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Project Resource Management and Performance of Large-Scale Water Projects in Rift Valley Region, Kenya

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Abstract: *Project resource management holds vital importance within the realm of project management, encompassing adeptly strategizing and employing the resources necessary for accomplishing a project. However, despite the tremendous investments, large-scale water projects in Kenya have encountered high failure rates over the past decade. The current study examined the effect of project resource management on the performance of large-scale water projects in the rift valley region, Kenya. The study was anchored by the resource-based view theory. A descriptive research design was adopted. The target population was the 14 large-scale water projects in Kenya's Rift Valley region. The unit of observation comprised 122 project members from the implementing agency, consultant, contractor, County government, water service provider, and community representatives. The questionnaire was employed in data collection. The descriptive statistical results showed that project resource management affects large-scale water projects' performance. Correlation analysis results established that there was a positive and significant relationship (r=0.515**, p=.000) between project resource management and performance. The result implied that higher levels of performance of large-scale water projects can be attained with efficient and effective management of resources. In regression analysis, the beta coefficient (β=0.452, p=.000<0.05) was significant at a 95% confidence level. This means that the performance of large-scale water projects is affected by project resource management. The study concludes that optimized resource management minimizes cost overruns and streamlines operations. The study recommends the prioritization of the allocation of critical resources to high-impact tasks, which will improve the performance of large-scale water projects.*

Keywords: *Project Resource Management, Performance, Large-scale Water Projects*

1. Introduction

Project resource management involves the systematic and efficient allocation and utilization of resources essential for project completion (Ghorbani, Hamidifar, Skoulikaris, & Nones, 2022). The main aim of the process is to optimize the utilization of these resources to achieve project objectives while minimizing waste, delays, and overruns. Project leaders are tasked with discerning the types and quantities of resources needed for each project task. This necessitates a comprehensive grasp of the project's scope and requirements. Once identified, resources are meticulously planned for in terms of availability, sourcing, and allocation. Ngene, Nwafor, Bamigboye, Ogbiye, Ogundare, and Akpan (2021) opined that effective resource allocation involves assigning specific resources to tasks based on their expertise, availability, and skill set. This precision ensures that resources are assigned appropriately to tasks, leading to heightened efficiency and productivity. Resources are aligned with project timelines and task dependencies, ensuring their optimal scheduling. According to Radujković and Sjekavica (2017) the project schedule outlines when each resource is required and for how long, promoting efficient resource utilization and preventing bottlenecks. Resource management strives for resource optimization, entailing the prudent use of resources to minimize waste while maximizing output. Effective communication among project stakeholders is imperative for resource management (Bao, Chen, Martek, Chan, & Jiang, 2023). A clear understanding of roles, responsibilities, and resource allocations is crucial for team members. As such, open communication helps prevent misunderstandings and facilitates seamless resource coordination and improved performance.

Nonetheless, despite substantial investments, water projects and initiatives in Kenya have encountered remarkably high rates of failure over the past decade (Musau, 2020).The existence of halted large-scale water projects that have consumed substantial public funds across the nation indicates poor project performance. Among the recent sizable water projects in the specified region, the Itare Dam (34 billion shillings) and Siyoi-Muruny Dam (10 billion shillings) fall into this category. As outlined in both the Auditor General Report of 2020/21 and the Parliamentary Inquiry Report (2020) on these

undertakings, these projects are noted to have already consumed billions of irrecoverable public funds. Moreover, there is a multitude of water initiatives in the Rift Valley Region that have experienced delays in implementation timelines and are at risk of further financial loss in contractor compensation. These delays primarily stem from reported funding disbursement delays, scope expansion, and project team inadequacies. The existing local studies have not addressed the relationship between project resource management and the performance of large-scale water projects adequately. For instance, Rotich, Mukulu, and Nyang'au (2022) assessed the determinants of resource planning on implementation of water construction projects in Bomet County. The findings revealed that resource planning had a significant influence on water project implementation. The current study evaluated the effect of project resource management and the performance of large-scale water projects in the rift valley region, Kenya.

