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The Extent of Adverse Selection in Rural Energy Projects inTanzania

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Abstract

This study examines the extent of adverse selection in the implementation of rural energy projects in Tanzania, grounded in the Information Asymmetry Theory and the Dynamic Capabilities View. Despite the Tanzanian government's efforts to expand rural electrification, only 40% of the rural population has access to electricity, with many projects struggling due to challenges related to financial viability and stakeholder collaboration. The research investigates how adverse selection, arising from information disparities among stakeholders, hinders effective collaboration and negatively affects project outcomes. Using Information Asymmetry Theory, the study explores how these information gaps lead to inefficiencies and misaligned expectations in rural energy projects. The findings suggest that improving transparency and communication among stakeholders can help reduce information asymmetry, thereby enhancing project effectiveness. Additionally, the study incorporates the Dynamic Capabilities View to explore how project managers can develop adaptive capabilities to navigate the complexities of rural energy projects.

In rural settings, where conditions are unpredictable and resources limited, dynamic capabilities—such as the ability to integrate local knowledge and adapt strategies in response to changing conditions—are essential for effective risk management. The study finds that fostering stakeholder engagement bridges information gaps and strengthens the adaptive capabilities of project teams by incorporating diverse local knowledge into decision-making processes. This approach ensures that risk mitigation strategies are contextually relevant and flexible enough to address the socio-cultural and economic realities of rural communities. Ultimately, the study underscores the importance of context-specific, transparent, and adaptive risk management strategies to enhance the sustainability of rural energy projects in Tanzania.This study investigates the extent of adverse selection in rural energy projects in Tanzania, framed within the Information Asymmetry Theory and the Dynamic Capabilities View. Despite the Tanzanian government's efforts to expand rural electrification, only 40% of the rural population has access to electricity, and many projects face challenges related to financial viability and stakeholder collaboration.

The research focuses on how adverse selection, driven by information disparities among stakeholders, impedes effective collaboration and negatively impacts project outcomes. By applying Information Asymmetry Theory, the study examines how these information gaps contribute to inefficiencies, misaligned expectations, and suboptimal decision-making in rural energy projects. The findings highlight

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that addressing these information asymmetries, particularly through enhanced transparency and communication among stakeholders, is crucial for improving project effectiveness. Furthermore, the study draws on the Dynamic Capabilities View to assess the role of project managers in responding to the complexities of rural energy projects. It emphasizes the importance of developing adaptive capabilities, such as integrating local knowledge and adjusting strategies based on changing conditions, to navigate these challenges. The study concludes that the extent of adverse selection in rural energy projects in Tanzania can be mitigated by fostering better stakeholder engagement and promoting adaptive project management practices. This approach improves project outcomes and ensures more effective rural electrification initiatives.

Keywords: Adverse selection, Risk management, Rural energy projects, Stakeholder engagement, Information asymmetry, Local knowledge integration

Introduction

The implementation of rural energy projects is critical for improving access to energy in developing regions, but the extent of adverse selection in these projects remains inconsistent. Understanding how adverse selection influences rural energy project implementation and the factors contributing to it is essential for improving project outcomes and ensuring sustainable energy access. This study focuses on Tanzania, a country facing significant energy challenges, to assess the extent of adverse selection and its impact on the success of rural energy projects.

An Overview of Risk Management Effectiveness in Rural Energy Project

Globally, energy access is essential for driving economic development and alleviating poverty. As reported by the International Energy Agency (IEA, 2022), over 750 million people remain without electricity, with rural areas disproportionately affected. Effective risk management is critical in energy projects to mitigate financial, operational, and environmental risks and to ensure the delivery of sustainable energy solutions. However, adverse selection, where data inequality leads to poorly informed decisions, can severely undermine these efforts. In sub-Saharan Africa, where energy deficits are particularly severe, the challenge of adverse selection is especially pronounced. A study by Karamoozian, Wu, Lambert, and Luo (2022) indicate how inadequate risk assessment frameworks in rural energy projects contribute to increased project failures. As regional initiatives aim to enhance energy access, understanding the implications of adverse selection is crucial for improving project design and implementation.

Tanzania, with its large rural population, provides a valuable case for examining the impact of adverse selection in energy projects. Despite several rural electrification programs initiated by the government, many face challenges due to adverse selection and ineffective risk management practices. The World Bank (2022) reports that only 40% of the rural population has access to electricity, with many projects struggling to achieve financial viability and effective stakeholder engagement. This research aims to explore the specific factors that influence the extent of adverse selection in Tanzania's rural energy projects, focusing on its impact on data inequality, stakeholder engagement, and local knowledge integration. Despite the potential benefits of rural energy initiatives in Tanzania, many projects fail to meet their objectives due to the persistence of adverse selection. This problem is compounded by disparities in information that hinder stakeholder collaboration and the overall success of projects. Understanding the extent of adverse selection particularly in relation to data inequality, stakeholder engagement, and local knowledge integration is critical for improving the success rates of rural energy projects in Tanzania. This study will investigate how these factors interact with the challenges posed by adverse selection, offering insights into improving project design and implementation in rural areas (Twesigye, 2021).

