie and Mispy, 2018). Of concern is the ability to make informed sustainable decision through participatory processes.

In the United States, the hydroelectric power generation policy is quickly shifting focus to efficient power generation approaches and technologies so as to counter the competing limitations of water resources and promote sustainability (Moran, Lopez, Moore et al., 2018). France and Switzerland are integration modern technologies in power generation for sustainable hydroelectric power generation. The trend is same in Spain, Sweden, United Kingdom, Switzerland and Portugal where hydropower generation infrastructure is integrated with solar and wind energy sources in order to promote sustainable power (O'Connor, 2017). In India, electricity demand as result of the increasing population is focing the government into huge investments in mini-hydroelectric power projects (UNEP, 2020). In China, Sri Lanka, Bangladesh, South Africa and Ghana, the governments are expanding power supply through mini and micro-power generation stations (Maxim, 2014). Nonetheless, the sustainability of these project is receiving mixed views from scholarly arena.

The Eastern Africa Community has put in place a robust regional strategy for increasing access to modern, affordable, reliability and sustainable energy services by integrating regional planning that focus on increasing the local investment capacities in hydro power projects (IWPDC, 2020). Over 39% of electricity in

Kenya is generated from hydropower (von Eije and Mokveld, 2018). In order to promote sustainable power generation, hydroelectric power generation is regulated by the national energy policy of 2018 (Republic of Kenya, 2018). The implementation of this policy has led to proliferation of small and micro hydropower projects all over Kenya. But the ability of these projects to reliably and sustainably supply electricity in line with the socioeconomic needs of the localities has been questioned relative to the prevailing needs of the stakeholders (Mbaka and Mwaniki, 2016).

Upon the realization of the potential financial and technical constraints in hydroelectric power generation in Mwea locality, The United Nations for Industrial and Development (UNIDO) in collaboration with the Government of Kenya initiated the implementation of the Mwea hydroelectric power project in Kirinyaga County in 2014 (UNIDO, 2017). The project budget was USD 2,066,101 and aimed at utilizing the free flow of water along the Mwea irrigation canals by installing turbines, control system and electricity distribution network so as to promote community welfare in the local community. While the project was completed within time frame (2015), the project was handed over in 2017 due to the poor community preparation. While the local community was involved throughout, issues of delayed handing-over, frequent breakdown of turbine machines, low number of businesses created and low connectivity of electricity to homesteads were reported (Theuri, 2017; Government of Kenya, 2020). These concerns created knowledge gap on the effectiveness of participatory implementation in promoting sustainable project impacts.

2.0 Problem Statement

Mwea hydro-power project was practically completed in 2015 (UNIDO, 2017). However, the actual handing over was done in the year 2017. The delay was necessitated by the need to adequately prepare the local community in running and operating the project post-implementation. Nevertheless, observations suggest that there are meagre socioeconomic gains generated by the project. For example, all of the nine (9) business that were initially connected to the power during the handing over of the project have closed due to unreliable power supply (Republic of Kenya, 2020). In addition, all the homesteads that were initially connected to the power from the project have switched to other sources of electricity due to frequent breakdowns. There are incidences of turbines and machine breakdown leading to frequent power breakdown in the locality. The breakdown is associated with poor maintenance due to inadequate operation capacities. Also, the turbine cannot produce any electricity when there is low water level in the canals especially during the dry seasons. While the project was expected to produce beneficial results like fuel saving, growth of business, employment, income generation and improving night security through lighting (UNIDO, 2017), questions arise regarding the stability of the project in delivering sustainable benefits.

Past studies associate participatory project management with sustainable decisions (Ratnayake, Wickramaarachch and Wattege, 2017; Hugue, 2020; Carrillo, 2020). Nevertheless, participation is narrowly over-studied from the aspects of communication and information sharing thereby limiting knowledge. While past studies faced methodological and contextual limitations, this lowered the validity for generalizing the results. These knowledge gaps were filled by examining how participatory project implementation influences sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya.