2. Objective of the study

The objective of the study was to determine the effect of project resource management on performance of large-scale water projects in rift valley region, Kenya.
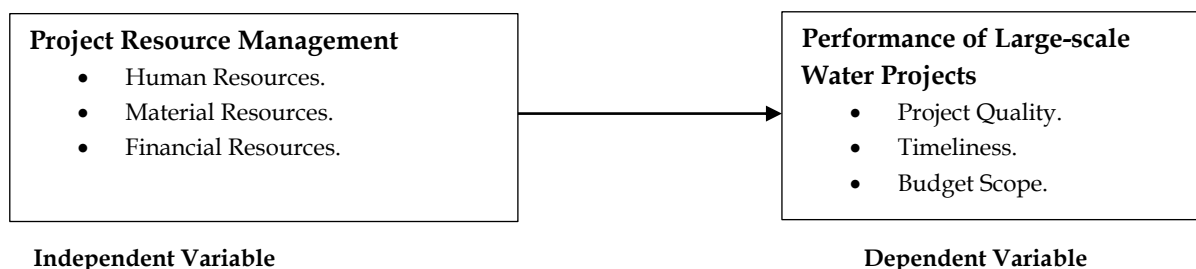
3. Literature Review

Project resource management entails the methodologies employed to locate, secure, and supervise the resources essential for executing a project (Vrchota, Řehoř, Maříková, & Pech, 2020). An effective resource management leads to equilibrium between achieving project goals, handling limitations, and maximizing the utilization of resources to attain successful project results, all within a constantly evolving process. A successful project necessitates an array of resources including people, materials, and finances, among others. Ndayisaba and Mulyungi (2018) asserted that both financial and human resources significantly influence the success or failure of a project. This means that proper allocation of financial resources to a specific project yields favorable implementation outcomes. Therefore, increasing the resource allocation for a project not only enhances sustainability but also broadens its benefits, establishing an accountable resource utilization system (Wan, Zhao, & Wang, 2019). Furthermore, a commonly held belief is that funding availability for ongoing expenses is a critical determinant affecting project performance. According to Mohamed and Ogolla (2018), many organizations fall short in dedicating adequate resources to projects, impeding successful implementation. The deficiency of financial support for water sector projects, in comparison to other sectors, poses challenges to their proper execution and sustainability. Both project implementation and sustainability hinge on appropriate financial backing. Inadequate funding has been linked to the poor implementation, maintenance, and even failure of specific water projects (Tian, Liu, Guo, Pan, & Hong, 2019). Material resources encompass relevant equipment, tools, infrastructure, and procured goods that facilitate seamless project execution. The effective deployment of both human and material resources significantly contributes to project implementation success.

Project performance pertains to the effective utilization of techniques, tools, methods, or strategies to achieve desired outcomes within a specific project context (Kosgei, 2021). A successful project completion often stems from the adept application of effective project performance strategies. However, the adoption of these strategies hinges on the specific needs of the organization. The achievement of successful project performance necessitates meticulous conceptualization, design, and execution, encompassing all the variables that could impact project success within a given context (Musau, 2020). In the context of extensive water projects, their distinctive attributes must be taken into account to ensure their successful execution. This entails considering factors like complexity, uncertainty, and the resource-intensive nature of capital and labor. Successful project performance encompasses the planning, envisioning, decision-making, evaluation, and meticulous execution of all project activities until their logical conclusion (Banadkooki, Xiao, Malekinezhad, & Hosseini, 2022). According to the resource-based view (RBV) theory, resources play a pivotal role in shaping a company's performance and competitive advantage (Alameri, 2018). RBV emphasizes the importance of adequate funding within a reasonable budget for successful projects. Baxter and Jack (2016) opined that resources can enhance a business's value proposition to customers, thereby enhancing performance. Organizations possessing advantageous resources can temporarily gain a competitive edge.

Resource-based view theory posits that employing appropriate resources is likely to significantly influence project implementation outcomes (Baccarini, 2014). Project management employs the triple constraint criteria, commonly known as time, scope, and cost, to evaluate project execution. Most of the project managers consider the triple constraint to be fundamental for meeting project requirements and achieving success. Addressing these three factors ensures high-quality, on-time project completion. Scope defines the project's quality limits, while cost quantifies the financial investment required for project completion. Time measures the duration for project execution. Although interconnected, each constraint has a distinct impact on the project's outcome (Alameri, 2018). Effectively managing these constraints can lead to reduced project lead times, cycle times, improved due date performance, and optimized inventory levels. This theory can elucidate project resource management and its influence on the execution of large-scale water projects. In large-scale

water projects, efficient management primarily revolves around the essential resources of human capital, materials, and finances. The association between the management of project resources and the performance of large-scale water projects is depicted in Figure 1.

