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Credit Risks Ascendancy on Water-Sanitation Infrastructure Investments in Kenya

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ABSTRACT

The study investigated the ascendancy of credit risks on water-sanitation infrastructure investments in Kenya. The study adopted a mixed methodology research design where qualitative and quantitative research approaches are used to test the research hypotheses. From a target population of 127, Total Population Sampling (TPS) was adopted whereby the whole population was studied. Both descriptive and inferential analysis methods were employed in the analysis. Standard deviation results range falls within the bracket of ≤1.25, which is acceptable. From our 5-point Likert scale the mean of variable data set ranges between acceptable levels. At |t|≥1.96 the overall t value for the independent values indicates a strong impact of the predicting quality of the coefficient. The overall p-value at less than 0.05 (typically ≤ 0.05) is statistically significant. For the Adjusted R square findings showed credit risks explain the variations in infrastructure investments while the difference explained in other factors not in the model. The value of r varies around 0.3 to 0.5 signifying Moderate/medium and strong/large correlation respectively. Generally, credit risks make a strong unique contribution explaining infrastructure investments. The study results show that that lack of access to funding infrastructure investments has seen poor cost recovery, weak governance and lack of institutional frameworks that adversely affect economic opportunities. From the empirical evidence and conclusion, an advancement to credit risks will need innovative financing models rolled out through co-financing and blended financing, risk pooling through tailor made infrastructure insurance products, private entity receiving a concession from the public sector to finance, design, construct, own, and operate a facility stated in the concession contract.

Keywords: Credit Risks, Water and sanitation, Infrastructure Investments, Exposure Rate risk

I. INTRODUCTION

Globally, access to water and improved sanitation is critical as affirmed by the Millennium Development Goals (MDG), Agenda 63 of AU and Kenya Vision 2030 (African Union Commission, 2015; Ndung'u, Thugge & Otieno, 2011). Thus, investing in the sector is critical. Based on tabled stakeholder briefs governments and other stakeholders have continued to invest resources currently estimated at between $74 and $166 billion per year (Hutton & Varughese, 2016). The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) recently reported, 2.2 billion people lack access to safely managed drinking water services and 4.2 billion people lack safely managed sanitation services.

Around forty percent of the population in Sub-Saharan Africa (SSA) lack access to safe drinking water sources, while sixty-nine percent do not have access to improved sanitation facilities (Africa Development Bank, 2011). The situation is worse in rural areas, where fifty-five and seventy-six percent have no access to safe drinking water and adequate sanitation, respectively (Africa Development Bank, 2011). Low access to sanitation and water supply are root cause of many diseases affecting continent. Access to water and sanitation is a human right, yet numbers show no guarantee to all. By 2025, it is estimated that Africa's population will have grown to approximately 1.34 billion people, and with uneven distribution of water across the continent, where some areas are already suffering lack of freshwater availability, more than 25 African countries will be subject to water scarcity or water stress, with Northern Africa facing the worst predictions (African Development Bank, 2011).

Figure 1 below shows the average annual infrastructure investments for Africa between 2012 and 2017at USD 70 billion, with governments meeting over 40% of the financing. Of this, water and sanitation received an annual average investment of USD 12.7 billion representing about one fifth of the estimated annual requirement of USD 56-66 million which indicates the need for greater effort to raise funds for the sector (Africa Development Bank, 2018 African Economic Outlook).

