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EFFECT OF NATURAL DISASTERS 'OCCURRENCE ON POOR PERFORMANCE OF ROAD CONSTRUCTION PROJECTS IN SOUTH PROVINCE OF RWANDA;

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Abstract

The Rwanda like other African countries is facing with the many challenges in road construction industry. These are uncertain and unstable construction environment, uncompetitive construction firms, changes in project design, climate changes and relocation of utilities and citizens. The study was cunducted to assess the effect of natural disaters'occurrence on poor performance of road construction projects in southern province of Rwanda. The 2 districts of South province such as Nyamagabe, and Gisagara were considered for this study and the descriptive research design was used for this study. The population comprises 520 whereby sample size was 122 respondents to provide relevant information for the study. The questionnaires were used as tools for data collection and statistical analysis was performed to establish relationship between effect on natural disasters 'occurrence and performance of road construction projects in south province of Rwanda. The frequencies, percentages, mean, standard deviations, correlation and regression coefficient were used to present, and to interpret the findings. The results indicated that; the correlation coefficient between Natural disaters'occurrence and poor performance of road construction projects is high as it was equal to (r =0.974); and regression coefficient was ($\beta3$= β3=0.659). Therefore, there is high positive correlation between natural disasters 'occurrence and poor performance of road construction projects; and this implies that; an increase by one unit in Natural Disasters, would result to an increase by 65.9% changes in overall poor performance of road construction projects in southern province of Rwanda. The effect of natural disasters is the fundamental project management challenge, that lead to poor performance of road construction project in southern province of Rwanda and it recommended that, this should be taken under consideration before during project design;

planning and before stating implementation of road construction projects in order to enhance project performance.

Keywords: Natural disaters'occurence, Road construction projects, poor performance of road construction projects

1. Introduction

Rwanda understands the importance of infrastructure especially roads in the development of private sector. the government of Rwanda has decided to invest heavily in infrastructure Development such roads, rail, and water with the intent of dramatically reducing the cost of transport to businesses and individuals (RDB,2015).

In Rwanda, land transport is concerned with the upgrading, rehabilitation and maintenance of national roads, districts roads, feeder roads development and unclassified roads to improve public transport services. However, the road construction projects encompassed the following main challenges in the country(RTDA, 2020).

However, the road construction projects encompassed the following main challenges in the country. These are;(1) Unpaved Road network in deteriorated condition due to inadequate maintenance and low investment leading to low levels of service and continuity;(2) Prioritization of road maintenance based on current classification does not adequately take into account functions, construction materials and level of usage of each link;(3) Faster deterioration of the road pavement due to overloaded trucks;(4) Quality control and assurance of road infrastructure inadequate due to application of various standards, guidelines and specifications and (5) Professional staff lack specialized training in procurement, analysis and design of complex road systems, and contract management(. (MININFRA, 2019). Therefore, the most construction projects in Rwanda take place in challengeable and competitive environment in which many changes occur and cause

negative project outcomes as were not managed properly (Mbabazi, 2016)

2. Statement of the problem

The main problems for road construction projects in Rwanda are expropriation issues that delayed implementation plan, lack of land titles for land owners, complaints and non-compliance of land owners, high expropriation cost due to deterioration of environment reserves, in appropriate Environment Impact Assessment (EIA), insufficient funds due to multi-projects implementation, natural disasters that results to damage of road infrastructures (RTDA, 2020). The research gap in the area of road construction projects, is based on challenges faced by contractors in relation to effect on natural disasters where there is very little knowledge about the challenges interfere the project activities-and results to poor performance of road construction projects in Rwanda. Therefore, this study is attempted to assess the effect of natural disasters on poor performance road construction projects in South Province of Rwanda as the main challenge faced by projects managers in road construction industry.

