# INFLUENCE OF STAKEHOLDERS` PARTICIPATION ON IMPLEMENTATION OF OFF-GRID MICROHYDROPOWER PROJECTS IN KENYA: A CASE OF IRIAMAINA MICRO HYDROPOWER IN BOMET COUNTY, KENYA.

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**A Research Project proposal Submitted In Partial Fulfillment of the Requirements for the Award of Degree of Master of Science in Project Planning and Management of the University of Nairobi**

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**DECLARATION**

This research project is my original work and has not been submitted for examination at any other University.

**Sign:**  **Date: 16th November 2022**

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This research project has been submitted with approval by the University of Nairobi supervisor.

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## DEDICATION

I dedicate this research to my children Emma Chepkemoi, Shirley Cherop & Brian Kimutai, My parents in -law Isaac &Esther Ruto for their financial support. To my parents Daniel &Eunice Koech and siblings for their encouragement. To my close friends who gave support towards my research work. I will forever remain grateful.

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## ABBREVIATIONS AND ACRONYMS

**CDM** Clean Development Mechanism

**EIA** Environmental Impact Assessment

**EPRA** Energy & Petroleum Regulatory Authority

**MW** Mega Watts

**NACOSTI** National Commission for science, Technology & Innovation

**NEMA** National Environmental Management Authority

**RE** Renewable Energy

**REREC** Rural Electrification & Renewable Energy Corporation

**TOR** Terms of Reference

**UNDP** United Nations Development Programme

**UNIDO** United Nations Industrial Development Organization

**WRMA** Water Resource Management Authority

**ABSTRACT**

Most hydropower projects follow face numerous implementation trials that impend sustainable realization of clean energy. Moreover, these projects follow a top-down approach paradigm whereby projects are identified, planned, and executed according to the governments' or investors' preferences. The purpose of this study was to evaluate the influence of stakeholder participation on the implementation of off-grid micro-hydropower projects in Kenya, a case of Iriamaina Micro hydropower in Bomet County. The objectives that guided the study were: to establish the influence of stakeholders' participation in decision-making on the implementation of off-grid hydropower in Kenya; to assess the influence of stakeholders' participation in project design on the implementation of off-grid hydropower projects, and to determine the involvement of stakeholders participation in project financing on the implementation of off-grid hydropower. The stakeholder theory and the systems theory served as the foundation for the study. The research used a descriptive survey methodology. The study population included stakeholders from the project committee and community at Iriamaina Micro hydropower in Bomet County. The data was collected using the Linkert scale and presented through standard deviation, Mean, and proportions. The inferential statistics used namely; Pearson's correlation coefficient(r) and regression analysis. The study had a hypothesis test. The target population of this study was 160 stakeholders. The response rate was at 96%, a proportion of 4% posed unavoidable discrepancies such as incompleteness. The quality of data entered in SPSS was above average. This translated to 153 questionnaires being utilized.  A cross-sectional research design was used during this study. Primary data was collected by the use of 5-point Likert levels highlighted in brackets (1-strongly disagree, 2=disagree, 3=neutral/undecided, 4=agree, 5=strongly agree) and interview guide. The data was reliable as Cronbach's coefficient was above 0.7. The data collected was sorted, keyed in, and analyzed with the aid of the Statistical Package for Social Sciences (SPSS). Descriptive statistics were used to know to what extent and where the stakeholders influenced project financing, project design, market assessment and project decision-making. The research findings on descriptive statistics indicated that majority of respondents agreed on involvement in project decision making with respective combined mean of (4.011), market assessment(4.394) , project financing (4.086) whereas the respondents were neutral on their involvement in project design (3.674). Pearson's correlation coefficient showed that there was a positive correlation as follows on the variables; decision making ($r = 0.323$), market assessment ($r = 0.145$), project financing ($r = 0.240$) and project design ($r = 0.401$). Findings showed a strong positive correlation between involvement of stakeholders and implementation of hydropower $r = 0.506$. Descriptive data showed that respondents agreed on being involved on implementation of Iriamaina micro hydropower with combined mean (3.54).The regression analysis showed that; involvement in project design, project financing and decision making were significant predictors of the implementation of hydropower ,however, the market assessment was not significant.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

There are several energy sources accepted worldwide and there are namely; natural gas, nuclear, oil, coal, hydro, geothermal, solar, wind and biomass. Oil is the most popular source of all the above, it is of more importance due to its energy products like heat, electricity, and mechanical energy. Critically, the generation of electricity by hydro, coal, nuclear or geothermal energy is more economically practical than any other sources (Hosseini & Wahid, 2016). All the above sources of energy occur naturally on earth even though they are not usually fairly spread among countries of the world. According to Infield and Freris (2020), geothermal and hydro are usually not transportable, however, heat or electricity generated can be sold and transmitted to other nations. Developed nations usually can secure all their energy needs even if they are not naturally gifted with some of these resources. As for developing countries, the fear is whether the natural resources are sustainable for future socio-economic developments against the rising demand.

Worldwide, countries like Vietnam, Nepal, China, and southern American countries have seen the development of mini and micro hydro projects in the last 30 years. In Nepal, energy consumption per capita and economic growth are mutually reinforcing. Nepal is one of the countries in which many micro-hydropower plants with an individual capacity of about 5 to 100kW are installed having a total of about 1,287 plants with a combined 25 MW capacity for decades and this trend has escalated over the last decade (Ghimire & Kim, 2018). The majority of off-grid micro-hydropower sources are used in several development projects to give the right to use energy for areas not connected to the central grid.

The lack of reliable energy sources remains one of Africa's greatest development obstacles. At least 600 million people worldwide do not have access to power, according to estimates. Traditional biomass is used by around 700 million people throughout the globe. A major issue in Africa, especially in sub-Saharan Africa, is the lack of access to reliable, affordable, and clean energy, which is the focus of Sustainable Development Goal 7. (D'Alessandro & Zulu, 2017). Electricity is more expensive in sub-Saharan Africa as compared to developed countries and it is for this reason that a small percentage of the population is connected to the national grid with the rural population with the lowest access as compared to the urban population. The demand for electricity in Eastern Africa is expected to increase by 5.3% yearly through the year 2020. To meet these demands, Uganda's and Rwanda's power generation volumes would need to be boosted by about 37.7% and 115%, respectively. 75.3% in Tanzania and 96.4% in Kenya. Notably, most countries in East Africa use off-grid power as a second alternative and grid-connected power as their main source of electrification. In Kenya, almost half of power comes from hydropower with large hydro (44%) and micro-hydro taking 5 % (Hafner et al, 2019). In Kenya, according to ERC, 2269 MW of total generation capacity generated 9139 GWh in the year 2015. Water resources used to generate hydropower are finite and therefore it got to be managed sustainably. Macro and micro hydropower produce up to 19% of global electric power and is thus very crucial. (Rahman, Nabil, & Alam, 2017)

