

Critical Success Factors for Private-Public Partnerships in Irrigation Development: Case Study of Galana Kulalu Irrigation Project

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Abstract

The success of Public-Private Partnership (PPP) irrigation projects hinges on realistic project scoping, thorough feasibility analysis, and the early involvement of qualified technical expertise. The Galana Kulalu Irrigation Project, initially conceived as a 1,000,000-acre scheme, has faced delays, cost overruns, and reduced output, raising concerns about inflated targets at the formulation stage and the adequacy of preparatory studies. This study, grounded in the Theory of Constraints (TOC) and Principal-Agent Theory, examines whether critical success factors (CSFs) were sufficiently addressed from conception to implementation. Using survey data from 92 purposively sampled stakeholders and triangulated with official audits, the study found that the original scope far exceeded available water resources and operational capacity, with no evidence of a comprehensive, independent feasibility study prior to commitment. Limited participation of experienced irrigation and agricultural engineers in the conceptualization stage contributed to unrealistic timelines, underestimated risks, and an absence of phased execution planning. Political imperatives, rather than technical feasibility, appeared to influence project initiation and scale. The findings emphasize the importance of aligning project ambitions with verified resource availability, engaging sector-specific expertise early, and adopting phased, evidence-based implementation to safeguard cost efficiency, timely delivery, and scope adherence. Policy recommendations include mandatory feasibility studies, independent technical vetting, and governance reforms to insulate PPP projects from politically driven scope inflation.

Keywords

Critical Success Factors (CSFs), Public-Private Partnerships (PPP), Irrigation

Project Development

1. Introduction

Kenya's agricultural sector remains highly dependent on rainfall, yet recurrent droughts, climate variability, and increasing water stress have made irrigation a critical pillar of national food security strategies [1]. Over recent decades, the Government of Kenya has implemented several large-scale irrigation schemes—such as the Bura, Mwea, and Ahero projects, with mixed results. While some initiatives have improved crop yields and supported livelihoods, many have been hampered by delays, cost overruns, inadequate management, and underutilized infrastructure [2]. Against this backdrop, the Galana Kulalu Irrigation Project was launched in 2014 as a flagship Public-Private Partnership (PPP) under Vision 2030, with the ambitious goal of irrigating 1,000,000 acres in Tana River and Kilifi counties to enhance maize production and reduce dependence on imports [3].

Despite its strategic objectives, the Galana Kulalu project has faced persistent challenges since inception. These include questions about the adequacy of water resources to sustain the proposed acreage, concerns over an inflated project scope at the formulation stage, delayed implementation, land ownership disputes, and limited evidence of a comprehensive feasibility study [4]. Similar issues have been observed in other Sub-Saharan African irrigation initiatives, where inadequate technical assessments, insufficient involvement of qualified irrigation and agricultural engineers, and politically influenced decision-making have undermined project outcomes [5].

Public-Private Partnerships are increasingly promoted as a means to mobilize private capital and expertise for large-scale infrastructure development, including irrigation projects [6]. However, their success depends on systematically addressing Critical Success Factors (CSFs), defined in this study as the essential elements in planning, financing, technical design, management, technology adoption, and stakeholder engagement that must be performed effectively to achieve a project's intended scope, cost, time, and quality targets [7].

At the planning stage, CSFs such as adequate financing, rigorous and independent feasibility studies, availability of skilled technical personnel, and secure land tenure are central to project readiness [8]. During the implementation stage, effective project management, integration of modern technology, and proactive stakeholder engagement are vital for avoiding delays, inefficiencies, and conflicts [9]. This paper examines these factors in the context of the Galana Kulalu Irrigation Project, providing insights into how addressing CSFs at both the planning and execution phases can improve the success and sustainability of PPP irrigation initiatives in Kenya and other developing economies.

1.1. Problem Statement

The Galana Kulalu Irrigation Project, a flagship PPP initiative in Kenya, was con-

ceived to enhance food security and drive economic growth through large-scale irrigation [8]. However, despite its strategic significance, the project has encountered substantial setbacks, including delays, budget overruns, and execution inefficiencies. These challenges raise critical concerns about the effectiveness of key success factors in ensuring the project's successful implementation and long-term sustainability.

At the planning stage, several fundamental issues have hindered the project's smooth execution [9]. Insufficient project financing, coupled with a lack of sustainable financial planning, has led to stalled operations and resource constraints. Additionally, a shortage of technical expertise in large-scale irrigation engineering has resulted in suboptimal project design, inefficient risk management, and implementation gaps. Land conflicts, particularly disputes over ownership and compensation, have further worsened delays, impeding stakeholder alignment and weakening project momentum.

During implementation, managerial inefficiencies, outdated technology, and stakeholder resistance have posed significant obstacles to progress [10]. Weak coordination among project stakeholders has led to misaligned objectives and fragmented decision-making, reducing overall project efficiency. Furthermore, the continued reliance on obsolete irrigation technologies has constrained operational effectiveness and project scalability. Resistance from local communities, regulatory agencies, and private sector partners has added another layer of complexity, limiting the project's adaptability and long-term viability.

The success of PPP projects such as Galana Kulalu is typically measured by their ability to meet cost, time, and scope expectations [11]. However, persistent financial overruns, extended timelines, and deviations from the original project scope underscore the need for a thorough evaluation of the critical factors influencing execution. If these challenges are not addressed, the project risks failing to meet its intended objectives, ultimately undermining broader efforts to transform Kenya's agricultural sector and enhance national food security.

This study aims to investigate the impact of critical success factors on the execution and overall success of the Galana Kulalu Irrigation Engineering Project. By identifying key barriers and proposing strategic interventions, this research seeks to provide actionable insights for optimizing PPP frameworks in large-scale engineering projects, particularly in the context of developing economies.