Project Resource Management	Performance of Large-scale Water Projects
• Human Resources. • Material Resources. • Financial Resources.	• Project Quality. • Timeliness. • Budget Scope.
Independent Variable	Dependent Variable

Figure 1: Conceptual Framework

The performance of water projects and project resource management have been connected through empirical investigations. For instance, Mohamed and Ogolla (2018) looked at what influences how water projects are implemented at the Coastal Water Services Board in Kenya. Using stratified random sampling, the study's descriptive research design addressed 203 respondents. To gather information from a sample of 134 respondents, the study used a questionnaire. The results showed that budget allocation, management, project resources, and project mission all significantly impacted how water projects were implemented. Their research recommended that budget allocation, project management, and resource deployment be done efficiently. Their research, however, was restricted to resource management, included all kinds of water projects, and omitted other success variables and their impact on the effectiveness of significant water projects.

Musau (2020) looked at the effects of several project management techniques on the execution of a borehole water project in another study. They used a cross-sectional survey approach for their investigation. A semi-structured, open-ended questionnaire that was given to 89 project chairs for borehole water was used to gather quantitative data. Their research revealed that the implementation of borehole water projects was considerably and favorably influenced by project resource management. They thus concluded that project resource management positively and significantly influenced the implementation of borehole water projects. However, though their study addressed other project success factors, their study was limited to borehole water projects which do not consume huge amounts of many as compared to large-scale water projects

Similarly, Kamau and Mungai (2019), investigated the impact of project delivery on the long-term viability of water and sanitation projects in Kenya's Nyeri County. Targeting 94 community members—managers of water service providers, administration, and community leaders—the study used a cross-sectional descriptive survey research design. Utilizing questionnaires, a sample size of 40% of the target population was determined. According to their findings, the sustainability of water and sanitation projects fell short of expectations in terms of water quality and cost coverage for operations and maintenance. The study also discovered that government backing, community involvement, project funding, and technical capacity all had a positive and statistically significant impact on the sustainability of water and sanitation initiatives. However, focused on water and sanitation and did not focus exclusively on the performance of large-scale water projects. Furthermore, Rotich, Elegwa, and Nyang'au (2022) examined the influence of resource planning on the implementation of water projects in Bomet County, Kenya. The study used a descriptive survey design and targeted 440 respondents. The study used a sample size of 164 respondents and data was collected by use of self-administered questionnaires. Their findings indicated that resource planning significantly influenced the implementation of water projects. Their study thus concluded that resource planning influenced the implementation of water projects. However, their study was limited to resource planning and did not address other project success factors. Furthermore, their study addressed all types of water projects and did not exclusively investigate large-scale water projects.

Research gaps were identified from the empirical studies. The research works by (Mohamed & Ogolla, 2018; Musau, 2020; Kamau & Mungai, 2019; Rotich et al., 2022) established a positive correlation between project resource management and the successful implementation of water projects. Furthermore, some studies have delved into resource planning specifically (Rotich et al., 2022). Additional research has focused on borehole water projects (Musau, 2020) and water and sanitation initiatives (Kamau & Mungai, 2019), while others have centered on project sustainability rather than implementation. However, these studies inadequately covered crucial dimensions of resource management, including human capital resources, material resources, and financial resources. Therefore, the present study sought to address the research gaps by examining the effect of project resource management on the performance of large-scale water projects.

4. Methodology

The study employed a descriptive research design. The target population was the 14 large-scale water projects located in Kenya's Rift Valley region, which encompasses eight counties: West Pokot, Elgeyo-Marakwet, Baringo, Nakuru, Nyandarua, Bomet, UasinGishu and Narok. This geographical area falls under the jurisdiction of the Rift Valley Water Works Development Agency. The unit of observation consisted of project members from various entities, including the implementing agency, consultant, contractor, county government, water service providers, and community representatives, as detailed in Table 1.

Table 1: Target Population

County	Projects	Project Members
Nakuru	2	18
Baringo	2	18
ElgeyoMarakwet	2	16
Nyandarua	2	16
Narok	2	18
West Pokot	1	9
Bomet	1	9
UasinGishu	2	18
Total	**14**	**122**

Closed-ended questionnaires were utilized in this study to collect data. Questionnaires were adopted since they are simple, take up less time for both the researcher and the respondents, and make it simple to reach a sufficient number of respondents. The researcher performed data cleaning before beginning data analysis to guarantee that incomplete or improperly completed questionnaires are discovered and isolated. The collected data was analyzed using both descriptive (frequencies, percentages, means and standard deviations) and inferential statistics (Regression and Correlation). Statistical Package for Social Science (SPSS) aided data analysis. The following model was used in regression analysis:

$Y = \beta_0 + \beta_1 X_1 + \varepsilon$

Where: Y = Performance of Large-scale Water Projects

β_0 = Constant

X_1 = Project Resource Management

β_1 = Beta Coefficient

ε = Error Term

5. Results

This section outlines the descriptive and inferential statistical results of the study regarding the effect of project resource management on performance of large-scale water projects in rift valley region in Kenya. 109 out of the 122 questionnaires issued questionnaires were fully filled and returned, which led to 89.3% response rate. Therefore, the results are based on the responses of the 109 respondents.