The typical components of micro-hydropower projects are a water intake, a weir or dam, penstock pipelines, a turbine, and a power house. To prevent aquatic life or other materials from entering the turbine, water flowing from a water body—typically a river—is directed into the feed reserve. Water enters the intake, travels through the penstock pipe, and then is directed toward the turbines inside the power plant. Water turns turbines, which power and drive the generators that generate electricity. Then, using transformers and transmission lines, this electricity is delivered to homes. (Anaza, Abdulazeez, Yisah, Yusuf, Salawu, & Momoh, 2017). The work description involves site assessment surveys, a detailed topographical survey, and the development of engineering drawings for the project. The system of Micro hydropower involves; a water course then it goes to the intake to the settling tank, then pen stock then to the power house for electricity generation and the water returns to the course. The electricity generated can therefore be distributed off-grid or to the national grid (Shrada, 2009)

### 1.2 Statement of the Problem

Energy from the water provides up to 19% of energy globally (Hossain, Madlool, Rahim, Selvaraj, Pandey & Khan, 2016). National energy policy and related incentives are intended to support hydropower energy development, however, could pose a major amount of risk and insecurity to infrastructure projects like micro hydropower projects. Such risks could be challenging to mitigate in the planning and developmental stage. The legal and regulatory frameworks together with national policies could change in the process of development which in turn changes the economic feasibility of the project. All kinds of engagement practices, from hotel meetings to small setting groups meetings with local, discussion groups, informal votes, and listing of alternatives can happen during the stakeholder engagement process. Even though suggestions could vary from beneficial constructive comments to irrelevant assaults, nevertheless, it is a learning process. In any kind of project, stakeholders wish to be treated with importance to feel part of the development. Stakeholder influence and opposition can cause delays, cancel a project, or change government policy (Edelenbos, Van Buuren, Roth & Winnubst, 2017).

Studies done by Bhattacharyya and Palit (2016), found that there are various methodologies for socio-economic growth. Nonetheless, top-down paradigms were initially used in development initiatives. Projects were chosen, organized, and carried out per the government's preferences. At the moment, development initiatives have a stronger local, participation, social capital, and interest focus. Environmental organizations, security services, and proponents of human rights are additional factors. Early development was imposed in a top-down paradigm and was insensitive. (Swanson, 2016). After World War II, the modern theory of development began. In those early days development was part of colonialism whereby the colonialists planned development for their colonies. Colonialism was viewed to be unfair to the local people. The majority of parties are ready to negotiate what is best for them. Mostly different actors can come to a consensus by letting go of their stands and appreciating each other's interests. Basic human necessities persuade everyone alike as the needs are similar for all groups. Every participant in the project has to have their welfare met to come to any arrangement. The larger the number of stakeholders involved, the more conflicts are anticipated over the direction of development. The adoption of a mediation framework of viewpoints, interests, and requirements will make it simpler to come to a consensus. This framework would also work well during the planning and evaluation of projects.

Research done by Yang and Chen (2018) found several factors that influence the global rise of the need for renewable energy: ratification of the Kyoto protocol, increasing awareness of carbon emission effects, security risk, and conflicts on a global scale brought on by the use of fossil fuels from unstable areas of the world. Furthermore, as technologies mature, the market expands, and the price of traditional fuels rises, the economics of unconventional energies continue to progressively improve. Major initiatives have been launched by international development banks, bilateral organizations, and multilateral institutions to encourage the production of alternative energy in poor nations. Every player in the energy sector needs to identify their roles, interests, and desired results. A renewable market growth convention must also address energy delivery following preferences, price stability, boosting local employment opportunities and development objectives, reducing carbon emissions and other detrimental environmental effects of power generation, improving the green economy, and financial support to meet these goals. (Da Silva, Cerqueira, & Ogbe, 2018). It is noteworthy that the incorporation of elements including the infusion of fresh ideas, use of creative technology, involvement of all parties, a suitable legal and policy framework, as well as cutting-edge funding methods, are all a crucial part of the equation.

**1.3 Purpose of the study**

The objective of this study was to evaluate the influence of stakeholder involvement on Kenya's implementation of off-grid micro hydropower. A case of Iriamaina Micro hydropower in Bomet County.

**1.4 Research Objectives**

The following goals served as the study's guidelines:

i. To ascertain the impact of stakeholder involvement on market analysis on the implementation of off-grid hydropower by Kenyan micro hydropower projects.

ii. To determine how decision-making processes involving stakeholders affect the implementation of off-grid hydropower by micro hydropower projects in Kenya.

iii. To determine how stakeholders' input into project design affects Kenyan micro hydropower projects' ability to implement off-grid hydropower.

iv. To determine the influence of stakeholders' engagement in project financing on implementation of micro hydropower projects in Kenya.

**1.5 Research Questions**

The following research questions have been addressed:

I. How do stakeholder market assessments influence the implementation of Kenya's off grid micro hydropower projects in Kenya?

II. How does stakeholders' participation on project decision-making influence the implementation of off-grid hydropower projects in Kenya?
III. How does participation of stakeholders on project design affect the implementation of off grid micro hydropower projects in Kenya?
IV. How does stakeholders participation in project financing influence implementation of off grid micro hydropower projects in Kenya?

### 1.6 Significance of the Study

The study findings can assist policy makers in the energy sector to make decisions regarding financing and partnership development of micro hydropower projects, it will also help investors and developers to analyze financial, regulatory, and legal requirements to avoid, transfer or mitigate foreseen risks. The outcome of the study might also be used to ensure off-grid projects benefit the community in time as per the need. The lessons learned would in the future facilitate project managers on the importance of the involvement of all energy actors in project decision-making and involvement on project design.

The outcomes of the study would also help donors to make an informed decision when it comes to off-grid hydropower projects and their potential significance for economic development. This information would also benefit scholars researching micro hydropower projects in Kenya as few pieces of research on this have been done previously, however, some research has been done regarding the mega hydro powers in Kenya. This research has equipped REREC to sponsor young researchers in renewable energy as mandated by the Energy Act (2019).

### 1.7 Delimitation of the Study

The study's case study, Iriamaina Micro Hydropower Bomet County, examined the impact of stakeholder involvement on the implementation of micro hydropower projects in Kenya. These involved views from the beneficiary (community representatives) , the County Government of Bomet, the Department of Energy, EPRA (regulator), the financier (UNDP), the developer (UNIDO), WRMA (regulator), NEMA (regulator), National Ministry of Environment and Natural Resources and REREC.

### 1.8 Limitations of the Study

This study's limitation was the community representatives gave inaccurate information on their views of this project for fear of the information being used against them. The study was solely based on stakeholder participation on implementation of an off-grid micro hydropower project in Bomet County.

### 1.9 Assumptions of the Study

This study assumed that every respondent provided truthful information without bias or concern for intimidation. It is also assumed that time allocated for the study was sufficient to complete the research in the desired manner.

### 1.10 Definition of Significant Terms used in the Study

**Community:** a sociological group of any dimension whose members reside in a particular location. It can also be used to describe a city, district, or locality. According to this paper, the community refers to Bomet County and the people who were to benefit directly or directly from Iriamaina micro hydropower project.