3. Literature Review

3.1. Natural disaster occurrence

Most soils of Rwanda have high clay content in deeper soils that increase the water holding capacity, soils layers rich in clays are in deep horizons and cause slumps in south and western provinces of Rwanda (Moeyersons, 2003). Natural disasters such as landslides due to high rainfall resulted in damage of roads constructed, then after the project require extra amount for maintenance and cause cost overruns in projects. Therefore, large

amount of the debris is accumulated in the roads must be removed off and these tasks require additional labour and equipment that incur addition project cost and time. Therefore, the project contactors are faced with the problem of increasing the cost/budget of overall project activities (Safapour, Kermanshachi, & Nipa, 2020). Natural disasters affect road projects as cause damage the land, equipment led to financial stress of project managers. The damage of roads a long project implementation can cause temporary cessation of construction project, and delay for repairing and restoration of road infrastructures damaged (Safapour, Kermanshachi, & Nipa, 2020). The un expected situations can occur to impact the completion of road construction projects and may increase the project costs, these un expected can arise from natural disasters such as earthquakes, hurricanes and floods (Rouhanizadeh & Kermanshachi, 2019).

Natural disasters disrupt natural environment where population or citizen's dwell. These unexpected natural disasters can affect the performance of road construction projects as it requires to find out the disaster management strategies and logistic support for the damaged utilities (Anthopoulos, Kostavara, & Pantouvakis, 2013). Road's destruction, is general resulted with problem of soil ground, and this is indicated by road slides, and loss of strength of the soil. The types of soil' particles determine the strength of the soil to persist on natural disasters (Santos,2007). For instance, if the soil particles are loose, the earthquakes can cause the direct damage of roadway, and landslides provide the considerable masses of debris which block roads, thereafter demand the operating cost to remove these debris from roadways (Noy,2009).

3.2. Effect of natural disasters and poor performance of road construction projects

Pethkari and Birajdar, (2014) emphasized on causes of delay in building construction project and findings revealed that effects of natural disasters like unforeseen subsurface and changing ground conditions such as soil, water table cause the disruption in implementation of construction projects that affect the performance of project vis a vis cost budget, time and quality of project outputs. The study conducted by Shebob, Dawood, and Xu, (2011), indicated that delay in land acquisition and expropriation, faulty soil investigation report, delaying in performing site inspection and testing, delay in obtaining permits from municipality, and inappropriate environment impact assessment reports are challenging factors that humper the performance of construction projects.

According to Safapour, Kermanshachi and Nipa (2019), conducted the study for investigating the challenges of road construction projects. They concluded that, the natural disasters resulted in damage to structures that led to reconstruction costs of approximately $5 billion. Safapour, Kermanshachi, and Nipa (2020), concluded that, natural disasters are among major factors that cause failure of road construction projects because they raise the costs of the projects and completion at behind schedule. Chang, Wilkinson, Seville, and Potangaroa (2012), indicated that, natural disasters resulted in shortages of resources, such as labors, construction materials, and additional project budget for maintenance of roads damaged after disaster's occurrence. Ham, Lee, and Chowdhury, (2017) said that, natural disasters, resulted to increase the skilled road engineers, and land

surveyors in order to redesign the road construction projects as one of strategy for disaster management and resiliency to natural disasters.

4. Research methodology

The research design of this study was descriptive research, whereby both quantitative was used. With descriptive research design, the correlation technique was undertaken in order to describe the relationship between effect of natural disaster 'occurrence and poor performance of road construction projects in South province of Rwanda. The target population of this study are all stakeholders of road construction projects in southern province of Rwanda. The 2 districts of South province such as Nyamagabe, and Gisagara were considered for this study. The four road construction projects were under consideration for the study. These projects are; (a) Project of upgrading works of Huye-Kitabi Asphalt Road;(b) Project of rehabilitation of Kirengeri-Buhanda-Kaduha gravel road;(c) Project of rehabilitation of Save-Mamba gravel Road; and(d) Project of upgrading Huye-Gisagara Asphalt Road. The population of this study comprises (269) employees of these projects, the contractors' managers (23), technical services providers (69), Communities around road construction projects (91), Rwanda Transport Development Agency (RTDA) staff (15), Local Government administrators (28) and senior site engineers (25); and making a total of 520 project stakeholders.

In order to get this sample, mathematical formula of (Yemane,1967) was manipulated.

