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Influence of Project Beneficiary Socio-Economic Factors On Adoption of Rain Water Harvesting Projects In Kilifi County

Kevin MutuaMutuku[1*], Samson Kitheka, PhD[2]
[1](Jomo Kenyatta University of Agriculture and Technology, Kenya)
[2](Technical University of Mombasa, Kenya,)

Abstract:*Despite the availability of simple and low-cost rainwater harvesting technologies in arid and semi-arid lands (ASALS), the adoption of these methods and technologies is still low, therefore, thwarting the attainment of the achievement of the SDGs and Vision 2030 of ensuring safe drinking water, promoting gender equity, and reducing poverty and hunger (UNEP, 2011). A study was undertaken to investigate the Influence of Project Beneficiary Socio-economic factors on the adoption of rain water harvesting projects in Kilifi County, Kenya. A descriptive survey design was used on the pretext that it has the capability to observe and describe the behavior of a subject without influencing it in any way. The target population was 139, comprising county extension officers, ward administrators, self-help groups, NGOs, county water officers and county water engineers and were selected because they were involved in the implementations of the rain water harvesting projects in Kilifi County. Stratified random sampling was used to select a sample of 103 respondents. A structured questionnaire was used to collect data which was administered through Kobo collect mobile data collection application which saved time and ensured accuracy and comprehensiveness of data collection. The researcher conducted a pre-testing of the questionnaire to ensure its reliability and validity. The pre-test was conducted among project implementers, representing 10% of the sample size. Cronbach's alpha reliability was used to determine the internal reliability of the questionnaire. Validity was assessed by determining the accuracy of the instrument used. The researcher used KMO-Bartlett's test to measure internal consistency. Data was edited for completeness, clarity, and consistency, and analyzed using SPSS Version 28. Hypothesis testing was conducted to determine the impact of user involvement, needs assessment, project exit strategy, and project risk on adoption of rain water harvesting projects in Kilifi County. Multicollinearity tests using tolerance and VIF showed that all the variables had a tolerance value >0.2 and VIF values <10. The study found that the overall model was statistically significant, with an F statistic of 156.058 and a reported p value (0.000), indicating that the independent variables were effective predictors of the adoption of rain water harvesting projects.*
The study recommended that user involvement, community participation, needs assessments, exit strategies, comprehensive risk management, and rainwater harvesting are essential tools for project success in arid and semi-arid lands with insufficient surface water.

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I. Introduction

Rainwater harvesting can be divided into two: in-situ and moisture conservation (KRHA, 2021). In-situ methods collect rainwater on the surface, while moisture conservation involves using it within the field. Research has shown that nearly 85% of rain water falls specifically into the ocean and approximately 15% into the hinterland (KRHA, 2021). Climate change and lack of infrastructure contribute to water scarcity and pollution. In-situ methods collect rainwater directly, while moisture conservation uses subsurface water storage methods like dams. Both methods help address water scarcity and human health.

Water harvesting is increasingly being used globally to offset pressures from existing water sources, as water availability is decreasing and the global water demand is expected to face a 40% deficit by 2030. Over 80% of the world's population uses drinking water from contaminated sources, with Australia being the highest water user (Yannopoulos et al., 2021). Roof Water harvesting has been a source of domestic water supply for centuries, but due to ecological factors and pollution, it has been shifted to rainwater harvesting. Rainwater harvesting technologies can help improve food security in rural societies, but adoption rates are lower than expected due to ecological and socioeconomic constraints (Ngigi, 2003). In sub-Saharan Africa, droughts have become more severe due to climate change, making communities more vulnerable (Wubetu, 2022).

A study in Nairobi's Eastlands area found that while rainwater is generally perceived as safe, it contains specific pathogens (Gakungu, 2021) The study also examined rainwater contamination in Kilifi County, a region prone to hazards and disasters. The county experiences both long and short rains, with a high proportion of households having access to piped water and potable water. The government has implemented rainwater harvesting projects, but adoption is low. Roofwater catchment is challenging in Kilifi County due to Makuti thatched roofs and pollution.

The objective of this study was therefore to examine and put to record the influence of project beneficiary socio-economic factors on adoption of rain water harvesting projects in Kilifi County.

II. Materials and methods

The study aimed to examine the factors influencing the adoption of rain water harvesting projects in Kilifi County, Kenya. A sample of 103 respondents was selected from the target population using stratified random sampling. The respondents were divided into 16 county extension officers, 3 ward administrators, 45 self-help groups, 18 NGOs, 12 county water officers, and 14 county water engineers. The respondents ranged in age from 25 to 65 years, with an average age of 40.