1.2. Contribution

This study examines the CSFs influencing the execution of the Galana Kulalu Irrigation Project, a major PPP initiative in Kenya. It identifies key planning challenges, including insufficient financing, lack of technical expertise, and land conflicts, as well as implementation issues such as poor management, outdated technology, and stakeholder resistance. By analyzing these barriers, the study provides strategic recommendations for optimizing project governance, financial planning, and stakeholder engagement. Beyond the Galana Kulalu project, the research con-

tributes to improving PPP frameworks in developing economies, offering insights into cost, time, and scope management. The findings inform best practices in large-scale engineering projects, supporting infrastructure development, agricultural transformation, and food security initiatives.

2. Related Works

2.1. Theoretical Review

Public-Private Partnerships (PPPs) are collaborative arrangements between government entities and private sector organizations for the financing, design, implementation, and/or operation of public infrastructure and services [6]. They are structured to leverage private sector efficiency, innovation, and capital while retaining public oversight to ensure that projects align with broader socio-economic objectives. PPP models vary, including Build-Operate-Transfer (BOT), Build-Own-Operate (BOO), Design-Build-Finance-Operate (DBFO), and lease or concession arrangements [7]. In Sub-Saharan Africa, PPPs have been applied in sectors such as transport, energy, and increasingly in water and irrigation projects, for example, the Bura Irrigation Scheme in Kenya, the Kpong Irrigation Scheme in Ghana, and the Bakolori Project in Nigeria [8].

Despite their potential, PPP irrigation projects in the region often face significant challenges: weak regulatory and contractual frameworks, misaligned incentives between partners, inadequate feasibility studies, political interference, and insufficient financing [9]. In many cases, projects are initiated without clear risk-sharing arrangements, leading to cost overruns, delays, or underperformance.

In the Galana Kulalu Irrigation Project, the PPP arrangement involved the Government of Kenya, through the National Irrigation Authority (formerly the National Irrigation Board), and the private firm Green Arava from Israel [10]. The project was formulated as a PPP from the outset, with the government responsible for providing land, facilitating water rights, and financing initial infrastructure, while Green Arava was contracted to design, supply, and install irrigation systems, develop a 10,000-acre model farm, and provide technical training to Kenyan personnel. The expectation was that this model farm would serve as a proof of concept for scaling up to the full 1,000,000 acres. However, the PPP faced governance challenges, including delayed delivery of equipment, inadequate monitoring of contractor performance, and unclear enforcement of contractual milestones.

2.1.1. The Theory of Constraints (TOC)

The Theory of Constraints (TOC), developed by [12], posits that every project or system contains at least one constraint that limits its overall performance. In PPP irrigation projects like Galana Kulalu, such constraints frequently occur in financing, managerial coordination, land tenure resolution, and the adoption of appropriate technology. According to TOC, these bottlenecks must be systematically identified and addressed to improve project outcomes in terms of cost, time, and scope.

In this study, constraints such as insufficient financing, reported by 74% of respondents, emerged as primary barriers to success. TOC helps explain how erratic funding flows delayed the procurement of materials and machinery, leading to missed deadlines. Land conflicts, cited by over 65% of stakeholders, functioned as socio-political constraints that slowed stakeholder engagement and hindered access to project sites. These findings align with the TOC principle that “a chain is only as strong as its weakest link”, in this case, weak institutional coordination and resource allocation. By applying TOC, the study recommends “exploiting and elevating” these constraints through measures such as re-allocating budgets, strengthening inter-agency coordination, and integrating advanced irrigation technologies.

2.1.2. Principal-Agent Theory and Risk Allocation

Principal-Agent Theory [13] examines the inefficiencies that arise when one party (the principal) delegates work to another (the agent) whose interests may not fully align. In PPPs, this misalignment can manifest as poor contract enforcement, inadequate risk sharing, and opportunistic behavior. In the Galana Kulalu case, the Kenyan government acted as the principal, while Green Arava functioned as the agent. Although the contract stipulated the development of a 10,000-acre model farm within a set timeframe, weak oversight mechanisms, such as advance payments without milestone verification, resulted in delays, scope drift, and under-delivery.

Empirical data from this study show that over 70% of respondents were dissatisfied with project governance, pointing to inadequate accountability structures. According to Principal-Agent Theory, such outcomes are common when contracts lack performance-based incentives and rigorous monitoring. For example, contractors may defer procurement or reduce quality assurance checks if they anticipate minimal repercussions, particularly in contexts with weak institutional capacity [14]. These dynamics help explain the observed project inefficiencies and underscore the need for better risk allocation, enforceable timelines, and transparent reporting mechanisms in PPP irrigation agreements.

2.2. Empirical Review

2.2.1. Existing Studies

Successful project planning is crucial in PPP irrigation projects, as it lays the foundation for execution. Research by [15] identified financial planning, managerial competence, and stakeholder engagement as key CSFs in construction projects. However, their study was not specific to irrigation projects, leaving a contextual gap. Similarly, [16] emphasized sustainability-oriented CSFs but did not consider large-scale PPP agricultural projects, limiting applicability to cases like Galana Kulalu.

In Sub-Saharan Africa, [17] found that poor financing structures, lack of expertise, and corruption significantly affect irrigation projects, leading to cost overruns and project delays. This is evident in Kenya, where expensive irrigation pro-

jects like Bura and Bakolori have struggled due to poor financial planning [18]. The Galana Kulalu project has faced similar issues, with budgetary constraints limiting execution and expansion. While studies highlight general planning challenges, there is limited research on how these factors specifically impact PPP irrigation projects, creating a gap that this study seeks to address.

The implementation phase determines whether planned strategies translate into successful outcomes. [19] identified management inefficiencies and poor risk allocation as major constraints in construction projects. While their study confirms the impact of governance on project execution, it lacks direct application to PPP irrigation projects.