$n=N/[1+N(e)^2]$; Where, n= Sample size; N= Population; and e= Error term of 10% was assumed for random sampling survey;

By using the above formula

$n=N/[1+N(e)^2]$

$n= 520/ [1+520(0.1)^2]$

$n= 520/4.25= \textbf{122;}$ therefore, the sample size is 122 respondents.

The purposive sampling technique was used as researcher want to collect required data from key personnel/experts in the road construction projects. Under this study, the sampling frame comprised, employees of road construction projects, the contractors' managers, technical services providers, communities around road construction projects, Rwanda Transport Development Agency (RTDA) staff, Local Government administrators in south province, and senior site engineers. The questionnaires were prepared to collect information to address the effect of natural disaster's occurrence on poor performance of road construction projects in Southern province of Rwanda.

Descriptive statistical parameters such as frequencies, mean, standard deviations and percentages were used to analyze the data. Correlation coefficients and ANOVA were manipulated to test the hypotheses and to verify the relationship between natural disaters'occurrence and poor performance of road construction projects in southern province of Rwanda.

5. Major findings

5.1. Analysis of responding rate of questionnaires

Table 5.1. Response rate of questionnaires

	Questionnaires	Response rate/ Non response rate (%)
Turned back	112	91.8%≈92%

| Non turned back | 10 | 8.1%≈8% |
| Total | 122 | 100% |

Source: Primary data,2022

The findings indicated that 112 questionnaires were successfully answered with response rate of 92%, but 10 questionnaires were not answered (8%). As response rate of questionnaire is above 90%, the findings were accepted to for the study.

5.2. Analysis of characteristics of respondents

Table 5.2. Gender of respondents

		Freq	Percent (%)	Valid %
Valid	Male	98	87.5	87.5
	Female	14	12.5	12.5
	Total	**112**	**100.0**	**100.0**

Source: Primary data,2022

The findings presented in table52; indicate that, the majority of respondents (87.5%) were males and (12.5%) were females. These findings confirmed that, males dominate in management and implementation for roads construction projects in comparison to females.

Table 5.3. Age category of respondents

		Freq	Percent (%)	Valid %
Valid	20-30	9	8.0	8.0
	31-40	19	17.0	17.0
	41-50	47	42.0	42.0
	51-60	37	33.0	33.0
	Total	**112**	**100.0**	**100.0**

Source: Primary data,2022

The findings in table 5.3, indicate that, the majority of respondents (42.0%) were 41-50 years, 33.0% were in 51-60 years; 17.0% were in 31-40years and 8.0% were in 20-30 years. These findings implied that, the information regarding to project management challenges and poor performance road construction projects were collected form mature people who are able to express their opinions and views in relation to study matters.

Table5.4. Educational background of respondents

		Freq	Percent (%)	Valid (%)
Valid	Primary	0	0	0
	Secondary	27	24.1	24.1
	Bachelor	48	42.9	42.9
	Master	34	30.4	30.4
	Doctor	3	2.6	2.6
	Total	**112**	**100.0**	**100.0**

Source: Primary data,2022

The findings presented in table 5.4, indicate that, the majority of respondents (42.9%) participated in this study were holders of bachelor 's degree; 30.4% of respondents were holders of Master's degree, 24.1% of respondents have accomplished secondary education and 2.6% of respondents were Doctors. This implies that, the road construction projects mostly require the professionals, who are able to provide the expertise, analyzing information, able to face with challenges, looking to improve the situation and adapting to situation changes. Education background of respondents provide information to explore a multitude factors and theories need to be combined in order to analyze the challenges of road construction projects.

Table 5.5. Working experience of respondents

	Freq	Percent (%)	Valid (%)

Valid	1-2Years	0	0	0
	2-4Years	0	0	0
	4-6Years	42	37.5	37.5
	>6Years	70	62.5	62.5
	Total	**112**	**100.0**	**100.0**

Source: Primary data,2022

The findings presented in table 5.5, indicate that, the majority (62.5%) of respondent's hove working experience over 6 years in road construction projects, followed by 37.5% of respondents reported that they have working experience between 4-6yeas in road construction projects.