**Generation:** refers to the installation and use of compact integrated power producing systems that can be combined with energy management and storage systems. Mostly utilized to develop end-user operations for electrical power distribution systems. These plans occasionally connect to the electric grid or are not yet connected.

**Implementation**: It is the actual execution of installation of the hydro turbines to generate power and distribute for use by the community.

**Market assessment:** refers to a detailed analysis project's effect on the environment including benefits, impacts, resources, and constraints.

**Micro hydropower:** This refers to a hydropower plant with a generation capacity that ranges from 5kW to 100kW.

**Off-grid:** refers to not being a part of a grid, especially when referring to the main or national transmission grid for energy.

**Project design:** refers to the first stage of a project, during which the main components, organizational structure, success criteria, and important outputs are all planned out. The objective is to create one or more designs that can be applied to realize the intended project objectives.

**Project financing:** refers to a business that uses the project's rights, interests, and assets as secondary collateral but principally depends on the project's cash flow for repayment.

**Renewable energy:** refer to Carbon-free energy sources like biomass, tidal, wind, and solar energy that naturally replenish on a human timescale.

**Stakeholder:** refers to a party that has an interest, is affected, or is ought to bring some influence in the project in this case all individuals involved in setting up of the micro hydropower plant.

### 1.11 Organization of the Study

There were three main sections to this investigation. An overview of the topic and context for the research and design of the micro hydro power project are presented in the introductory chapter, along with a statement of the problem, research objectives, research questions, the significance of the study, its delimitation and limitations, and the assumptions upon which the research is based. In Chapter 2, we will discuss the literature review, the introduction, and the factors that will be studied. Research design; population of interest; sample size and sampling processes; data collecting instrument and procedures; data analysis methods; ethical issues and variable definitions are all covered in detail in chapter three, which explains the research methodology used in this study. In Chapter 4, the Information Is Presented And Analyzed.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Introduction

This chapter examines previous efforts and studies on how stakeholders' involvement affects off-grid micro-hydropower implementation. It provides an insight into the implementation of off-grid micro hydropower, stakeholder participation in market assessment, project financing, project design, and decision-making. The study focuses on two theories: Stakeholder theory and Systems theory. Additionally, a conceptual framework is offered to emphasize the connections between the variables.

## 2.2 Implementation of Off Grid Micro Hydropower

One of the key forces behind economic growth is energy. Among the most important factors and predictors of economic growth is per capita energy consumption. Although electricity is not an end in itself, many social and economic activities need energy to be facilitated (Riva, Ahlborg, Hartvigsson, Pachauri, & Colombo, 2018). In developing countries such as Nepal, energy consumption per capita and economic growth are mutually reinforcing. Nepal is one of the countries in which many micro-hydropower plants with an individual capacity of about 5 to 100kW are installed having a total of about 1,287 plants with a collective capacity of 25 MW for decades and this trend has escalated over the last decade (Ghimire & Kim, 2018). The majority of off-grid micro-hydropower sources are used in many development projects to provide access to energy for places without connection to the main grid.

Off-grid systems offer self-sufficiently controlled hydroelectric power with similar quality and reliability to the national grid. Off-grid electricity connections are a type of power source utilized in places where there is limited access to energy because of a dispersed or remote population. (Gonzalez-Longatt, Sanchez, & Singh, 2019). It could be any form of power generation. Mohammadi, and Mehrpooya (2018), postulate that electricity may be generated locally from renewable energy sources like solar, hydropower, wind, or geothermal energy; or using a generator and sufficient fuel supplies. To supplement the energy supply produced by other renewable fuel sources, which are referred to as "green energy" in some industrialized countries, the power can also be connected to the national grid or used off-grid.

Vietnam, Nepal, China, and southern American countries have seen the development of mini and micro hydro projects in the last 30 years. In developing countries, particularly in Kenya, investments are concentrated in the large hydro power stations which are mostly connected to the national grid. Although this sector has not generally been studied in Kenya, Uganda estimates that there is a good potential for mini-hydropower on 71 rivers with an estimated capacity of 220MW (Othieno & Awange, 2015). Kenya has significant endowment sites that are suitable for hydropower production. One of the established ones includes Tungu-Kabiru micro hydropower scheme. Implementation of this type of project is cheap, sustainable, and small-scale technology which decreases the use of diesel for milling, wood, and dung for cooking, and kerosene for lighting stagnate (Michaelowa, Hoch, Weber, Kassaye & Hailu, 2021).

Over a couple of decades, developing countries are increasingly realizing the need for micro hydropower for economic growth, particularly in rural areas. The intended purpose of electricity generated varies from one region to another based on their needs. For instance, it can be used for rural industrial applications such as water pumping, milling, and carpenter workshop. It can also be used for domestic applications like lighting, heating and other power uses. The generation of hydropower is based on the principle that if water is piped from a higher ground and directed to a lower ground, the resulting force is used to turn a turbine. The hydro turbine converts the water pressure into mechanical shaft power, which in turn turns an alternator that generates electricity (Sultan & Rahman, 2015).

## 2.3 Stakeholder Participation in Market Assessment and Implementation of Off Grid Micro Hydropower

Market assessment and research are crucial in determining micro hydropower energy sustainability (Tronchin, Manfren, & Nastasi, 2018). The assessment helps in handling issues on micro hydropower technologies and applications such as integrated information communication technology and renewable energy technology transfer, environmental and social impact, policies/regulations and planning, obstacles, and impending framework to improve energy development and sustainability and climate change mitigation (Wassie & Adaramola 2019).

According to Cardenas and Halman (2016), evaluation of the environmental impact of the project is considered to minimize the implementation of activities that may in any way affect the environment and simultaneously make it possible to select the optimal option from the proposed projects implementation alternatives to the alternative with the least negative impact on the environment on a proposed activity. Environmental impact assessment (EIA) procedures are conducted before project initiation for both public and private projects to determine the effects on the environment. In Kenya, EIA is conducted by EIA/EA experts and approved by National Environment Management Authority (NEMA) (Muigua, 2016). Ugwoke, Sulemanu, Corgnati, Leone, and Pearce (2021) suggested that the impact of rural electrification needs the involvement of other stakeholders so that it can be assessed as one component of the integrated rural development program. During the initial project preparation stage, it is vital to establish if a project to be initiated can benefit the local community, satisfy the stakeholders and it can achieve the intended objectives.

Given the increasing demand for energy in Kenya due to the rapidly growing population stirring economic growth, there is a need to solve the power outage challenges and reduce the cost of electricity (Oyewo, Farfan, Peltoniemi & Breyer, 2018). Once the power challenges are solved it will help to create job opportunities for the community, solve social and economic problems, and also helps boost local energy production. Nyabera (2015) suggested that to achieve this, it is vital to undertake stakeholder analysis and needs assessment. The country's vision 2030 entails more production of renewable sources of energy whereby its goal is to generate 100% of renewable energy(RE) and this can be supported by setting up off-grid micro hydropower plants (Kenya Vision 2030).

