UNIVERSITY of RWANDA COLLEGE OF SCIENCE AND TECHNOLOGY ACE-ESD AFRICAN CENTER OF EXCELLENCE IN ENERGY FOR SUSTAINABLE DEVELOPMENT

Title: Assessment of Determinants influencing the Development and Implementation of hydro power Projects in Rwanda (SUPPLY SIDE)

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Advisor: **Dr .Wilson BASHAIJA**

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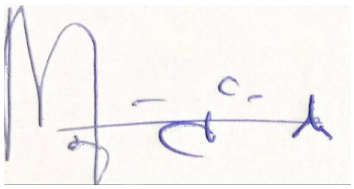
Kigali-Rwanda

DECLARATION

I, **Andrew MBANGUKIRA**, hereby declare that the thesis /dissertation entitled «**Assessment of Determinants that influences the Development and Implementation of hydro power Projects in Rwanda,**is to the best of my knowledge, my original work and it has never been submitted for any award by anybody else at any higher learning institution. However, references were provided for the items utilized by others and all sources of resources utilized for this research project were explicitly acknowledged by;



Andrew MBANGUKIRA

CERTIFICATION

I confirm that the work presented in this work presented in this research work was conducted by this candidate under my supervision.

Dr. Wilson BASHAIJA is the supervisor's name.

31/October/2022

Signature …….Date ……

DEDICATION

This research study project is dedicated to my children **Keilah** and**Kedrick**.

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ACRONYMS &ABBREVIATIONS

BRD	: Development Bank of Rwanda
CO	: Carbon monoxide
CO2	: Carbon dioxide
EDCL	: Energy Development Corporation Limited
EDPR	: Economic Development and Poverty Reduction Et al and others
EUCL	: Energy Utility Corporation Limited
FS	: Feasibility studies
GDP	: Gross domestic product
GHG	: Greenhouse gasses
GNP	: Gross national product
HPP	: Hydro power projects
IDA	: International development Association
IPPs	: Independent Power Producers
Kw	: Kilo Watt
KWh	:Kilo Watt Hour
MW	:Mega Watt
NST	:National Strategy for Transformation
O&M	:Operation and Maintenance
PPA	:Power purchase agreement
R&D	:Research and Development
RDB	:Rwanda development Board
RE	:Renewable Energy
REG	: Rwanda Energy Group
RES	:Renewable energy source
RET	: Renewable Energy Technologies
RURA	:Rwanda utilities regulatory authority
SDG	: Sustainable Development Goals
SPV	: Special purpose vehicle
Twh	:Trillion Watt Hour
WB	:World Bank

ABSTRACT

One of the most critical issues in polluting the environment is the energy sector which requires a dramatic transition away from fossil fuels and toward renewable energysources exploitation. This necessitates a significant shift away from fossil fuels and toward renewable energy (RE) mostly hydro power. As the global and local impact of fossil fuels grows, legislative and technological support for the deployment of clean energy technologies as a viable option for addressing environmental threats grows too. Drastic changes are happening and the commercial feasibility for green energy technologies are approaching, they are becoming increasingly desirable for a range in the environmental, social, economic, and factors related to technology.Regardless of the importance of renewable energy, scientific research on the factors influencing projects development and execution are very few, in order to collect data and deep researchin this study, a descriptive survey research method was used. The top, middle, and lower management staffs from financial sector, operational hydropower companies (IPP's), energy promoter companies and project investors or owners were the study's target population. The sample sizes of 35 from 156 target population were chosen using stratified random sampling. The study had a total of 35 participants. The researcher relied on original data forquestionnairesto collect primary data from respondents; structured questionnaires with closed and open-ended questionnaires were employed. The data were analysed using descriptive statistics and according to the report, financial, technical, environmental and stakeholder engagement are very importantfactors to consider in the development of hydropower projects.

The study also indicates and revealed that the stakeholder participation has a substantial influence on the implementation of hydroelectric power projects. The research also suggests that the Rwandan government should invest major resources in technological innovation and skill development for national engineers. It further suggests that technical studies be conducted to minimize environmental difficulties, the report indicates that the cost of investing in hydropower projects is huge and that the Rwandan government should offer incentives and grants to the projects owners, commercial banks should have a more positive attitude toward hydropower projects in order to provide money in the form of loan financing, flexibility on collateral security requirements and favourable interest rates on project funding loans.

CHAPTER ONE:

GENERALINTRODUCTION

1.1 The Study's General Background

Energy is a backbone of development around the world and Rwanda's developing economy is aided by electricity and its strategic development goals, the energy sector, among others, have made significant contributions towards the development; its development history is based on rapid growth of estates, urbanization, manufacturing, agro-processing, tourism, and mining, among other things all of which have relied on electricity as a prerequisite for achieving the country's goals in such sectors(Hahlborg, 2021)**.**From a global point of view, the world's industrial economy has relied heavily on fossil fuels for many years. Fossil fuels accounted for around 86 percent and 89 percent of total energy consumption in China in 2015 respectively. The heavy reliance is on fossil fuels currently and poses a danger to the global economy as a result of climate change. According to (Zhao and Chen 2014), China suffers from environmental pollution as a result of high reliance on fossil fuels, sources of renewable energy such as hydro and solar power have been offered as a clean energy and a long lasting solution. It was the first time that China and the United States announced concrete and verifiable pledges to cut fuel use and with China too, for example, pledging to reduce coal consumption by 100 million tons and CO2 emissions by 180 million tons by 2030.Turkey also for example, joined other big countries to adopt to Renewable energy resources to non-renewable sources like fossil fuel in order to mitigate harmful environmental consequences and generate clean energy in the ecosystem (Danlami,2017), By 2020. Hydropower energy should account for a significant portion of the European Union's energy mix, this new aim was highlighted according to (Nabola, 2021) and is not a problem because renewable energy sources presently accounts for 6.5 percent of the European Union's energy mix. If the essential reductions in import dependency and greenhouse gas emissions are to be achieved, meeting the target is very critical. This lofty goal was achieved due to a well-functioning energy market that paved the way for the creation of an effective emission trading mechanism and a renewable energy industry(Mitrovic, 2021). A unified European renewable energy market produced a competitive environment in which renewable energy production expanded and developed efficiently (Ramos, 2021).As a renewable energy source, hydropower is becoming increasingly important throughout Europe and elsewhere. Its proportion of total energy use varies per country by providing unique issues in each. According to an energy

policy report, Member states of the European Union are obligated to increase the quantity of renewable energy in their energy mix (Klessmann, 2011). This article assesses the problems of increasing hydropower in four nations with various amounts of domestic energy output from hydropower plants; (Albania shares 100% in 2019), Slovenia (25.7%), Poland (1.1%), and Estonia (1.1%). (0.3 percent) Concerns of appropriate water resource management have received a lot of attention in Europe's energy policy. As a consequence of the case study investigations, the challenges in hydropower development have been discovered and potential solutions are in place. Furthermore, a thorough assessment of the impact onsocial, economic, and environmental and climate change aspects on hydropower growth was carried out (Bogoviz, 2017). It is now hard to predict whether the European Union's energy policy's stated targets will be met across the entire continent as per energy policy of 2011.

In order to reach such goals, countries must compile comprehensive studies on renewable energy sources including hydropower. Hydropower is an important part of most countries' overall energy economy. Hydropower is becoming increasingly significant in Europe and the interest in this sort of renewable energy source (RES) stems from a variety of challenges, including a desire to preserve the environment and mitigate climate change. In 2019, hydropower provided 18% of Europe's electricity; however, this varied widely between nations. Hydropower is used much in Denmark, while the Netherlands and Estonia have the lowest share of domestic electricity production that is less than 0.5 percent, Albania has the most share with (100 percent) and Norway with (95.8 percent), according to(Rathmann et al 2011).

Kenya has three major energy sources; biomass, petroleum and hydroelectric electricity which account for 74.6 percent, 19.1 percent and 5.9 percent of the region in which Rwanda is located, respectively. Kenya's total primary energy consumption in 2007 was 3.62 Mt. In the same calendar year, hydro energy generated as a percentage of total energy used 10.9 percent (excluding fuel wood and charcoal).

From a national standpoint, Rwandaas a small country in East Africa with a population of over 12 Million people, is spread across a total area of 26,338 km2, 94.7 percent of which is land as well as the remaining 5.3 percent by water bodies such as lakes, rivers and swamps, according to the national institute of statistics report (NIS) 2018. Its geographical location is between 1.050 and 2.840 degrees south latitude and 28.860 and 30.900 degrees east longitude. It has two rainy seasons throughout the year and this rain feeds the country's seasonal river systems, contributing to the country's increased hydro power generation.

(Bimenyimana, 2018).Rwanda is bordered on the north by Uganda, Tanzania on the eastand Burundi on the south and the Democratic Republic of the Congo on its west. Despite the fact that Rwanda has experienced rapid economic growth in the last ten years and has been endowed with significant natural energy resources such as rivers for hydropower, peat, sunlight for solar power, methane gas in Lake Kivu and biomass energy produced from burning husks that have not yet been fully exploited, Rwanda has many natural energy resources, including rivers that may be used to generate electricity, peat, sunlight for solar power, methane gas in Lake Kivu, and biomass energy produced from burning husks (Ituze, 2017).Currently, the national grid has a capacity of 238 MW, which is generated from various energy sources and can service the entire country. According to the energy sector strategic plan, the government has a competitive feeding tariff that is higher than East African countries in the region, with an electricity tariff ranging from 0.009 USD cents to 0.22/USD cents per kW/h (Bamundekere, 2019). The Rwandan government's goal is to provide a dependable, efficient, and economical power supply by 2024, with 100 percent electrification (Mugisha, et al, 2021) the report which was published in 2018 and according to Rwanda Energy Group (REG) energy status report where 62% of Rwanda’s population has access to electricity making 41% is connected on the National grid while 21% population is off-grid connected. Rwanda's mission and vision, on the other hand, is to expand the grid through the Energy Access Roll-out Program (EARP), which aims to connect 52 percent of households to the grid by 2024, while off-grid solutions, such as solar home systems (SHS), are part of the Rural Electrification Strategy (RES), which aims to increase energy supply to 48 percent of all households by 2024 by strengthening off-grid solutions (Energy Sector Strategic Plan, 2015).

The Rwanda energy group (REG) resolved to boost generation, enhance transmission, diversify energy sources, cut prices, and develop a comprehensive legislative and regulatory framework. Hydropower energy output is planned to come from the RUSUMO and RUSIZI III projects by 2024, which will be shared by Rwanda, the Democratic Republic of the Congo, Burundi, and Tanzania. However, biomass energy generated by gasification of husks technology (burning husks with a gasifier machine) will play an important role without diminishing the function of methane gas power from Kivu and GISHOMA peat power from GISAGARA District, Thermal power and off grid energy to mention but a few. All the on grid power plants in Rwanda are working together via interconnection network through synchronization of the network systems by the synchronization mode known as synchro scope, synchronizing lamps and synchronizing relays as per rural electrification strategy

report (Nwapi,2017).Rwanda has 333 potential hydropower sites, the majority of which are small and micro plants with potential generating capacity less than 5MW. Rwanda is a developing country with a country-wide integrated dispersed generating network. A vision of 100 percent electrification is within reach due to the rapid growth of solar power, hydroelectricity and thermal power. However, small-scale hydropower projects confront contextual constraints that impede project development and execution (Andrews 2017).