Kenya's Vision 2030 identified large-scale irrigation as a key driver of food security, yet the implementation of projects like Galana Kulalu has been plagued by governance issues, stakeholder conflicts, and technical inefficiencies [20]. [21] reported delays in Kenyan megaprojects due to unclear regulations, land disputes, and inadequate cost estimation. Similarly, [10] argued that large-scale agricultural projects often suffer from unrealistic expectations and mismanagement, leading to slow progress and inefficient resource utilization.

Despite its potential, the Galana Kulalu project has been marred by execution challenges, including contractor inefficiencies, misallocation of funds, and underutilization of available land. Previous studies have examined irrigation projects from a general perspective, but few have analyzed CSFs at both planning and implementation stages within PPP frameworks, particularly for large-scale projects [22]-[24]. This study fills that gap by providing a comprehensive evaluation of the CSFs influencing the execution of PPP irrigation initiatives in Kenya.

2.2.2. Research Gap

Existing literature on PPP projects has largely focused on regulatory frameworks, risk allocation, and governance structures in developed economies [15]-[18]. Studies on PPP infrastructure in Kenya have predominantly examined road projects [2], with limited research on large-scale irrigation projects. Furthermore, while research on CSFs in construction projects exists, the unique challenges of PPP irrigation projects remain understudied.

No study has comprehensively analyzed how financial, managerial, and technological factors impact both the planning and execution stages of PPP irrigation projects like Galana Kulalu. This study bridges that gap by providing empirical insights into the challenges faced in large-scale irrigation projects and proposing strategies to enhance their success.

2.3. Conceptual Framework

Figure 1 indicates that the execution of PPP irrigation projects, such as the Galana Kulalu Irrigation Engineering Project, is significantly influenced by CSFs that impact cost, time, and scope. These CSFs emerge at two key stages: planning and implementation, each presenting challenges that affect project execution and overall success.

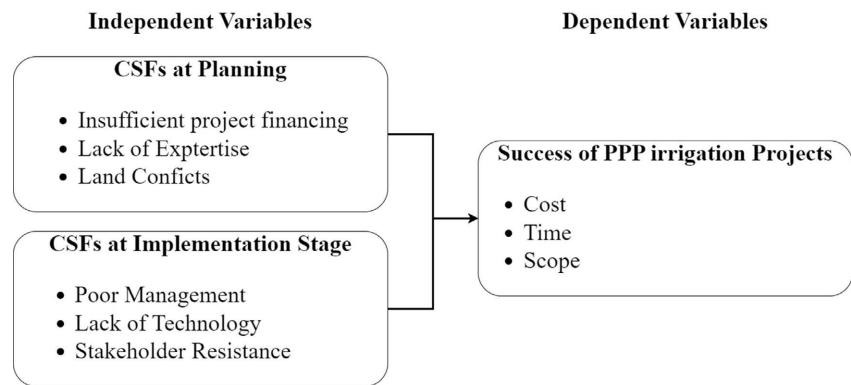


Figure 1. Conceptual framework.

At the planning stage, three major CSFs determine project feasibility. Insufficient project financing leads to funding gaps, delays, and inefficiencies in infrastructure development. The lack of expertise in irrigation engineering, financial planning, and project management results in poor decision-making, unrealistic scheduling, and increased maintenance costs. Additionally, land conflicts arising from disputes over ownership, compensation, and environmental concerns create legal and social obstacles that delay implementation.

In the implementation stage, further challenges arise, affecting operational efficiency. Poor management weakens coordination, leading to delays, cost overruns, and ineffective leadership. The lack of technology limits the adoption of modern irrigation systems, reducing efficiency and agricultural productivity. Moreover, stakeholder resistance from local communities, regulatory bodies, and private investors can disrupt execution due to misalignment of interests and conflicting priorities.

The success of PPP irrigation projects like Galana Kulalu is evaluated based on three primary performance indicators: cost, time, and scope. Cost efficiency is crucial to prevent financial overruns, while timely completion ensures that the project delivers expected benefits without delays. Additionally, scope adherence prevents inefficiencies arising from unplanned modifications.

By examining the effect of critical success factors in execution, this study aims to provide insights into overcoming financial, managerial, technological, and stakeholder-related challenges. Understanding these factors will help policymakers, project managers, and investors enhance project execution, ensuring that large-scale irrigation projects contribute effectively to food security, economic development, and sustainable agriculture in Kenya.

3. Methodology

3.1. Research Design

This study adopted a survey research design method of gathering information by administering a questionnaire to sampled individuals. The main feature of this survey research design was to describe specific characteristics of a large group of persons, objects, or institutions through questionnaires. The design was used due

to its descriptive nature in order to assist in collecting data from members of the sample for estimating the population parameters used in the questionnaire.

3.2. Target Population and Sampling Procedure

A population refers to any group of institutions, people or objects that have common characteristics. The target population comprised 120 professionals directly involved in the Galana Kulalu Irrigation Project. These included engineers, project managers, procurement officers, field supervisors, and technical consultants. A stratified random sampling method was employed to ensure representation across these professional categories, recognizing their differentiated roles and perspectives in project execution. Using Cochran's formula adjusted for finite populations, a sample size of 92 respondents was derived. The strata were proportionally allocated: 20% project engineers, 25% site supervisors, 15% procurement staff, 20% finance officers, and 20% policy/monitoring experts. Participants were randomly selected within these strata to reduce selection bias. The sample size was calculated from the study population of 120 using Cochran's formula with an adjustment for finite populations to yield approximately 92 respondents.

The data collection instrument in this study was questionnaire, which was used due to its ability to reach respondents within a short time, its ability to give respondents adequate time to respond to the items, and it offers a sense of security (confidentiality) to the respondents. The questionnaire was divided into the main areas of investigation, except the first part, which captured the demographic characteristics of the respondents. The second part of the questionnaire focused on CSFs for PPP for large engineering irrigation projects in Galana Kulalu, Kenya. The questions used the Likert Scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

The first question asked the respondents, "To what extent do you agree that critical success factors at the planning stage contribute to success of the Galana Kulalu irrigation project?" The second question asked the respondents to how the indicators have influenced effect of CSFs at planning stage on success of Galana Kulalu irrigation project (based on a Likert Scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree) as indicated in **Table 1**.