Literature Review and Theoretical Underpinning

Theoretical Perspectives

Theoretical frameworks that grounded this study to understand the relationship between adverse selection and risk management effectiveness on Rural Energy Project Implementation are the the Information Asymmetry Theory by Akerlof in 1970) and The Dynamic Capabilities framework by Teece in 1997.

Information Asymmetry Theory

The Information Asymmetry Theory (Akerlof, 1970) suggests that in many transactions or projects, one party often possesses more or better information than the other, leading to an imbalance in decision-making power. In the context of rural energy project implementation in Tanzania, this theory is highly relevant because rural energy projects often involve multiple stakeholders, such as government bodies, private investors, local communities, and non-governmental organizations (NGOs), who may have differing levels of knowledge or access to information. For instance, local communities may lack access to critical technical or financial information, which could impact their ability to assess risks or make informed decisions about the project. Conversely, project implementers may not fully understand local needs, environmental conditions, or community concerns, further intensifying data inequality. This theory helps to explain the impact of data inequality asymmetry on risk management effectiveness in rural energy projects. The study can assess how the unequal distribution of information affects the identification, assessment, and mitigation of risks within the projects. For example, if stakeholders do not share critical risk-related information, such as potential environmental impacts or community challenges, the risk management process may be incomplete or ineffective. Furthermore, the theory is used to explore the role of information sharing and transparency in reducing risks, fostering collaboration, and improving the overall management of rural energy projects.

The Dynamic Capabilities Framework

The Dynamic Capabilities Framework (Teece, Pisano, & Shuen, 1997), focuses on the ability of organizations to integrate, build, and reconfigure internal and external resources to address rapidly changing environments. In the case of rural energy projects in Tanzania, this theory is applicable because the projects often operate in volatile environments with constantly evolving risks, such as political instability, technological changes, climate variability, or shifts in community needs. The dynamic capabilities of the stakeholders involved (governments, local businesses, and communities) to adapt to these changing circumstances and effectively manage risks play a crucial role in the success of the projects. This framework is used to evaluate how stakeholders' dynamic capabilities such as their ability to learn, innovate, and adapt to emerging risks impact the effectiveness of risk management practices in rural energy projects. Project developers may need to develop new methods of engaging with local communities or reframe risk assessments based on feedback from stakeholders.

Empirical Review and Development of Hypotheses

The transition to renewable energy sources (RES) is critical for mitigating climate change and reducing dependence on fossil fuels. Chebotareva, Strielkowski, and Streimikiene (2020) highlight the role of government support in enhancing RES development, emphasizing that effective policy frameworks are essential to mitigate risks associated with these projects. However, political uncertainties and ineffective state measures can worsen these risks, ultimately hindering project success. This underscores the importance of assessing the soundness of government-sponsored initiatives to identify how information asymmetry impacts risk management in the renewable energy sector, particularly in rural areas. The complexities of implementing renewable energy projects in Turkey illustrate the inherent risks tied to data inequality. Kul, Zhang, and Solangi (2020) present a Multi-Criteria Decision Methodology (MCDM) to evaluate risk factors in renewable energy investments (REIs), utilizing tools like the Delphi method and the Analytical Hierarchy Process (AHP). Their findings reveal significant economic and business risks that stem from insufficient information sharing among stakeholders, which can impede decision-making and increase investment uncertainty. This highlights how asymmetrical information and data inequality can influence risk assessment and management practices, necessitating effective communication channels among stakeholders to facilitate informed decision-making.

In the context of China, the challenges posed by data inequality are further examined by Song, Mangla, Wang, Zhao, and An (2022), who explore the inefficiencies in coal reduction plans due to gaps in information regarding clean energy potential. Their nonparametric production frontier model identifies provincial disparities in coal utilization efficiency, pointing to the need for better information dissemination and transparency in energy policies. This aligns with the idea that improved information flow can enhance the effectiveness of risk management strategies by ensuring that stakeholders are well-informed about both risks and opportunities related to energy transitions. Leonard, Ahsan, Charbonnier, and Hirmer (2022) expanded on the concept of data inequality in renewable energy development by linking it to the resource curse literature. They propose a framework to assess risks associated with RES, focusing on context-specific factors that determine the success or failure of renewable initiatives. This framework illustrates how inadequate information can lead to misaligned expectations and resource misallocation, ultimately resulting in adverse social and environmental outcomes. Their findings emphasize the necessity of proactive risk assessments that consider the complexities of local contexts and the critical role that transparent information exchange plays in successful renewable energy projects.