This research study investigated all the factors affecting development and implementation of projects whether economically, technically, and environmentally in nature. The main objective of this article and research study is to conduct a thorough deep analysis on the elements that influence the growth of hydropower project and execution in Rwanda, as well as the accompanying issues and future recommended solutions to the highlighted challenges. The results will help the government of Rwanda and other key players to respond to some of the bottleneck to develop energy sector and this will facilitate in attaining 100% electrification by 2024 in Rwanda. (Energy capacity report 2019).

1.1.1 The Renewable Energy concept

Diverse countries employ a variety of energy sources to fulfil consumer demands, power industry and maintain public infrastructure. Hydropower is a type of renewable energy that is utilized all over the world (public transport, public buildings, public lighting etc.). Many Proposals from the scientific community as well as other important stakeholders demand for the creation of alternative solutions in response to the consequences of primary energy sources such as fossil fuels and in order to reduce current and future climate change impacts (Radhi, 2009).One approach for lowering CO2 emissions is to diversify and employ alternative energy sources that release much less greenhouse gas (GHG) emissions, notably carbon dioxide (Asumadu,2016). The bulk of these energy sources are provided by solar power, both direct and indirect (hydropower, wind and bioenergy), as well as non-solar power sources such as tidal and geothermal. All of them have been used by humans, some for thousands of years and others for only a few decades. However, depending on the energy source, implementation location, and availability of technology, there are several hurdles to adopting such Renewable Energy sources (Kiarie, 2017).It is imperative good to study how these can be overcome efficiently, since many positive impacts that can be obtained from

(local) renewable energy sources as the fact that reducing GHG emissions benefits include enhancing energy supply and security, encouraging local development, and creating direct and indirect jobs in Rwanda (Shaikh et al 2017).

1.1.2 Energy profile in Rwanda

One of Rwanda's strategies is economic development and poverty reduction for achieving the SDGs, according to the EDPR II (Sustainable Development Goals). "Affordable and clean energy is one of its key aims in the energy sector," according to the Sustainable Development Goal and according to the (Mudaheranwa, 2019) research study report, Rwanda's government has set a goal of boosting renewable energy consumption to increase access to power from 42% to 100% by 2024. However, it has been determined that energy Consumption is rising at a rapid rate of 6% per year while supply is growing at a slower rate, providing a significant challenge in fulfilling demand and making the SDGs' target to become hard to be attained.

Rwanda offers a diverse range of energy options, including solar, biomass, hydro, methane gas, and geothermal, according to Valin's research (Valin, 2018). Unfortunately, the bulk of these vital resources are being underused. To the tune of 1.2MW, these energy sources have yet to be exploited. This owesbecause of the fact that wood remains the most often used energy source. In addition to petroleum goods imported from other countries, roughly 90% of the population uses wood energy for daily activities. Despite accounting for only 2% of the country's overall energy demand, the government expects electricity consumption to rise in order to support Rwanda's economic growth. Biomass accounts for 85 percent of all energy utilized, whereas (Cipcigan, 2019) claimed that petroleum accounts for 13 percent of the country's overall energy consumption. Looking at energy consumption, it was discovered that the majority of energy users (82 percent) utilize energy in the form of conventional fuels such as wood.

Transportation consumes the most energy (8%) followed by industry (6%), and public services (3%) or (4 percentage points) The section that follows gives information on the condition of Rwanda's electrical energy business, including sub-sectors including hydro power, thermal power, geothermal power, solar power, and biomass power. In addition, essential data and barriers are highlighted for a better understanding of the viewpoint. Rwanda has a capacity of 218 MW installed with 212.5 MW created with a 5.5 MW import

option according to the ministry of infrastructures' (mapping toward 2019 sustainable development targets) report from July 2018. This capacity includes hydro, which accounts for around 45 percent of installed capacity.

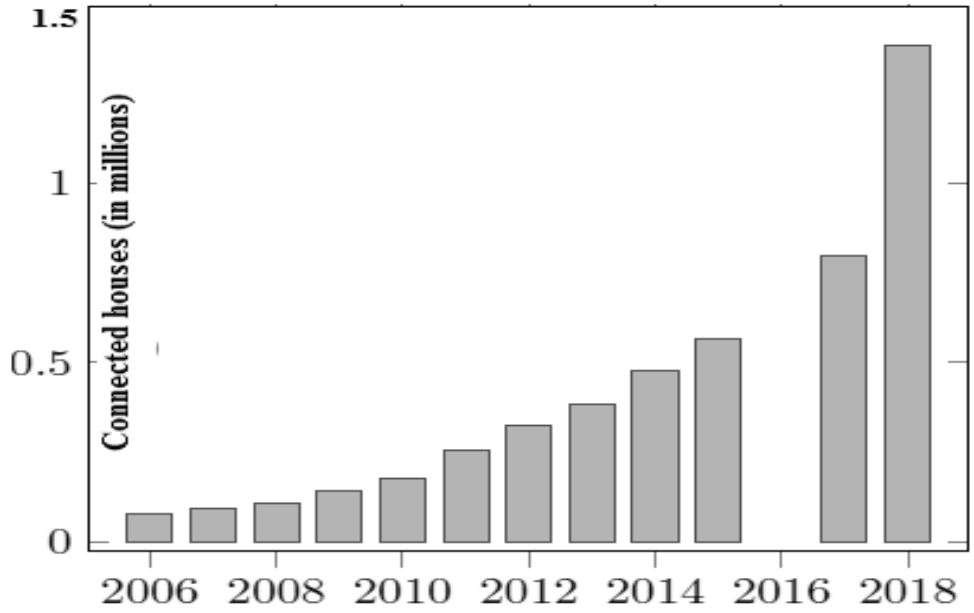
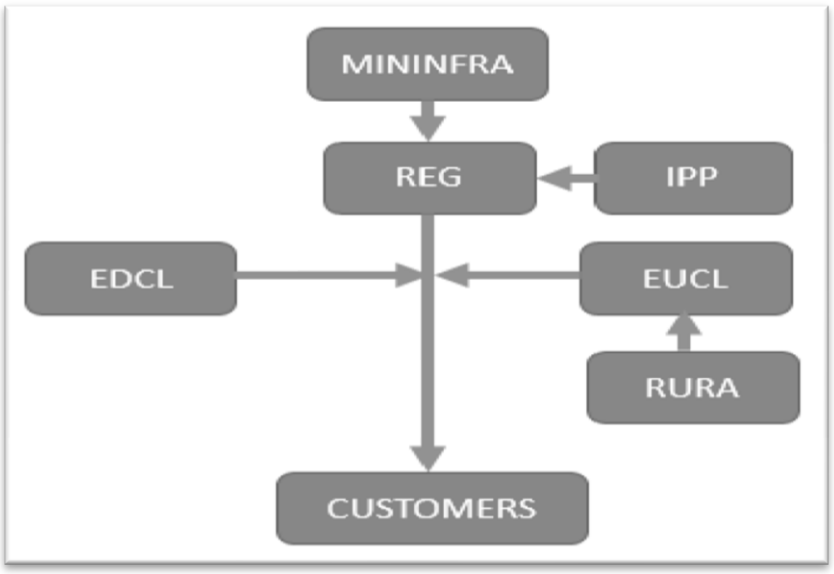


Fig5. Evolution in household's connectivity in Rwanda



Source: *Pigaht& Van der Plas (2009), Innovative private micro-hydro power development in Rwanda (Energy policy)*

Fig 5: A structure for Rwanda's energy promoter companies and utility

As a developingcountry, Rwanda is working hard to achieve its long-term development goals. The analysis is that the country's electrical energy system's present situation and forecasted its

future performance while taking into consideration the country's energy conservation initiatives and regulations. The modelling findings in this respect have demonstrated the possibility of reducing fuel use while integrating renewable energy supplies and expanding interconnection capacity. (Liliana, 2019)

1.2 Statement of the problem

Drastic changes are taking place, and the commercial practicality of hydro power energy technologies is approaching a tipping point, they are fast becoming appealing as a consequence of a range of circumstances, including economic development and general scientific improvement. Despite the fact that technologies are being developed to exploit all hydropower energy projects in a cost-effective and widely accepted manner, the overall development process faces a number of challenges that must be addressed in order to overcome potential roadblocks to the widespread development and implementation of hydropower projects(Kiara, 2013).

A variety of variables that impact the completion of hydro power infrastructure projects, key determinants include stakeholder involvement and participation, the technological component of innovation, environmental concerns and financial resource availability. This issue centres on the present institutional structure, modern economic realities, political situations, and a big part of the people in developing nations' lack of understanding.Large, long-term expenditures in energy infrastructure in resource-dependent African countries with high levels of economic instability and a tiny income base to fund expenses pose a severe danger. Using state resources (including equity investments, loans, and guarantees from both commercial and financial institutions) to support private investment produces a massive extra debt load in African nations, particularly Rwanda. **(**Mulugetta, et al 2019).

Previous local and international investigations discovered that there are no factors influencing the execution of energy infrastructure development projects. Despite of the importance of renewable energy specifically hydro power, there is a lack of empirical study on the variables impacting the execution of hydro power energy projects under development in Rwanda. In this context, the researcher tried to determine the factors determining the development and implementation of hydropower infrastructural projects in the sectorof energy, specifically in Rwanda(Baechler,2013).

1.3 OBJECTIVES

1.3.1 Major Objectives

The goal of this study was to evaluate the elements that influence or determine development and implementation of infrastructure development projects of hydro power projects in the energy sector, specifically in Rwanda and to resolve Rwanda's energy question by responding to such challenges of power production and attaining full electrification.

1.3.2 Specific Objectives

Below are the objectives;

- Examine the impact of economic variables on the development and execution of hydropower projects in Rwanda.
- Determine how stakeholders' engagement effects the implementation of hydropower projects in Rwanda.
- To determine how technological factors influence on implementation of hydro power energy projects in Rwanda.
- To investigate environmental factors ondevelopment and implementationof hydro power projects in Rwanda

1.3.3. Research Questions

- How do economic factors affect the development and implementation of hydropower projects in Rwanda?
- How dotechnological factors affect the development and implementation of hydropowerprojects in Rwanda?
- To what extent does innovation/technology influence the implementation and development of hydropower projects in Rwanda?
- Do environmental factors influence development and implementation of hydro power projects in Rwanda?

1.4 Scope of the study

When looking at finance for hydropower projects in Rwanda, the scope and delimitation of the research were constrained, and the analysis was confined to Rwandan commercial banks and development banks. Bank Guarantees and loans are used to provide financing in compliance with national bank legislation. There are other technical and environmental factors to consider. In this study, the researcher looked at the role of finance, environmental variables, stakeholder participation and technological aspects such as long-term loans, equity financing, environmental concerns, and technological factors in general. Only two Rwandan commercial banks and one Rwandan developmental bank that finances hydropower project business were reviewed to mention but a few, to aid the researcher in evaluating the role of each in the Rwanda energy sector over a period of years. However, in order to gather sufficient data, the researcher spoke with bank clients (investors) in the sector to determine their understanding of the policies governing loan practices for hydropower projects as well as scrutinizing environmental and technical issues while keeping in mind the role of stakeholders in the same sector.

1.5 The Purpose of the Study and Its Importance

1.51. The objective of the research

The primary purpose of this research study was to investigate the factors that determine hydropower project execution in Rwanda so that we may better understand why some project sites were not executed, limiting Rwanda's ability to attain full electrification. This research will assist policymakers, investors, financial institutions, and other stakeholders in understanding why the majority of mini and micro grid projects have not progressed to the next stage of construction and energy production, resulting in Rwanda's government failing to meet its 100 percent electrification target.