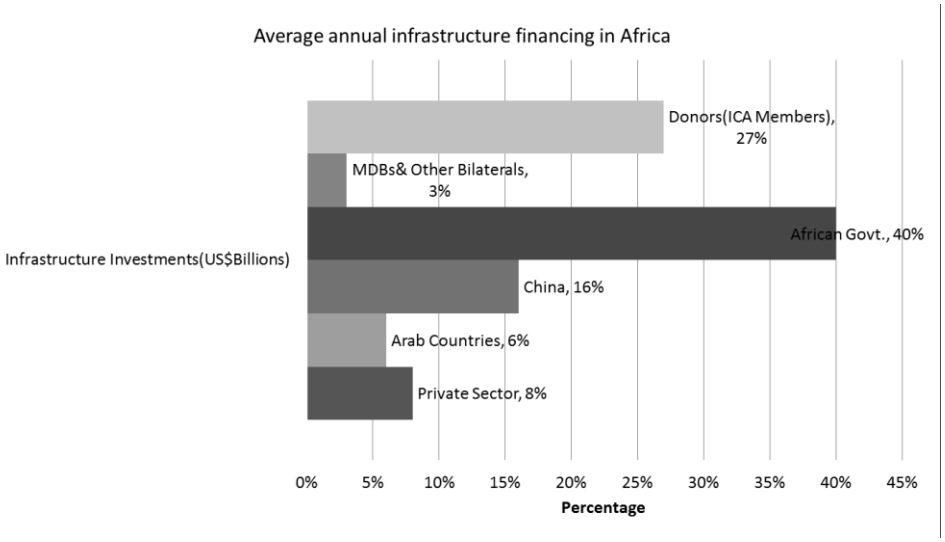


Figure 1: Average annual infrastructure financing in Africa, by source (2012-17) in US $ billion
Source: Africa Development Bank, 2018 African Economic Outlook

In Kenya, the drive towards improvement in water and sanitation infrastructure investments dates back in the late 1960s upon attainment of independent. This has seen investment in basic facilities including water and sewerage nationalized for purposes of improved economic access to water and sanitation services aimed at improving health outcomes (Nyanchaga, 2016). The sector, however, continues to face risks as water and sanitation infrastructure investments targets especially in rural coverage is below the expectations as indicated in the Ministry's blue print. In the National Water

Services Strategy, the government aimed at achieving 80% access to safe and reliable water for urban areas and 75% for rural areas by 2015 (Ministry of Water and Irrigation, 2007). The WASH joint monitoring programme report (2019) by The World Health Organization and UNICEF however show that only 59% of Kenyans have access to basic water services and only 29% have access to sanitary services.

II. THE PROBLEM

Capital investments relating to Water and sanitation infrastructure according to a report by WHO/UNICEF in 2017 was estimated at between $74 and $166 billion per year. Despite this, 2.2 billion people worldwide lack access to safely managed drinking water services and 4.2 billion people lack safely managed sanitation services. 40 percent of the population lack access to safe drinking water sources, while 69 percent do not have access to improved sanitation facilities (Armah et al., 2018). The situation in rural areas is even worse, with 53 percent and 76 percent not having access to safe drinking water and adequate sanitation, respectively (Armah et al., 2018). It is estimated that investment required to meet Africa's water needs is between US$50 billion to U$54 billion per year for each of the next twenty years (African Development Bank, 2011). Forecasts on annual spending required for the water sector reveal a sizeable financing gap.

In Kenya, water supply and sanitation investments only cater for 42 percent and 31 percent of the population (World Bank, 2020). Lack of water and sanitation exacerbated by accelerated inflation, poor cost recovery, Lack of access to financing, weak governance and institutional frameworks adversely affects Kenyan citizens' health, as well as their access to educational, economic opportunities, their work efficiency and labor productivity. Further Water Service Provider (WSP) responsible for providing water and sanitation services are hobbled by weak incentives for better performance, aging infrastructure, ineffective operations and maintenance, weak institutional capacity, and little accountability to consumers. Uncompetitive water and sanitation tariffs, inadequate investments and infrastructures are key causes of inadequate water supply and sanitation investments.

III. OBJECTIVE

The study sought to examine the influence of credit risks on water-sanitation infrastructure investment in Kenya by specifically looking at exposure rate risk, recovery rate risk, sovereign risk and finally settlement risk.

IV. LITERATURE REVIEW

Merton model

In 1974, Merton proposed this model used to assess the credit risk of a company's debt. Analysts and investors utilize it to understand how capable a company is at meeting financial obligations, servicing its debt, and weighing the general possibility that it will go into credit default (Tudela & Young, 2003).