Research Design: descriptive survey design

Study Location: Kilifi County

Study Duration: December 2022 to March 2023.

Sample Size:103 respondents

Sample Size Calculation: The population size was estimated to be 139, with a 5% margin of error. The sample size was calculated using the formula$n = \frac{N}{1+N(e)^2}$**.** Substituting the study values, the sample size is 103. The sample size calculation assumed random selection from the population, ensuring the sample is representative and generalizable to the population as a whole. This ensured the study's results are representative and applicable to the population.

Subjects and Selection Method: The subjects of the study are county extension officers, ward administrators, self-help groups, NGOs, county water officers, and county water engineers involved in the implementation of rain water harvesting projects in Kilifi County. A Stratified random sampling method was used to select the subjects. The population was divided into six strata: county extension officers, ward administrators, self-help groups, NGOs, county water officers, and county water engineers. A sample of 16, 3, 45, 18, 12, and 14 subjects was randomly selected from each stratum respectively.

Procedure and Methodology

After securing written research consent, the study used a structured questionnaire to gather demographic information and factors influencing the adoption of rainwater harvesting projects. The questionnaire was divided into four sections: Demographics, User Involvement, Needs Assessment, Project Exit Strategy, Project Risk, and Adoption of Rainwater Harvesting Project. It asked about the respondent's employment length, education level, user involvement, needs assessment process, exit strategy, project risk, and adoption level of the rainwater harvesting project. The questionnaire used a Likert scale with five options: strongly disagree, disagree, not sure, agree, and strongly agree, allowing respondents to provide a nuanced assessment of their agreement with each statement. The survey aimed to assess the project's effectiveness and suitability for its intended beneficiaries. The questionnaire was administered through Kobo Collect, a mobile-based application. A pilot study was conducted to test the questionnaire's reliability and validity, with a Cronbach's alpha value of 0.8 and a KMO-Bartlett's test value of 0.9. The data was analyzed using SPSS version 28 using correlation and multiple regression analysis to determine the relationship between the dependent and independent variables and identify the factors most influencing the adoption of rainwater harvesting projects. The reliability and validity of the questionnaire were confirmed through these methods.

Statistical Analysis

The researcher used correlation analysis and regression analysis to assess the relationship between user involvement, needs assessment, project exit strategy, and project risk in Kilifi County. Hypothesis testing was used to test the hypothesis that user involvement, needs assessment, project exit strategy, and project risk have no significant influence on the adoption of rainwater harvesting projects. The F-test and T-test were used to test the overall significance of the regression model and individual regression coefficients. The decision rule for hypothesis testing was to reject the null hypothesis if the P-value is less than or equal to the significance level (α).

III. RESULTS AND DISCUSSIONS

The study found a strong and significant relationship between user involvement, needs assessment, project exit strategy, and project risk in the adoption of rainwater harvesting projects. Enhancing project risk could improve project adoption. The study also tested the normality of turnover intention, Durbin-Watson test, and multicollinearity. The overall regression analysis was suitable for explaining the phenomena, confirming normality in user involvement, needs assessment, project exit strategy, and project risk.

User Involvement

The study analyzed the impact of user involvement on the adoption of rainwater harvesting projects in Kilifi County. The results showed that users participated in project activities, were adequately trained and educated, were involved in project initiatives, identified key stakeholders at the initiation stage, and had adequate consultation with beneficiaries with standard deviations of.89071, .99061, .57349, .78019, .69930, .92622 and .82617. The correlation between needs assessment and adoption of rain water harvesting projects was established to have a positive, strong and significant relationship ($r = 0.924$; $p < 0.05$) The findings had an average mean of 3.8141. The study aligned with Aga & Vallejo's (2020) study on passive and genuine community participation, which assumed that projects align with local needs and have minimal adverse social effects. Genuine community participation, however, faces risks of dominance by a few individuals. Organizations are now promoting community participation, particularly disadvantaged women and men, in project design, leading to successful project implementation. Gichuru (2021) found that community involvement in initiation, consultation, construction, and post-implementation is vital for project success. See table 1;

Table 1: Descriptive analysis of User Involvement

Statements	N	Mean	Std. Deviation
Users participate in project activities aimed at actualizing new projects	93	3.6559	.89071
Users are adequately trained and educated on rain water harvesting projects	93	3.6022	.99061
Users are involved in project initiatives	93	3.7742	.57349
There is identification of the key stakeholders at the initiation stage of the project	93	4.0000	.78019
There is user involvement of the during project planning, implementation and closure of the project	93	4.0108	.69930
There is adequate consultation with project beneficiaries	93	3.8925	.92622
Users have basic training and knowledge about adoption of rain water harvesting projects	93	3.7634	.82617
Average Mean		3.8141	