Shyu (2020) suggested that any type of sustainable off-grid in rural areas mainly needs active participation from the local community from the assessment, planning, development, and implementation stage of the project. Largely, the energy situation in the present day generally is dependent on renewable energy. A lot of nations are making efforts to develop and use renewable energy instead of non-renewable energy. Due to its affordability in comparison to other energy sources, micro hydropower is a fantastic option. Additionally, it is environmentally beneficial and can help developing nations like Kenya deal with their energy crisis (Kathumbi, 2016). In Kenya's rural areas, access to electricity is represented in a variety of profitable uses. Despite some counties in Kenya being well endowed with RE sources they are still ranked as energy insecure due to a weakly integrated framework, lack of technical capacity, and cost-related challenges (Hafner, Tagliapietra, & De Strasser, 2018).

## 2.4 Stakeholder Participation in Project Financing and Implementation of Off Grid Micro Hydropower

Palit and Bandyopadhyay (2016) discovered that the bulk of rural electrification initiatives has been carried out for decades in various nations by governmental, commercial, and non-governmental organizations. The majority of countries now finance these initiatives primarily through subsidies. Findings indicate that these projects are not meeting their objectives to the satisfaction of the intended stakeholders, despite tremendous effort on the part of the organizations implementing them and the modernization of technologies. The economic, technical, and social sustainability of these initiatives frequently falls short (Wamugu and Ogollah, 2017). The Covid 19 pandemic has significantly impacted the countries in Sub-Saharan Africa, which are home to nearly three-quarters of the world's population and have limited access to power. For the first time since 2013, estimates show that the population without access to electricity expanded significantly in 2020. Therefore, initiating and organizing development finance institutions and donors is vital to ensure that the energy connection quest does not stagnate (Michaelowa, Hoch, Weber, Kassaye & Hailu, 2021).

According to Almeshqab and Ustun, (2019) electrification of rural areas would hardly progress without the involvement of corporate funding and official cooperation, mobilizing the necessary resources thus becomes challenging. Equally, the banks are hesitant to get involved in off-grid projects. Hence, pinpointing creative ways to pool capital and boost funding is vital in the development of electrification of the rural. According to Bhattacharyya and Palit (2016), the effective operation and maintenance of a project is a crucial component of the performance of an off-grid project. Generally, the management of micro hydropower project on operation and maintenance may not be successful if finances are limited and frequent support from stakeholders are not provided.

## 2.5 Stakeholder Participation in Project Decision Making and Implementation of Off Grid Micro Hydropower

The project siting and development of a micro hydropower plant is a complex process that involves some level of uncertainty on the range and magnitude of outcomes. The concept is factual to some extent as it involves significant environmental impact. As much as the project may be of benefit to the local community at large the range of impact remains uncertain

(Bustamante, Roitman, Aide, Alencar, Anderson, Aragão, & Vieira, 2016). Complex projects like off-grid micro hydropower plants call for an adaptive approach by management to minimize the dilemma in natural resources as it has a huge environmental impact with high risk and may typically stagnate if the public is unwilling to accept a certain level of uncertainty (Schandl et al., 2016).

Rural electrification is closely related to key aspects of sustainability. The symbiotic relationship between capacity, growth and environmental impacts should be better understood to create sustainable energy solutions (Bustamante, et al 2016). Involvement in decision-making fosters poverty reduction energy programs that focus more on awareness of the role of energy in the livelihoods of the local community. Energy requirements must be taken into account in an overall sense of rural population, and systemic alignment of energy policies and programs with other initiatives for rural development such as education, job creation, health, and agriculture (Almeshqab & Ustun, 2019).

Dizdaroglu (2017) suggested that the community's role during the past two decades on project site and development decision-making was limited typically to commenting on the proposed statements and regulations. However, currently, the public has been given varied positions to participate and raise their voices in public hearings, meetings, and even the decision-making process. Birnbaum (2016) posited that establishing legitimacy highly depends on the degree of stakeholder involvement. Participation of the community yields satisfaction and compliance as they feel they own the project since their input is well utilized. The concept of legitimacy brings fairness to the participants even if the mandates contradict their self-interest. Budiman (2018) suggested that making use of public knowledge ensures that the challenges are being identified and addressed before setting up the site to cater to the needs of the community as they rely on the resources around the protected site.

According to Schaltegger and Hörisch (2017), Involving stakeholders in decision-making is more crucial if you want to create long-lasting relationships. Between the resource users and the contracting company. By participating actively, stakeholders will most likely take credit for the designation, acknowledge the benefits derived from the protected area and abide by the regulations put in place. Therefore, setting up micro-hydropower plants in rural areas of less developed nations like Kenya can offer substantial benefits to the residents served, particularly in the context of generating income from electric power. With the involvement of the stakeholder, the income generated from the project can be utilized for the socio-economic development of those areas (Almeshqab & Ustun, 2019).

### 2.6 Stakeholder Participation in Project Design and Implementation of Off Grid Micro Hydropower

The conventional sources of energy still account for a larger portion of 76.3 % of the total energy produced globally. Hydropower is the global leading source of renewable energy covering 16.6 % although other renewable sources are still underutilized (Renewables, 2016). Owusu and Asumadu-Sarkodie (2016) suggested that there is a need to set up more sustainable energy sources such as hydropower plants that will improve energy production and also help mitigate climate change and reduce carbon emissions.

Micro hydropower plants need to be constructed to act as a supplement for conventional energy sources to reduce the greenhouse effect (Chandel, Shrivastva, Sharma & Ramasamy, 2016). How much energy can be made from a river depends on how much water is in it. At the design stage, it is very important to know how much water is in the river and how it flows throughout the year (Bazimya, 2018). Vision 2030, Kenya's plan from 2008, is based on three main pillars: economic, social, and political. These will help Kenya go from being a developing country to a newly industrialized one, giving all of its people high living standards by keeping the environment clean and giving those jobs. As part of the country's Vision 2030, the economic pillar puts a lot of emphasis on clean, efficient, and spatially distributed energy production (Kenya Vision, 2030).

Carmichael, Eastham, and Antrim (2016) suggested that micro hydropower plants generate sustainable energy that helps in minimizing environmental impact. The environmental impact related to areas with limited access to electricity includes flooding, sedimentation upstream of weirs, reduced oxygenation of the water, electrical machinery noise and erosion of the turbine's draft tubes situated proximately downstream, and so on. Based on the size of the micro hydropower plant and the suitable design techniques used, all these difficulties might be reduced. (Antipa and Paul, 2019). Hence, the final product is probably an economic renewable energy source with minimal impact on the environment than the impacts of non-renewable sources which emit carbon that contributes to global warming (Nathaniel, Anyanwu, & Shah, 2020).

### 2.7 Theoretical Framework

This study focuses on two theories: Stakeholder theory and Systems theory, which are discussed below in detail.