This model was later extended by Fischer Black and Myron Scholes to develop the Nobel-prize winning Black-Scholes pricing model for options. Basic assumptions include, all options are European and are exercised only at the time of expiration, no dividends are paid out, Market movements are unpredictable (efficient markets), no commissions are included, underlying stocks.

A recent report by the Auditor General on Non-performing loans meant for Water & sanitation Infrastructure Investments in Kenya currently amount to Kshs.101.6 billion. Investors shy away from firms unable to abide by the terms, conditions of any financial contract. A credit risk is risk of default on a debt that may arise from a borrower failing to make required payments. In the first resort, the risk is that of the lender and includes lost principal and interest, disruption to cash flows, and increased collection costs. The loss may be complete or partial. Water and sanitation Infrastructure investment risks need to be known and measured to the investors for purposes of forecasting returns.

V. METHODOLOGY

Positivism was adopted whereby deductive reasoning was used to put forward theories that were tested by means of fixed, predetermined research design and objective measures. The study adopted a mixed methodology research design where qualitative and quantitative research approaches were used to test the research hypotheses. A causal design was used to measure the impact a specific change will have on existing norms and assumptions. As seen in Appendix 1 the target population constitutes one twenty-seven (127) Government and Non-Government entities whose main mandate is water supply-sanitation (WSS) services in Kenya and oversee related infrastructure investments. Total population sampling was adopted whereby the whole population of interest in these case members who share a given characteristic was studied. It is most practical when the total population is of manageable size, such as a well-defined subgroup of a larger population. The total population sampling would be a good way to conduct a survey meant to get the opinions of different players in the Water Sanitation Infrastructure Investment space. In practice, total population sampling is done when the target group is small and set apart by an unusual and well-defined characteristic.

The questionnaires as one of the primary data collection tools were pilot tested and revised before they are used in the research project. The pilot and pretesting, followed by a through revision of the questionnaire will produce a much better measurement instrument that will cause far fewer problems during the research and will give more accurate results. Responses from questionnaires were coded with numbers. Since a scale was used, the numbers were the scale points. Numbers were arbitrarily assigned to nominal categories for questionnaire items that do not use magnitude-type measurement. These numbers are typically placed into fixed columns on one or more data lines. These data lines contain all the responses for a single questionnaire. For Secondary data a preliminary search for information was

key, location of relevant materials, evaluation of sources, making notes and inclusion in the final project through proper citation of sources.

The study used the Test-Retest/Stability Reliability which compares results from an initial test with repeated measures later, the assumption being that if the instrument is reliable there were close agreement over repeated tests if the variables being measured remain unchanged. The Kappa score, specificity, and positive predictive values (PPVs) were also used to measure reliability and validity, respectively. Reliability was tested using Cronbach's alpha. Cronbach's alpha is known as a good measure of reliability. The values of Cronbach's alpha ranges between 0 and 1 where the Cronbach's alpha values between 0.8 and 1.00 indicate a considerable reliability, values between 0.70 and 0.80 indicate an acceptable reliability while values below 0.70 are considered less reliable and unacceptable (Nunnally, 1978). In this study, Cronbach's alpha coefficient which is a measure of internal consistency was used to assess reliability. Reliability indices for the pilot study ranged from 0.934 to 0. 962. This suggested acceptable levels of internal consistency. This implies that the items included in measuring different constructs were indicative of the same underlying disposition. Reliability of the constructs is shown in the table below.

Table 1: Reliability Test of Constructs

Variables	Cronbach's Alpha	Number of Items	Reliability
X-Credit risks	.934	23	Accepted

To test the causality and to determine the nature of the relation between credit risk factors and investment in water and sanitation infrastructure, regression model was used. This enabled to determine how the independent variables influence the dependent variable. The mode adopted was $Y = \beta 0 + \beta_1 X_1 + \varepsilon$

Where Y: = Infrastructure Investments in Water and Sanitation

X_1 = Credit risk constructs that included exposure rate risk, Recovery rate Risk, Sovereign Risk, Settlement Risk,

β_1 = The sensitivity of Infrastructure Investments in Water and Sanitation to the independent variable i (coefficients of the independent variables)

ϵ = The error term.