Needs Assessment

The study evaluated the impact of needs assessment on the adoption of a rainwater harvesting project in Kilifi County. The results showed that community participation in project priority development, adequate geographical coverage, time, and budgetary allocation to needs assessment were crucial factors in generating understanding about the problem. Intervention gaps were clearly identified and adopted as community preference, and there was adequate involvement of beneficiaries in identifying them before the project began with standard deviations of.62461, .90166, .96260, .62180 and 1.27615. The findings align with Okinyi's (2020) recommendations, emphasizing the importance of a needs assessment before planning development work. The project should aim to strengthen community weaknesses and help achieve part of its vision. A needs assessment should identify community assets and potential concerns, and focus on identifying barriers to successful adoption and finding solutions. The study also highlights the need for effective communication of project goals and targets to all stakeholders. See table 2 below;

Table 2: Descriptive analysis of Needs Assessment

Statements	N	Mean	Std. Deviation
Adequate involvement of beneficiaries in identification of intervention gaps before the project began	93	4.1505	.62461
Community participates in the development of project priority	93	3.5699	.90166
There is beneficiary analysis	93	3.4946	.96260
Intervention gaps were clearly identified and adopted a community preference	93	4.3011	.62180
The geographical coverage, time and budgetary allocation to needs assessment was adequate to generate enough understanding about the problem	93	3.6237	1.27615
Average Mean		3.8279	

Project Exit Strategy

The study analyzed the impact of project exit strategy on the adoption of a rainwater harvesting project in Kilifi County. The results showed that transition meetings with community groups at the end of the project were adequate, and communities were trained on project management with a mean of 3.9742. The donor team periodically assessed project progress after completion, and the community advocacy capacity was strong.in a nutshell, The study found a significant positive relationship between project exit strategy and adoption of rainwater harvesting projects ($r = 0.635$; $p < 0.05$), indicating a positive and strong correlation. The study agrees with Levinger and Mcleod (2021) that exit strategies should be formulated from the beginning of the project to ensure successful project adoption. Bora et al. (2021) suggest identifying potential leaders within the private and public sectors to support the project's goals. Networking with local and international organizations is essential for accessing resources after the program ends. Building local organizational and human capacity is also crucial. Makau et al. (2021) recommend identifying, prioritizing, and scheduling key elements of program adoption, and planning for local actors' new roles and responsibilities. See table 3 below;

Table 3: Descriptive analysis of Project Exit Strategy

Statements	N	Mean	Std. Deviation
Transition meetings with the community groups at end of project was adequate	93	4.0645	.65618
The communities are trained on how to manage the project	93	3.7419	.96575
The donor team periodically assesses progress of the project after completion	93	3.6882	.95529
The community advocacy capacity is strong to ensure lobbying for the project continuity	93	4.1613	.68032
The donor post project advisory role has been adequate in aiding the adoption of rain water harvesting projects	93	4.2151	.60522
Valid N (listwise)		3.9742	

Project Risk

The study examined the impact of project risk on the adoption of rainwater harvesting projects in Kilifi County. The results showed that new technologies increase uncertainty, a strong risk identification system significantly impacts project adoption, specification changes usually affect adoption, technical complexity significantly affects adoption, beneficiaries are involved in risk identification, and urgency with project delivery greatly affects adoption with standard deviations of .60753, .65100, 1.05139, 1.04201, .85905 and .76796 ($r = 0.831$; $p < 0.05$). This finding aligns with Kariuki's (2017) study, which found that other project risk subsets, such as technical complexity and technological uncertainty, also negatively affect project adaptation. Unused technologies can lead to problems with building works projects, delay the project, and require a more plan-based approach. Large project sizes can also negatively affect effective project implementation, especially for agile projects. See table 4 below;

Table 4: Descriptive analysis of Project Risk

Statements	N	Mean	Std. Deviation
New technologies increase uncertainty	93	4.3118	.60753
Strong risk identification system has an impact on adoption of rain water harvesting projects	93	3.9892	.65100
Specification changes usually affects adoption of rain water harvesting projects	93	3.7849	1.05139
Technical complexity has a marked effect on adoption of rain water harvesting projects	93	3.8172	1.04201
Beneficiaries are involved in risk identification	93	4.1505	.85905
Urgency with which a project ought to be delivered greatly affects adoption of rain water harvesting projects	93	4.2258	.76796
Valid N (listwise)		4.0466	