Table 1. CSFs at planning on success of Galana Kulalu irrigation project.

Question	1	2	3	4	5
To what extent do you agree that insufficient project financing influences the success of PPP irrigation projects during the planning stage?					
To what extent do you agree that lack of expertise influences the success of PPP irrigation projects during the planning stage?					
To what extent do you agree that land conflicts influence the success of PPP irrigation projects during the planning stage?					

The third question asked the respondents to indicate "To what extent do you they agree that implementation-stage is critical success factors contribute to the success of the Galana Kulalu irrigation project?" based on Likert Scale of 1 =

strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. The fourth question, presented in **Table 2**, asked the respondents to indicate how the indicators have influenced effect of CSFs at implementation stage on success of Galana Kulalu irrigation project (based on a Likert Scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree).

Table 2. To assess the influence of CSFs at implementation on success of Galana Kulalu irrigation project.

Question	1	2	3	4	5
To what extent do you agree that poor management influences the success of PPP irrigation projects during the implementation stage?					
To what extent do you agree that lack of technology influences the success of PPP irrigation projects during the implementation stage?					
To what extent do you agree that stakeholder resistance influences the success of PPP irrigation projects during the implementation stage?					

3.3. Validity

Validity refers to the accuracy and meaningfulness of research findings, ensuring that the data accurately represent the study variables. This study assessed validity through content validity, ensuring that questionnaire items aligned with the research objectives. Reliability, on the other hand, measures the consistency of a research instrument over time. Cronbach's alpha was used to assess reliability, with a threshold of 0.7 indicating a dependable questionnaire. The study computed Cronbach's alpha for key constructs, including legal framework, risk sharing and allocation, and project governance, ensuring reliable measurement of these factors.

3.4. Data Source

To enhance validity, the study integrated secondary data sources to triangulate findings. These included the Office of the Auditor General's (2019) project audit report, documentation from the National Irrigation Authority (2020), and financial reports provided by the Ministry of Agriculture. These sources were used to cross-verify claims made by respondents, especially in regard to financing delays, procurement irregularities, and project performance outcomes. This triangulation helps offset the limitations of sole reliance on self-reported data and increases the robustness of the study's conclusions.

4. Findings and Discussion

4.1. Validity

To validate the data collection instrument, ten professionals from government agencies, private partners, and consultants in PPP projects reviewed the questionnaires. The content validity index was calculated using a relevance scale, and SPSS version 26 was used for analysis. A validity coefficient above 0.75 confirmed the instrument's suitability for the study. The Cronbach alpha test was used to assess the internal consistency reliability of the constructs in this investigation, as shown in **Table 3**.

Table 3. Reliability statistics.

Constructs	Cronbach's Alpha	Number of Items
CSFs at Planning	0.853	3
CSFs at implementation	0.809	3

The table shows four constructs: *CSFs at Planning* ($\alpha = 0.853$), *CSFs at Implementation* ($\alpha = 0.809$). According to conventional reliability benchmarks, values above 0.9 indicate excellent reliability, values between 0.8 and 0.9 suggest good reliability, and values between 0.7 and 0.8 indicate acceptable reliability. The results indicate that the study's measurement instrument is statistically reliable, meaning that the survey or questionnaire items used for data collection effectively capture the intended constructs.

4.2. Response Rate

The information was gathered from specialists in government agencies such as the Public Private Partnership Unit (PPPU) at the Ministry of Agriculture's Water and Irrigation Department, as well as private partners and consultants involved in PPP projects. A total of 92 questionnaires were distributed, with 88 being returned as complete, indicating that they were all viable for processing. This translated to 95.7% percent response rate. This commendable response rate was made a reality after the study engaged research assistants to administer the questionnaires. This survey was therefore said to be successful.

4.3. Respondents Demographic Information

The researcher was also interested in knowing the demographic information about the respondents that participated in the survey.

4.3.1. Respondents Gender

The researcher also inquired about the gender representation of the respondents and the results are presented in **Figure 2**.

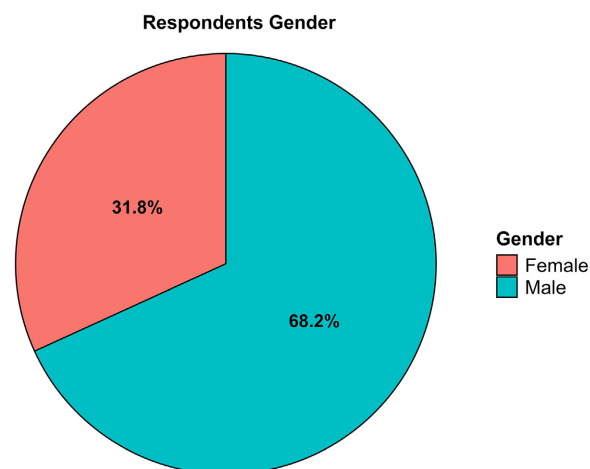
**Figure 2.** Respondents gender.

Figure 2 indicates that there are 61 male respondents and 28 female respondents, making males the majority group. In terms of percentages, males account for approximately 68.5% of the total sample, while females constitute 31.5%. This demonstrates a clear gender imbalance, with the number of male respondents more than double that of females.

4.3.2. Respondents Level of Education

The researcher inquired about the level of education of the respondents, and the results are presented in **Figure 3**.

