International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

Analysis of Factors Affecting Performance of Rural Electrification Projects in Rwanda: A Case of Scaling Up Energy Access Project (SEAP)

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Abstract: ***The proposed Scaling-Up Energy Access project was launched in 2013 and expected to be phased out in November 2017. The project covers the Northern and Western provinces of Rwanda. The project expected to upgrade and rehabilitate two existing substations in Northern Province, the Gifurwe substation to 10MVA capacity and the Rulindo substation (also to be relocated) to 20MVA capacity; (ii) build about 464 km of medium voltage (MV) and 710 km of low-voltage (LV) distribution networks in both provinces; and (iii) connect 25,438 households and priority institutions (179 schools, 29 health centers and 25 sector administration offices) to the grid along the constructed distribution network areas. According to the project evaluation report of September, 2017 on performance of Scaling-Up Energy Access project, the project managed to achieve its targets in respect of connecting 179 schools, 29 health centers and 25 sector administration offices. By 15th September, 2017 which is the time the performance evaluation was carried out, and only 15, 568 households were connected against 25,438 targeted. The project evaluation report did not reveal the factors behind the failure of Scaling-Up Energy Access project to connect all of the targeted households. Given this situation; several factors like resources inadequacy, poor monitoring and evaluation, lack of technical designs, lack of effective contract management systems, poor infrastructures like roads, dispersed households and poor access to finance for local people are said to be on the top of the factors that led to poor performance of Scaling-Up Energy Access project in respect of connecting all of the targeted households. Up to now, there is no consensus among the project's stakeholders about the real factors that led to poor performance of Scaling-Up Energy Access project in respect to connecting all targeted households. Therefore, the researcher is eager to analyze the factors affecting performance of rural electrification projects in Rwanda. The researcher undertook quantitative research. Its sample size equaled to 158 respondents. Primary data were collected through the use of questionnaires. Based on the information drawn from findings the researcher concluded that the effect of technical design factors on performance of Scaling up Energy Access Project is significant. It was found out that the project could not perform without operational feasibility. Project also should not succeed without efficacy of technical feasibility. The findings demonstrated that there is a strong relationship between resource factors and performance of Scaling Up Energy Access Project. The study found out that financial resources have a great effect on successful completion of the project's activities. It showed that the increase of one unit in resource factors would increase the performance of Scale Up Energy Access project by .298 units if other variables remain constant. The findings study demonstrated that there is a strong relationship between contract factors and performance of Scaling Up Energy Access Project where the increase of one unit in resource factor increases the performance of Scaling Up Energy Access Project by .176 units if other variables stay constant. After analysis and interpretation of data, the researcher came up with the following recommendations: Project management should consider technical design factors in order to ensure effective implementation of project activities, Project managers should put much emphasis in availing enough resources including human, financial and material so as to ensure the successful performance of the projects and Project managers and their project teams must consider the contract factors so as to ensure that the tendering processes are effective and all materials needed are available on time.***

Keywords: Technical design factors, Resource factors, Contract factors, Project performance

1. Introduction

In Rwanda, 80 % of the people who have limited access to Energy live in rural areas and that's why one of the Rwanda's EDPRS II objective, is to increase the number of citizens who have access to Energy. According to United Nations (2010), progress on the MDG target to reduce by half the proportion of people without access to Energy by 2015 was on track. Yet rural areas in developing countries across the world remain severely disadvantaged, with eight out of ten people not having access to Energy supply. Only 47% of the rural communities of sub-Saharan Africa have access to Energy supply. The Government of Rwanda recognizes that availability of efficient and reliable energy supply is a pre-requisite for social prosperity, human development and economic growth. These are also the key objectives of Rwanda's Vision 2020 whose overarching goal is to transform the country into a middle income economy by improving its competitiveness while ensuring unity and inclusive growth. Achieving the Vision 2020 objectives will necessitate transforming the country from a low-income agrarian economy to a medium income export oriented economy, operating as a knowledge-based service hub. Three key constraints will need to be overcome. First, the nascent but growing private sector is yet to play its role as a growth driver, in spite of the sustained improvements in the business regulatory environment. Second, inadequate physical infrastructure remains a key binding constraint to economic growth, human development and growth in exports. Third, institutional and technical capacity has emerged as bottleneck to achieving the desired rapid economic growth. The energy sector is also faced with a cross-section of all these bottlenecks. An energy sector policy and strategy was prepared in 2009 and articulates the mandate of the energy sector to effectively contribute to the country's development agenda. However, achieving the sector's goals and objectives will require prioritizing the following policy imperatives: (Rwanda Energy Sector Review and Action Plan 2013).