The interplay between data inequality and stakeholder engagement is crucial in rural energy initiatives. Projects that fail to account for diverse stakeholder perspectives often experience increased risks due to a lack of understanding of local conditions and needs. This gap in knowledge can lead to ineffective strategies that do not align with community expectations or capabilities. Enhancing stakeholder engagement through transparent communication and information sharing can mitigate these risks, facilitating a more comprehensive approach to incorporates local knowledge and expertise. Although there is extensive literature on the extent of adverse selection in renewable energy, a notable gap persists in understanding the specific influence of data inequality (DI) on these practices within rural energy projects. Existing studies often highlight the importance of stakeholder engagement and policy frameworks but do not adequately explore the nuances of information dynamics and their implications in rural energy projects. Therefore, this study aims to fill this gap by hypothesizing that:

H1: Data inequality negatively influences the effectiveness in rural energy projects outcomes.
Stakeholder engagement (SE) is increasingly recognized as a critical factor in the success of renewable energy (RE) projects, particularly in rural contexts. Abba, Balta-Ozkan, and Hart (2022), emphasize the importance of understanding risk drivers and their interactions to enhance investment in renewable energy, especially in developing regions like Sub-Saharan Africa. Their study presents a holistic multi-dimensional risk management framework that incorporates various risk types-technical, economic, social, political, and policy risks, highlighting the complexity and interrelated nature of these factors. This framework is essential for identifying actionable insights that can mitigate risks and facilitate better investment outcomes. As such, effective stakeholder engagement can play a pivotal role in the application of this framework, allowing for a more nuanced understanding of local contexts and challenges. The relationship between SE and organizational culture is further explored by Salvioni and Almici (2020), who argue that transitioning to a circular economy necessitates a change in corporate culture through improved stakeholder relations. Their findings indicate that stakeholder engagement can foster values aligned with sustainability and environmental protection, reinforcing the idea that collective input is crucial for effective risk management. This cultural shift can enhance the responsiveness of energy projects to local needs and mitigate risks by ensuring that stakeholder concerns are integrated into decision-making processes.

In a similar vein, Malik et al. (2023) investigated the communication factors that impact stakeholder engagement and project success in Pakistan's renewable energy sector. Their research demonstrates that effective internal and external communication is crucial for fostering stakeholder involvement, which, in turn, enhances project outcomes. By employing structural equation modeling, they confirm that stakeholder engagement mediates the relationship between communication factors and project success. This suggests that improving communication channels can significantly enhance the effectiveness of risk management strategies in rural energy projects, as engaged stakeholders are more likely to provide critical insights and feedback. Han, Wei, Johnston, and Head (2023) contributed to this discussion by systematically exploring the configuration of stakeholder engagement in energy transition initiatives. Their analysis reveals that stakeholder participation is often minimal or lacks meaningful impact, particularly when stakeholders are involved only in the early planning phases. This highlights the need for a more dynamic engagement strategy that empowers stakeholders throughout the project lifecycle. By leveraging insights from stakeholder contributions, project managers can better anticipate risks and devise effective mitigation strategies that are sensitive to local contexts.

The construction industry also offers valuable lessons for enhancing risk management through stakeholder engagement. Maqbool and Jowett (2023) examine the challenges surrounding sustainable construction practices, emphasizing that despite the availability of strategies for carbon emission reduction, many practices remain underutilized. Their findings suggest that greater engagement with stakeholders, including construction professionals and local communities, can foster a culture of sustainability that informs risk management practices. By involving stakeholders in the decision-making process, projects can better align their objectives with community needs and values, thereby reducing potential risks. Despite the wealth of literature on stakeholder engagement and its impact on project success, there is a notable gap regarding its specific role in enhancing risk management practices in rural energy projects. While existing studies highlight the importance of SE in various contexts, they often lack focused investigations into how effective engagement can systematically improve strategies tailored to rural energy initiatives. Therefore, this study aims to address this gap by hypothesizing that:

H2: Enhanced stakeholder engagement positively influences rural energy projects outcomes.

The integration of local knowledge into risk management practices has gained prominence in the context of rural energy projects. Various studies illustrate how indigenous and local knowledge (ILK) enhances resilience to environmental challenges and informs decision-making processes. This article synthesizes findings from recent research to explore the critical role of ILK in risk management, particularly within rural energy initiatives, highlighting barriers and proposing frameworks for effective integration. The concept of social learning is pivotal in fostering community resilience. Choudhury, Haque, Nishat, and Byrne (2021) emphasized the need for a biopolitical perspective, arguing that the intersection of power, knowledge, and institutions can either facilitate or hinder social learning processes. Their research underscores that formal institutions often overlook ILK, leading to a deficit in social memory and preparedness, especially in disaster-prone areas like coastal Bangladesh. By contrast, Ainsworth, Redpath, Wilson, Wernham, and Young (2020) demonstrate the potential of collaborative stakeholder engagement in Scotland, revealing that integrating local and scientific knowledge can mitigate environmental conflicts and enhance decision-making. Both studies highlight the necessity of recognizing local perspectives in resilience-building efforts.

Furthermore, the significance of ILK is echoed in the realm of climate adaptation strategies. Filho et al. (2023) illustrate that communities in the Global South utilize ILK to forecast climate-related events, yet national policies frequently neglect these valuable insights. This gap results in vulnerability to climate impacts, emphasizing the need for effective integration of ILK into formal adaptation frameworks. Similarly, Mazzone et al. (2023) call for a triangular approach combining climate policy, social inclusion, and ILK, advocating for policies that recognize the interdependencies among these dimensions to enhance community resilience in Morocco. The exploration of renewable energy initiatives also reveals the importance of local knowledge. Wang et al. (2023) discussed the photovoltaic poverty alleviation project in China, indicating that understanding local residents' perceptions is essential for adoption. They note significant peer effects and the role of cognitive processes in fostering willingness to embrace renewable solutions. This mirrors the challenges highlighted by Omole, Olajiga, and Olatunde (2024), who emphasize that socio-cultural factors significantly impact rural electrification efforts, suggesting that recognizing local dynamics is crucial for project sustainability.