1.5.2 Significance of the research study

The study aids the Rwandan government, investors, and other key players in the sector, as well as the general public, in better understanding the procedures for obtaining financing, managing environmental issues and technical challenges during project development and implementation, confirming proposed solutions to raised concerns while also assessing the role of stakeholder's role towards achievingthe goal of electrifying the entire country.

Any organization or firm looking to create hydro power infrastructure will benefit from this study. Hydropower projects investors will have more good outcomes because they can bridge the gap between sustainable and non-sustainable initiatives that contribute to the economy and society's overall well-being. The highlighted issues can be used to chart a course forward that will improve the adoption of excellent project implementation methodologies while taking into account the many contributing aspects discussed in this study. Because this case study focuses on a government corporation, it can assist the government in positioning itself and identifying strategies for implementing and developing projects through independent power producers (IPP's) aimed at providing power to the country and fulfilling current demand while also planning for future growth. This can be achieved if the government implements a number of ideas offered as contributors to the implementation of hydropower infrastructure projects. In the sense that it advised better ways to implement energy-related initiatives, the study concluded that it is applicable to other organizations or government entities.

1.5 Limitation of the Study.

This research focused on Rwandan hydropower projects and included both dependent and independent variables. Renewable energy technologies include hydropower, wind energy, and solar energy to mention but a few. This research focused primarily on Rwandan hydro power energy projects in attempt to figure out why some hydropower sites are underutilized. This study looked into the elements that influence the development and implementation of efforts aiming at attaining full electrification in Rwanda with a particular emphasis on renewable, notably hydropower projects. The economics of hydropower technologies and expenses were also taken into account in the investigation. In order to scope the investigation,

this study focuses on the factors that influence execution of hydropower projects while also analysing the factors influencing the execution of such initiated project and particular constraints were mentioned, including difficulties in collecting paperwork, permissions, data, permits, and a time restriction.

CHAPTER TWO:

LITRATURE REVIEW

2.1 Theoretical Background

Rwanda, like any other African country in sub-Saharan, has significant undiscovered renewable energy resources that may help achieve universal access to power, catalyse social and economic progress, and reduce greenhouse gas emissions (GHG).According to the (Hlborg, 2021) report, hydro power projects are influenced socially, economically, environmentally, and technologically during their development and implementation: silts, sediments, erosion, and landslides, as well as cost. The fact that the country is mountainous contributes to some of the reasons. The researcher was guided to prove his hypothesis by reading theoretical background, other published books, journals, articles, and Theses have guided the researcher to provide relevant references in the research study.Increased input of sediments, for example, has been identified as a sustainability problem by (Thakur et al 2014), who observed that silts in rivers are one of the primary causes of turbine wear and early failure. The authors also stated that turbine efficiency can be affected by silt wear, depends on the quantity of silt, the size of the silt, the velocity, and the duration of operationThe cost of manufacturing, operation, and maintenance is a crucial part of every country's economic progress. In particular, energy use rises in the winter. Several studies have shown that Renewable energy is one of the most vital factors in a country's economic development. Money, national income, and the values of import and export balances are all important economic factors. Non-renewable energy price increases have had a negative influence on global economies, and other sources of renewable energy that represent an alternative for future economic development (Gardeazabal, 2003).

The Government of Rwanda's support is a very key stakeholder to the success of the hydro power project. It also facilitate in development of energy resources, particularly during the prior stages of technology development, protecting natural rivers and swamps, enforcing favourable policies, and providing political and financial assistance. Feed-in-Tariff (FiT) programs are government factors that influence the success of hydro energy project implementation, particularly hydro power plants. Through the implementation of the REFIT strategy, new governmental policies were implemented in developing nations to make

modifications to their present energy systems in order to attain highly sustainable energy systems.(Mathiesen et al, 2015).

Technology describes a new type of energy source that enhances the technical technique of doing things and doing them correctly. Technology introduction is critical in the energy business, as it affects the industry's development. According to Research and Development, technological innovation, new information, and technology are examples of technological variables that influence the success of renewable energy (Ramla, 2019).

2.1.1The concept of Hydro power

Hydropower has now become the most preferred source of electricity in the world, according to Rwanda's (Energy strategic plan 2014-2018). Moving or falling water generates hydropower energy. Because of various advantages, history shows that the cost of energy has remained stable over many years; most countries currently use hydropower as a major source of electricity. The advantage of hydro power generation is not only is a green and clean energy source (renewable), but also that has environmental friendly emissions nor are any greenhouse gases such as carbon dioxide emissions produced, making it an environmentally friendly kind of energy.

This control system's purpose is to keep the system within a set range in any circumstance by managing water flow through a control valve at the dam and outflow through the drain valve for safety and efficient hydroelectric power. Because of nonlinear or time-varying behaviour, such as fast variations in reservoir and canal water levels, manually managing reservoirs in dams is challenging (Samuel Bimenyimana, 2016).

2.1.2 Economic Factors

According to (Gerrard, 2000) investment costs include capital costs, expenditures, and operating costs. Because finances are such important factors in project implementation, this study focused on the ease with which investors can obtain funds through loans, grants, project partnerships, and equity financing. After all, money is the backbone of hydropower project development and implementation and this study aimed to investigate the function of finance

in the form of economic aspects that play an important role in every country's economic growth. Energy utilization is increasing, particularly in renewable resources as one of the fundamental elements that contribute to a country's economic progress. Money, national income, and the values of import and export balances are all important economic elements. The rise in the price of non-renewable energy sources has had a detrimental influence on global economies and renewable energy sources represent an option for future economic development. For example, economic considerations influencing the success of hydropower projects include investment costs, production costs and operational and maintenance costs as earlier mentioned. Because of rising fossil fuel prices and diminishing fossil fuel sources, hydro energy is receiving has been focused on than any other renewable energy source for economic development. This corresponds with the assertion in (Pandey and Mokan, 2019)'s books that "installation of current systems utilizing renewable energy is more cost effective than other sources such as fossil energies," however extra analysis was done on this topic in this research in the pages that follow.

According to (Lee &Ramlan, 2014) in their research, financial viability and economic feasibility should be addressed quickly before building a power production plant. They went on to say that economic factors such as operation, maintenance and investment cost, research and development costs, production costs, and return on investment all play an important function in the selection of renewable energy sources to be considered during development and implementation, with hydro power being a prime example. The study will looked into the impact of operation and maintenance during operation, as various studies have stated that having adequate funding for operation and maintenance is a good managerial decision in order to avoid surprises.

The researcher evaluated if Technical Knowledge and Skills as well as a lack of availability to replacement parts that would be a problem for the Rwandan hydro power plants that would be studied in this research. Human capital theory is founded on education and economic spheres and it asserts that the more one's education, the greater one's economic returns to society. According to (Gasore,2021) and other academics such as (Baum, 2007), training and skill development effect an individual's personal income both formally and informally. They all examined formal education and job experience as determinants of human capital, which this study did in depth.

2.1.3 Financial Resources

Traditional project financing methods rely on debt and equity. The most crucial element in this case is security. This means that a project's funding is dependent on the ability of shareholders to spend their own money or borrow solely on the basis of security. Since the 1990s, new patterns have emerged that are considered to as contemporary. Project financing using a project business structure known as a special purpose vehicle (SPV), venture capital, and other forms are among the developing trends. This method has improved fund mobilization for project investment and this has been applied in developed countries like China. (De Jong 2010) mentioned that a traditional project finance is organized to allow the project business to generate income on a daily basis, with payment paid in arrears This income structure, however, is far from typical and it is no longer customary for a project's revenue to include proceeds from forward sales options (Lemire, 2005). Project financing can be obtained from a range of sources, which can be classed in many ways. Internal financial accruals, asset securities, protected loans, capital advances, miscellaneous sources, bonds, and debentures are the numerous types of funding. The purpose of project finance, includes how to create a financial plan, assess risks and develop the financial mix and raise money, may all be classified as either equity or debt. This is in contrast to public finance which is based on taxation and government money(Kiara, 2013).

Government provisions, public/private partnerships, and public-private financial frameworks are examples of legal arrangements that assist project finance. However, knowledge of lender credit requirements show how to determine the project's borrowing capacity and how to prepare cash flow projections and use them to calculate expected rates of return, tax and accounting considerations and analytical techniques to validate the project are all required in project finance, according to (Delmon, 2017) mentioned that when it comes to project finance, the financier normally has little or no access to the borrower's or sponsors' non-project assets. When a project is financed with no or limited recourse project financing is at risk. The loan will only be reimbursed once the project is properly functioning and if there will be project failure, the financiers are likely to have a bad debt and lose a significant value of money(Hoffman,2007).

As a result, it is unsurprising that financiers will go to great efforts to ensure that project risks are reduced or avoided totally. Furthermore, due of the risks involved, the cost of such financing is frequently greater and the process takes longer(Arndt, 1998). The world bank has

provided a grant of $100 million through international development association (IDA) additional financing for the third Rwanda energy sector development policy operation (DPO) today (August 29, 2019). The world bank board of directors approved the first operation on august 29, 2019, and now The extra finance, in the form of budget support, will allow the Rwandan government to prepare a timely fiscal response to the economic shock caused by the COVID-19 pandemic, set up plat forms, and set up plat forms.The Third Rwanda energy development policy operation was of last provided and amounting to $375 Million programmatic series,the first of which was approved in December 2017. The series helps the government of Rwanda to achieve its energy sector goals under the national strategy for transformation (NST1), including universal access to electrification by 2024, while balancing tradeoffs with fiscal and financial sustainability (World Bank 2006).

Rwanda is expected to electrify more than 61% of its houses, close the gender gap in electricity access, and reach the national strategy for transformation (NST1) target of universal access to electricity by 2024. Rwanda also intends to modernize the Rwanda Energy Group's operations, as well as the government planning and decision making procedures, and fiscal transfers to the sector will be limited to no more than 1.5% of GDP during the NST1 term(Mbago,2019).

The World Bank'sinternational development association (IDA), established in 1960, aids the most poor nations by providing grant facility and low or no interest rate loans for projects and programs that promote economic growth, reduce poverty improve the poor living standards. The international development association (IDA) is one of the most important sources of helping the world's 76 most countries, 39 of which belong to Africa. The resources supplied by IDA were to help 1.6 billion people who live in the IDA funding countries. Since 1960, IDA has sponsored development programs in 113 countries. Annual pleadges have average more than $21billion over the previous 3 years with around 61% going to Africa (Weiss, 2007).

Small-scale renewable energy systems continue to dominate, with the private sector remaining a modest participant. The vast bulk of private sector funding is non-local and originates from foreign lending institutions, with beneficiary governments in developing countries such as Kenya and Rwanda guaranteeing it (Kiara, 2013). As a result, it is critical that the experiences of international finance institutions engaging with the private sector be used to encourage private sector engagement in hydropower projects on a local level. It is directly tied to a lack of help from financial institutions that promote the business and market

environment of technology. Commercial banks, development banks, and other international finance institutions are among those that help to minimize the extremely high transaction costs of clean technology in African nations.(Stewart,2012).

The capital cost of developing hydropower projects is a significant hurdle to their implementation, particularly for newer, more expensive technologies with a less proven track record. Financing can be obtained from both governmental and private sources, as follows: Hydropower energy projects can be funded by the government through grants or loans: Low-interest loans typically made through national or regional financial institutions and backed by state subsidies; loan guarantees, likewise backed by public subsidies. Banks and other financial institutions, such as venture capital, are essential sources of private sector investment for hydropower projects, contributing to their long-term commercialization.It can be supplied in combination with or without public subsidies, depending on the project's financial sustainability (Briscoe,1999).