5.1 Descriptive Statistical Results

The study sought to determine the effect of project resource management on performance of large-scale water projects. Descriptive statistical results are presented in Tables 2 and 3.

Table 2: Project Resource Management and Performance of Large scale Water Projects

	N	SD 1	D 2	N 3	A 4	SA 5	Mean	Std. Dev
Human resources available are well motivated and thus enable faster project completion	109	45.9%	34.9%	7.3%	6.4%	5.5%	1.91	1.135
Our project team is made up of competent and qualified individuals	109	47.7%	31.2%	3.7%	15.6%	1.8%	1.93	1.144
Our project team is also well trained who adequately execute all project needs	109	40.4%	29.4%	23.9%	4.6%	1.8%	1.98	1.000
We have in our disposal adequate equipment and materials to effectively execute project activities	109	31.2%	48.6%	9.2%	8.3%	2.8%	2.03	0.995
Our project has adequate infrastructural resources aligned with our project needs	109	45.9%	28.4%	10.1%	12.8%	2.8%	1.98	1.155
All materials and equipment used in our project meet all quality requirements	109	38.5%	32.1%	14.7%	9.2%	5.5%	2.11	1.181
Our project teams have well-planned and adequate budget to meet all project needs	109	37.6%	38.5%	6.4%	9.2%	8.3%	2.12	1.245
Our project has adequate financial resources to meet all our project demands	109	46.8%	22%	15.6%	13.8%	1.8%	2.02	1.163
Financial resources are availed on time, in the right amount and as scheduled	109	51.4%)	20.2%	15.6%	10.1%	2.8%	1.93	1.152

From the findings, majority of the respondents (80.8%) disagreed that human resources available were well motivated and thus enable faster project completion while only 11.8% agreed. Further, 78.9% disagreed that their project team was made up of competent and qualified individuals while only 17.4% agreed. Similarly, 69.8% disagreed that their project team was also well trained to adequately execute all project needs while only 6.4% agreed. Further, 79.8% disagreed that they had in their disposal adequate equipment and materials to effectively execute project activities while 11.1% agreed. Similarly, 74.3% disagreed that their project had adequate infrastructural resources aligned with their project needs while 15.6% agreed. Further, 76.1% agreed that project teams had well-planned and adequate budget to meet all project needs while only 17.5%. Similarly, 68.8% disagreed that their project had adequate financial resources to meet all their project demands while only 15.6% agreed. Finally, majority (71.6%) disagreed that financial resources were availed on time, in the right amount and as scheduled while only 12.9% agreed. The findings agree with those of Musau (2020) examined influence level of project management practices on implementation of borehole water project and found that project resource management positively and significantly influenced implementation of borehole water projects. They thus concluded that project resource management positively and significantly influenced implementation of borehole water projects. Similar findings were reported by Mohamed and Ogolla (2018) examined the factors influencing implementation of water projects at the Coastal Water Services Board, Kenya and found that project mission, project resources, management and budget allocation played a significant role in influencing implementation of water projects. Their study suggested the efficient deployment of project resources, management and budget allocation in implementing water projects.

Table 3: Performance of Large-scale Water Projects

	N	SD 1	D 2	N 3	A 4	SA 5	Mean	Std. Dev
Our projects are started and completed according to the set timelines	109	59.6%	33%	4.6%	1.8%	0.9%	1.51	0.753
All teams adhere to project schedules therefore ensuring completion on time	109	46.8%	45.9%	3.7%	2.8%	0.9%	1.65	0.762
Our projects are often completed based on cost and budget provisions	109	57.8%	31.2%	6.4%	3.7%	0.9%	1.59	0.841
Financial resources deployed are usually adequate and cater for arising contingencies	109	33.9%	45.9%	11%	8.3%	0.9%	1.96	0.932
All our water projects are meet the intended quality standards	109	34.9%	25.7%	22.9%	11.9%	4.6%	2.26	1.189
All our projects are undertaken and completed based on the set technical requirements	109	40.4%	28.4%	11.9%	17.4%	1.8%	2.12	1.176
Our projects are completed based on the user and community satisfaction	109	47.7%	38.5%	7.3%	3.7%	2.8%	1.75	0.944
Our projects are usually evaluated based on the preset objectives	109	23.9%	15.6%	11%	22%	27.5%	3.14	1.560
All our projects also meet sustainability requirements of projects	109	40.4%	21.1%	5.5%	22%	11%	2.42	1.474