Despite the evident benefits of integrating ILK, challenges persist. Janota, Vávrová, and Bízková (2023) proposed a methodology for local production of alternative energy fuels, emphasizing that sustainable practices must be context-specific to overcome economic and geographic barriers. Their approach aligns with Yu and Mu (2023), who highlight the need for localized implementation of nature-based solutions in China. Both studies stress the importance of community engagement and contextual understanding in facilitating successful energy initiatives. While these insights are valuable, gaps still exist in understanding how the integration of local knowledge specifically influences the effectiveness of risk management in rural energy projects. Current literature provides a broad view of ILK's role in resilience and adaptation but lacks focused studies examining its direct impact on risk management outcomes in energy initiatives. This article aims to address this gap by hypothesizing that:

H3: The effective integration of local knowledge influences in rural energy projects outcomes.

Methodology

Research Design and Procedures

In this study, a cross-sectional research design was chosen as the primary methodology. This design enabled the efficient collection of data using closed end questionnaire distributed to 175 project managers from REA projects completed in 2023 in Tanzania. The cross-sectional approach was selected for its ability to gather data quickly, aligning well with the study's time constraints. Additionally, selecting project managers from completed REA project was crucial, as their roles were essential to the study's objectives. The research also assessed various variables using multiple indicators, including the impact of data inequality (DI), role of stakeholder engagement (SE) and local knowledge integration (LK) in rural energy projects. The study examined project managers from a sample of 175 who managed to complete REA projects in Tanzania in 2023. These project managers were chosen due to their critical roles in daily operations, which made them highly relevant to the study's objectives. By including project managers from various projects, the study aimed to gain a comprehensive perspective on the challenges and best practices related to the research.

Data Collection Instrument and Validation

Quantitative data collection for this study was carried out using a closed-end questionnaire carefully crafted to provide statistical insights relevant to the formulated hypotheses. The development of the questionnaire followed a rigorous process as outlined by Churchill and Iacobucci (2004), which included nine recommended steps. Each item about the variables under scrutiny was rated on a seven-point Likert scale to gauge respondents' perceptions accurately. The decision to employ quantitative data stemmed from its inherent capacity to generalize findings and formulate predictions, as highlighted by Mohajan (2020). To facilitate data collection, the closed end questionnaire was distributed to selected audit firms. Before the main study, a pilot investigation was carried out with 17 projects (10% of the sample) to test the validity of the questions in the final questionnaire. Convergent validity indices were calculated, showing values of 0.561 for the Influence of Data Inequality on Rural Energy management implementation (DI), 0.670 for stakeholder engagement (SE), and 0.726 for local knowledge integration (LK). Reliability analyses were also conducted, yielding coefficients of 0.848 for DI, 0.930 for SE, and 0.926 for LK. Based on the pilot study's findings, redundant, overly complex, or ambiguous items were removed from the final questionnaire, enhancing the clarity and effectiveness of the instrument for the main study.

Techniques of Data Analysis

The researcher began by inputting field-collected data into the Statistical Package for the Social Sciences (SPSS Version 27). To ensure data integrity, rigorous checks were conducted to identify and correct any potential entry errors, as well as to address missing values and outliers. Following best practices outlined by Hair, Black, Babin, and Anderson (2010), linear interpolation was employed to impute missing values, minimizing any disruption to the dataset's integrity. Additionally, an examination of box plot results confirmed that outliers were not widespread, further validating the dataset's suitability for analysis. With a solid data foundation, the researcher conducted a comprehensive analysis using Partial Least Squares Structural Equation Modelling (PLS-SEM), focusing on the coefficient of determination (R^2) as a key metric for assessing the model's predictive power.

Emperical Results

Measurement

Confirmatory factor analysis (CFA) was employed as a methodological tool to rigorously evaluate the alignment of the proposed model with the collected dataset. This encompassed an in-depth examination of both the reliability of individual indicators and the broader constructs they represent, along with a thorough assessment of both convergent and divergent validity. The outcomes of this analysis underscored a robust fit of the measurement model to the data, with a substantial majority of factor loadings surpassing the conventional threshold of 0.7 (Hair, Ringle, & Sarstedt, 2013). The evaluation of construct reliability was conducted through the calculation of composite reliability, where a minimum value of 0.7 was considered indicative of satisfactory scale reliability (Hair et al., 2013). Moreover, the reliability of constructs was further scrutinized using Cronbach's alpha coefficient, revealing values exceeding 0.7 for all constructs, thus affirming a commendable level of internal consistency and reliability (Hair & Alamer, 2022). To ascertain convergent validity, the average variance extracted (AVE) criterion was employed, with all constructs demonstrating AVE values of at least 0.5, thereby signaling a robust level of convergent validity (Hair & Alamer, 2022). Furthermore, divergent validity was accurately assessed by comparing the square root of the AVE in a diagonal with the correlation values between constructs. The discerned results, accurately laid out in Table 2, affirmed the presence of satisfactory divergent validity among the constructs, thus corroborating the distinctiveness of each construct (Fornell & Larcker, 1981; Hair et al., 2021).