Real and perceived economic restrictions exist. Competition with powerful conventional energy projects has an impact on the real ones. Hydropower projects are hampered by high initial capital requirements, high hook-up costs and a lack of suitable finance mechanisms for small projects. They are seen as a high economic risk with a bad economy structure, long amortization, and high risk (Fuso Nerini et al 2020).

2.1.4 Preferential funding for hydroelectric power generation.

The cost of getting money is an important factor to consider when investing in a business. This is especially true for infrastructure projects like electricity generation, which can have large upfront expenditures, lengthy building timelines, and limited operational lifespans. As a result, improved financing arrangements, such as lower interest rate or longer payback terms, can significantly reduce project cost. Germany and India, for example, have set up specific financial organizations to provide low-interest loans for renewable energy projects. Furthermore, development institutions such as the World Bank provides loan guarantees and at lower interest rates subsides by reducing risks for commercial lenders and thus lowering interest rates; the Rwandan government has mobilized a large amount of funds for the energy sector through the Rwanda Development Bank at a lower interest rate(Mathur,2001).

Mostly because renewable usually require more upfront finance and equity than power plants with smaller capital expenditures, such as solar, financing conditions are especially important to hydro power project investors. A number of other factors make it more difficult for hydro power project to obtain reasonable funding than for more popular generation technologies. Many hydropower projects are viewed as having significant resource and technological risks by the financial sector (Pueyo, 2018). Most financial institutions have little expertise assessing the risks associated with Rwanda's hydropower energy resources.

Most hydroelectric energy projects are likewise regarded as untested, with a significant risk of failure. Because of institutional memory of prior project failures and surprises, many hydroelectric project developers find acquiring funds difficult and costly. Financing is sometimes more expensive for more traditional generating sources due to these real and perceived risks (Madlener, 2000). According to one estimate, if wind developers were offered financing terms and prices comparable to hydro power IPPs, the nominalleve-lisedcost of wind power might be cut by 25%. Policies may have unanticipated negative effects on the financing process and expenditures, reducing overall efficiency(Richard, 2016).A case in point adds value, the United States federal government presently grants a 10 year 1.5Kwhproduction Tax credit to eligible wind power and biomass facilities in other countries in the form of a tax on hydro power project invoices to be paid by utility companies and capital structure (Barbose,2007). Although these incentive policies have the potential to stimulate the development of hydropower projects, because of their impact on the capital structure (the mix of debt and equity used to fund a project), they inadvertently increase the effectiveness of hydropower project financing and have been moderately reduced as a result of this secondary effect.Although the production credit allows for reduction in the hydro energy sales price by giving a return to equity investors, an energy price reduction might result in a breach of the minimum debt service coverage requirement unless the capital structure changes (that is operating income is not sufficiently high to service the full debt payments). To address this issue, the project developer must increase the percentage of higher-cost equity in the capital structure, which raises the contract price above what it would be under an equal cash incentive (which can be used to service debt) (Wohlgemuth,2000).

Subsidies for direct capital investment might be provided per Kwh of rated capacity or as percentage of the total investment cost. Direct subsidies are the most basic incentive and are popular due to their simplicity; nevertheless, they must be strictly monitored to prevent abuse and ensure the project costs are not artificially inflated. Investment tax credits, like

investment subsidies, allow developers to deduct the amount invested in eligible projects from their taxes. They may be useful in persuading prosperous businesses or high income people to enter the hydropower market in order to lower their tax obligationsbut they can be inefficient if the investors are more interested in maximizing their Tax shelter than in achieving actual electricity production(Morthorst,2002).

There are numerous more investment incentives available for example importing tariff exemption or reduction for example, have been utilized to reduce the cost of imported equipment in developing countries such as Rwanda. Accelerated equipment depreciation, property Tax discounts and value added rebates are among the other tax breaks available. Power purchase agreements that are reliable are likely the single most important need for a renewable energy plant (Tuomi, 2012). The great majority of hydroelectric energy projects were built by IPPs who were assisted in selling their electricity to the utility transmission and distribution to the national grid as well as in getting a contract for selling the power a contract to sell the power to the utility. Because hydropower projects are often seen as hazardous by financial institutions, a consistent, predictable, and hence credible long term revenue stream is critical for getting funding easily and affordable (Sovacool, 2021)..

Operating incentives like capital investment incentives are subsides that reduce the cost of generating electricity from renewable sources. Operating incentives, like investment incentives can be paid for from the general Tax base or by a charge on consumer energy bills. In contrast to investment incentives, which are based on initial capital expenditure, operational incentives per Kwh of electricity generated, and the utility company (EUCL) is also responsible for paying value added tax (VAT).

2.2 Technological Factors

The most common hydropower projects are ultra-low-head (3-40M head) and high-head (40M and 200M head), Rwanda offers 333 prospective sites for small hydropower project construction, according to the report, and it recommends medium- to high-head pico- and micro-hydro designs based on run-off-River plant designs. According to hydropower (Atlas, 2007) the majority of Rwanda's potential hydropower sites have an electricity production capacity ranging from 50 to 1000 kW. According to the survey data, some sites are environmentally and socially excluded from consideration as potential sites due to sensitive

watersheds, poor access to grid or population centres, intermittent water flow and human activities like mining which add a lot of silts and contribute erosion to the rivers and hence a problem on machines in long run.

According to researcher (Hlborg, 2021) mentioned that among the many potential sites, few with a small fraction of 8 % of the numbers of the potential sites of hydro power projects were implemented in Rwanda. The researcher mentioned that the list of good sites is very long but the development moves at a slow pace due to various reasons that will be investigated in this research.

This study found out that the nature of Rwanda's rivers is a factor that stymies project development technologically. The majority of Rwanda's rivers have relatively low flow rates during the dry seasons which create a stumbling block to project development in the sense that project viability becomes an issue and this adds to Rwanda's slow pace of project development. Investors are hesitant to put their money into a project with limited cash flow during the dry season which might last up to half a year (Ashebir, 2009).

According to a study by (Gasore et al 2021) employee skills are a critical factor in the development and implementation of a hydropower project in Rwanda. The majority of technical experienced personnel (technical experts) are outsourced from European countries, Asia, and India, and this comes at a high cost for project design, feasibility studies, environmental studies and operation and maintenance techniques, all of which consume a significant amount of funds. The researcher discovered a number of elements that influence the technical sustainability of power plants in this study. These are frequently associated with resource potential, design, and technical dependability or managerial capacity like mentioned in his research touching base on the nature of Turbines, River discharge, Generators which is major factor in plant operation.

According to (Didik et al 2017), the majority of the equipment, such as turbines, generators, Runners, Transformers, Penstock, and Pipes, is generally supplied from far-flung regions such as Europe, India, Turkey and China, where they are expensive. Machines account for 70% of project expenditures, posing a considerable challenge to project planning and implementation. This research is significant because it will give information on the expenses of machinery and tools utilized in Rwandan project development. The economic component will be discussed in the following paragraphs. The researcher did, however, leave out a detail concerning the type, size and origin of the devices which were addressed in the research.

2.3 Environmental Factors

The phrase "environment" refers to everything in one's immediate surroundings, both living and non-living. Traditional energy production is tied to social acceptability of renewable energy power producing initiatives. The following are significant concerns that should be evaluated while considering environmental factors as a priority in hydropower project development.

Environmental variables predominantly influence water output and sediment levels; for example, (Luis et al 2013) said in their study that increasing silt input year after year is a challenge, among other key aspects that cause turbine wear and early failure. Similarly, the authors believe that silt wear has an impact on turbine performance, with erosive wear varying with silt concentration, silt size, stream velocity, and operation duration. The researchers, however, failed to account for climate change, which has a considerable influence on power plant projects throughout both planning and operation. This study is intended for energy developers, scholars and other stakeholders.

Soil erosion caused by human activities such as mining and agriculture results in large amounts of rubbish and sediments which are the most major factors threatening the long-term viability of Rwanda's small-scale hydropower facilities. This study looked into the issue of water competition between hydropower investors and water treatment projects. Although the researcher mentioned it as a challenge, he did not go into detail about it, it is likely to be a major issue in today's energy sector because all hydropower plants are designed for maximum available discharge. Municipalities are using a lot more water for residential purposes, and this is a higher priority than other initiatives that may or intend to be put in Rwanda. This research will analyse why all water users need to apply for water abstraction permit and at later stage, not considered important (Hlborg,2021)

Hydro power projects development and implementation in Rwanda are also hampered by hilly and mountainous terrain, Rwanda as the slogan goes“is a country of 1000 Hills” and its seasonal running rivers are located in hills which has an impact on hydropower project design both negatively and positively. This study will look into how this factor affects project implementation both positively and negatively.

2.4 Top Management Decision Making

The world being interconnected in nature, top management involvement is arguably more important than ever, any company's issue whether economic development or environmental concerns in a shared power world necessitates a participatory approach by top management in identifying and solving problems that may affect project implementation (Bryson, 2004), in order to promote their common benefit and achieve project objectives, more attention should be paid to owners' interests and wants. People are interested in and appreciate what they have contributed to the development when it comes to building a sense of ownership in decision making, engaging owners and upper management may be critical. Senior management should be actively involved in the project developed tosuit their demands in order to create a sense of ownership. Stakeholders have the capacity to influence the project's outcome in either a positive or negative way(Ward & Chapman,2008)

In a constructive project, top management perspective is very important; if top management is dissatisfied, it can significantly block project implementation resulting in cost overruns and schedule delays owing to conflicts and controversies. Top management brings a diverse set of talents, knowledge and experiences to the project and if successfully managed, they can contribute to its success. The inclusion or absence of involvement of project owners and top management in project Cycle management has been related to the success or failure of many traditional development projects (Irfan et al 2019).

2.5 Human Resources Willingness to Perform Tasks

Indeed, the success of a project closely depend the employees who will to perform work have significant impact on project execution and implementation. The relationships between independent factors and project performance vary depending on where the project is in its life cycle, according to numerous studies. The study's findings will show that the three different structures (functional, project-based and matrix) as well as the Management Support and Troubleshooting factors all have significant impact on project success(Pinto & Prescott, 1990).

The goal for this research study was to investigate and prove the existence of a moderating effect between the dependent variables and hydro power project success. This study looked at how to hypothesize human resource management in a project that is still in the early phases. While strengthening the psychometric properties of project management questionnaires, the researcher was able to improve the construct validity of the Personnel variable. This research also revealed an issue with multi-co linearity in personal usage which appears to be excessive(Gauvreau,20042).

2.6. Stakeholder Participation/Involvement

In any firm, it is very important for stakeholders and key players to be involved in the success of a project and this implies that in the project environment, stakeholders are generally many and can vary substantially in terms of impact. Stakeholder /key player participation can happen at all stage of project development and at various levels of society and it can take numerous forms. Project predetermination, inputs, consultation, information sharing, empowerment, cooperation and decision-making are some of these forms. The process through which individuals and communities cooperate and contribute in the development of a project is known as stakeholder / key player participation(Nguyen & Wong, 2009).

Energy stakeholders need reliable ways to exchange problems and perspectives constructively in order to deal with the increased hydropower energy output. For instance, a forum to allow organizations to get together and propose actual initiatives to expand the usage of hydro power in various energy-intensive activities such as cooking, the forum would have to address the previously noted uncertainty and geographical differences. The forum

would also have to deal with any issues of trust that may arise amongst groups who have had tense relationships in the past (Hemmati, 2012). Before policy decisions are finalized, any stakeholder engagement process must have some type of uniform, transparent manner of giving timely information to all sectors. This is especially relevant given the fact that many energy decisions are typically made through hierarchical top-down processes.