VI. RESULTS

A. Statistical tests

Various statistical tests were conducted including normality tests, Homoscedasticity, linearity and multicollinearity. The results summarized in Table 4 indicate Skewness was between -2 to +2 and Kurtosis between -7 to +7. Correlation coefficient was less than 0.7 indicating lack of Multicollinearity.

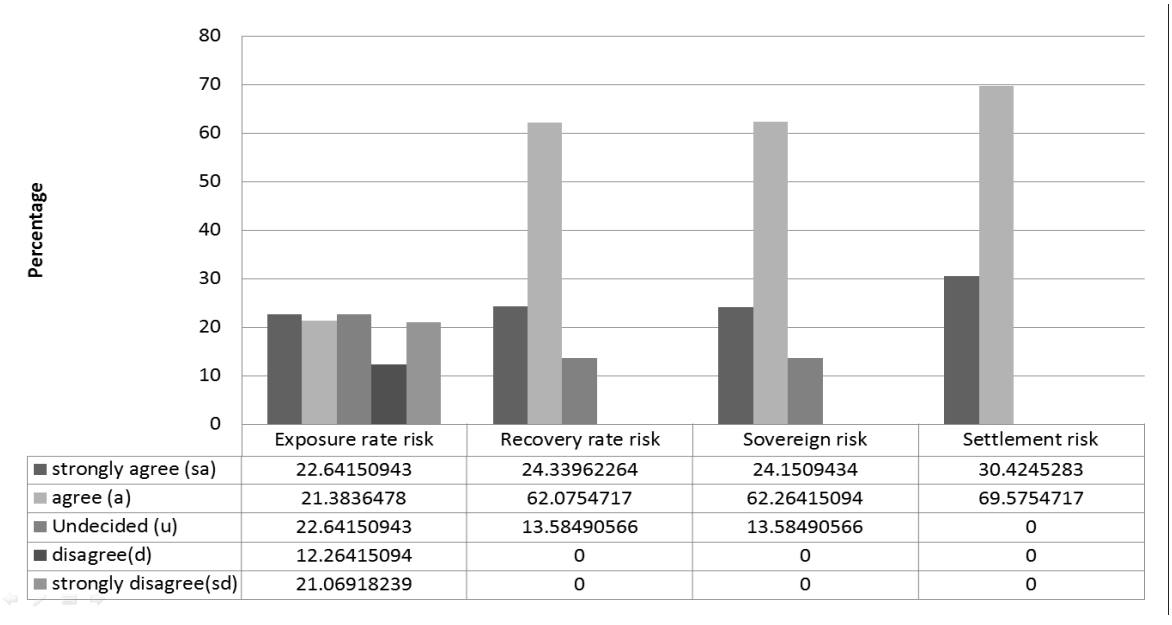
The data distribution has a very tight distribution to the left of the plot, and a very wide distribution to the right of the plot an indication that the data is not homoscedastic. The predictor variables in the regression have a straight-line relationship with the outcome variable.

Table 2: Statistical test results related to Credit risk

Risks	**Normality tests**		**Homoscedasticity test**	**Linearity test**	**Multicollinearity test**
	Skewness	**Kurtosis**			
Credit risks	Y (-0.28) X1(0.25)	Y (-1.22) X1(-1.14)	From the plot the data is not homoscedastic. The data distribution has a very tight distribution to the left of the plot, and a very wide distribution to the right of the plot.	The predictor variables in the regression have a straight-line relationship with the outcome variable.	Ranges between 0.119325 to 0.54622

B. Descriptive Statistics Credit risk and Water-Sanitation Infrastructure Investment

Results show that respondents agreed that exposure rate risk, recovery rate risk, sovereign risk and settlement risk affect infrastructure investments in the water and sanitation sector respectively, at 43%, 86%, 86% and 100%