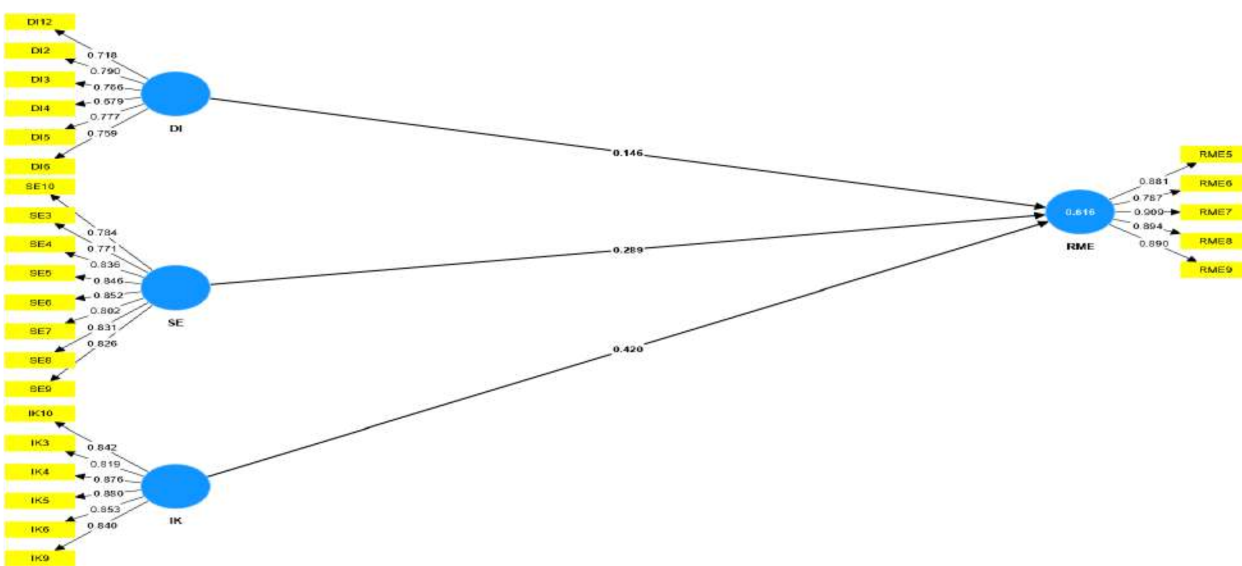

Figure 1: Structural model

Table 1: Factor loading for constructs, composite reliability and VIF

Indicator	DI	IK	PM	SE	VIF
DI12	0.718				1.618
DI2	0.790				2.015
DI3	0.766				2.021
DI4	0.679				1.496
DI5	0.777				1.839
DI6	0.759				1.843
IK10		0.842			2.891
IK3		0.819			2.741
IK4		0.876			4.115
IK5		0.880			3.472
IK6		0.853			2.619
IK9		0.840			2.826
RME5			0.881		2.957
RME6			0.787		1.963
RME7			0.909		3.584
RME8			0.894		3.244
RME9			0.890		3.206
SE10				0.784	2.195
SE3				0.771	2.006
SE4				0.836	3.021
SE5				0.846	3.364
SE6				0.852	3.136
SE7				0.802	2.526
SE8				0.831	2.634
SE9				0.826	2.652

Table 2: Construct reliability and validity

Construct	**Cronbach's alpha**	**Composite reliability (rho_a)**	**Average variance extracted (AVE)**
DI	0.843	0.848	0.561
IK	0.924	0.926	0.726
RME	0.922	0.929	0.762
SE	0.930	0.930	0.670

Table 3:Discriminant validity-HTMT

Construct	DI	IK	SE
DI	0.844		
IK	0.758	0.797	
SE	0.838	0.801	0.764

Table 4: R-square and Q-square to assess the Quality of the structure model

Variable	R^2	Q^2	f^2
RME	0.616	0.485	
DI		0	0.183
IK		0	0.048
SE		0	0.360

The tables presented in this study on the extent of adverse selection in Rural Energy Projects Implementation in Tanzania provide key insights into the validity, reliability, and relationships between the constructs influencing Rural Energy Projects oucomes. Table 1 shows the factor loadings for each indicator of the constructs, with all indicators displaying loadings above the recommended threshold of 0.6, suggesting strong indicators for the respective constructs (Data inequality, Local Knowledge, Stakeholder Engagement, and Risk Management Effectiveness). Additionally, the Variance Inflation Factor (VIF) values for these indicators are within acceptable limits, indicating that multicollinearity is not a concern. Table 2 assesses construct reliability and validity. All constructs (DI, IK, RME, SE) exhibit good internal consistency, as evidenced by Cronbach's alpha values above 0.7 and composite reliability scores above 0.8. Furthermore, the Average Variance Extracted (AVE) values exceed 0.5 for all constructs, confirming convergent validity. In Table 3, the discriminant validity is tested using the Heterotrait-Monotrait Ratio (HTMT), with all HTMT values being below the critical threshold of 0.85, indicating that the constructs are sufficiently distinct from one another. Finally, Table 4 presents the R-square and Q-square values for assessing the quality of the structural model. The R-square values indicate that the three constructs have a moderate explanatory power ($R^2 = 0.616$). The Q-square values greater than 0 suggest predictive relevance for all constructs, with RME showing the highest value ($Q^2 =$ 0. 0.485). These findings underline the significance of stakeholder engagement and risk management effectiveness in enhancing the effectiveness in rural energy projects, while also emphasizing the relatively lesser role of data inequality and local knowledge in this specific context.