#### 2.7.1 The Stakeholder Theory

This paper presents the Stakeholder theory as one of the theories that go into more detail about how stakeholder involvement affects the production of micro hydropower off the grid. This theory came into being due to acknowledgment of the role that stakeholders play in effective project implementation hence, the organization's success (Freeman et al., 2010). Stakeholder management is important to ensure the implementation of the generation of off-grid micro hydropower, just like any other technical project. It also enhances the project's outcome by balancing conflicting interests and surrounding their opportunities in the project.

Research done by Harrison (n.d) showed that the involvement of stakeholders could result in better execution of projects in the energy sector. The article further states effective management can be done by coming up with strategies that boost the concern of powerful and majority stakeholders. This is because project sustainability, particularly in the energy sector, can be inhibited by low power or interest to enforce it.

The stakeholder theory presents an integrated management approach which is important in understanding the influence of stakeholders in the implementation of energy projects such as off-grid micro hydropower. Analysis of this theory presents four key attributes relevant to the off-grid micro hydropower project. These key attributes include power, interest, proximity, and time. To put it into context, Bonnafous-Boucher & Rendtorff (2016) explained power as the most established attribute in that their power has a direct influence on the project's outcome. Power can be positional, personal, or political.

Positional is whereby, for instance, the stakeholder has the authority to stop or continue a project. In this case, a powerful stakeholder may have the ability to influence the project. Personal can be explained from a perspective where a stakeholder possesses influential personal traits which directly affect the project. For instance, some of the stakeholders of the Iriamaina micro hydro power have the knowledge and expertise in executing the project. These influential personal traits will directly impact the project implementation. Lastly, the political aspect comes about when a stakeholder has a high level of influence on other stakeholders or other parties which may positively or negatively impact the project (Bonnafous-Boucher &

Rendtorff, 2016). For instance, political connectivity may ensure smooth sourcing of funds so that the project can be implemented within the stipulated time.

According to Bourne (2016), interest is a defining characteristic of stakeholders that gives them power and influence. She continues by saying that those who aren't invested in the project's success might discourage others from becoming involved. Stakeholder identification may be further subdivided into value and action characteristics. The value that a stakeholder gives to the project will determine whether they are interested or not. On the other hand, action determines how willing the stakeholder is (Bourne, 2016). This includes the time, money, and effort they spend to ensure the project becomes successful.

Proximity to the location of the project is one of the attributes. For instance, in the case of Iriamaina hydropower, the stakeholders who live close to where the project will have a degree of influence on its implementation. Proximity can also be interpreted as the involvement of the stakeholders in day-to-day activities and decision-making that directly affect the project (Bundy, 2019). In conclusion, Nicholas and Steyn (2020) have examined the characteristic of time at length, highlighting its significance for the engagement of stakeholders in the result of a project. Additional benefits of early stakeholder participation and integration are highlighted in the paper. It improves the odds of getting the best results, speeds up the decision-making process, and uses stakeholder feedback and input as soon as possible (Nicholas and Steyn, 2020).

To sum it up, this theory gives an insight into stakeholder management and its influence on a project. It provides knowledge about the needs, roles, and expectations of stakeholders who have the potential to influence a project. It is very important to understand stakeholders and their influence to balance conflicting interests and encompass their expectations to achieve the desired goals and objectives.

### 2.7.2 System Theory Approach

The system theory was formulated by Katz and Kahn who modified General System Theory into organizational behavior (Lyden et al., 2017). This theory observes organizations as open social systems that must intermingle with their environment to thrive. Organizations depend on their environment to get shareholders who invest, customers, employees to provide labor, suppliers of materials, and government to regulate. In other words, a hydropower project is a system that consists of various subsystems including the technical team, shareholders, the community, the end users, and other stakeholders.

According to Systems theory, the most effective organizations adapt to the environment. Jackson (2007) related an open system to an organization or project which consists of various stakeholders to ensure that its goals and objectives are met. Therefore, these sub-systems directly affect the unified subsystem. As such, the subsystems are interdependent and do not function in isolation from each other. Lyden et al. (2017) classified systems as either open or closed. Open systems are those organizations that interact with their external environment while closed ones do not. From this definition, the Iriamaina hydropower project system is open and responsive to its surroundings. This means that a change in any part of the organization will largely affect the entire project. For instance, when the local community becomes defiant and cites interference in their day-to-day lives by the project, this will largely affect its execution. The same applies to when a shareholder or investor pulls out from being part of the project.

Bartalanffy (2015) explained that the system is affected by both external and internal environments. However, this paper focused on the internal environment to further understand how stakeholders' participation influences the project under study. The success and performance of the project largely rely on interdependence among the diverse stakeholders (Kiran, 2017). For instance, a change in one part of the system, that is a single stakeholder, will significantly impact the implementation of the entire project.

This Theory is important to this study since it provides a way to evaluate the overall effectiveness of the project rather than influenced by the individual subsystems such as the stakeholders. It also points out that the achievement of a project is fundamentally reliant on the interaction between internal and external factors (Jackson, 2007). In summary, this theory asserts that the decisions and actions of one stakeholder will affect the entire project. It provides a theoretical model that can be used to predict and control phenomena to manage hydropower projects effectively.

### 2.8 Conceptual Framework

Pencavel (2018) defined it as a collection of principles or a framework that directs a researcher in determining the connections between theories, concepts, and empirical data and how they apply to the research topic. The independent variables investigated in this study are stakeholders' involvement in project financing, market assessment, project design as well as decision making. The dependent variable is the generation of micro hydropower while government policy acts as a moderating variable.