The purpose of this study was to determine how participatory implementation influences sustainability of Mwea Hydroelectric power project in Kirinyaga County Kenya

The null hypothesis stated that: there is no significant relationship between participatory implementation and sustainability of Mwea Hydroelectric power project in Kirinyaga County Kenya

3.0 Literature Review

Implementation is the process of executing the activities, tasks and coordinating efforts so as to achieve the set goals. In carrying out the activities, project stakeholders are facilitated and given opportunity to perform their duties and responsibilities in a suitable environment in order to ensure productivity and performance (PMI, 2017). Stakeholders play a crucial role for project to succeed. A stakeholder can participate in the implementation as a consultant, service provider, worker, supplier or in the management team (Bulgacov, Paola, Marcia et al., 2015). Project managers create synergetic and sense of determination through effective leadership and teamwork. Participatory implementation is claimed to enhance responsibility and accountability. In addition, stakeholder involvement in the execution of project tasks promotes sense of worthiness and respect thus leading to innovation in overcoming implementation challenges (Nilsen, Stendal, Gullslett et al., 2020). Therefore, participation of stakeholders in the implementation of a project increasing opportunities for building a strong project team for steering the project to successive and sustainable conclusion (Uzochukwu, Okeke, Ruiz et al., 2020).

In Norway, Nilsen et al. (2020) used a qualitative design to inquire on the shareholders` involvement in execution of community eHealth projects whereby 20 interviews were conducted on employees and the

qualitative analysis showed that participation of stakeholders in the implementation enhances communication for good performance. However, the qualitative results suffered methodological and design limitations. To solve it, this study used mixed research methodologies so as to increase validity for concluding and generalizing the findings on the how stakeholders' engagement in implementation contributes to the sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya.

In Nigeria, Uzochukwu, Okeke, Ruiz et al. (2020) assessed how stakeholders' capacity shaped project implementation. A survey design, a random sample of 31, questionnaire and grounded theory were used to implement the inquiry and descriptive statistics showed that participation of stakeholders in implementation strengthens decision making process for sustainable impacts. Nevertheless, the findings could not be generalized due to subjectivity in the qualitative methodologies. This study used mixed research methodologies so as to increase the validity in concluding and generalizing the findings the contribution of stakeholders' engagement in implementation stage of project contributes to the sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya

Ochunga and Awiti (2017) conducted a survey on participation of stakeholders in project-management cycle and sustainability of CDF in Homa Bay Town Sub-County, Kenya whereby a random sample of 113 respondents and structured questionnaire gathered data. Inferential statistics showed that involvement of stakeholder during implementation enhances efficiency and effectiveness thus increasing chances of project sustainability. But the study suffered contextual limitations which limited generalization of the findings. In overcoming the limitation, this study assessed the contribution of stakeholders' engagement in implementation stage of project to sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya.

4.0 Theoretical Framework

Stakeholder theory was the main theoretical foundation in the study. It was reinforced by theory of sustainability. Freeman advanced theory of stakeholder in 1980s. Freeman proclaimed that projects derive the most gains from participation of stakeholders (Freeman, 1984). Stakeholders theory emphasizes on development of a logical approach towards effective stakeholders' involvement so as to optimize stakeholders` potentials and capacities in project development. Stakeholder theory linked very well with the independent variable (participatory implementation) and was used to strengthen the argument that stakeholder involvement enhances sustainability projects.

Developed by Mr. Felix Ekard Ekardt in 2009, theory of sustainability emphasis on creation of a long term and universally accepted practices that protect the future life and economic (Ekardt, 2014). The premise of theory of sustainability is that the current generation should not exploit the nature to meet its needs at the cost of future generations. Among the sustainable development principles is public participation in sustainable decision making (Enders and Remig, 2015). Public participation promotes transparency, equity and fairness, openness and ownership to public projects and programmes. Sustainability theory linked well with the dependent variable (sustainability) for this study.