In SEM, a Q^2 value greater than zero for a reflective endogenous latent variable indicates the model's predictive relevance for that specific construct. According to the guidelines by Hair, Sarstedt, Hopkins, and Kuppelwieser (2014) a Q^2 value of 0.02 suggests small predictive relevance, while $Q^2 = 0.15$ implies medium relevance, and $Q^2 = 0.35$ indicates large predictive relevance. By assessing the Q^2 values, we can ascertain the extent to which the SEM model accurately predicts the variability in the reflective endogenous latent variables. These values offer valuable insights into the model's ability to capture and explain the underlying relationships among the constructs under investigation. In the results from Table 4, Q^2 values notably exceed zero, providing substantial evidence supporting the model's predictive relevance for the specified endogenous constructs. For example, Risk Management Effectiveness (RME) shows a relatively high Q^2 value of 0.485, indicating large predictive relevance for this construct, while Stakeholder Engagement (SE) also shows medium relevance with a Q^2 value of 0.360. These findings suggest that the model does a good job in predicting the variability in these key constructs. On the other hand, the Q^2 values for DI (Data inequality) and IK (Local Knowledge) are low, indicating minimal predictive relevance for these constructs, which aligns with the earlier conclusion that their direct influence on risk management effectiveness is limited in this context.

Furthermore, Table 4 also includes f^2 values, which assess the effect size of each construct on the endogenous variables. The f^2 value for data inequality (DI) on Risk Management Effectiveness (RME), for instance, helps to understand the relative importance of DI in explaining variations in RME. A higher f^2 value suggests that DI has a significant impact on RME. This would indicate that addressing information asymmetry can substantially improve project management practices in rural energy projects. The results show that Stakeholder Engagement (SE) has the largest impact on the effectiveness of risk management, as its predictive relevance is marked by a strong f^2 effect. This suggests that stakeholder engagement plays a pivotal role in managing risks effectively in rural energy projects, further emphasizing its importance as highlighted in the study's objectives. Summarily, the combination of Q^2 and f^2 values provides a comprehensive understanding of the SEM model's predictive power and the relative importance of the different constructs in explaining risk management effectiveness in rural energy projects. Stakeholder engagement and project management are found to be key determinants, while information asymmetry and local knowledge contribute less to the model's predictive power.

The findings of this study are in line with both Information Asymmetry Theory and The Dynamic Capabilities View. Information Asymmetry Theory highlights the challenges posed by unequal access to information (data inequality) between project stakeholders, but the study reveals that data inequality (DI) has high impact on risk management effectiveness, suggesting that the expected conflicts arising from unequal information is also influential in the context of rural energy projects. On the other hand, The Dynamic Capabilities View emphasizes the importance of an organization's ability to adapt and reconfigure its resources to meet changing environments, and the study finds that the ability of stakeholders to engage, learn, and adapt to emerging risks plays a crucial role in enhancing risk management practices. This aligns with the view that continuous learning, innovation, and collaboration are key to managing the complex and dynamic risks inherent in rural energy projects. Specifically, Table 5 presents the results of the structural model for testing the hypotheses. The table reports the path coefficients, sample mean, standard deviations, T-statistics, and p-values for the relationships between data inequality (DI), Local Knowledge (IK), Stakeholder Engagement (SE), and Rural Energy Projects outcomes(RME). These findings provide critical insights into how these constructs influence risk management in the context of rural energy projects, and they align with both Information Asymmetry Theory and The Dynamic Capabilities View.

The relationship between data inequality (DI) and rural enenery Project outcome (RME) shows a positive effect with a path coefficient of 0.146, which is statistically significant with a T-statistic of 2.442 and a p-value of 0.007. This confirms that reducing data inequality has a positive influence on the effectiveness of in rural energy projects outcomes. Information Asymmetry Theory helps explain this result, as it highlights how imbalances in information between key stakeholders (e.g., project funders and implementers) can lead to inefficiencies and risks. When information is not shared transparently, decision-making becomes impaired, and agents may act in their self-interest. Addressing data inequality through improved communication and information sharing can mitigate these risks, thereby enhancing project management effectiveness, particularly in rural energy projects where access to reliable information is often limited.