Depending on the technology and location, project management and stakeholder involvement encounter distinct challenges, more general considerations, such as the kind of social networks that emerge around new energy projects, as well as the negotiation and alignment of expectations must be made. These networks may include business specialists and technology providers (as project partners, suppliers, or competitors) national and local authorities and politicians, non-governmental organizations and other interested groups, local residents and customers and so on, depending on the nature of a project. It's also worth remembering that stakeholder perspectives shift regularly during discussions; stakeholders aren't monolithic, and their bearings aren't static.

Stakeholder expectations necessitated negotiation on a variety of topics, some of these, such as the distribution of costs and benefits (the allocation of economic expenses among players, the balance of local and global environmental benefits) may be referred to as "real differences of interest" (Kiara, 2013). Fundamental value differences arose from time to time, for example, over nature's utilitarian vs intrinsic or amenity worth or opposing perspectives on acceptable future economic and social growth. Furthermore, there were significant knowledge and assurance gaps such as genuine concerns about the performance, repercussions and application of numerous new energy technologies. Other obstacles are more commonly referred to as "organizational problems," such as trust building when there are no precedents or poor past experiences, communication issues such as explaining the project goal or understanding local concerns, culture and communication patterns or negotiation issues such as defining roles and responsibilities or finding appropriate procedures for negotiation and arbitration (Leach, 2004).

2.6.1 Stakeholders Theory

The objective of a corporation, according to the Stakeholder idea, is to provide as much value to its stakeholders as feasible. To prosper and remain sustainable over time, CEOs must maintain customers', suppliers', employees', communities' and shareholders' interests aligned and moving in the same direction. According to the traditional conception of the business, the shareholders or the company's owners and the firm has a binding fiduciary obligation to meet their needs first and increase value for them (Venkataraman,2006).Other parties engaged in stakeholder theory include governmental organizations, political groups, trade associations, trade unions, communities, financiers, suppliers, workers and customers. Because of their capacity to affect the company and its other morally acceptable to the stakeholders, rivals are frequently considered as stakeholders too. The definition of a stakeholder is a contentious issue in scholarly writing, there are hundreds of definitions as per researchers (Zyglidopoulos, 2018).

2.6.2 Project implementation and stakeholder participation

Project implementation, particularly large ones with many stakeholders have been nervous with difficulties in recent years. Lack of process owner buy-in, champion support, demanding expectations or needs from project sponsors and lack of support from the surrounding community, unwillingness to change, cultural obstacle and at times language issues are just a few of the difficulties. Stakeholder management is critical because it assists a firm in achieving its strategic goals by assessing and influencing both the external and internal environments, as well as establishing strong connections with stakeholders, the management of stakeholder expectations and agreed-upon objectives and critical to the overall success of the project (Abiero, 2010). The purpose of this study was to identify stakeholder management challenges in the implementation of Rwanda's Hydro Power Project. The study's objectives were to ascertain the extent to which the surrounding communities' and other stakeholders' expectations of the project pose a challenge to its planned implementation to assess the impact of local residents' resistance to change on the project's strategic achievement and to ascertain the benefits, if any, of stakeholder participation to both the project and stakeholders (Hasan, 2018).

Stakeholders in this research included members of the Technical Committee (TC), project workers, Civil Society Organizations (NGOs), the Provincial Administration and contractual partners. The research looked at all stakeholders not only those who may be injured by the transfer but also those who were impacted in some ways but were not relocated, Because all of the aforementioned stakeholders are participating in the implementation, the community's expectations are more realistic and project implementers are more aware of their capabilities and limitations in satisfying some of their requirements (Sinh, 2002).

2.6.3 Project implementation and Human Resources willingness to work

This report provides an overview of the key findings from the scenarios examined in Rwanda's energy policy strategy, planning and prospective energy initiatives and alternatives (Hydropower, Biomass, Solar, Methane, Peat, and so on), as well as other Government Development Frameworks aimed at poverty reduction and economic development. In this context, the paper seeks to analyze the role of renewable energies, particularly micro hydropower in resolving Rwanda's energy supply and management concerns for long-term development, with the managerial/human resource willingness. The main conclusion is that when human resources are willing to perform their duties/tasks, the electrification target will be met without fail, and of course, these renewable energies (micro hydropower) significantly contribute to reducing greenhouse gas emissions and improving diversification of energy production and supply into the national grid as well as independent off-grid systems, particularly in rural areas far from the grid, this becomes much more essential and crucial when considering the country's electrical access. Although other variables are still important to meet urgent and pressing power demand, Renewable energy sources are well placed in offering medium and long term solution in a sustainable manner (Rutagengwa, 2013).

2.6.4 Project implementation and Investor’s decision making

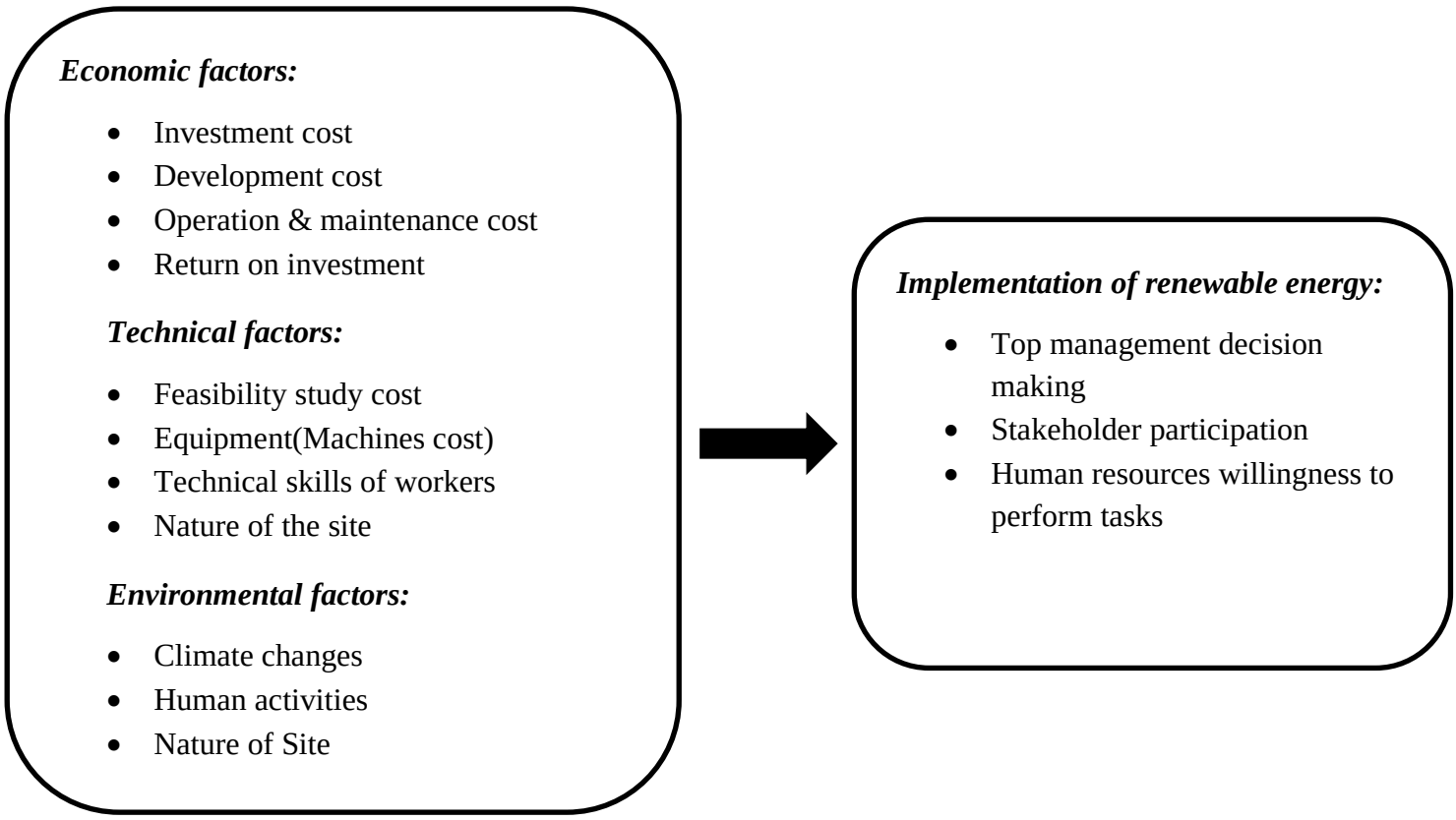
Renewable energy (hydropower) investments are gaining popularity as a way to boost economy and speed up the recovery from the recent financial crisis. Despite their popularity and a slew of regulations aimed at promoting these technologies, the uptake of hydro power

projects has lagged below predictions in Rwanda. This low adoption is attributable to a lack of adequate funding as well as a reluctance to invest in these technologies by investors. In order to shed light on these phenomena, we analyze the decision-making process that underpins investments in renewable energy technology in this article.

We develop and evaluate a conceptual model that investigates the structural and behavioral elements that influence investor decisions as well as the link between hydro power investments and portfolio performance. We examine how investors' a-priori beliefs, policy preferences, and attitude toward technical risk impact the likelihood of investing in hydro power projects using possible ways of quick decision making. We also show that increasing hydro power projects percentage in a portfolio improves portfolio performance. Scholars, investors, technology managers, and policymakers will benefit from the findings which the researcher will have addressed (Dreveskracht, 2011).

2.7 Conceptual Framework

A conceptual framework is a versatile analytical tool that may be used to a wide range of situations,it’s utilized to arrange thoughts and make conceptual differences and strong conceptual frameworks embody something actual in an easy-to-remember and utilize format. It is a model that has been suggested that identifies the variables and their relationships (Goldman, et al 2016). The conceptual framework, as indicated below, is made up of independent and dependent variables.



METHOD

Figure 1: Independent & Dependent variables

2.8 Variable Definition

The above framework depicts the relationship between the three independent variables, one of which is the financial resource factor, another is the technical resource factor and the third is the environmental resource factor. However, dependent variables include top-level management, stakeholder involvement/participation and human resource willingness to perform tasks in order to achieve Rwanda's full electrification.

2.9 Overview of the Chapter

A literature review indicated a number of key research issues in the study of variables that impact the implementation of infrastructure development projects in hydropower projects.

This section identifies a number of research gaps that this study intends to cover in order to contribute to the existing theoretical framework. However, there was no study in various literatures that addressed variables such as human resource willingness, financial resources, stakeholder engagement, environmental considerations and technical influence in the execution of hydropower development projects(Wolsink, 2012).

The elements that impact the implementation of hydropower infrastructure development projects in the energy businessesare investigated in this research study. It also investigated the ideas of human resource availability, financial resources, stakeholder participation and technological influence in the development of renewable energy projects.

Despite of the availability of such research in the western world, few studies have looked into the variables that impact the execution of infrastructure development projects and none of any researcher investigatedon the determinants that influence the development of hydropower projects in Rwanda. There is an urgent need to do research in this area and offer clear answers for why specific projects are not being carried out and why Rwanda is falling behind in reaching full electrification.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the study's research design, target demographics, sample design, data collecting, data validity and reliability, data analysis procedures and ethical issues.

The researcher used the Doctrinal approach to obtain information in this study which included both quantitative and qualitative techniques. The researcher reviewed and analysed a wide range of scientific literature, including textbooks and journal articles, both in physical and online libraries. In addition, the researcher used the questionnaire method with selected employees from commercial banks involved in hydropower project financing and other financing institutions documentation to learn about banks' and financing institutions' perspectives on loans and equity finance issues. Finally, the researcher engaged utility companies and private energy companies to gather relevant information about project development and implementation in Rwanda.