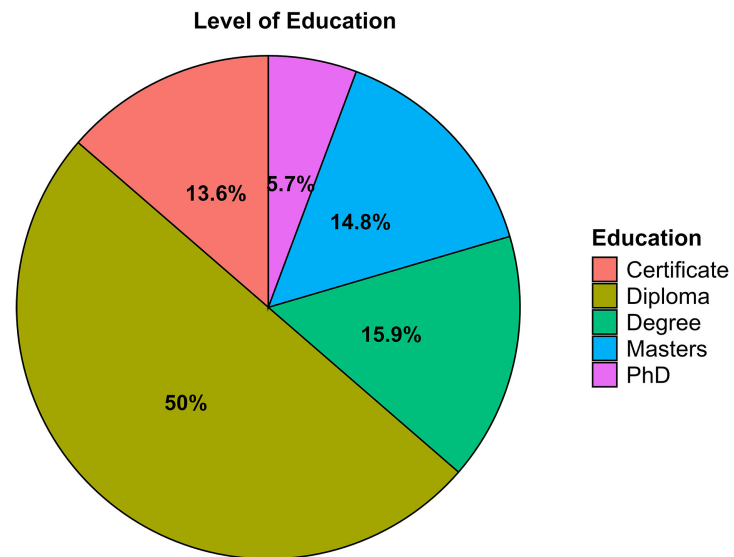


Figure 3. Respondents level of education.

Figure 3 indicates that the study's respondent profile shows that 50% hold a Diploma, making it the most common qualification. This suggests that most participants are mid-level professionals with technical expertise, crucial for executing large irrigation projects like Galana Kulalu. Individuals with Degrees (15.91%), Masters (14.77%), and PhDs (5.68%) likely represent managerial, strategic, and policy-making roles, contributing to high-level decision-making and project governance. Meanwhile, Certificate holders (13.64%) are likely entry-level staff involved in operational tasks.

This distribution highlights the study's strength in capturing practical, field-based insights but indicates a limited representation of advanced-degree holders, who contribute to long-term planning, policy formulation, and innovation. While the workforce's technical expertise is well-represented, fewer highly educated professionals may constrain the study's exploration of strategic and theoretical factors.

4.3.3. Respondents Position

The researcher also wanted to know the respondent's position in the organization, and the results are presented in **Figure 4**.

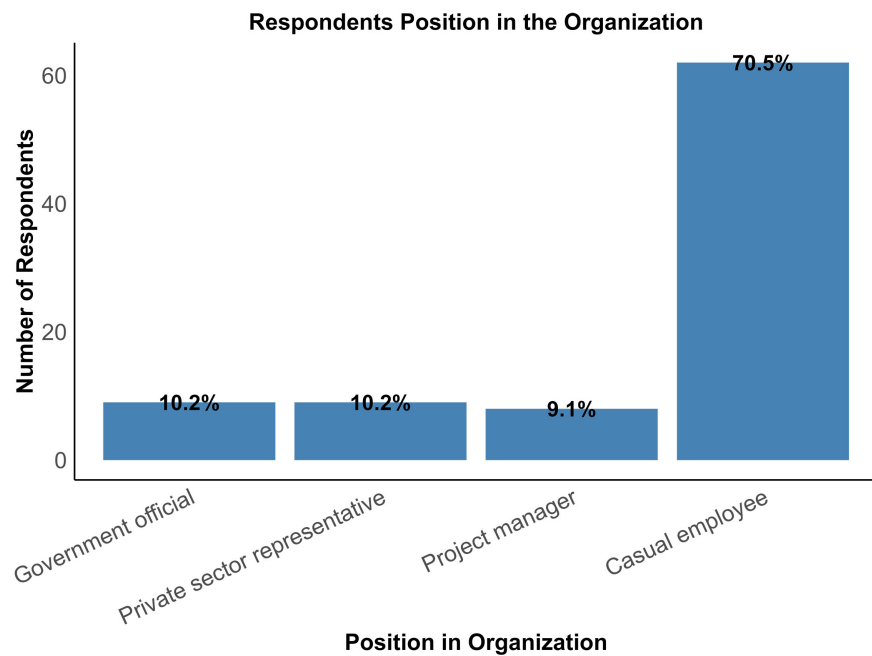


Figure 4. Respondents position in the organization.

The study's respondent distribution shows that casual employees make up 70.45%, while government officials (10.23%), private sector representatives (10.23%), and project managers (9.09%) form smaller portions. This suggests that the study predominantly captures operational perspectives, as casual workers handle daily project tasks. Their insights are valuable for identifying on-the-ground execution challenges but may lack depth in strategic planning, policy formulation, and governance issues.

The underrepresentation of government officials, private sector representatives, and project managers limits the study's ability to fully explore high-level decision-making, institutional frameworks, and stakeholder coordination, which are essential for PPP project success. While practical execution challenges are well-documented, the study may offer a less comprehensive analysis of policy alignment and project oversight factors.

4.3.4. Respondents Duration of Employment

The researcher inquired about respondents' duration of employment, and the results are presented in **Figure 5**.

The study's respondent distribution shows a workforce split between long-serving employees (29.55%) with over 10 years of experience and newer employees (less than five years, totaling 55.68%). Employees with 6 - 10 years of experience form the smallest group at 14.77%, suggesting a potential gap in mid-level experience.

The presence of long-serving employees provides deep institutional knowledge and insights into long-term project trends and CSFs. Conversely, the high proportion of newer employees may indicate recent hiring trends or workforce turn-

over, bringing fresh perspectives but lacking historical context. The low representation of midlevel employees may affect the balance between operational expertise and strategic oversight, potentially impacting project continuity and knowledge transfer within the Galana Kulalu Irrigation Project.