The relationship between Local Knowledge (IK) and Rural Energy Projects outcomes (RME) is also statistically significant, though weaker, with a path coefficient of 0.420 and a T-statistic of

4.864 (p-value of 0.000). This suggests that local knowledge positively influences project management practices, but its effect is less pronounced compared to other factors like stakeholder engagement or data inequality. The Dynamic Capabilities View provides insight here, as it emphasizes an organization's ability to reconfigure and integrate resources to respond to changing conditions. In the case of rural energy projects, integrating local knowledge with other resources such as stakeholder engagement and strategic planning is essential for adapting to local contexts and managing risks. While local knowledge is valuable for identifying risks and opportunities, its full potential can be realized only when combined with other capabilities, like the dynamic ability to adjust strategies and the collaborative engagement of various stakeholders.

The relationship between Stakeholder Engagement (SE) and Rural Energy Projects (RME) is the strongest among the paths tested, with a path coefficient of 0.420, a T-statistic of 2.838, and a p-value of 0.002. This indicates that stakeholder engagement plays a significant role in improving project management effectiveness in rural energy projects. According to The Dynamic Capabilities View, this result underscores the importance of fostering collaboration, shared decision-making, and joint risk management to build the dynamic capabilities necessary for project success. Engaging stakeholders local communities, government entities, and the private sector provides diverse perspectives and resources that contribute to more informed decisions, sustainable project designs, and enhanced risk management. The strong influence of Stakeholder Engagement (SE) on Rural Energy Projects outcomes (RME) aligns with the view that the ability to leverage relationships, knowledge, and resources from key stakeholders is crucial in complex and resource-constrained environments, such as rural energy projects.

Table 5: Structural model for testing hypothesis

Path	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T-statistics (|O/STDEV|)	P values
DI -> RME	0.146	0.151	0.076	1.915	0.028
IK -> RME	0.420	0.416	0.099	4.250	0.000
SE -> RME	0.289	0.287	0.089	3.232	0.001

Source: Field data (2024)

The findings reveal that all three hypotheses H1 (DI -> RME), H2 (SE -> RME) and H3 (IK ->RME) are accepted indicating that there is a causal relationship between adverse selection and Rural Energy Project outcomes.

Discussions and Conclusions

This study aimed to evaluate the extent of adverse selection in rural energy projects in Tanzania, focusing on data inequality, stakeholder engagement, and local knowledge integration. The findings offer valuable insights into how these factors interact and shape the risk management strategies for rural energy projects in Tanzania.

The study found that data inequality had a moderate positive effect on Rural Energy Projects outcomes, with a path coefficient of 0.146 ($p = 0.028$). This result is supported by Information Asymmetry Theory, which posits that imbalances in information between key stakeholders (e.g., project funders or external stakeholders as principals, and project managers or contractors as agents) can lead to inefficiencies and suboptimal decision-making. The findings confirm that addressing data inequality is an important element in improving risk management and overall project performance. However, the effect of DI was less pronounced compared to other factors such as stakeholder engagement and local knowledge integration, suggesting that while mitigating data inequality is crucial, it alone cannot ensure optimal risk management. This aligns with the broader literature on the importance of transparency and information sharing in managing risks and improving outcomes in complex projects.

The study also examined the role of stakeholder engagement and local knowledge integration, which emerged as crucial elements in enhancing Rural Energy Projects outcomes. These factors highlighted the importance of The Dynamic Capabilities View, which emphasizes an organization's ability to reconfigure its resources and processes to adapt to changing environments and complex challenges. By integrating local knowledge and engaging stakeholders effectively, project managers can build dynamic capabilities that allow them to anticipate risks, adjust strategies, and respond to unforeseen challenges. This dynamic approach helps mitigate the risks inherent in rural energy projects, where local context and stakeholder involvement play a critical role in ensuring the sustainability and success of the projects (Aben, van der Valk, Roehrich, & Selviaridis, 2021; Amin, Scheepers, & Malik, 2023). In contexts where information is scarce or unevenly distributed, increasing transparency and communication becomes crucial to enhance risk management processes.

Stakeholder engagement emerged as the most influential factor in improving project management effectiveness, with a strong path coefficient of 0.289 ($p = 0.001$). This finding aligns with The Dynamic Capabilities View, which emphasizes the importance of building adaptive capabilities in organizations to respond to changes and challenges in the project environment. Effective stakeholder engagement fosters collaboration and shared decision-making, which enables project managers to identify and mitigate risks more effectively throughout the project lifecycle (Adebayo, Ikevuje, Kwakye, & Esiri, 2024). By involving diverse stakeholders such as local communities, government agencies, and private sector actors, projects can adapt to emerging challenges and optimize risk management strategies. This aligns with previous studies like Kumaraswamy (2024) and Hindarto (2023) who indicate that highlight the significance of stakeholder engagement for ensuring the success of complex projects, particularly in resource-constrained environments like rural energy projects in Tanzania.

Local knowledge integration was found to have a positive but modest effect on project management effectiveness, with a path coefficient of 0.420 ($p = 0.000$). This result is consistent with The Dynamic Capabilities View, which suggests that local knowledge is a valuable resource for fostering organizational flexibility and responsiveness in project management. Local knowledge provides insights into the specific needs and risks of rural communities, helping to improve the relevance and sustainability of projects (Leal Filho et al., 2024). However, the influence of local knowledge on risk management was weaker compared to stakeholder engagement, indicating that while it is a critical component, its impact is most effective when combined with other dynamic capabilities such as stakeholder collaboration and effective communication. This finding underscores the importance of integrating local context into project planning, but it also suggests that local knowledge alone is not sufficient for addressing the complex risks involved in rural energy projects.