The study's main goal was to create a project development and implementation performance checklist that all project participants could use to better understand and improve development performance throughout the project life cycle. The information for this study came mostly from a thorough literature research and questionnaire data collecting. A tentative set of development performance criteria was created in early stages of this study and these lists were submitted to the selected interviewers for their feedback via questionnaire data collecting. Questions were organized with several project partners via various methods, including the Utility Company (EUCL), Development bank BRD, 5private companies (investors), 2Commercial banks, 5Employees/contractors. This strategy yielded useful feedback on the appropriateness of the preliminary checklist of established projects in Rwanda. Throughout the study, a team-oriented strategy was used by engaging in extensive conversations within the research team.

According to the above hypothesis, the determinants impacting project development and implementation performance were investigated using two variables (independent and dependent): economic development factors (EF), technological factors (TF), and environmental factors (EF). Stakeholder participation, human resource desire to complete

duties, and top management decisions, on the other hand, have a substantial influence on the implementation of the project. As shown in the table below, a matrix structure was created for a framework of project execution factors.

3.2 Table 1: Framework of project Development and implementation performance Factor

	Project development and implementation performance factor			
Project stage	EF	TF	EF	SHP
Development /Inception	EF I	TF I	EF I	SHP I
Design	EF II	TF II	EF II	SHP II
Construction	EF III	TF III	EF III	SHP III
Operation & Maintenance	EF IV	TF IV	EF IV	SHPIV

3.3. Chapter Overview

This chapter also looked into the methodology to be used to perform this researchstudy work. This chapter focused on the research design, data gathering and data analysis methods. This part included the target population, sample size determination, sampling methodology, research tools and data gathering methodologies, pilot testing, and analysis of the data.

3.4 Research Design

To collect data, aexpressive survey revision approach was used. A research design is the fundamental plan for answering the research topic (Durrheim, 2006). This design is regarded suitable for the study's goal and analysis which is to identify the factors that determine the development and project execution of hydropower projects in Rwanda's energy sector. This study was both descriptive and explanatory. It is explanatory in the sense that it examines the problem in order to determine the causal links between variables. On the other hand, it is descriptive because it attempted to depict the phenomenon by describing events, settings and processes.The goal of this study was to look into a condition or problem in order to figure out

how variables interacted (Yilmaz 2013). Because it was based on people's experiences and comprehensive accounts of events, this study took a qualitative approach. In addition to the foregoing, survey research design is a scientific procedure that entails watching and describing a subject's behaviour without affecting it in any manner (Andrew 2007). This approach is thus suited for this research since it seeks to raise general awareness and understanding of hydropower project finance, as well as how it is handled through the use of bank loans and other forms of funding.The purpose of the research design is to ensure that the researcher collects the variables and obtains a true image of the situation as it occurs progressively in project financing. The study's objectives were defined clearly as well as population's delimitation. The data collecting instruments' validity and reliability were validated which is crucial for any descriptive investigation (Peter Schott 2007).

3.5 Target Population

According to Reynolds (2005), a population is completeset of relevant units of study or data. The target demographic was chosen from among those actively participating in the implementation of infrastructure development projects in Rwanda, such as hydroelectric energy projects, financial institutions, and organizations with project team members. The entire population collection is referred to as a population of components that must be referred to. The study focused on top level managers, middle level employees, and low level employees who work in Rwandan commercial banks, private energy investors, and some top management in utility companies (EUCL) and other executives from the development bank (BRD). The target population for this study is 156 people (respondents) who were chosen from two commercial banks out of fifteen in Rwanda; for example, Kenya Commercial Bank, Rwanda Development Bank (BRD) and Bank of Kigali (BK) financed the majority of hydro power projects ranging from 100 kw/h to 10 MW/h. The majority of the funding came from loans and other ventures to help with project creation, execution, and completion.

3.6 Determining the Sample Size

Purposive sampling is used to select the two commercial banks, with sample respondents from each bank, Development bank employees, Energy private developers (EPD), Investors

who own hydro power projects, Utility company (EUCL), Employees from hydro power project still in the development stageand Employees from hydro power project still inin thedevelopment stage and completed project in Rwanda, bringing a total of 156 respondentsaccording to (Verhoogen, 2009).

As previously stated, the objective study sample size would include two commercial banks, one foreign financing institution, one development bank, one utility business, one association company for private developers (EPD), and Rwandan investors (owners). Bank of Kigali Plc, Kenya Commercial Bank Rwanda Plc, Development Bank of Rwanda (BRD) and GROFIN Rwanda, an international financing institution based in the Netherlands, as well as public private utility companies (EUCL) and private companies involved in hydropower projects, are among the banks targeted. The respondents were chosen for the convenience sample by distributing questionnaires on soft copies via a link delivered to the target respondents.

Table 2: Target Population

Name of institutions	**Total number of employees**	**Selected pln.**	**Percentage (%)**
Top level manager for Kenya Commercial Bank (KCB)	20	5	1
Top level managers for Bank of Kigali (BK)	30	5	1.5
Top level manager for Development Bank (BRD)	15	5	0.75
Top level manager for Energy Private Developers (EPD)	6	5	0.3
Managers for Energy Utility Corporation Limited (EUCL)	35	5	1.75
Private Investors	10	5	0.5
Managers from Energy private companies	40	5	2
Total population	**156**	**35**	54.6
Sample Size		**35**	

The total population is 156for sample.

3.7 Sampling Procedures

The data was collected from a sample of 35 top managers and employees from three head office banks in Kigali City and companies in the business, taking into account the time allotted for the research study and the likelihood of receiving responses from the targeted respondents with the assurance that the researcher obtained some information to feed the research results. Due to COVID 19 protective measures, the researcher was unable to explore

getting data from Rwanda's upcountry region. The researcher used a convenient sampling strategy. The size of the population was determined by the type of data analysis the researcher desired and the amount of time he or she had allocated to devote to the study. Besides, when the population is homogenous, a small sample size is sufficient for the study (Elam, 2013).

3.8 Research Instruments and Data Collection Techniques

Questionnaires were used to obtain information. The reason for utilizing questionnaires was that in terms of field surveys, questionnaires are usually the most successful tools for study, Furthermore, due to time constraints and the researcher's difficulty moving from one respondent to the next as previously mentioned due to COVID 19 preventive measures, electronic (system or software based on the use of google form) questionnaires were used to ensure that the desired number of responses were obtained as well as the necessary information. As a result, 35 replies were received from personnel of both banks participating in loan financing,investors, and manager of hydro power projects. To achieve these objectives of the research, after receiving the data from the respondents, the data was thereupon interpreted and analysed in accordance with the research questions.

3.9 Questionnaire design

This study's questionnaire was broken into two sections: section A, which had 9 demographic questions and section B, which included 25 research questions. The respondent's personal information was kept secret in order for the respondent to feel unbiased, free and at ease answering all of the questions without fear of the researcher releasing his or her personal information.

The first nine questions in the first section of the questionnaire are concerning the respondent's personal information. The questionnaire asked information about the respondents' general characteristics, such as the composition of their financial resources, in this part, the experience of working in hydro power projects or financing project and the

number of years spent in the bank and/or role, the experience in the banking industry and so on.

The researcher prepared the questionnaire in the second section such that the responder had a thorough comprehension of the independent factors. The reasons for not implementing hydro power projects in Rwanda were measured in this section of the questionnaire, which included high interest rates on loans, delayed approvals by the utility company, fear of risks by financing institutions and a lack of trained personnel to analyse project viability by the funding banks. The researcher sought to grasp clearly the influence of project implementation owing to the participation of stakeholders such as off takers, project beneficiaries and the government in the section dealing to stakeholder involvement and researchers.

The researcher wanted to include questions relating to the technological and environmental hazards involved in project implementation in the fourth portion of the questionnaire and before ending chapter five, mitigation of highlighted risks and recommendations from respondents will be presented.

3.9.1 Pilot Testing

Before being distributed, the questionnaire was proofread by two banking employees with extensive knowledge of the subject matter and minor corrections, two experienced investors in the sector and one top level manager from Energy Private Developers (EPD), a company that represents independent power producers (IPPs) and changes were made to improve the questionnaire's clarity and visual layout. The surveys were also tested with five colleagues from the technical area of hydropower projects. The pilot study was undertaken to ensure the questionnaire's validity, sequence and relevance to this research topic. The questionnaire was created, filled out and analysed or interpreted in English language.

3.9.2 Data Analysis

Research data was collected, analysed and double-checked to ensure its correctness and completeness. In the data analysis, descriptive statistics were applied, which blended qualitative and quantitative approaches. Parts A and B were examined using frequency tables,

whereas Part C was examined using frequenciesStandard deviations and mean scores, the statistical analysis was performed using the Statistical Package for Social Sciences (SPSS). Finally, the researcher analysed the information and moderated conversations based on the replies to the questionnaire provided by the researcher.

5.3 Validity of Study Tools

Research data quality was integrated throughout the study procedure, particularly during the data collecting stage to ensure that questionnaires were complete, records were readable, and responses were legitimate. Data cleaning, validation and confidentiality are all instances of quality control during the data processing stage. Because there were no statistical procedures for determining validity, the researcher had to rely on his or her own judgment. Nonetheless, three different types of validity were examined and described.

CHAPTER FOUR:

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 introduction

This section discusses the research study and variables presentations that contribute to the development of hydropower projects in Rwanda, the results were generated from raw field data collected using authorized data collection equipment and techniques. The study results are provided in accordance with the study's goals and research questions and data in this study were presented using frequency tables, percentages, mean, and standard deviation and T test (Succop, 2016).

4.2Back ground information

Gender, level of education, finance composition and degree of participation in the development and implementation of hydropower projects were utilized to define the respondents to the research study. This data is vital for the study's critical examination of respondents' perceptions on project implementation. The researcher did not include the respondent's age and gender identity as part of the study since the two characteristics did not appear to be essential in terms of the subject matter.

4.3 Hydro power project implementation and distribution of respondents

The respondents were asked if they worked for any of the selected banks, hydropower project investors, power plant technicians or Electrification promoters. It was critical to consider this data since it depicts the true state of knowledge about the subject among financial institution personnel, investors, project technicians and proponents of electrification (Khatib, 2003).

The results are summarized in the table below.

Table 3: Respondents distribution

Respondents distribution	**Frequency**	**Percentage(s)**
Employee of financing institutions	**14**	**40%**
Hydro power Project investors	**07**	**20%**
Power Plant Technicians/Engineers	**08**	**22.9%**
Electrification promoter	**06**	**17.1%**
Total	**35**	**100%**

Source: Primary data, 2021

Out of the 35 members of the sample size, 100% of the target population answered to the researcher's survey, which consisted of a questionnaire and were able to participate in the study. Employees from financial institutions, including the Rwanda Development Bank (BRD), Bank of Kigali (BK) and Kenya Commercial Bank (KCB) Plcs, were among the respondents. The Project Co (project Companies) were also evaluated for the study; however, because project implementation is heavily reliant on finance, respondents from financing institutions far outnumbered those from Project Companies. In fact presence of banks represents liquidity for project funding; the researcher focused his attention on personnel from financing institutions. However, the researcher had an easier time reaching out to responders from project businesses since they are better familiar with the industry.