	Exposure rate risk	Recovery rate risk	Sovereign risk	Settlement risk
strongly agree (sa)	22.64150943	24.33962264	24.1509434	30.4245283
agree (a)	21.3836478	62.0754717	62.26415094	69.5754717
Undecided (u)	22.64150943	13.58490566	13.58490566	0
disagree(d)	12.26415094	0	0	0
strongly disagree(sd)	21.06918239	0	0	0

Figure 1: Summary statistics and graphs are used to present the Credit risk properties

C. Regression analysis of Credit risk and Water-Sanitation Infrastructure Investment

The results show that Credit risk on Infrastructure investments in Water and Sanitation is significant. The regression equation can be used to predict Infrastructure investments in Water and Sanitation. This means that our model explains the Adjusted R Square of the variance in Credit risks. The result stipulates that there is a highly significant, direct and positive relationship between the sub-variable and

Infrastructure investments in Water and Sanitation. The variable makes a strong unique contribution to explaining risks associated with Infrastructure investments in Water and Sanitation.

Table 3: Regression Statistics results

Multiple R	0.439959
R Square	0.193564
Adjusted R Square	0.161626
Standard Error	0.174972
Observations	106

ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*
Regression	4	0.742187	0.185547	6.060619	0.000206
Residual	101	3.092129	0.030615		
Total	105	3.834316			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	2.496637	0.518786	4.812459	5.23E-06	1.467505	3.525769
Exposure Rate	0.175919	0.054638	3.219729	0.001726	0.067532	0.284306
Recovery Rate	-0.08522	0.086223	-0.98832	0.325358	-0.25626	0.085828
Sovereign	0.118694	0.104738	1.133249	0.259793	-0.08908	0.326465
Settlement	0.216602	0.129471	1.672978	0.097426	-0.04023	0.473438

D. ANOVA Credit Risk and Investment in Water and Sanitation Infrastructure

The results indicate a strong impact of the predicting quality of the coefficient. The results show that Credit risk on Infrastructure investments in Water and Sanitation is significant. The t value at 4.160731 for the independent values indicates a strong impact of the predicting quality of the coefficient. With a p-value of 0.0000654 statistically is highly significant. We therefore accept our earlier supposition that Credit risks have a significant relationship with Water-sanitation infrastructure investments in Kenya. This therefore implies that credit risks analyzed significantly negatively impacts past and ongoing Water and Sanitation Infrastructure Investments hence the gaps.

Table 4: analysis of variance

ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.547173	0.547173	17.31168	6.55E-05
Residual	104	3.287143	0.031607		

Total	105	3.834316

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	2.482421	0.392894	6.318301	6.67E-09	1.703298	3.261544
Credit Risk	0.417682	0.100387	4.160731	6.55E-05	0.218611	0.616752

E. Comparison of Results Related to Credit Risks

Comparison of test results from measures of Central tendency, Variation, Skewness, Regression Analysis and Correlation analysis to show the contribution of credit risks explaining infrastructure investments in the water and sanitation sector.

Table 5: Comparison of Results Related to Exposure Rate Risk, Recovery Rate Risk, Sovereign Risk and Settlement Risk

Variable	Std. Dev.	Mean	t Stat	P / Sig F	Adj. R^2	Beta	Corr. analysis
X_2 -Credit risk	0.017	3.91	4.16	0.00	0.13	0.42	0.38
Sub-Variable	Std. Dev.	Mean	t Stat	P / Sig F	Adj. R^2	Beta	Corr. analysis
Exposure Rate risk	0.46-0.48	1.36- 4.67	3.86	0.00	0.12	0.18	0.35
Recovery Rate risk	0.42-0.47	3.32- 4.33	1.23	0.22	0.00	-0.09	0.12
Sovereign risk	0.45-0.46	3.32- 4.32	3.12	0.00	0.08	0.12	0.29
Settlement risk	0.45-0.47	4.28- 4.33	3.12	0.00	0.08	0.22	0.29