Adoption of Rain Water Harvesting Projects

The adoption of rainwater harvesting projects in Kilifi County was assessed using various questions. The results showed that beneficiaries receive adequate water for household consumption, livestock consumption, and irrigation. The increase in adoption of these projects was 4.1398, and a satisfactory number of community beneficiaries are replicating project gains. The study by He et al. (2021) found that adoption rates of rainwater-harvesting technologies in Malawi are lower than expected due to ecological and socioeconomic constraints in rural areas. Assessing social, economic, environmental, and institutional factors could help policymakers develop strategies to promote rainwater harvesting and enhance food security. See table 5 below;

Table 5: Descriptive analysis of Adoption of Rain Water Harvesting Projects

Statements	N	Mean	Std. Deviation
Beneficiaries receive adequate water for household consumption	93	4.2151	.64013
Beneficiaries receive adequate water for Livestock Consumption	93	3.9677	.77251
Beneficiaries receive adequate water for irrigation	93	4.2688	.64504
Increase in adoption of a rain water harvesting project in households	93	4.1398	1.10917
Satisfactory number of community beneficiaries are replicating project gains	93	4.0430	.46424
Routine community meetings are addressing the management challenges of the project	93	4.1183	.91900
Valid N (listwise)		4.1254	

IV. CONCLUSION

The study examined the impact of socio-economic factors on the adoption of rainwater harvesting projects in Kilifi County. It found that user involvement, needs assessment, project exit strategy, and project risk all positively influence the adoption of these projects. User involvement is crucial for project activities, needs assessment helps identify intervention gaps, and project exit strategy reduces risks. Project risk significantly influences project adoption, and a strong risk identification system and specification changes are essential. Technical complexity and urgency also play a role in project adoption. Project management teams should promote community participation in project design for successful implementation. Needs assessment is essential for identifying problems and identifying appropriate interventions. Project risk management should be comprehensive and systematic, focusing on risk identification, analysis, and response to achieve project objectives. Further research is needed to explore other aspects of project beneficiary socio-economic factors and compare findings across different counties and geographical locations.

V. Recommendations

1. Having strong user involvement contributes to perceived project success in terms of scope but not time, cost and quality. Lack of user experience negatively and significantly affected project performance. This implies that users should have basic experience, training, education and knowledge about their business domain. In addition, project management team need to promote the participation of communities in particular disadvantaged women and men in project design which will lead to successful project implementation. User involvement should either be passive or genuine community participation.
2. Needs assessment is an effective tool to clarify problems and identify appropriate interventions or solutions within a community. By clearly identifying the problem, finite resources can be directed towards developing and implementing a feasible and applicable solution especially towards adoption of rain water harvesting project. Gathering appropriate and sufficient data informs the process of developing an effective project that will address the groups' needs and wants. Needs assessments are only effective when they are ends-focused and provide concrete evidence that can be used to determine which of the possible means-to-the-ends are most effective and efficient for achieving the desired results which is needed in designing a project. Having knowledge on what a community really needs is important in developing a project with lasting benefits. A needs analysis is focused on identifying the possible barriers to successful adoption of rain water harvesting projects in a community and possibly finding solutions to these challenges.
3. In order to make the exit strategy most effective, project sponsors should identify, prioritize and schedule the staggering of key elements of a programme adoption. Also, plans on how and when local actors will take on new roles and responsibilities need to be made. It is worth noting that upon ending project or programme intervention, the relationship between the sponsor and the taking over organization should not end as well. Furthermore, exit strategies should be formulated from the beginning of the project or programme. This, allows external and local actors to focus on their time frame as an opportunity to achieve programmatic and capacity-building outcomes to ensure project adoption.
4. Project risk management should be a comprehensive and systematic way of risk identification, risk analysis and risk response with a view to achieving the project objectives. Mitigating risk by lessening their impact is a critical component of project risk management. Implemented correctly, a successful project risk mitigation strategy should reduce adverse impacts. In essence, a well-planned and properly administered risk mitigation strategy is a replacement of uncertain and volatile events with a more predictable or controlled response. Moreover, other project risk subsets such as technical complexity and technological uncertainty also negatively affect adaptation of rain water harvesting project. The use of unfamiliar technologies can also lead to problems with building works projects that reduce the performance of the products or delay the project for traditional approaches than for agile approaches.
5. Rain water harvesting is an essential in most arid and Semi-arid lands where surface water is inadequate to meet people's demands and they have to depend on ground water. Due to rapid urbanization, the infiltration

of rainwater into the sub-soil has decreased drastically and recharging of ground water has diminished leaving rain water harvesting as the sole source of water in most areas. Moreover, there is need to replicate as well as scale up of the cash for assets projects at the household levels.

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