2. Statement of the Problem

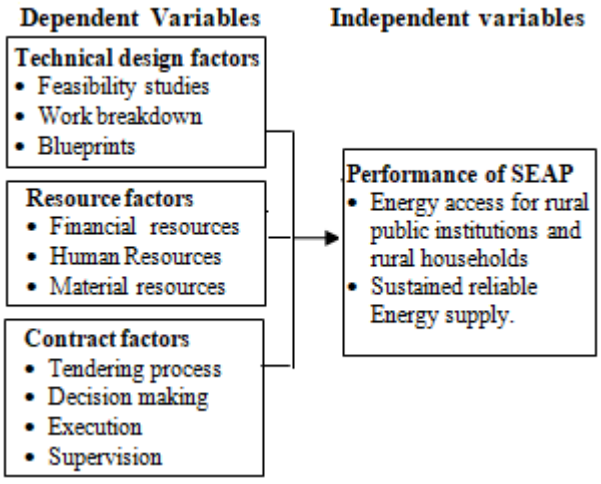
The proposed Scaling-Up Energy Access project was launched in 2013 and expected to be phased out in November 2017. The project covers the Northern and Western provinces of Rwanda. The project expected to upgrade and rehabilitate two existing substations in Northern Province, the Gifurwe substation to 10MVA capacity and the Rulindo substation (also to be relocated) to 20MVA capacity; (ii) build about 464 km of medium voltage (MV) and 710 km of low-voltage (LV) distribution networks in both provinces; and (iii) connect 25,438 households and priority institutions (179 schools, 29 health centers and 25 sector administration offices) to the grid along the constructed distribution network areas. According to the project evaluation report of September, 2017 on performance of Scaling-Up Energy Access project, the project managed to achieve its targets in respect of connecting 179 schools, 29 health centers and 25 sector administration offices. By 15th September, 2017 which is the time the performance evaluation was carried out, and only 15, 568 households were connected against 25,438 targeted.
The project evaluation report did not reveal the factors behind the failure of Scaling-Up Energy Access project to connect all of the targeted households. Given this situation; several factors like resources inadequacy, poor monitoring and evaluation, lack of technical designs, lack of effective contract management systems, poor infrastructures like roads, dispersed households and poor access to finance for local people are said to be on the top of the factors that led to poor performance of Scaling-Up Energy Access project in respect of connecting all of the targeted households. Up to now, there is no consensus among the project's stakeholders about the real factors that led to poor performance of Scaling-Up Energy Access project in respect to connecting all targeted households. Therefore, the researcher is eager to analyze the factors affecting performance of rural electrification projects in Rwanda.

3. Objectives of the study

3.1 General objective

The general objective of this study was to analyze the factors affecting performance of Scaling-Up Energy Access project. Its pacific objectives were to assess the effect of technical design factors on performance of Scaling up Energy Access Project, to examine the effect of resource factors on performance of Scaling up Energy Access Project and to determine the effect contract factors on performance of Scaling up Energy Access Project.