Standard deviation results range between 0.42-0.48. This falls within the bracket of ≤1.25 which is acceptable. From our 5-point Likert scale the average value of the credit risks data set ranges between 1.36- 4.67. At $|t| \geq 1.96$ the overall t value for the independent values indicates a strong impact of the predicting quality of the coefficient. The Overall p-value at less than 0.05 (typically ≤ 0.05) is statistically significant. For Adjusted R square findings showed that Credit risks explain the variations in water sanitation investments while the difference is explained in other factors not in the model. According to Cohen (1988, 1992), the effect size is weak/low if the value of r varies around 0.1, Moderate/medium if r varies around 0.3, and strong/large if r varies more than 0.5. Settlement risk makes the strongest unique contribution explaining infrastructure investments followed by exposure rate risk, sovereign risk and Recovery rate risk making the least contribution.

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IV. DISCUSSION

Change in the capital structure of the firm which dictates how funds are sourced for infrastructure projects greatly influences stakeholder's decisions. According to Canuto, Dos Santos and de Sá Porto (2012) on investigating Sovereign risk and the role of credit rating agencies, there is indeed a strong correlation between a country's ratings and the level of macroeconomic variables, and between a country's ratings and the variation in levels of government debt. Exposure rate risk indicate the company is exposed to financial loss as the result of the inability to access cash in a timely manner and fund the operational or financial obligations of the company. The company processes do not effectively ensure funds are used in a manner most beneficial to future earnings and operations of the company. Respondents did not agree that information is distributed in a manner which allows its use for an unintended purpose or one for which it lacks relevance. These results are also compatible with recommendations by De Servigny et al. (2004) who tabled tools and techniques for controlling credit risk exposure of all types, in every environment.

"The Standard & Poor's Guide to Measuring and Managing Credit Risk" shed light on every aspect of credit risk and provide you with today's most up-to-date techniques and models for identifying, measuring, monitoring, and controlling your organization's credit risk exposure. Lando (2009) considers the two broad approaches to credit risk analysis: that based on classical option pricing models on the one hand, and on a direct modeling of the default probability of issuers on the other. He offers insights that can be drawn from each approach and demonstrates that the distinction between the two approaches is not at all clear-cut. Recovery rate risk indicate in the event the principal and accrued interest on defaulted debt cannot be recovered banks and non-banking financial companies (NBFC) shy away from entities who are unable to service past loans (principal and accrued interest). During poor macroeconomic conditions, businesses face reduced profitability and a greater risk of defaulting on its debt. Business issues that affect a company's ability to conduct business and generate profits play a key role in the recovery rate. Debt that is more senior within a capital structure offers a higher recovery rate. It is due to the senior debt being accorded more claims to assets as opposed to debt ranked lower in the capital structure. The findings agree with arguments by Morrison (2005) who examined the consequences for the real sector of disintermediation in the debt markets. The specific phenomenon in the study is the market for credit derivatives. The funding model developed is closely related to that of Holmström and Tirole (1997). Guo et al. (2016) study proposes a data-driven investment decision-making framework for Peer-to-Peer lending /Crowd funding as an emerging market.

Sovereign risks indicate possibility of the government not paying the agreed yields to the creditor/lender. Difficulties in accessing additional financing in the event of non-performing loans. Reduced trust in the government by potential investors in the event of history of defaults in loans. Listing by the credit reference bodies as an indication of history of defaulters.

The company is exposed to actual loss or opportunity cost because of the default (or other failure to perform) by an entity with which the company does business. Canuto et al. (2012) analyzed the concept and determinants of "sovereign risk" and the role of the credit risk rating agencies which serve internationally as the main reference instruments employed by economic agents to assess this risk. The study concluded there is indeed a strong correlation between a country's ratings (be it the average ratings or one of the agency's ratings) and the level of the macroeconomic variables listed above, and between a country's ratings and the variation in levels of government debt and external.