4.4 RESULTS AND DISCUSSIONS

4.4.1 DESCRIPTIVE STATISTICS

Table1. Description of occupation of the respondents

occupation of the respondent	Freq.	Percent	Cum.
Employee of financing institutions	13	37.14	37.14
hydro power Project investors	7	20.00	57.14
Power Plant Technicians	8	22.86	80.00
Electrification promoter	6	17.14	97.14
Other	1	2.86	100.00
Total	35	100.00	

Table1 above describes the occupation of the respondents in the survey where 37.14 percent of the respondents are employees of the financing institutions, 20 percent are hydro power plant investors while 22.86 percent are power plants technicians and then 17.14 percent are electrification promoters with 2.86 percent from the other occupation.

Table 2. Description of main composition of the financing

What is the main composition of your financing? (Only for financing institution	Does your company operate hydro power project (s)?		
	Yes	No	Total
Equity / Project development financing cost	5	3	8
Project partnership financing	5	1	6
Loan financing	4	7	11
Grant financing	2	0	2
Others	4	4	8
Total	20	15	35
Percentage(%)	57.14	42.8	100

The table 2 above describe the main composition of the financing from the financial institution for both groups of companies operate and which do not operate hydro power projects, where 20 or 57.14 percent of the respondents are from the companies operating hydropower projects and only 15 or 42.8 percent of respondents are from the companies that do not operate the hydropower projects with 8 or 22.8 percent of the respondents indicating that the main composition of their financing is equity/ project development financing cost, , 6 or 17.14 percent of the respondents revealed that their main composition of their financing is from project partnership financing 11 or 31.4 percent of the respondents indicated that their main composition of financing is from the loan financing and 2 or 5.7 percent of the respondents discovered that their main composition of financing is from grant financing while the remaining 8 or 22.8 percent of the respondents revealed that their main composition of financing is from other sources (Catalano, 2017).

Table3 description of education level with full electrification target

Education level of the respondent	Do you think Rwanda's hydro power projects implementation is affected by inadequate technical skills?		
	Yes	No	Total
PHD	1	0	1
Masters	8	4	12
Bachelor	11	10	21
Diploma	0	1	1
Total	20	15	35

The table3 above indicates the education level of the respondents and their understanding on the inadequate technical skills affect projects at rate of 100 percent. The table indicates that in the survey, participantsof the survey only one respondent is PhD holder, who at the same time agreed that inadequate technical skills affects hydro power projects development and implementation, 12 participants with master'sdegree level,where 8 of them agreed that inadequate technical skills affect negatively project at the rate of 100 percent while the other 4 participants did not agree with the statement, out of 21 respondents with bachelor degree level, the 11 of them agreed that inadequate technical skill of project designers negatively affect project development while 10 of them did not agree to the statementand the only one participant with only diploma level did not agree the statement of inadequate technical skills affects project development and implementation (Giffoni,2017).

4.5 SURVEY RESULTS ANALYSIS

To establish how financial resources shape implementation of projects in Rwanda.

Table 4 Descriptive Statistics (for both operating and non-operating Hydro power project)

Variable	Mean	Std. Dev.	Min	Max	T-test
Project execution entails significant capital expenses, which include, but are not limited to, development costs such as preparatory studies, site ownership costs, and the cost of establishing a power plant and associated equipment.	4.457	.817	1	5	-2.818
Acquiring and securing all related permits to implement a project is too costly	3.743	1.197	1	5	-1.406
Securing Power purchase agreement and its related tariff takes a lot of time and a lot of logistical cost.	4.057	1.056	1	5	-2.083
The sector's major investors are foreigners while local investors are still deterred by the large expenses involved.	3.829	1.224	1	5	-2.959
Financing institutions are not willing to provide financing due to fear of risks in the sector and project owners do not have collateral security for the projects.	3.629	1.215	1	5	-2.989
Processing infrastructural loans is costly and takes a lot of time and involve a lot of bureaucracy	3.8	1.079	2	5	-1.619
There are a limited number of trained, certified, and competent professionals available for hydropower installation, operation, and maintenance. The few available are in high demand and the expense of recruiting them is prohibitively expensive.	3.429	1.195	1	5	-2.296
Huge interest rate on both local and international loans is still a challenge to the investors who intends to implement hydro power project.	4.257	.95	1	5	-2.351

From table4 above, It indicates that on average the determinants that influence project implementation involves high capital expenses and technical costs involved in setting up a hydro power plant. However, it is seen that the driving factor related to the securing power purchase agreement and acquisition of Feed in Tariff (FIT) takes a lot of time and a lot of logical cost which has highly accounted to the lagging behind of the various project implementation of the hydro power project on most of the sites in Rwanda.

It is evident from the results that the major investors are foreigners (international investors) and the local ones are still intimidated by the huge costs of developing a hydro power project. Moreover, financing institutions are not willing to provide financing due to the perception of high risks involved in hydro power project implementation. It is needless to say that the processing of infrastructural loans involves a lot of bureaucracy and thus negatively impacting hydro power project implementation, like the researcher(Kong, 1998) also mentioned.

Finally, limited qualification, skills and experience for the national project technicians as well as low capacity building for individuals undertaking feasibility studies for hydro power project thus the few available, it yet another challenge for the same, the available ones are expensive coupled with huge interest rate on both local and international loan schemes on the project financing which scares the investors from hydro energy sector.

To analyze how the engagement of stakeholders affects the development of hydro power energy projects in Rwanda.

Table 4 Descriptive Statistics (for both operating and non-operating Hydro power project)

Variable	Mean	Std. Dev.	Min	Max	T-test
The governmental policies in the sector are favourable to the investors	3.686	1.183	1	5	2.462
Regulation policies and associated fees are huge and hence still a challenge to the local investors and hence Independent power producers (IPPs) fear to penetrate on the market.	2.971	1.071	1	5	-2.026
Compliancy regulations or policies are not favourable to the Independent power producers (IPPs) in Rwanda	3.857	1.033	1	5	-1.097
The public acceptance and community involvement is key towards success of a hydro power project implementation.	3.743	1.172	2	5	-2.134
The process of securing approvals for hydro power project takes long on the side of investors and hence it scares them devote their finances in the sector	3.686	1.183	1	5	-3.253

From table 5 above, The data available indicates that the average scaling of governmental policies in the energy sector are unfavorable to the investors and this is highly taken to be inducing factor through which stakeholder involvement in the implementation of hydro power project are unfavorable too.For example average point of regulation policies and associated fees a are huge and still challenging the investors, this hinders independent power producers(IPPs) to penetrate on the market and this is moderately accounted as driving factor for not implementing hydro power project in Rwanda and that why most of the sites are idle.

Averagely, compliance regulations or policies are not favourable to the independent power producers (IPPs) in Rwanda and this cannot be undermined towards the slow move of hydro project implementation in Rwanda.

Another important reason in favour of project implementation is stakeholder involvement. Low average shows that public acceptance and community involvement are highly considered towards the success of hydro power project implementation, while the process of securing approvals for hydro power project takes a long time for investors, scaring both local and international investors to invest in the energy sector, and this is highly taken into consideration for reasons why hydro power project implementation is difficult.

To ascertain the impact of technology on the development of hydropower energy projects in Rwanda.

Table 6 Descriptive Statistics (for both operating and non-operating Hydro power project)

Variable	Mean	Std. Dev.	Min	Max	T-test
The gradual and consistent changes in hydropower plant technologies and machinery affect the competitiveness and project implementation.	3.429	1.065	1	5	-3.070
Highly trained, qualified and competent technicians or engineers for designing a power plant project are all foreigners (Westerners) and expensive and this impacts negatively energy projects implementation.	3.8	1.158	1	5	-2.542
Rivers and water flow is still huge challenge in Rwanda as most of the rivers are seasonal in nature and hence limit project viability.	3.943	.968	1	5	-1.378
Silts, Erosion and sediments associated with rivers in Rwanda also discourage investor due affecting machines during operation of a plant.	3.771	.973	2	5	-2.411
The technology used at the power plant is sufficient to supply enough electricity to fulfil market demand.	3.343	1.083	1	5	3.268
There is a high level of power usage supplied to the national grid and hence motivates utility company (REG/EUCL) to accept new investment applications in the sector	3.143	1.192	1	5	2.154

This part was designed to get a sense of how technology influences the development and implementation of hydropower energy projects from responders.

Table 6 demonstrates that the average point of progressive and continuous change in hydro power plant technology and machinery is yet another important component to consider as a driving reason for hydro power project implementation in Rwanda being sluggish. There is a severe shortage of competent, skilled, qualified, and eager technicians who are ready and prepared to carry out project studies and even those that are accessible are primarily from Western countries, making them prohibitively expensive for Rwandan project investors to recruit making this is a strong reason that is taken into consideration as the technological influencing factor of the hydro power project implementation at an average point view.

Another intriguing occurrence is that rivers and streams are naturally seasonal and water flow remains a problem for project viability throughout the year, which is largely attributed as a technological stimulating element for hydro project execution. To the researcher's surprise, table 6 above shows that, on average, silts and erosions of the mentioned rivers affect

machinery technology (equipment) during project operation in the long run and this is widely regarded as a technological driving factor influencing the slow implementation of hydropower projects, however, the technology deployed at the hydropower plant is sufficient to meet market demand, and this has been moderately considered as a technological influencing factor in the hydropower project implementation. Interestingly, the high level of power usage supplied to the national grid, which motivates utility companies (REG/EUCL) to accept new investment applications in the sector, has been moderately considered as a crucial technological inducing factor in the hydropower project implementation.

To investigate the role of environmental factors in affecting hydro power projects development and implementation in Rwanda

Table7. Descriptive Statistics (for both operating and non-operating Hydro power project)

Variable	Mean	Std. Dev.	Min	Max	T-test
Awareness to local community towards hydro power projects should be correlated with the hydro power energy to ease implementation of such project;	3.771	.843	2	5	1.043
Nature of the sites is faced with a lot surprises like earthquake, Erosion, landslides which also hinders project implementation in Rwanda.	4.000	.642	2	5	-1.636
Prolonged Dry seasons that dries up running rivers in the year is another stumbling block in the sector, low flow affects energy productivity in the business.	3.914	.853	1	5	-0.509
Relocation of the population that is close to proximity to the power plant is very expensive to the investors.	3.686	.9	1	5	-0.267
The policy of reserving 10% water flow in the river is unfavourable to the power plant operator which limit power production.	3.257	1.094	1	5	1.213

Table 7 shows that local community awareness of hydropower projects should be in correlation with hydropower energy projects to facilitate implementation of such projects, which is highly considered as an inducing environmental factor to the hydropower project development and implementation at the average point, while the nature of the sites in Rwanda, which is faced with a lot of erosions and landslides, which were highly taken into account in the development and implementation of such projects. However From the table 7, It shows that Rwanda has a long dry season that dries up running rivers and streams throughout the year, as well as low water flow, which is heavily accounted for as an environmental stumbling block in the development and implementation of hydro power projects on average. As if that wasn't enough, the cost of relocating people from the power plant's proximity to the investors was moderately considered as an environmental determining factor to disfavour hydro power projects production viability which was moderately taken as significant environmental determining aspect of the hydro power project implementation and development.

4.6 Ethical Considerations

The research was conducted in complete secrecy. Before conducting questionnaires survey, the researcher first obtained the consent of the respondents. Because they were not disclosing their names, and the information acquired from them was not transferred to any other third party, I offered a Google form for the Respondents to feel comfortable in delivering their answers. The data was only collected for the study's purposes. In the initial portion of the survey, the researcher had to introduce himself to the respondents.

CHAPTER FIVE:

RECOMMENDATION AND CONCLUSIONS

5.1 introduction

This study investigated the long and short term determining factors that affect the development and execution of a hydropower projects in Rwanda, because generation has been low and even decreasing over the years, despite growing demand for electricity through Rwanda's goal of reaching 100% electrification by 2024.