4. Conceptual framework of the study



- **Research Design**: The researcher undertook quantitative research.
- **Target Population**: The target population of this study was 260 members of the project implementation unit and stakeholders including project manager, electrical engineer, civil engineer, and environmentalist, social safeguard specialist and chief accountant.
- **Sample Size**: The Yamane formula was used to calculate the sample size: $n = \frac{N}{1+N(e)^2} = \frac{260}{1+260(0.05)^2} = \frac{260}{1.65} =$ 158 respondents. Where: n= sample size, N= target population, e= level of precision which is equal to 0.05 and confidence level is 95%. Using this formula the researchers come up with a sample size of 158 respondents
- **Data Collection Instruments:** Primary data were collected through the use of questionnaires. The questionnaire had both closed-ended and open-ended questions. The questionnaires were dropped and picked later from respondents.
- **Data Analysis and presentation:**

According to Mugenda (2003), data analysis is the process of data to obtain answers to research questions. The purpose of descriptive statistics is to allow for meaningful description of a distribution of scores or measurements using a few indices or statistics. The primary data were processed through Statistical package for Social Sciences (SPSS) as the most suitable tool, mean, standard deviation and variance were used to interpret the results.

5. Summary of Research findings

5.1 Assessment of the effect of technical design factors on performance of Scaling up Energy Access Project

Table 1: Conducting operational feasibility before implementing the project

Statement		Frequency	Percentage	Cumulative Percentage
	Strongly agree	45	28.5	28.5
	Agree	80	50.6	79.1
	Undecided	30	19.0	98.1
	Disagree	3	1.9	100.0
	Total	158	100.0	

Source: Field Data (2018)

The findings in Table 1 revealed that 50.6% of all respondents agreed that in Scaling Up Energy Access Project the study of operational feasibility has been well conducted before implementing the project, 28.5% of all respondents strongly agreed that that in Scaling Up Energy Access Project the study of operational feasibility has been well conducted before implementing the project and only 1.9% disagreed to that in Scaling Up Energy Access Project the study of operational feasibility has been well conducted before implementing the project

Table 2: Conducting scheduling feasibility before implementing the project

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	69	43.7	43.7
	Agree	69	43.7	87.3
	Undecided	15	9.5	96.8
	Strongly disagree	5	3.2	100.0
	Total	158	100.0	

Source: Field Data (2018)

According to the information from Table2, 43.7% of all respondents strongly agreed that in Scaling Up Energy Access Project, the study for scheduling feasibility has been well conducted before implementing the project, 43.7% of all respondents strongly agreed that in Scaling Up Energy Access Project, the study for scheduling feasibility has been well conducted before implementing the project, 9.5% of all respondents were that in Scaling Up Energy Access Project, the study for scheduling feasibility has been well conducted before implementing the project while only 3.2 % of all respondents strongly disagreed that in Scaling Up Energy Access Project.

Table 3: Conducting technical feasibility study before implementing the project

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	75	47.5	47.5
	Agree	70	44.3	91.8
	Undecided	10	6.3	98.1
	Disagree	3	1.9	100.0
	Total	158	100.0	

Source: Field Data (2018)

The findings in Table3 revealed that; 47.5% of all respondents strongly agreed that in Scaling Up Energy Access Project the study for technical feasibility has been well conducted before implementing the project, 44.3% of all respondents agreed that in Scaling Up Energy Access Project the study for technical feasibility has been well conducted before implementing the project, 6.3% of all respondents were undecided to the statement saying that in Scaling Up Energy Access Project the study for technical feasibility has been well conducted before implementing the project while only 1.9 % of all respondents disagreed that in Scaling Up Energy Access Project the study for technical feasibility has been well conducted before implementing the project.

Table 4: Conducting economic feasibility before implementing the project

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	72	45.6	45.6
	Agree	21	13.3	58.9
	Undecided	51	32.3	91.1
	Strongly disagree	14	8.9	100.0
	Total	158	100.0	

Source: Field Data (2018)

According to the findings in Table 4; 45.6% of all respondents strongly agreed that in Scaling Up Energy Access Project, the study for economic feasibility has been well conducted before implementing the project, 32.3 % of all respondents were undecided to the statement saying that in Scaling Up Energy Access Project, the study for economic feasibility has been well conducted before implementing the project, 13.3 % of all respondents agreed that in Scaling Up Energy Access Project, the study for economic feasibility has been well conducted before implementing the project while only 8.9% strongly disagreed that in Scaling Up Energy Access Project, the study for economic feasibility has been well conducted before implementing the project.