Duration Working in Galana Kulalu Irrigation Project

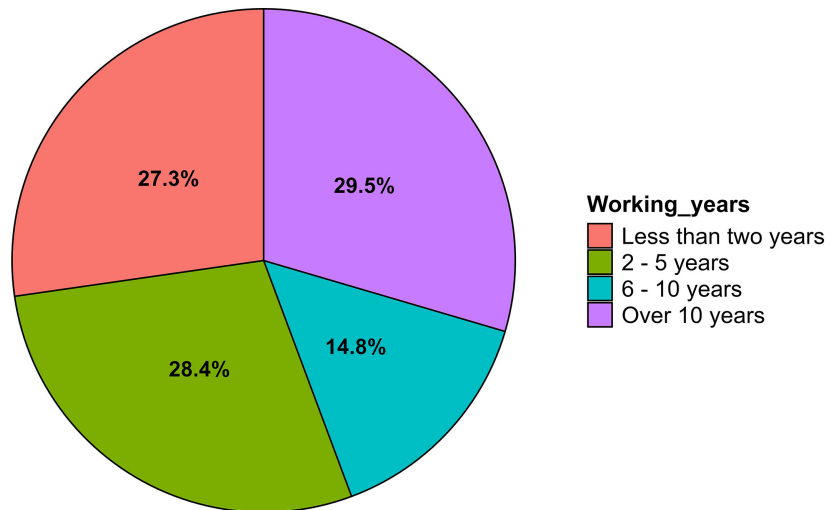


Figure 5. Respondents duration working in Gulana Kulalu irrigation project.

4.4. Descriptive Analysis

4.4.1. Success of PPP in Galana Kulalu Irrigation Project

The researcher sought to inquire the respondents’ ratings on the success of PPP in Galana Kulalu irrigation project based on cost, timelines and scope. The data was collected using 5-point Likert Scale in order to capture the respondents’ feedback. When asked “Kindly indicate agree the extent to which Galana Kulalu PPP irrigation project has been a success.” The respondents survey is presented in **Table 4**.

Table 4. Success of PPP in Galana Kulalu irrigation project.

Scale	Frequency	Percentage (%)
Strongly Disagree	6	6.8
Disagree	10	11.4
Neutral	13	14.8
Agree	21	23.9
Strongly agree	38	43.2
Total	88	100

Table 4 presents respondents’ ratings on the overall success of the PPP in the Galana Kulalu Irrigation Project. Out of the 90 respondents, 43.2% strongly agreed and 23.9% agreed that the PPP has been successful, giving a combined pos-

itive rating of 67.1%. At face value, this suggests that most respondents believe the project has achieved significant milestones in line with its objectives. However, this finding contrasts with the widely held public perception, and independent audit reports, that the project has underperformed. This divergence may stem from differences in how “success” is defined. Many respondents were directly involved in project operations and may have based their assessments on partial achievements, such as completion of the 10,000-acre model farm, installation of some irrigation infrastructure, and delivery of training programs, rather than the full 1,000,000-acre target initially envisioned.

The study’s own findings identify lack of adequate financing as a major constraint to project implementation, a factor that has directly limited scope expansion and delayed broader benefits. Furthermore, no reliable data was obtained on the percentage of originally intended beneficiaries currently farming on irrigated land, an essential metric for objectively determining the project’s real impact. Without this information, claims of overall success should be interpreted as perceptions of operational progress among certain stakeholder groups, rather than definitive evidence of the project’s achievement of its intended scale and socio-economic outcomes. This interpretation aligns with the Critical Success Factors framework supporting this study, which emphasizes that successful delivery in PPP irrigation projects requires meeting scope, cost, and time objectives concurrently. While some CSFs, such as partial infrastructure delivery, may have been met, other equally critical elements, including sustained financing, broad beneficiary reach, and phased scaling, remain insufficiently addressed, limiting the project’s overall success.

The findings in **Table 4** suggest that while the majority view PPP in Galana Kulalu as successful, a notable proportion of respondents remain either unsure or critical. This could indicate the presence of unresolved challenges. Respondents were asked to agree on some factors affecting success of PPP in Galana Kulalu irrigation project based on Likert Scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. The results are summarized in **Table 5**.

Table 5. Success of PPP in Galana Kulalu irrigation.

Question		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
Would you rate cost management as a contributing factor in success of the Galana Kulalu irrigation project?	Frequency	4	1	6	32	45	4.28	0.98
	%	4.5	1.1	6.8	36.4	51.1		
Would you rate timely completion as a contributing factor in success of the Galana Kulalu irrigation project?	Frequency	3	3	4	34	44	4.09	0.80
	%	3.4	3.4	4.5	38.8	50		
Would you rate scope achievement as a contributing factor in success of the Galana Kulalu irrigation project?	Frequency	6	3	3	30	48	3.98	0.79
	%	6.67	3.33	3.33	33.33	53.33		
Overall							4.12	0.857

The evaluation of cost management, timely completion, and scope achievement as success factors for the Galana Kulalu Irrigation Project reveals strong agreement among respondents on their importance. Cost management emerged as the most critical factor, with 51.1% strongly agreeing and 36.4% agreeing that it significantly contributes to project success. The mean score of 4.28 emphasizes its priority, while the standard deviation (SD) of 0.98 indicates moderate variability in responses. This suggests that while most respondents agree on its significance, experiences with budgeting challenges vary across project roles.

Timely completion also ranked highly, with 50% strongly agreeing and 38.8% agreeing that meeting deadlines is crucial. The mean score of 4.09 and SD of 0.80 suggest broad consensus on the importance of scheduling efficiency. Lower variability in responses indicates that timely completion is recognized across all levels as essential for project success.

Scope achievement had a mean score of 3.98 and an SD of 0.79, slightly lower than the other factors. While still considered important, the lower mean suggests that meeting all project objectives poses some challenges. Cost management and timely completion emerge as top priorities, emphasizing the need for effective financial oversight and strict adherence to project schedules to ensure PPP success.

4.4.2. CSFs at Planning

The researcher sought to inquire into whether CSFs at the planning stage influence the success of PPP in the Galana Kulalu irrigation project. The results are presented in **Table 6**.

Table 6. CSFs at planning stage.