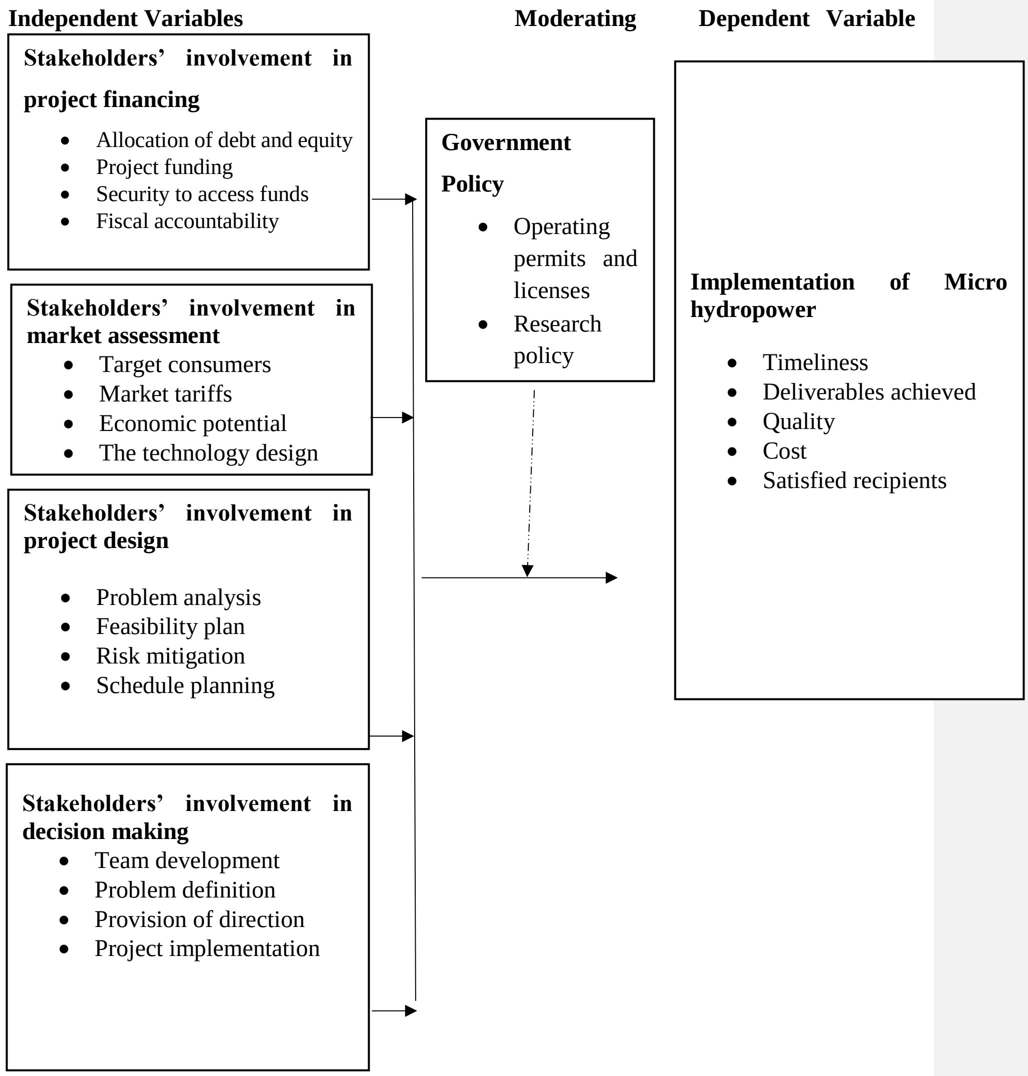


**Figure 1: Conceptual Framework**

## 2.9 Summary of Literature Review

Renewable energy such as micro hydropower is significant for sustainable power generation that aims to alleviate the acute shortage of electricity in rural areas. Off-grid systems offer an alternative supply of power to regions that have no access to the national power grid. Also hydropower tariff in Kenya is relatively cheaper than the national grid. This review expounded on the impact of stakeholders' involvement in the production of off-grid micro hydropower. Research previously done by various authors' shows that any sustainable off-grid micro-hydropower requires active participation from stakeholder's right from assessment, and planning development up to the implementation stage. The review was based on the implementation of off-grid Micro hydropower, the influence of stakeholders' participation in market assessment, project financing, design, and decision making. The study was also founded on two major theories namely stakeholder theory and systems theory. The stakeholder theory presents an integrated management approach which is important in understanding the influence of stakeholders in the implementation of energy projects such as off-grid micro hydropower. Systems theory, on the other hand, sees organizations as open social systems that depend on interaction with their surroundings to survive. Lastly, a conceptual framework was drawn to provide the direction needed for the study.

## 2.10 Knowledge Gap Matrix

A significant number of studies have been done on the impact of stakeholders' involvement in project performance. Even though, these researches were limited to diverse sectors and industries. This study filled the gap specifically on off-grid micro hydropower Implementation projects. Table 2.1 expounds more on the research gaps that this study seeks to fill.

**Table 2.1: Research Gaps**

| Variable | Author & year | Title | Findings | Research Gap |
|---|---|---|---|---|
| Implementation of off-grid Micro hydropower | Kathumbi (2016) | Sustainability Assessment of Micro Hydropower Projects: Kenyan Case Study | This study found that Micro hydropower provides sustainable electricity for local communities that are not yet connected to the main grid. | This study focused more on the technical aspect of the project and did not consider the influence of stakeholders on its outcome. |
| Stakeholder Involvement in Market Assessment | Nyabera (2015) | Influence of stakeholder participation on implementation of projects in Kenya: a case of compassion international assisted projects in Mwingi sub-county | The researcher noted that stakeholder's inadequate participation in market assessment led to poor project implementation and end result was not met as expected. | This study was focused to non-governmental organizations and the resource requirements are not the same as those in micro hydropower projects. |
| | Tronchin, L., Manfren, M., & Nastasi, B. (2018) | Energy efficiency, demand side management and energy storage technologies – A critical analysis of possible paths of integration in the built environment | The researcher realized that there was a problem of energy infrastructure technology specifically storage systems to cushion during low water flow seasons | The study was in a context of a country with a properly developed and empowered energy sector whereby they have qualified researchers in hydropower technology unlike Kenya whereby the hydropower technology still requires more capacity building on the hydro technology that includes storage of power. |
| | Oyewo, Farfan, Peltoniemi & Breyer, 2018 | Repercussion of large scale hydro dam deployment: the case of Congo Grand Inga hydro project. *Energies*, *11*(4), 972. | The researcher acknowledged that the financial feasibility of Inga hydro project was not well assessed that is why the solar and wind energy could have more cost as opposed to the intended benefit | The research however focused on a mega hydro power while the focus of my study was a micro hydropower thus the results could be different |
| Stakeholder involvement in | Wamugu and Ogollah (2017) | Role of stakeholder's participation on the performance of constituency development fund | Participation in project financing, initiation, implementation and execution had a progressive and huge | This study was focused on performance of CDF projects in Mathira East constituency and |

| | | | | |
|---|---|---|---|---|
| Project Financing | | projects in Mathira East constituency in Kenya. | effect on performance of CDF projects. | therefore, may not apply to hydropower projects. |
| | Michaelowa, A., Hoch, S., Weber, A. K., Kassaye, R., & Hailu, T. (2021). | Mobilising private climate finance for sustainable energy access and climate change mitigation in Sub-Saharan Africa | Active involvement by public sector on clean Development Mechanism in sub-Saharan Africa could speed funding by private investors as it reduces the capital cost of investment | The study highlighted how the government of Ethiopia has Accessed sustainable energy through government initiative ,however, this research focused on an NGO CDM initiative to fund the project |
| | Almeshqab, F., & Ustun, T. S. (2019). | Lessons learned from rural electrification initiatives in developing countries: Insights for technical, social, financial and public policy aspects. *Renewable and Sustainable Energy Reviews*, *102*, 35-53. | The community in rural Senegal came up with the needs which were the guiding item for funding of the projects. | This study was conducted in rural Senegal thus the dynamicas might be different since it is another African region thus this research was done in rural Kenya to establish the influence of various Stakeholders involvement on financial planning to generate hydropower. |
| Stakeholder involvement in Project Design | Bazimya (2018) | Influence of stakeholders participation on performance of public projects in Rwanda: a case study of water, sanitation and hygiene (WASH) project in Musanze district | The study found that involvement of stakeholders in project design contributed to its success | This research was based on Rwanda and its findings might not necessarily be similar to Kenya.<br>Also, this study was focused on Water, Sanitation and Hygiene. |
| | Almeshqab, F., & Ustun, T. S. (2019). | Lessons learned from rural electrification initiatives in developing countries: Insights for technical, social, financial and public policy aspects. *Renewable and Sustainable Energy Reviews*, *102*, 35-53. | The community in rural Senegal came up with the needs which were the guiding item for funding of the projects. | This study was conducted in rural Senegal thus the dynamics might be different since it is another African region thus this research was done in rural Kenya to determine the effect of various Stakeholders involvement on project design to generate hydropower. |
| | Antipa, C. K., & Nyanga'u, S. P. (2019). | Influence of Stakeholders Participation on Performance of Road Projects in Kenya (A Case Study of Road | The research recognized that participation of stakeholders influenced the outcome of road projects in terms of time ,cost and even quality | The paper main focus was on stakeholders involvement vis performance of road projects in Kenya, |