5.2 summary of findings

The findings revealed that there are numerous challenges in financing hydro power projects with equity and debt financing posing a problem for the majority of investors in the hydro power sector. It can also be deduced from the study that the method of financing renewable projects by commercial banks had an impact on project implementation. It is also clear that Rwandan commercial banks are hesitant to finance hydropower projects since they pose a higher risk than other projects such as real estate, housing, and other companies. The study also found that local banks' ways of funding hydropower projects are unsustainable since they seek collateral security which is normally next to impossible to most of the investors.

The development and implementation of hydropower projects in Rwanda is inclined by a variety of factors, according to the findings. These pricesburden include, but are not limited to, development costs such as preliminary studies, land ownership costs, setting up a power plant with associated equipment costs, securing a power purchase agreement and its associated tariff, and securing a power purchase agreement and its related tariff. Foreigners are the sector's major investors but local investors are still scared by the large expenses involved. Compliance rules or policies in Rwanda are unfavourable to independent power producers (IPPs) and regulating policies and related fees are prohibitively expensive, making it difficult for local investors to enter into the Rwandan market.

As previously stated, the method of financing the project has an impact on project implementation; therefore, the Rwandan government should consider putting subsidies in place, such as the World Bank's loan guarantee, which reduces the risks for commercial lenders and, as a result, lowers interest rates. Investors will only participate in hydro power

energy projects if the government offers incentives (subsidies, import duty exemptions, direct capital investment subsidies, investment tax credits) and pre-existing power purchase contracts, allowing the projects to be sustainable. Bonds are an important funding tool for ensuring long-term viability, reliability, stability and credible long-term revenue stream. Past project performance real and perceived hazards may make funding hydropower projects difficult or expensive, rendering them unviable in comparison to conventional generating source developments.

The gradual and consistent changes in hydropower plant technologies and machinery affect competitiveness and project implementation; for example, the policy of reserving 10% water flow in river streams is unfavorable to low-flow rivers, reducing project viability in the long run through reduced power production, and this is also considered a driving factor inducing the development and implementation of hydropower projects in Rwanda. The company has a reliable system in place that considers the interests of energy stakeholders when making decisions. In most cases, the shareholders, often known as stockholders, are the company's owners. According to the conclusions of the study, the majority of hydropower projects are owned by private persons, which simplifies project development and implementation despite the sector's inherent problems (Watson, 2019)

As previously said, hydro power projects need significant resource allocation in order to maintain a creative edge and remain competitive in an ever-changing industry. In his book, (Kiara, 2013) stated that hydro power project technologies benefit from research and development assistance to assure the industry's continuing development. Solar energy projects, methane gas, peat extraction, biomass technology, energy efficiency, and other technologies, many of which are being implemented in Rwanda, can all help Rwanda achieve full electrification. In certain cases, a lack of knowledge and abilities to adapt to new technologies might stymie the acceptance and deployment of new technology of the mentioned projects. Toachieve the increase in development such projects, changing of financial policies is key or continuous improvement of existing policies, training or skill/technology transfer, environmental assessment and deep stakeholder involvement in the process of project development and implementation.

5.3 Conclusions

The study indicates that the financial sector subsidizes the execution of hydropower energy projects, which are primarily carried out by Rwanda's Development Bank. Rwanda's electrification objective will be met if other commercial banks and other financing institutions contribute in the same spirit; this may be done through both equity and loan funding. It may also be argued that stakeholder involvement and participation are critical to the development of hydropower projects. Investor-friendly regulations will be critical to the quick development and execution of energy projects. The research also finds that stakeholders should have faith in both local and foreign investors in the industry; they may organize investor and stakeholder forums and meetings on a regular basis to better understand the problems they face throughout the development of projects. As shown in the study, the engagement of stakeholders has an impact on the implementation of hydropower projects. The research went on to say that hydropower investors should be creative when it comes to investing significant resources to technological development. The research also indicates that there is constant technical innovation in order to prepare local experts who conduct studies to find feasible answers to the high cost incurred to foreign engineers which sometimes reduce project viability.

In the end, the study suggested that environmental scanning and a thorough research study should be conducted on the potential project sites in order to prevent project failures after they have incurred expenditures. Cub environmental concerns that impact operating projects should be given a high priority for continuous technical improvement.

5.4recommendations

The research suggests the following:

1. Commercial banks should modify their attitudes about hydropower projects in order to offer funding in the form of loan financing, flexibility on collateral securities, and low interest rates on project funding loans.
2. This research work also recommends that high-level technological developments be applied which may be done by allowing national technicians and engineers to solve the issue of costly project study and design expenditures. Rwanda's government would adjust to new research and development strategies.
3. In terms of project execution, stakeholder engagement is critical; utility firms (REG, EUCL, and EDCL) should actively participate in project development and implementation.
4. The research suggests that the government of Rwanda could implement measures to address environmental concerns such as silts and erosion. This can be accomplished by planting trees along the banks of flowing rivers to prevent erosion.

5.6 Suggestions for additional research in future.

The study suggests that more research on other variables such as social issues, governmental policies, and political aspects in the development of hydropower projects in Rwanda would be of a value.

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APPENDIX 1: QUESTIONNAIRE FOR RESPONDENTS

This research instrument was designed to gather data for the goal of conducting research to gain a better knowledge of the factors that impact the development and implementation of hydropower projects in Rwanda. Please keep in mind that your responses to these questions will be kept strictly secret and will only be used for the purposes of this research.

SECTION A:

a) Respondent Demographic Characteristics
b) Respondent category (check the box)
c) Employees of financial institutions
d) Investors in hydropower projects
e) Power Plant Technicians
f) Electrification promoter
g) Others ……

2. Age of respondents (tick with √)

a) 25-30 years ☐
b) 30-40 years ☐
c) 40-50 years ☐
d) ≤ 50 ☐

3. Gender of the participants (tick with √)

Male ☐
Female ☐

4. Marital status of respondents (tick with √)

Single ☐
Married ☐
Widowed ☐
Divorced ☐

5. Your education level (tick with √)

PHD ☐
Masters ☐
Bachelor ☐
Diploma ☐
TVT ☐

A'level certificate ☐

6. Experience in the working /financing energy projects (tick with √)

Less than 1-3 years ☐

3-5 years ☐

5-7 ☐

8-10 ☐

Above 10 years ……..

7 What is the main composition of your financing? (Only for financing institutions)

Equity / Project development financing cost ☐

Project partnership financing ☐

Loan financing ☐

Grant financing ☐

Others, please specify …….

8. Does your company operate hydro power or an ongoing project (s)?

Yes ☐

No ☐

A Member in the sector, (please specify) ……..

9. Do you think Rwanda will attain full (100%) electrification before 2024?

Yes ☐

No ☐

If No/ Yes, please clarify your answer …….

Section B: The external and internal determinants that influence implementation of hydro power projects.

Indicate your degree of agreement with the following statements on the assessment of external and internal drivers that impact the development of hydropower projects in Rwanda

1 = strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree 5 = strongly agree

STATEMENTS					
Objective I :To establish how financial resources shape implementation of hydro power projects in Rwanda	**1**	**2**	**3**	**4**	**5**
1. Project execution entails significant capital expenditures, which include, but are not limited to, preliminary study development costs, site ownership costs, and the cost of establishing a power plant and associated equipment.					
2. Acquiring and securing all related permits to implement a project is too costly					
3. Securing Power purchase agreement (PPA) and its related approvals takes long and demands high logistical cost.					
4. The sector's major investors are foreigners, while local investors are still deterred by the heavy expenses involved.					
5. Financing institutions are not willing to provide financing due to fear of risks in the sector and project owner do not have collateral security for the projects.					
4 Processing infrastructural loans is costly and takes a lot of time and involve a lot of bureaucracy					
7. There are a limited number of trained, certified, and competent professionals available for hydropower installation, operation, and maintenance. The few available are in high demand, and the expense of recruiting them is prohibitively expensive.					
5 Huge interest rate on both local and international loans is still a problem to the investor who intends to construct a hydro power project.					

Objective II. To assess how stakeholders' involvement influences the implementation of hydro energy projects in Rwanda.	**1**	**2**	**3**	**4**	**5**
10. The governmental policies in the sector are favorable to the investors					
11. Regulation policies and associated fees are huge and hence still a challenge to the local investors and hence IPPs fear to penetrate in the market.					
12. Compliancy regulations or policies are not favourable to the Independent Power Producers (IPP's) in Rwanda					
13. The public acceptance and community involvement is key towards success of a hydro power project					
14. The process of securing approvals for hydro power project takes long on the side of investors and hence it scares them devote their finances in the sector					
15. May be Energy available on grid is or will be enough for the available demand and hence utility company is not willing to issuemore new Power Purchase Agreement.					
Objective III. To determine how technology influence the implementation of hydro power energy projects in Rwanda					
16. The gradual and consistent changes in hydropower plant technologies and machinery affect the competitiveness and project implementation.					
17. Highly trained, qualified and competent technicians or engineers for designing a power plant project are all foreigners (whites) and expensive impact negatively energy projects implementation.					
18. Rivers and water flow is still huge challenge in Rwanda as most of the rivers are seasonal in nature and hence limit project viability.					
19. Silts, Erosion and sediments associated with rivers in Rwanda also discourage investor due affecting machines during operation of a plant.					

20. The technology used at the power plant is sufficient to supply enough electricity to fulfil market demand.					
21. There is a high level of usage of power supplied to the national grid and hence motivates Rwanda Energy Group (REG/EUCL) to accept new investment applications in the sector					
Objective IV: To investigate the role of environmental factors affecting hydro power projects development and viability in Rwanda					
22. Unawareness of local community towards hydro power projects should be correlated with the hydro power energy to ease implementation of such project; some are hesitant to offer their land where the line would affect their land.					
23. Nature of the sites in Rwanda with a lot surprises like earthquake, Erosion, landslides and etc also hinders project implementation in Rwanda.					
24. Dry seasons that dries up rivers in the year is another stumbling block in the sector					
25. Relocation of the population that is close to proximity to the power plant is very expensive to the investors.					
26. There are more trained technicians in the field to handle studies like Environmental impact assessment					
27. The policy of reserving 10% water flow in the river is unfavourable to the power plant operator which limit production of energy.					

Thank you for your Participation in this research.

Appendix 2: Letter from the university

UNIVERSITY of RWANDA College of Science and Technology

ACE-ESD AFRICAN CENTER OF EXCELLENCE IN ENERGY FOR SUSTAINABLE DEVELOPMENT

Kigali, 25th March 2021

To Whom It May Concern

Dear Sir/Madam,

RE: Industrial Attachment Recommendation Letter–Academic use only

This is to certify that **MBANGUKIRA ANDREW** enrollment **Nº: 220001083** is our Masters student at the African Center of Excellence in Energy for Sustainable Development (ACE-ESD) hosted by the College of Science and Technology, University of Rwanda (CST, UR) in Energy Economics program. As part of his graduation requirements, he needs to translate theories learnt in classrooms and perform assignments in an actual working environment in your organization/institution/company/plant to comprehend and appreciate real-life working experiences. We highly request your assistance in this regard. Please do not hesitate to contact us for any clarification needed.

Your cooperation will be highly appreciated.

Sincerely,

Dr. Charles Kabiri
Ag. Center Director (ACE-ESD)
c.kabiri@ur.ac.rw
P.O. Box 4285 Kigali, Rwanda
Website: www.aceesd.ur.ac.rw

Appendix 3:Amap showing all approved hydro power project sites in Rwanda.