Scale	Frequency	Percentage (%)
Strongly Disagree	6	6.8
Disagree	12	13.6
Neutral	11	12.5
Agree	18	20.5
Strongly agree	41	46.6
Total	88	100

Table 6 summarizes respondents' views on whether CSFs at the planning stage influence the success of PPPs in the Galana Kulalu irrigation project. Out of the 90 respondents, the majority, 46.6%, strongly agree that planning-stage CSFs significantly affect PPP success, while 20.5% agree, bringing the total positive responses to 67.1%. This suggests that most respondents recognize the importance of effective planning in achieving project success. A smaller percentage, 12.5%, remained neutral, indicating some uncertainty or lack of strong opinion on the matter. Meanwhile, 13.6% of respondents disagree and 6.8% strongly disagree, totaling 20.4% who do not believe planning-stage CSFs significantly impact success. These findings highlight the general consensus on the critical role of planning in

PPP success. Respondents were asked to agree to an extent that CSFs at planning leads to success of Galana Kulalu irrigation based on Likert Scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. The results are summarized in **Table 7**.

Table 7. Indicators of CSFs at planning leads to success of Galana Kulalu irrigation.

Question		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
To what extent do you agree that insufficient project financing influences the success of PPP irrigation projects during the planning stage?	Frequency	0	1	2	32	53	4.56	0.6
	%	0	1.1	2.2	35.6	58.9		
To what extent do you agree that lack of expertise influences the success of PPP irrigation projects during the planning stage?	Frequency	2	3	5	31	47	4.34	0.91
	%	2.2	3.3	5.6	34.4	52.2		
To what extent do you agree that land conflicts influence the success of PPP irrigation projects during the planning stage?	Frequency	3	4	4	31	46	4.28	0.99
	%	3.3	4.4	4.4	34.4	51.1		
Overall							4.39	0.83

Table 7 indicates that insufficient project financing was identified as the most critical factor, with 58.9% strongly agreeing and 35.6% agreeing on its significant impact. This resulted in a high mean score of 4.56 and a low SD of 0.60, indicating strong consensus. Lack of expertise also had a high impact, with 52.2% strongly agreeing and 34.4% agreeing, yielding a mean score of 4.34 and a slightly higher SD of 0.91, suggesting broader variation in opinions. Land conflicts followed closely, with 51.1% strongly agreeing and 34.4% agreeing, leading to a mean score of 4.28 and an SD of 0.99, reflecting slightly more diverse responses.

The overall mean of 4.12 confirms the importance of cost management, timely completion, and scope achievement in PPP success, while the low SD of 0.86 indicates strong agreement among respondents. These findings align with Okereke (2020) and Kamundia (2016), who identified poor planning, financial constraints, and political interference as key obstacles to irrigation projects in Africa. To enhance success, the study emphasizes better funding structures, capacity-building for technical expertise, and effective land conflict resolution mechanisms, ensuring financial sustainability and strategic planning in large-scale PPP irrigation projects like Galana Kulalu.

The identification of financing gaps and land ownership disputes as primary barriers aligns with the Theory of Constraints. These elements serve as systemic bottlenecks that disrupt the flow of resources and processes critical to project implementation. By focusing reform efforts on these constraints, such as increasing budget allocations and legal streamlining, project throughput can be significantly improved.

4.4.3. CSFs at Implementation

The researcher sought to know the influence of CSFs on success of PPP in Galana

Kulalu irrigation projects. The result is presented in **Table 8**.

Table 8. CSFs at implementation stage.

Scale	Frequency	Percentage
Strongly Disagree	5	5.6
Disagree	12	13.6
Neutral	6	6.8
Agree	29	33.0
Strongly agree	36	40.9
Total	88	100

Table 8 indicate that among the 88 respondents, the majority, 40.9%, strongly agree, and 33.0% agree, bringing the total proportion of positive responses to 73.9%. This indicates that most respondents acknowledge the crucial role of implementation-stage factors in determining the success of PPPs. A proportion of 6.8% of respondents remain neutral, suggesting some uncertainty or a lack of strong opinion on the matter. 13.6% disagree, and 5.6% strongly disagree, resulting in a total of 19.2% of respondents who do not believe that CSFs at the implementation stage significantly affect project success.

The high percentage of agreement (73.9%) indicates a strong agreement that the success of PPPs is significantly influenced by the quality of implementation. This aligns with the idea that even well-planned projects can fail if execution is poor, highlighting the need for efficient resource allocation, stakeholder coordination, and adherence to project timelines during implementation. The 6.8% neutrality suggests that a small fraction of respondents may perceive other stages, such as planning or monitoring and evaluation, as equally or more critical to success. Respondents were asked to indicate how the following indicators have influenced effect of CSFs at implementation stage on success of Galana Kulalu irrigation project based on Likert Scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree. The results are summarized in **Table 9**.

Table 9. Indicators of CSFs at implementation on success of Galana Kulalu irrigation project.

Question		Strongly disagree	Disagree	Neutral	Agree	Strongly Agree	Mean	SD
To what extent do you agree that poor management influence the success of PPP irrigation projects during the implementation stage?	Frequency	1	4	2	30	51	4.43	.84
	%	1.1	4.5	2.3	34.1	58.0		
To what extent do you agree that lack of technology influence the success of PPP irrigation projects during the implementation stage?	Frequency	4	4	8	33	39	4.13	1.05
	%	4.5	4.5	9.1	37.5	44.3		
To what extent do you agree that stakeholder resistance influence the success of PPP irrigation projects during the implementation stage?	Frequency	4	4	6	36	38	4.14	1.04
	%	4.5	4.5	6.8	40.9	43.2		
Overall								

Table 9 indicates that poor management emerged as the most critical challenge, with 58% strongly agreeing and 34.1% agreeing on its negative impact. A high mean score of 4.43 and a low standard deviation (SD) of 0.84 indicate strong consensus. Respondents emphasized the importance of effective leadership, project oversight, and managerial efficiency in ensuring smooth implementation.