From the findings, 92.6% disagreed that their projects were started and completed according to the set timelines while only 2.7% agreed. Similarly, 92.7% disagreed that all teams adhered to project schedules therefore ensuring completion on time while only 3.7% agreed. Furthermore, 88.2% disagreed that their projects were often completed based on cost and budget provisions while only 4.6% agreed. Similarly, 79.8% disagreed that financial resources deployed were usually adequate and cater for arising contingencies while only 7.2% agreed. Further, 60.6% disagreed that all their water projects met the intended quality standards while 16.5% agreed. Similarly, 68.8% disagreed that all their projects were undertaken and completed based on the set technical requirements while 19.2% agreed. Similarly, 86.2% disagreed that projects were completed based on the user and community satisfaction while only 6.5% agreed. Further, 49.5% agreed that projects were usually evaluated based on the preset objectives while 39.5% disagreed. Finally, 60.5% disagreed that their projects met sustainability requirements of projects while 16.5% disagreed. Further, the study analyzed the means of the responses and established that majority tended towards a disagreement on all the propositions on performance of large-scale water projects.

5.2 Inferential Statistical Results
Inferential analysis was conducted to establish the relationship between the independent variable and the dependent variable. This included the correlation analysis and regression analysis.

5.2.1 Correlation Analysis
Correlation analysis was undertaken to establish the strength and direction of relation between project resource management and performance of large-scale water projects. Results are presented in Table 4.

Table 4: Project Resource Management and Performance of Large-scale Water Projects

		Performance of Large-scale Water Projects
Project Resource Management	Pearson Correlation	.515**
	Sig. (2-tailed)	.000
	N	109

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

From the correlation analysis, it was established that there was a moderately strong positive correlation between project resource management and performance of large scale water projects (r=0.515**, p=.000). The moderately strong and positive correlation implied that higher levels of performance of large scale water projects can be attained with efficient and effective management of project resources. The findings agree with those of Musau (2020) who found that project resource management positively and significantly influenced implementation of borehole water projects.

5.2.2 Regression Analysis

Regression analysis was conducted to establish the relationship between project resource management and performance of large-scale water projects. Results are presented in Tables 5, 6 and 7.

Table 5: Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.515a	.265	.258	.35045

From the findings in Table 5, it was established that the R-square of 0.265 implied that the project resource management explained 26.5% of variation in performance of large scale water projects. Therefore, other factors not investigated in the present study explained 73.5% of variation in performance of large scale water projects.

Table 6: ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	4.738	1	4.738	38.582	.000b
Residual	13.141	107	.123		
Total	17.879	108			

Furthermore, from the findings in Table 6, the overall model was found to be statistically significant (F = 38.582; p=.000). This means that human, material and financial resources taken together affect the large-scale water projects.

Table 7: Regression Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.141	.149		7.636	.000
Project Resource Management	.452	.073	.515	6.211	.000

The regression model $Y = \beta_0 + \beta_1 X_1 + \varepsilon$ was interpreted as; $Y = 1.141 + 0.452 X_1 + \varepsilon$. The beta coefficient ($\beta$=0.452; p=.000<0.05) was significant at a 95% confidence level. This means that the performance of large-scale water projects is affected by project resource management.

6. Conclusion

The study concluded that human resources available were not well-motivated and thus did not enable faster project completion. Further, it was concluded that project teams were not made up of competent and qualified individuals. Similarly, it was concluded that project teams were also not well trained to adequately execute all project needs. Further, it was concluded that project teams did not have at their disposal adequate equipment and materials to effectively execute project activities. Similarly, it was concluded that project teams did not have adequate infrastructural resources aligned with their project needs. Further, the study concluded that project teams did not have well-planned and adequate budget to meet all project needs. Similarly, it was concluded that large scale water projects did not have adequate financial resources to meet all their project demands. Finally, it was concluded that financial resources were not availed on time, in the right amount and as scheduled. Since there was a moderately strong positive correlation between project resource management and performance of large scale water projects, the study concluded that project resource management was a significant predictor of performance of large scale water projects.

7. Recommendation

The study recommends the prioritization of the allocation of critical resources to high-impact tasks or project milestones. This will ensure that the vital activities are well-supported and progress is not hindered. They should also smooth out resource demand over time to avoid spikes in resource requirements.

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