The conceptualization for the influence of participatory implementation and sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya is illustrated in Figure 1

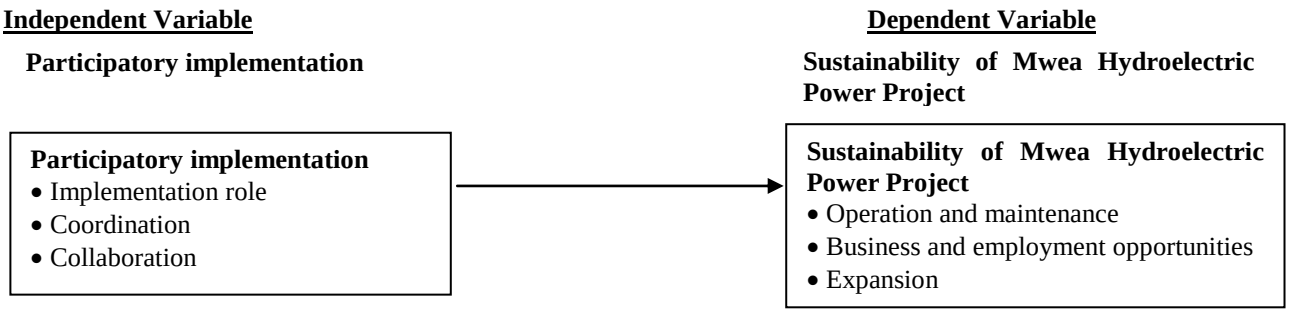

Figure 1: participatory project implementation and sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya

5.0 Research Methods

5.1 Research Design

Descriptive survey research design was used to carry out the study. The descriptive type of survey was preferred because it systematically and accurately allows for collection of data that describes a population as it naturally occurs (Kothari, 2004). In addition, descriptive survey allows for answering questions related to when,

where, how and what about a variable by integrating numerous techniques. For this reason, descriptive survey design was helpful in collecting disaggregate data from project management committee, the current board members and members of Kiuria Community in order to explain and understand how participation of stakeholders related to the sustainability. Descriptive survey research design has reliably been utilized in past related studies (Matu, Kyalo, Mbugua et al., 2020a; Okul and Nyonje; 2020)

5.2 Target Population

The research inquiry had a target population of 207 comprising of 13 Project management committee members, current 7 board members Kiuria Community Micro-Hydropower Scheme and 187 members of Kiuria Community Micro-Hydropower Scheme

5.3 Sample Size

The Krejcie and Morgan table of sample determination was used to sample 134 elements out of the population of 207. Proportionate stratified random sampling method was then used to draw representative samples in each sub-population. In this case, 9, 5 and 120 respondents were selected from project management committee members, board members and other members of Kiuria Community Micro-Hydropower Scheme respectively.

5.4 Data Collection Instruments

Primary data were gathered from the respondents using structured questionnaire, unstructured interview and focused group discussion. While questionnaires were structured to collect quantitative data from the community members of Kiuria village, interview schedule and focused group discussions were unstructured in order to collect opinions and views of the project management committee members and board members of Kiuria Community Micro-Hydropower Scheme respectively.

5.5 Reliability and Validity of the Instruments

The internal-consistency of questionnaires was established by means of split-half technique and subjected to Cronbach's Alpha Coefficient at α=0.7 (Creswell, 2014). Content validity was enhanced through matching the indicators of the constructs to the questions in the data collection tools.

6.0 Results

6.1 Descriptive Results

Respondents were asked to rate six items describing participation of stakeholders during project-implementation and sustainability of Mwea hydroelectric power project in Kirinyaga County. The data is presented in Table 1

Table 1: Descriptive Data on Participatory Project Implementation and Sustainability of Mwea Hydroelectric Power Project

Items	Strongly disagree	Disagree	None	Agree	Strongly agree	n	Mean	Standard deviation
Respondent participated in physical project work	0(0.0%)	3(2.5%)	4(3.4%)	63(53.4%)	48(40.7%)	118	4.32	0.66
Respondent contributed money to the project budget	0(0.0%)	2(1.7%)	7(5.9%)	64(54.3%)	45(38.1%)	118	4.29	0.66
Respondent gave important information in the implementation of the project	0(0.0%)	5(4.2%)	8(6.8%)	64(54.3%)	41(34.7%)	118	4.19	0.74
Respondent assisted in making project implementation decisions	2(1.7%)	8(6.8%)	13(11.0%)	63(53.4%)	32(27.1%)	118	3.97	0.90
The coordination of the project was effective	3(2.5%)	3(2.5%)	7(5.9%)	46(39.1%)	59(50.0%)	118	4.31	0.89