| | | | | |
|---|---|---|---|---|
| | | Projects in Nakuru County). *International Journal of Recent Research in Social Sciences and Humanities (IJRRSSH*, *6*(2), 132-139. | | whereas my research was focused on influence of stakeholders effect on generation of micro hydropower in Kenya |
| Stakeholder involvement in Decision making | Antipa and Paul (2019) | Influence of stakeholders participation on performance of road projects in Kenya (a case study of road projects in Nakuru County) | How the stakeholders relate with each other is imperative at each project implementation stage. Involving all stakeholders in decision making have an huge impact on the capability, timely manner of implementation and the standards of the venture | This paper focused on road projects and may not apply to energy projects. |
| | Dizdaroglu (2017) | The role of indicator-based sustainability assessment in policy and the decision-making process: A review and outlook. *Sustainability*, *9*(6), 1018. | The use of indicators and the kind of framework to use boosts the aspect of sustainability of projects | Ensuring sustainability of a project this research paper acknowledges that various indicators for decision making are interlinked thus not easy to measure whereas my research would look at how and to what degree the specific indicators influenced the participation of stakeholders |
| | Creamer, E., Eadson, W., van Veelen, B., Pinker, A., Tingey, M., Braunholtz-Speight, T., ... & Lacey-Barnacle, M. (2018). | Community energy: Entanglements of community, state, and private sector. *Geography compass*, *12*(7), e12378. | The importance of multiple stakeholders in boosting local energy initiatives is under researched | The study focused majorly on the role of private ,state and community decision making on community energy initiatives ,however my got data on how and to what extend each stakeholder influenced |

# CHAPTER THREE

# RESEARCH METHODOLOGY

## 3.1 Introduction

Methods, approaches, and processes for gathering and analyzing data are all part of a research's methodology. In this chapter, we lay out the research methodology in great detail. Research design, demographic, sample size, data collecting devices and processes, data analysis techniques, ethical issues, and operationalization of variables are all part of the methodology used.

## 3.2 Research Design

Creswell & Creswell (2017) defined research design as the creation of a conceptual research structure in which the investigation is conducted. It involves the procedure of gathering, gauging, and examining data. This study used a descriptive survey approach because it enables the integration of numerous techniques when responding to what, how, when, and where-related questions. This method allows the researcher to observe variables and measure them to accurately and systemically describe the population. Consequently, descriptive research was helpful when gathering information from the members of the Iriamaina cooperative society, the residents of the Iriamaina community, and the committee members of the project management. Monsen & Horn (2007) explained that descriptive research illuminates knowledge that otherwise one would not notice or even encounter. Therefore, it encourages creative exploration and organizes findings to fit them with explanations, validate and test them.

## 3.3 Target Population

Before starting a study project, the target population was determined and agreed upon. It was to be the entire population or a group that the researcher was interested in. According to Tonon (2018), the target population in a research study encompasses events, objects, and people that a researcher is interested in studying. The study's target population was 1600 stakeholders comprising 1550 Community members of Iriamaina, 40 management committee members of Iriamaina Cooperative society, and 10 members from the project management committee.

Residents or community members are included since they are the target consumers of the micro hydropower project.

**Table 3. 1: Target Population**

| Category | Target population |
|---|---|
| Community members of Iriamaina | 1550 |
| Committee members of project management | 10 |
| Board members of Iriamaina Cooperative Society | 40 |
| **TOTAL** | **1600** |

**Source (Iriamaina community residents):** County integrated development plan. Website: http://www.kpda.or.ke

Table 3.1 shows the target population of this research drawn from the community members, who are majorly the residents of Iriamaina. Committee members of the project management were drawn from various government agencies involved in the project as well as project members within the county.

### 3.4 Sample Size and Sampling Procedure

Research by Flynn and Kramer (2019) indicates that sample sizes need to be big enough to accurately reflect the population under investigation. Therefore, the sample size selected for this research was able to give enough information on the population of the study and was simple to examine to fulfill the study's goals.

#### 3.4.1 Sample Size

Sakai (2018) said that information gathered from the sample should be a representation of the total population, enough and be easy to be analyzed. If the population is not too large, a suitable sample should reflect 10% of the population, according to Ramji (2009) (More than 2000). Because of the need to choose representative samples from a variety of subpopulations, this study used a stratified random sampling technique. nh=(Nh/N)*n is the formula where;

nh= sample size for stratum h

Nh = population size for stratum h

N = total population size

n=total sample size

Using the above formula, table 3.2 shows the samples from each category of the total population.

**Table 3. 2: Target Population**

| **Category** | **Number** |
|---|---|
| Community members of Iriamaina **[nh = (Nh / N) * n]** | **(1600/1600)x160=160** |
| Project management committee members **[nh = (Nh / N) * n]** | **10** |
| Board members of Iriamaina Cooperative Society **[nh = (Nh / N) * n]** | **40** |
| **TOTAL** | **210** |

A sample size of 160 people was selected from a total population of 1600 people, as shown in the table above. 10% of the population was represented by the sample size.

### 3.4.2 Sampling procedure

160 respondents from the target population were selected for this study using stratified random sampling. This method enables one to obtain a precise representation of the population that is homogenous (Yin, 2017). During the research, there were questionnaires tailored for both category of the sample population. Then the 50 were census method considering they were key respondents in the interview. Except for the community members of Iriamaina, the researcher randomly selected the respondents from a list of names from all other categories provided by the project management team. Since there was no list tabulating the community members, sampling was done randomly depending on the availability of those members.

## 3.5 Research Instrument

Tools that are used to gather first-hand information are known as research instruments. Structured questionnaires were employed for this study's purpose (Saddhono et al., 2019). The use of questionnaires was made possible by their greater budgetary and time efficiency. There were seven sections in the questionnaire. Questions in Section A are focused on the respondent's sociodemographic data. Five-point Likert scale surveys were used in Sections B through F to gather information from all respondents. A score of 1 indicated strong disagreement, 2 moderate disagreement, 3 Undecided, 4 agreement, and 5 strong agreement on the surveys. The final piece, Section G, inquired about the respondent's broad perspective.