5.2. Poor performance indicators of road construction projects

Table 5.6. Poor performance indicators of road construction projects

	N	Mean	Std. Dev
Failure to complete road project with specified budget (Budget overrun)	112	1.6071	.88386
Additional cost for rework or maintenance	112	2.0446	.95284
Completion of project behind of schedule	112	2.2411	1.26096
Poor road quality after project handover	112	1.7054	.56375

Source: Primary data,2022

The findings presented in table 5.6, indicate statistical presentation of poor performance indicators road construction projects in Southern province of Rwanda.

The findings revealed that, failure to complete road project with specified budget/Budget overrun (N=112; Mean=1.6071; Std. Dev = 0.88386); additional cost for rework or maintenance (N=112; Mean=2.0446; Std. Dev = .95284); completion of project behind of schedule (N=112; Mean=2.2411; Std. Dev = 1.26096); and poor road quality after project handover (N=112; Mean=1.7054; Std. Dev = 0.56375). These poor performance indicators, do not differ significantly, as indicated in the standard deviations of more than one (Std. Dev >1.0), poor road quality after project handover (Std. Dev <1.0); (Failure to complete road project with specified budget (Budget overrun) (Std. Dev <1.0), do significantly differ as reflected in standard deviations.

These findings are in comparison of Mathethwa (2016) noted that, the poorest performance indicators in infrastructure projects are cost overrun, poor quality of project outputs, and projects being completed long after the time scheduled initially. The damage of roads a long project implementation can cause temporary cessation of construction project, and delay for repairing and restoration of road infrastructures damaged (Safapour, Kermanshachi, & Nipa, 2020). The un expected situations can occur to impact the completion of road construction projects and may increase the project costs, these un expected can arise from natural disasters such as earthquakes, hurricanes and floods (Rouhanizadeh & Kermanshachi, 2019). Road's destruction, is general resulted with problem of soil ground, and this is indicated by road slides, and loss of strength of the soil. The types of soil' particles determine the strength of the soil to persist on natural disasters (Santos,2007).

5.3. Effect of natural disasters on poor performance of road construction projects

Table 5.7. Effect of natural disasters on poor performance of road construction projects

	N	Mean Dev	Std.
Occurrence of unexpected natural disasters resulted in demand of additional money for materials and labors	112	1.4643	.61408
Occurrence of unexpected natural disasters resulted in increase of project schedule for rework and maintenance	112	2.2411	1.30312
Occurrence of earthquakes frequently in southern of Rwanda was resulted to destruction of roads	112	1.8125	.83322
Characteristics of clay soils that hold seepage water and cause road slides	112	2.3929	1.48480
Inappropriate of EIA for project sites has resulted for unplanned cost for expropriation	112	2.0982	1.04803

Source: Primary data,2022

The findings presented in table 5.7, indicate statistical presentation of responses about effect of natural disasters and poor performance of road construction projects in Southern province of Rwanda. The questions were asked to the respondents whether the poor performance of road construction projects depends on effect of natural disasters.

The findings indicated that; occurrence of unexpected natural disasters resulted in demand of additional money for materials and labors (N=112; Mean=1.4643; Std. Dev = 0.61408); occurrence of unexpected natural disasters resulted in increase of project schedule for rework and maintenance (N=112; Mean =2.2411; Std. Dev = 1.30312); earthquakes frequently in southern province of Rwanda was resulted to destruction of roads (N=112; Mean=1.8125 ; Std. Dev =0.83322); characteristics of clay soils that hold more water and cause road slides (N=112; Mean=2.3929; Std. Dev =1.48480); and inappropriate of EIA for project sites has resulted for unplanned cost for expropriation (N=112; Mean=2.0982; Std. Dev = 1.04803). These are natural disasters that affect poor performance of road construction projects in southern province of Rwanda, but the extent to which poor monitoring and evaluation practices as major factor for poor performance of road construction projects, does not differ significantly, as indicated in the standard deviations of more than one (Std. Dev >1.0). The exception was found occurrence of unexpected natural disasters resulted in demand of additional money for materials and labors (Std. Dev <1.0); and earthquakes frequently in southern province of Rwanda (Std. Dev <1.0), do significantly differ as reflected in standard deviations. These findings implied that, effect of natural disasters is among the fundamental project management challenges, that lead to poor performance of road construction project in southern province of Rwanda. The findings supported by Pethkari and Birajdar, (2014) emphasized on causes of delay in building construction project and findings revealed that effects of natural disasters like unforeseen subsurface and changing ground