Settlement risks indicate possibility that one party fails to deliver or pay (the underlying asset or cash value of the contract) to another party in an exchange of securities. Probability that one party will not uphold their contractual obligation in a transaction or deal. Reduced trust if one party will not uphold their contractual obligation in a transaction or deal. Costs of future contractual engagements were high based on history of noncompliance. Merton and Perold (1993) paper developed a concept of risk capital that can be applied to the financing, capital budgeting, and risk management decisions of financial firms. Liability-related activities (such as deposit-taking and issuing guarantees like insurance and letters of credit) are mostly customer-driven, which makes such businesses credit-sensitive. Principal activities create a special set of financing, capital budgeting, and risk management decisions for the firm. Further developed a framework for analyzing those decisions within the principal financial firm. The framework is built around a concept of risk capital, which is defined as the smallest amount that can be invested to insure the net assets of the firm against loss in value relative to a risk-free investment.

VII. CONCLUSION

The result denotes that there is a highly significant, direct, and positive relationship between the constructs namely model, people, legal and political risks, and Infrastructure investments in Water and Sanitation. The variable makes a strong unique contribution to explaining credit risks associated with Infrastructure investments in Water and Sanitation. Water service providers are hobbling with weak incentives for better performance, aging infrastructure, ineffective operations and maintenance, weak institutional capacity, and little accountability to consumers. Keynes investment theory argued that profit expectations, and the degree of confidence or weight that managers place in their profit forecasts, determine investment. Future profitability and forecasts determine the capital-intensive investment projects undertaken by firms in the business of providing water and sanitation. Cost-Benefit Analysis (CBA) estimates and totals up the equivalent money value of the benefits and costs to the community of projects to establish whether they are worthwhile. In this case projects include Dams, Treatment plants, Bulk pipelines and Mega storage.

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VIII. RECOMMENDATIONS AND AREAS FOR FURTHER STUDY

Exploration from Credit risk influence on Infrastructure Investments in Water and Sanitation stipulate a significant positive relationship. An advancement to credit risks will need Innovative financing models rolled out through co-financing and blended financing, risk pooling through tailor made infrastructure insurance products, private entity receiving a concession from the public sector to finance, design, construct, own, and operate a facility stated in the concession contract.Negotiations need to look at the good interest of infrastructure investments to avoid losses that result from a potential change the exchange rate of one country's currency in relation to another country's currency and vice-versa. Debt recovery rate need to be benchmarked to enable the principal amount borrowed is recovered by banks and non-banking financial companies (NBFC). Lastly Government needs to set priority on debt repayment and monitor adherence to loan obligations.

The research serves the purpose of leading the policy formulators, industry players and stakeholders from a global perspective of water and sanitation infrastructure investment risks to the Kenyan context. Constructing the same research in a new context and addressing a new research problem within the settings of a different sector such as Commercial Facilities Sector, Communications Sector, Critical Manufacturing Sector or Energy Sector would build an all-inclusive and customizable Enterprise risk management strategy paper. To re-assess and expand the research framework future studies would best address the effects of emergence of new evidence and/or another recent phenomenon.

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Appendix 1: Sample Size Table

	List of clusters in the target population	**Cluster**	**Managers**
1	Eighty-Eight (88) Water Service Providers were in four clusters of water and sanitation providers as guided by the Water services Credit board IMPACT Report No. 11/2019.	Very large water service providers (≥ 35,000 Connections)	11
		large water service providers (10,000 - 34,999 Connections)	34
		Medium water service providers (5,000-9,999 Connections)	16
		Small water service providers (≤ 5,000 Connections)	27
2	State corporations regulating Water and Sanitation Infrastructure Investments.		9
3	Water Infrastructure Financing Institutions and stakeholders offering Grants, Concessional loans, Infrastructure Bonds and Private Equity Placements.		21
4	Water Works Development Agencies charged with the development, maintenance and management of water and sewerage infrastructure in 47 counties.		9
	Total Number of Managers		**127**

Source:

Ministry of Water, Sanitation and Irrigation
Water Services Regulatory Board (WASREB)