Table 5: Descriptive Statistics on assessment of the effect of technical design factors on performance of Scaling Up Energy Access Project

Indicators	N	Mean	Std. Deviation
Operational feasibility	158	1.94	.742
Scheduling feasibility	158	1.75	.872
Technical feasibility	158	1.63	.691
Economic feasibility	158	2.13	1.252
Valid N (list wise)	158		

Source: Field Data (2018)

From the table above, all statements are approximately equal to 2 the code of agree. This means that in general respondent have agreed that the operational feasibility study has been conducted before implementing the project, scheduling feasibility, technical feasibility and economic feasibility in scaling up energy access project have been conducted. The standard deviation of all statements is above 0.5 meaning that respondents' answers on these statements were far different from the mean, in other words, their answers to the statement were heterogeneous. This means that respondents' views on the above statements were varied.

5.2 Examination of the effect of resource factors on performance

Table 6: Availability of the financial resources for the successful completion of the project's activities

Response		Frequency	Percentage	Cumulative Percentage
	Agree	83	52.5	52.5
	Disagree	30	19.0	71.5
	Strongly disagree	45	28.5	100.0
	Total	**158**	**100.0**	

Source: Field Data (2018)

The findings from Table6 revealed that the majority of respondents which is equal to 52.5% agreed that in Scaling

Up Energy Access Project; financial resources were enough for the successful completion of the project's activities, 28.5% of all respondents strongly disagreed that in Scaling Up Energy Access Project, the project staff was enough for the successful while only 19% of all respondents disagreed that in Scaling Up Energy Access Project, the project staff was enough for the successful completion of the project.

Table 7: Availability of enough project staff for the successful completion of the Project

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	30	19.0	19.0
	Agree	38	24.1	43.0
	Undecided	10	6.3	49.4
	Disagree	60	38.0	87.3
	Strongly disagree	20	12.7	100.0
	Total	**158**	**100.0**	

Source: Field Data (2018)

According to the information from Table7, 38% of all respondents disagreed that in Scaling Up Energy Access Project, the project staff was enough for the successful completion of the project, 24.1% of all respondents agreed that in Scaling Up Energy Access Project, the project staff was enough for the successful completion of the project, 19% of all respondents strongly agreed that in Scaling Up Energy Access Project, the project staff was enough for the successful completion of the project, 12.7% of all respondents strongly disagreed that in Scaling Up Energy Access Project, the project staff was enough for the successful completion of the project while only 6.3% of all respondents were undecided to the statement.

Table 8: Availability of machines needed for the successful performance of the Project

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	78	49.4	49.4
	Undecided	7	4.4	53.8
	Strongly disagree	73	46.2	100.0
	Total	158	100.0	

Source: Field Data (2018)

According to the information from Table4.12, 49.4% of all respondents strongly agreed that in Scaling Up Energy Access Project all machines needed for the successful performance of the project were enough, 46.2% of all respondents strongly disagreed that in Scaling Up Energy Access Project, all machines needed for the successful performance of the project the project were enough while only 4.4% of all respondents were undecided to the statement.

Table 9: Availability of all equipment required for the successful performance of the Project

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	31	19.6	19.6
	Agree	69	43.7	63.3
	Disagree	58	36.7	100.0
	Total	158	100.0	

Source: Field Data (2018)

The findings in Table 9indicated that 43.7% of all respondents agreed that in Scaling Up Energy Access Project, all equipment needed were enough and every project staff had his/her own equipment which were required for the successful performance of the project, 36.7% of all respondents disagreed that in Scaling Up Energy Access Project, all equipment needed were enough and every project staff had his/her own equipment which are required for the successful performance of the project and only 19.6% of all respondents strongly agreed that in Scaling Up Energy Access Project, all equipment needed were enough and every project staff had his/her own equipment which were required for the successful performance of the project

Table10: Descriptive Statistics on the effect of resource factors on Project performance

Indicators	N	Mean	Std. Deviation
Financial resources	158	3.23	1.346
The successful completion	158	3.01	1.378
All machines needed	158	2.94	1.960
All equipment needed	158	2.54	1.176
Valid N (list wise)	158		

Source: Field Data (2018)

Findings from Table10 revealed that the mean values for all statements are rounded off to 3 the code for undecided. This means that majority of respondents have undecided that there is effect of resource factors on performance project. The standard deviation of all statements is above 0.5 meaning that respondents' answers on these statements were far different from the mean, in other words, their answers to the statement were heterogamous. This means that respondents' views on the above statements were varied.