conditions such as soil, water table cause the disruption in implementation of construction projects that affect the performance of project vis a vis cost budget, time and quality of project outputs. The same findings of Safapour, Kermanshachi, and Nipa (2020), concluded that, natural disasters are among major factors that cause failure of road construction projects because they raise the costs of the projects and completion at behind schedule. The results also supported by Chang, Wilkinson, Seville, and Potangaroa (2012), who indicated that, natural disasters resulted in shortages of resources, such as labors, construction materials, and additional project budget for maintenance of roads damaged after disaster's occurrence. Ham, Lee, and Chowdhury, (2017) said that, natural disasters, resulted to increase the skilled road engineers, and land surveyors in order to redesign the road construction projects as one of strategy for disaster management and resiliency to natural disasters.

Table5.8. Correlation analysis between Natural disasters and poor performance of road construction projects

		Effect of Natural disasters	Poor performance of road construction projects
Effect of Natural disasters	Pearson Correlation	1	.974**
	Sig. (2-tailed)		.000
	N	112	112
Poor performance of road construction projects	Pearson Correlation	.974**	1
	Sig. (2-tailed)	.000	
	N	112	112
**. Correlation is significant at the 0.01 level (2-tailed).			

Source: Primary data, 2022.

The findings revealed that, natural disasters is strong positively correlated to poor performance of road construction projects with Pearson's correlation coefficient (r =0.974)>0.7 and this, tell us that; the natural disasters on the sites, are strong positively correlated to poor performance of road construction projects in southern province of Rwanda.

Table 5.9. Regression coefficients

Coefficients					
Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	.181	.047		3.843	.000
Effect of Natural disasters	.659	.071	.767	9.353	.000
a. Dependent Variable: Poor performance of road construction projects					

Source: Primary data,2022

Regression analysis indicated that; effect of natural disasters has contributed to poor performance of road construction projects; as (β3=0.659), P-value =0.000<0.05 and considering that, other factors affected, the poor performance of road construction projects are remained constant at zero scale. This implies that; an increase by one unit in natural disasters 'effect, would

result to an increase by 65.9% in poor performance of road construction projects in southern province of Rwanda. These findings supported by the study conducted by Safapour, Kermanshachi, and Nipa (2020), who concluded that various unexpected situations in nature can occur that impact negatively the completion and performance of road construction projects.

6.Conclusion and recommendations

6.1. Conclusion

The unexpected and destructive power of natural disasters diminish the social stratification and cause physical damage of road infrastructures and psychological trauma to society and harm greatly the environment. The findings indicated that; occurrence of unexpected natural disasters such as earthquakes; roadsides and inappropriate of EIA for project sites. These natural disasters have resulted in demand of additional money for materials and labors; increased project schedule for rework and maintenance; and unplanned cost for expropriation. By conclusion, natural disaters'occurrence is among project management challenges considered for this study, that was resulted in poor performance of the road construction projects. This was verified by the findings under the study revealed that, effect of natural disasters greatly contributed to poor performance of road construction project in southern province of Rwanda.

6.2. Recommendations

The road construction projects; in most cases are poorly performed as they faced with natural disasters and managers of this projects deal with damage to buildings and infrastructures that must be repaired immediately. Sometime natural disaster recovery made without knowledge of effective strategies to prevent the

disaster's occurrence for the future. Based on the findings of this study; it recommended that; road engineers; contractors and government entities should sit together for better decision-making regarding, to the site inspections; soil testing; the timing and planning for construction materials in accordance to situation of the sites and for future disasters.

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