The data analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM) revealed that stakeholder engagement (0.289), data inequality (0.146), and local knowledge integration (0.420) all play significant roles in Risk Management and success of rural energy project implementation. These results highlight the pivotal role of stakeholder engagement in driving project outcomes, suggesting that projects with robust stakeholder involvement are better positioned to manage risks and ensure sustainability. While data inequality remains a moderate barrier, addressing communication gaps and promoting transparency can mitigate its negative effects. The study also found that while local knowledge integration is important, its influence is less pronounced compared to stakeholder engagement, reinforcing the idea that the dynamic interplay of various factors such as stakeholder involvement, information transparency, and the integration of local context are key to improving risk management effectiveness. These findings reflect the importance of building dynamic capabilities to handle the uncertainties inherent in rural energy projects, aligning with earlier studies like Ebekozien, Aigbavboa, and Ramotshela (2024) that stress the need for adaptive strategies and collaborative efforts in such contexts.

Conclusion

The study emphasizes that stakeholder engagement is the most critical factor in ensuring better rural energy projects outcomes in Tanzania. This finding aligns with The Dynamic Capabilities View, which underlines the importance of organizations' ability to adapt and respond to changes in their environment by leveraging diverse resources and competencies, such as stakeholder involvement. Active engagement of stakeholders, including local communities, government agencies, and private sector actors, enhances decision-making, helps identify risks early, and mitigates potential problems, thereby improving project outcomes. While data inequality and local knowledge integration play important roles in influencing risk management, their direct impact on project success is less pronounced than the ability to build collaborative relationships and adapt to the complexities of the rural energy project environment. These results highlight the need for project managers and policymakers to prioritize inclusive, transparent, and collaborative processes, enabling a more dynamic and resilient approach in rural energy implementation.

The study also suggests that although data inequality remains a challenge in risk management effectiveness, its direct impact on risk management effectiveness is somewhat limited in comparison to other factors like stakeholder engagement. Information Asymmetry Theory helps explain this by highlighting how the imbalance of information between key project stakeholders such as funders, project managers, and contractors can lead to inefficiencies and misalignment of interests. However, the study indicates that addressing data inequality alone may not be sufficient to optimize risk management outcomes. Instead, fostering open communication, transparency, and trust-building through dynamic capabilities like stakeholder engagement is more effective in mitigating risks. These findings provide valuable insights for improving risk management strategies in rural energy projects and suggest that future research could delve deeper into the interactions between data inequality, local knowledge, and stakeholder engagement, while also considering the influence of broader contextual factors such as political and economic conditions on project outcomes.

Implications

Theoretical Implications

The study enhances our understanding of risk management in rural energy projects by integrating Information Asymmetry Theory and The Dynamic Capabilities View. Information Asymmetry Theory explains how the lack of access to relevant information among stakeholders can undermine risk management efforts, creating inefficiencies and misaligned expectations. In rural energy projects, where stakeholders particularly in disadvantaged areas may have limited access to critical data, the gap in information can hinder decision-making and risk mitigation. The findings suggest that addressing data inequality by ensuring stakeholders are well-informed and actively involved in the project can significantly enhance risk management effectiveness. This underscores the importance of transparent communication and knowledge-sharing among stakeholders to mitigate risks and align expectations, particularly in resource-constrained environments.

The study also challenges traditional top-down risk management models, advocating for more dynamic capabilities in risk management frameworks that are context-specific and responsive to the diverse needs and knowledge of rural stakeholders. According to the Dynamic Capabilities View, the ability to integrate local knowledge and adapt project strategies based on stakeholder inputs is crucial for managing risks effectively in changing and unpredictable environments. The study suggests that rural energy projects should be flexible and adaptable, leveraging the unique insights of local communities, government bodies, and other stakeholders to build more resilient and effective risk management practices. Additionally, the Information Asymmetry Theory highlights the importance of balancing the information gap between project managers (agents) and local communities (principals). When this information asymmetry is not addressed, it creates misalignments that can hinder risk management effectiveness. This emphasizes the need for improved communication and alignment of incentives to ensure that the interests of both parties are considered in the decision-making process.

Methodological Implications

Methodologically, the study highlights the value of quantitative research in understanding the complexities of risk management in rural energy projects. It stresses the importance of context-specific data collection in rural settings, where formalized data may be lacking. The study's approach of involving local communities and practitioners in data gathering ensures that findings are grounded in real-world experiences, offering a model for future research in similar contexts.

Practical Implications

The practical implications of the study stress the importance of transparent communication and stakeholder engagement in managing risks in rural energy projects. The research shows that information asymmetry between stakeholders hinders risk management effectiveness, underscoring the need for robust information exchange mechanisms. Furthermore, it highlights the value of integrating local knowledge into risk management processes. By involving local communities in decision-making, projects can be more responsive to local realities, increasing trust and ensuring that risks are identified and addressed more effectively. This participatory approach can improve the resilience and sustainability of rural energy initiatives.

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