Lack of technology was also seen as a significant factor, with 44.3% strongly agreeing and 37.5% agreeing on its impact. However, the mean score of 4.13 and the highest SD of 1.05 suggest greater variability in responses, indicating differing experiences with technological adoption. The findings align with [19], who highlighted the role of modern technology in project success.

Stakeholder resistance was another major issue, with 43.2% strongly agreeing and 40.9% agreeing. The mean score of 4.14 and SD of 1.04 reflect moderate variability, suggesting that different stakeholders had varied experiences with opposition. Resistance stemmed from government agencies, private sector partners, and local communities, aligning with [10], who highlighted stakeholder conflicts in Kenyan megaprojects.

The overall mean of 4.23 confirms strong agreement on the impact of CSFs at the implementation stage, while the SD of 0.98 reflects moderate variability. The study underscores the need for strong leadership, modern technology integration, and proactive stakeholder engagement to improve project execution in large-scale PPP irrigation projects like Galana Kulalu. Respondents indicated that machinery deliveries were delayed and scope reduced without penalties, a clear indication of weak principal-agent mechanisms. Principal-Agent Theory explains this as a product of asymmetric information and lack of enforceable performance metrics, where the private agent maximizes its utility at the expense of project goals.

4.5. Discussion

The study revealed that insufficient financing was the most cited planning-stage constraint, mentioned by over 74% of respondents. This finding aligns with the broader literature. For instance, [2] reported that budget shortfalls were the leading cause of delays in Sub-Saharan Africa's irrigation PPPs, specifically in Uganda and Zambia. Similarly, [7] emphasized that the financial viability of PPP projects depends on accurate upfront funding, particularly during the feasibility study and procurement stages. Land conflicts, identified by 65% of respondents, also mirror findings from [13], where legal ambiguities on land ownership significantly delayed irrigation projects. This reinforces the idea that land security is a foundational determinant of infrastructure success, especially in arid and semi-arid regions. From a theoretical standpoint, these issues are well explained by the Theory of Constraints (TOC). The bottleneck created by erratic funding flows and unclear land tenure arrangements served as major constraints that stifled system throughput. Unless these constraints are elevated or removed, through legal reforms and financial planning PPPs, in agriculture will remain suboptimal.

Respondents ranked poor management (68%), lack of appropriate technology

(59%), and stakeholder resistance (57%) as the most significant obstacles during the implementation phase. These findings resonate with the work of [25], who argued that weak project governance structures in PPPs commonly lead to scope drift and inefficiency. In Galana Kulalu's case, Green Arava's failure to deliver promised infrastructure within the stipulated time and procurement bottlenecks mirror cases in the Bura

and Bakolori irrigation schemes (Nigeria), where weak performance monitoring led to misalignment between contractors and government entities. These problems are best interpreted through Principal-Agent Theory. The Kenyan government (principal) expected Green Arava (agent) to act in the project's interest. However, the lack of enforceable performance metrics and poor oversight resulted in agent opportunism, evidenced by delayed deliveries, minimal stakeholder training, and underutilized land. As [26] suggests, such outcomes stem from misaligned incentives and information asymmetry between stakeholders. The absence of digital project management tools (e.g., ERP, BIM integration) and continued use of legacy irrigation technologies further reduced efficiency. According to [27], incorporating digital tools improves scope accuracy by 17% - 25% in large-scale agricultural engineering projects.

5. Conclusion and Limitation

5.1. Conclusion

This study examined the CSFs influencing the execution and performance of the Galana Kulalu Irrigation Project, a Public-Private Partnership (PPP) initiative in Kenya conceived under Vision 2030. The findings indicate that insufficient project financing, lack of technical expertise, and land conflicts significantly constrained project planning, while poor management, limited technology adoption, and stakeholder resistance hindered implementation. Although the project was formulated as a PPP from the outset, bringing together the Government of Kenya, through the National Irrigation Authority, and the private contractor Green Arava, the arrangement did not follow the typical PPP funding structure. The government provided the bulk of the financing, land, and enabling infrastructure, while the private partner's role was limited to supplying irrigation technology, developing the 10,000-acre model farm, and offering technical training. The private partner did not provide capital investment for large-scale implementation, meaning that critical risks and financial burdens remained primarily with the public sector.

This financing arrangement partly explains why insufficient funding emerged as a major constraint despite the PPP label, raising questions about whether the project's structure met the standard definition of a risk- and investment-sharing partnership. The results highlight the importance of structuring PPP irrigation projects to ensure balanced contributions from both parties, financially, technically, and operationally. Addressing the identified CSFs through effective financial planning, robust contractual arrangements, strong leadership, modern technology adoption,

and proactive stakeholder engagement can improve cost efficiency, timely completion, and scope adherence. The study recommends that future PPP irrigation projects incorporate clear, enforceable risk-sharing agreements, independent technical vetting, and equitable funding commitments from both public and private partners to enhance sustainability and developmental impact.

5.2. Limitation

Given that the primary data source comprised self-administered questionnaires, the study acknowledges the inherent risk of response bias, where respondents may offer socially acceptable answers rather than factual accounts. This may particularly affect questions regarding project management efficacy and stakeholder satisfaction. To mitigate this, the questionnaire was pre-tested to enhance clarity and neutrality in question phrasing, and anonymity was guaranteed to reduce social desirability bias. Furthermore, the analysis emphasized cross-variable correlations to identify inconsistencies or inflated responses.

While triangulation and stratified random sampling were employed to improve reliability, some limitations persist. Self-reported data remains susceptible to bias, and complete documentation from private contractors was unavailable, limiting full triangulation. Although stratification helped reduce sampling bias, there is a possibility of residual selection bias due to potential non-responses or inaccurate contact lists from institutional databases.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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