5.3 Determination of the effect contract factors on performance of Scaling Up Energy Access Project

Table 11: Effectiveness of the tendering process

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	68	43.0	43.0
	Undecided	40	25.3	68.4
	Disagree	50	31.6	100.0
	Total	**158**	**100.0**	

Source: Field Data (2018)

According to the information from table11, 43% of all respondents strongly agreed that in Scaling Up Energy Access Project the tendering process was effectively done and all materials needed were available on time, 31.6% of all respondents disagreed that in Scaling Up Energy Access Project, the tendering process was effective and all materials needed were available on time while only 25.3% of all respondents were undecided to this statement.

Table 12: Effective decision making by tendering committee

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	30	19.0	19.0
	Agree	90	57.0	75.9
	Disagree	38	24.1	100.0
	Total	**158**	**100.0**	

Source: Field Data (2018)

The findings from Table12 revealed that 57% of all respondents agreed that in Scaling Up Energy Access Project there was effective decision making for tendering committee, 24.1% of all respondents disagreed that in Scaling Up Energy Access Project there was effective decision making for tendering committee while only 19.0% of all respondents strongly agreed that in Scaling Up Energy Access Project there was effective decision making for tendering committee.

Table 13: Fairness of execution of contract between the contractor and the client

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	100	63.3	63.3
	Agree	28	17.7	81.0
	Undecided	20	12.7	93.7
	Disagree	10	6.3	100.0
	Total	**158**	**100.0**	

Source: Field Data (2018)

The results in Table 13 indicate that 63.3% of all respondents strongly agreed that in Scaling Up Energy Access Project the execution of contract was fair between the contractor and the client, 17.7% all respondents agreed that in Scaling Up Energy Access Project the execution of contract was fair between the contractor and the client, 12.7% of all respondents were undecided to the statement while only 6.3% of all respondents disagreed that in Scaling Up Energy Access Project the execution of contract was fair between the contractor and the client.

Table14: Effective supervision from the supervision team

Response		Frequency	Percentage	Cumulative Percentage
	Strongly agree	66	41.8	41.8
	Agree	40	25.3	67.1
	Disagree	52	32.9	100.0
	Total	158	100.0	

Source: Field Data (2018)

The results in Table14 revealed that 41.8% of all respondents strongly agreed that in Scaling Up Energy Access Project there was effective supervision from the supervision team, 25.3 % of all respondents agreed that in Scaling Up Energy Access Project, there was effective supervision from the supervision team while only 32.9% of all respondents disagreed to this statement.

Table15: Descriptive Statistics on determining the effect contract factors

Indicators	N	Mean	Std. Deviation
The tendering process	158	2.46	1.324
Effective decision	158	2.29	1.036
The execution of contract	158	1.62	.935
Effective supervision	158	2.24	1.299
Valid N (list wise)	158		

Source: Field Data (2018)

From Table15, the mean values for all statements are rounded off to 2 the code for agree. This means that all respondents have agreed that contractor factors have an effect on performance of Scaling Up Energy Access Project. The standard deviation of all statements is above 0.5 meaning that respondents' answers on these statements were far different from the mean, in other words, their answers to the statement were heterogamous. This means that respondents' views on the above statements were varied.