Respondent collaborated well with the Project management committee	1(0.8%)	5(4.2%)	7(5.9%)	71(60.2%)	34(28.8%)	118	4.12	0.76
Combined mean and the standard deviation						118	**4.20**	**0.77**

Table 1 shows that the combined mean and the standard deviation for the participation of stakeholders in project-implementation and sustainability of Mwea hydroelectric power project in Kirinyaga County are 4.20 and 0.77 correspondingly. For the combined standard deviation of 0.77, it meant that the variation of scores around the mean was low leading to greater stability of the findings. For the combined mean of 4.20, it therefore meant that majority of respondents strongly-agreed that participatory project implementation led to greater sustainability of Mwea Hydroelectric Power Project. The items whose means surpassed the combined mean of 4.20 were: respondent participated in physical project work, respondent contributed money to the project budget, the coordination of the project was effective. The items with mean scores under the combined mean of 4.20 were: respondent gave important information in the implementation of the project, respondent assisted in making project-implementation and respondent collaborated well with the project-management.

6.2 Inferential Results

The relationship between participatory project implementation and sustainability of Mwea Hydroelectric power project relationship was established by means of Pearson's correlation analysis. Table 2 gives the correlational statistics

Table 2: Correlation between Participatory Project Implementation and Sustainability of Mwea Hydroelectric Power Project

		Sustainability of Mwea Hydroelectric power Project	**Participatory Project Implementation**
Sustainability of Mwea Hydroelectric power Project	Pearson Correlation	1	
	Sig. (2-tailed)		
	n	118	
Participatory Project Implementation	Pearson Correlation	0.86**	
	Sig. (2-tailed)	0.00	
	n	118	118

**. Correlation was significant at 0.01 sign. level (2-tailed).

The statistics show in Table 2 indicates that the coefficient of correlation of participatory project implementation with sustainability of Mwea hydroelectric power project was 0.86 for $p=0.00 <0.05$. This means that participatory project implementation has very strong positive relationship with sustainability of Mwea hydroelectric power project.

The null hypothesis stated that there is no significant relationship between participatory project implementation and sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya. The findings in Table 2 leads to the rejection of null hypothesis because there is evidence to conclude that at 95% confidence interval, p value (0.00) is less than 0.05 which signifies the influence of participation of stakeholders in project-implementation on sustainability of Mwea Hydroelectric power project.

Sustainability of Mwea Hydroelectric power project relationship was regressed against the independent variable (participation of stakeholders in project-implementation) and the data is illustrated in Table 3.

Table 3: Regression of participatory project implementation and Sustainability of Mwea Hydroelectric Power Project

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics			Sig. Change
					R^2 Change	F Change	df1	df2	
1	0.86[a]	0.74	0.74	0.14	0.74	338	1	116	0.00

a. Predictors: (Constant), participatory project implementation

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.29	1	6.29	338	0.00[b]
	Residual	2.16	116	0.02		
	Total	8.45	117			

a Dependent Variable: Sustainability of Mwea hydropower project
b Predictors: (Constant), Participatory Project Implementation

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.51	0.15		10.05	0.00
	Participatory Project Implementation	0.66	0.04	0.86	18.38	0.00

a. Dependent Variable: Sustainability of Mwea hydropower project

The model summary in Table 3 shows that when other factors are held constant, participatory project implementation predicted 74% variation in the sustainability of Mwea hydroelectric power project for $R^2 = 0.74$. The balance of 26% was explained by other factors.

From the ANOVA data in Table 4.13, F=338 for p= p=0.000<0.05, implying that participatory project implementation was significant in estimating sustainability of Mwea hydroelectric power project.

Still in Table 3, the coefficient table shows that when other factors were held constant, sustainability of Mwea hydroelectric power project would remain constant at 1.51 was participation of the stakeholders in project-implementation not factored. In addition, one-unit increase in participation of stakeholders in project-implementation would result into 0.66 increase in sustainability of Mwea hydroelectric power project when other factors were held constant.