Table16: Descriptive Statistics on performance of Scaling Up Energy Access Project

Indicators	N	Mean	Std. Deviation
Rural public institutions	158	1.89	.914
Rural households	158	2.01	1.065
Reliable Energy supply	158	1.54	.593
Valid N (list wise)	**158**		

Source: Field Data (2018)

From Table16, the mean values for all statements are rounded off to 2 the code for agree. This means that all respondents have agreed on performance of SEAP. The standard deviation of all statements is above 0.5 meaning that respondents' answers on these statements were far different from the mean, in other words, their answers to the statement were heterogamous. This means that respondents' views on the above statements were varied.

Table17: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.933[a]	.871	.868	.332

Results in Table17 An$R^2 = 0.871$ indicate that 87.1% of technical design factors, resource factors and contract factors can be explained by the success of performance of Scale Up Energy Access Project leaving only 13.9% of the variation in the dependent variable being explained by the error-term or other variables other than project success.

Table18: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	114.209	3	38.070	345.638	.000[b]
	Residual	16.962	154	.110		
	Total	131.171	157			

Source: Field Data (2018)
a. Predictors: (Constant), Technical design factors, Resource factors and Contract factors
b. Dependent Variable: performance of SEAP

The findings in Table18 show that predictors: Technical design factors, Resource factors and Contract factors have an effect on performance of Scale Up Energy Access Project. This is statistically significant with a p-value (.000).

Table 19: Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.111	.219		.507	.613
Technical design factors	.581	.060	.472	9.753	.000
Resource factors	-.042	.041	-.062	-1.031	.304
Contract factors	.321	.053	.464	6.019	.000
a. Dependent Variable: performance of SEAP					

6. Discussions of Results

The results indicate thatTechnical design factors, Resource factors and Contract factorshave statistically significant effect on success of project with a positive coefficient of determination of 0.933 (table 20) indicates that there is a strong positive correlation between Technical design factors, Resource factors and Contract factors with performance of SEAP. The coefficients of independent variables (TDF, RF and CF) $\beta_1, \beta_2 and \beta_3$are respectively 0.581; - 0.042 and 0.321 with a statistically significant ($p = 0.00$). Therefore, the model equation derived is: $y = 0.111 + 0.581x_1 - 0.042x_2 + 0.321x_3 + e$. The positive coefficient further demonstrates that a 1% increase in the technical design factors attributed to 0.581% improvement in performance of SEAP the t-statistic value (0.507) indicates the effect is statistically significant at 95% confidence level. A decrease of 1% on resource factors will decrease performance of Scale Up Energy Access Project given by - 0.041 % at the high t-statistic value (9.753) indicate the effect is statistically significant at 95% confidence level while a positive coefficient demonstrates that a 1% increase in contractor factors an increase of 0.321 on performance of Scale Up Energy Access Project with t-statistic value (6.019) indicate the confidence level of 95% the effect is statistically significant. This demonstrates that performance of Scale Up Energy Access Project exhibited in terms of Technical design factors, Resource factors and Contract factors executed excellently.

7. Conclusions

According to the interpretation of collected and analyzed data during the course of this study; the researcher came up with the following conclusions:

1) Based on the information drawn from findings the researcher concluded that the effect of technical design factors on performance of Scaling up Energy Access Project is significant. It was found out that the project could not perform without operational feasibility. Project also should not succeed without efficacy of technical feasibility.
2) The findings demonstrated that there is a strong relationship between resource factors and performance of Scaling Up Energy Access Project. The study found out that financial resources have a great effect on successful completion of the project's activities. It showed that the increase of one unit in resource factors would increase the performance of Scale Up Energy Access project by .298 units if other variables remain constant.
3) findings study demonstrated that there is a strong relationship between contract factors and performance of Scaling Up Energy Access Project where the increase of one unit in resource factor increases the performance of Scaling Up Energy Access Project by .176 units if other variables stay constant.

8. Recommendations

After analysis and interpretation of data, the researcher came up with the following recommendations:

1) Project management should consider technical design factors in order to ensure effective implementation of project activities
2) Project managers should put much emphasis in availing enough resources including human, financial and material so as to ensure the successful performance of the projects
3) Project managers and their project teams must consider the contract factors so as to ensure that the tendering processes are effective and all materials needed are available on time

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