6.3 Qualitative Results

When asked to express their experiences, opinions and views on how participation of stakeholders in implementation affected sustainability of the Mwea Hydroelectric Power Project, Project management committee members affirmed that participatory implementation promoted efficiency, effectiveness, accountability and ownership of project processes. The specific response to this item is hereby summarized:

> "S*takeholders took different roles during implementation depending on their interests and capacities. For example, the donor was UNIDO, Republic of Kenya ensured that all regulations were complied with in delivering beneficial impacts to the local citizens, local community contributed to the project implementation both physically and materially. Kirinyaga University and the Kenya Industrial Estates offered training services to the local community. This strengthened collaboration with stakeholders in delivering sustainable impacts. However, stakeholders were not always responsive in time when called upon. Others had competing hidden interests. Financial constraints especially from the local community jeopardized their full contribution to the project endeavor. Some stakeholders resisted change decisions especially*

when their hidden interests were touched which resulted into withdrawal of their efforts and support. But there were robust lobbying and negotiations to restore stakeholder support and commitment" (Project management committee members).

The focused group discussions that was conducted to the board of Kiuria Community Micro-Hydropower Scheme project revealed mixed reactions. For example, whereas stakeholder engagement during implementation was cordial, many stakeholders completely withdrew their efforts after project handover. Whereas the community was trained managing the project after the closure, members complained of delays when receiving support services in key areas. For instance, there were complains of frequent machine breakdown whereby the spares had to be imported all the way from Japan. The members also complained over inadequate technical skills in maintaining the turbine apparatus. Further, members raised concerns over inadequate business and entrepreneurial skills in starting own business.

The findings from descriptive analysis showed that participation of stakeholders in project-implementation improved sustainability of Mwea hydroelectric power project. The correlational results showed that an increase in participatory project implementation led to very strong increase in the sustainability of Mwea hydroelectric power project. The finding concurs with the conclusions from a research by Nilsen et al. (2020) that participation of the stakeholders in the implementation enhances success and long-term performance of community eHealth projects in Norway. Similarly, Uzochukwu, Okeke, Ruiz et al. (2020) conducted a related study and concluded that participation of stakeholders in implementation strengthens decision making process for sustainable impacts of development projects in Nigeria. Also, Ochunga and Awiti (2017) conducted a study on participation of stakeholders in project-management cycle and sustainability of CDF in Homa-Bay Town Sub-County in Kenya and concluded that involvement of stakeholder during project-implementation enhances efficiency and effectiveness thus increasing chances of project sustainability. The qualitative data showed that participation of stakeholders in implementation contributed positively to the sustainability of the Mwea Hydroelectric Power Project by enhancing efficiency, effectiveness, accountability and ownership of project processes and outputs. Nevertheless, financial constraints and stakeholder's resistance hindered effective participation of stakeholders in the implementation process which adversely limited their full integration in suitability decisions. Stakeholders theory advocates for full integration of stakeholders in implementation decisions in order to realize impactful results. As a result, sustainability is achieved. Therefore, participatory project implementation is an important part of promoting sustainability of a project.

7.0 Conclusions and Recommendations

The objective of the study was to establish how participatory project implementation influences sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya. Based on the descriptive and correlational findings, it was concluded that participatory project implementation is critical aspect for promoting sustainability of Mwea Hydroelectric power project in Kirinyaga County, Kenya

Practitioners and professionals in project management can utilize this finding to enhance sustainability of future project. For instance, early participation of stakeholder in decision making increases chances of making informed and sustainable decisions. Government of Kenya can use the findings from this study to institute suitable procedures and guidelines for regulating participation of stakeholders in the implementation of future projects so as to promote sustainability. Furthermore, government can use the findings from this study to develop a criteria and standards for appraising sustainability of future projects based on the level of stakeholder participation in the project cycle. The current study conceptualized the relationship between participatory project implementation from a linear perspective. This limitation can be overcome when future studies consider the possibility existing multiple effects on the dependent variable.

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