### 3.5.1 Pilot of Instruments

A pilot test is used to evaluate the accuracy and dependability of data gathering tools (Specht & D'Ely, 2019). The article further stated that ten percent of the sample should be used as a pilot test when conducting a study. Therefore, in this study, 13 respondents, which represent 10% of the sample size underwent a pretest as recommended by Sherry (2019). The choice for this test was Chania Mataara small hydropower which is situated along river Chania in Kiambu County. The power station has an installed capacity of 1.0MW and is classified as small hydropower (KenGen, 2018). The power station was therefore suitable to be used for pilot testing for this study.

### 3.5.2 Validity of Instruments

The degree to which the outcomes of the data analysis accurately reflect the research phenomenon can be used to define the validity of an instrument. (Saddhono et al., 2019). This study focused on face and criterion validity. Face validity checks whether the research questions are clear to avoid misunderstanding and misinterpretation. Criterion indicates how the research questions predict a known outcome. The research instrument validity was improved with the support of an expert in the area of study and the supervisor.

### 3.5.3 Reliability of Instruments

Creswell (2017) defined instrument reliability as the constancy with which the instrument performs. Measures analyze and give accurate results to achieve the desired outcome. Therefore, this consistency was evaluated using Cronbach's alpha coefficient, which is frequently employed with multiple-choice questions. The range of Cronbach's Alpha ($\alpha$) is 0 to 1. According to Mallette and Duke (2020), structures should be regarded as dependable if they have a cut-off of 0.7 or higher. Given that the Cronbach alpha ($\alpha = 0.799$) was greater than the suggested cut-off value of 0.7, the research instrument was trustworthy.

### 3.6 Data Collection Procedure

Information was gathered from respondents via the use of questionnaires. The first stage in this procedure was to get a letter of reference from the University of Nairobi and a license from the National Commission for Science, Technology, and Innovation (NACOSTI). Questionnaires were administered through hand delivery. The researcher used personal visits and made phone calls to schedule meetings with respondents and followed up on them and ensured that the questionnaires are duly filled. However, contacts were made with the prospective respondents so as mutually agree upon the date and time of distribution of the questionnaires. The researcher booked appointments with Bomet County government Energy Officers, NEMA, WRMA, EPRA, UNIDO, UNDP, and REREC officers, and interview guides were given to them.

### 3.7 Data Analysis Techniques

For the purpose of gathering information for this research, both open-ended and closed-ended questionnaires were used to collect data, with the latter kind being used for gathering qualitative data. The Statistical Package for the Social Sciences (SPSS) was used in order to conduct analysis on the quantitative data, while descriptive statistics were utilized in order to conduct analysis on the qualitative data. As a form of descriptive statistics, the mean, the standard deviation, and the frequency distribution were used. The research had hypothesis test. Inferential statistics such as regression analysis and Pearson's correlation coefficient (r) were used in this study. The following is how the relationship between the independent and dependent variables is interpreted: values for the correlation coefficient (r) of -1, 0, and +1 The relationships were characterized as perfect positive relationships, perfect negative relationships, and zero relationships, respectively. For correlation coefficient values(r) of between 0 and 0.4, between 0.4 and 0.7, and between 0.7 and 1 the relationship was interpreted as weakly positive, moderately positive, and strong positive relationship correspondingly. For correlation coefficient values (r) of between 0 and -0.4, between -0.4 and -0.7, and between-0.7 and -1.0 relationships were interpreted as weak negative, moderate negative, and strong negative relationships correspondingly.

The study also used Pearson's correlation coefficient in testing the influence of independent and dependent variables (Creswell, 2017). This made it possible for the researcher to determine the strength of the relationship of data

### 3.8 Ethical Considerations

Ethics is the code of conduct that governs humanity and affects their well-being significantly (Iphofen and Tolich, 2018). Ethical issues should be taken into consideration to ensure the credibility of the study. This study acknowledged work borrowed from other academicians, thus, avoiding plagiarism. Moreover, consent of voluntary respondents was sought during data collection. Also, there was strict adherence to respondent confidentiality and they were assured that the information provided is strictly for learning purposes. The respondents didn't need to provide their names for the sake of confidentiality. The University of Nairobi approved the collection of research data, and NACOSTI granted a research permit. All research parties were respected and no one was coerced to participate in the inquiry. During data analysis, no forgery or manipulation was done thus true representation.

### 3.9 Operationalization of Variables

The independent factors in this study included the impact of stakeholders' involvement in project financing, market assessment, project design, and decision-making. The dependent variable was the implementation of the off-grid micro hydropower project in Iriamaina, Bomet County. The method of collection for all the variables was through questionnaires. Table 3.3 shows the definition of the operational variable including objectives, variables, indicators, measurement scale, type, and tool of data analysis.

**Table 3.3: Operationalization of Variables**

| Objectives | Variable | Indicators | Measurement scale | Type of data analysis | Tools of data analysis |
|---|---|---|---|---|---|
| To determine the influence of stakeholder participation on market assessment on implementation of off-grid micro hydropower projects in Kenya | **Independent** Stakeholders participation in market assessment | • Target consumers<br>• Market tarrifs<br>• Economic potential<br>• Feasibility study | Ordinal<br>Interval | Thematic analysis<br>Descriptive statistics<br>Inferential statistics | Arithmetic mean, standard deviation, percentiles<br>Pearson Correlation & Regression analysis |
| To establish the influence of stakeholders participation in project in decision making on implementation of off-grid hydropower projects in Kenya. | **Independent** Stakeholders participation in decision making | • Team development\<br>• Problem definition<br>• Identification of alternatives<br>• Provision of direction<br>• Project implementation | Ordinal<br>Interval | Descriptive statistics<br>Inferential statistics | Arithmetic mean, standard deviation, percentiles<br>Pearson Correlation coefficient & Regression analysis |
| To assess influence of stakeholders participation in project design on implementation of off-grid microhydropower projects in Kenya. | **Independent**Stakeholders participation in project design | • Problem analysis<br>• Feasibility plan<br>• Risk mitigation<br>• Schedule planning | Ordinal<br>Interval | Descriptive statistics<br>Inferential statistics | Arithmetic mean, standard deviation, percentiles, Pearson Correlation coefficient & Regression analysis |
| To determine the involvement of stakeholders participation in project financing on implementation of off-grid micro hydropower projects in kenya | **Independent** Stakeholders participation | • Sourcing of funds<br>• Security to access funds<br>• Stake in debt and equity<br>• Fiscal accountability<br>• Resource planning | Ordinal<br>Interval | Descriptive statistics<br>Inferential statistics | Arithmetic mean, standard deviation, percentiles<br>Pearson Correlation coefficient & |

| | | |
|---|---|---|
| | in project financing | Regression analysis |

# CHAPTER FOUR

## DATA PRESENTATION, INTERPRETATION, AND DISCUSSION

### 4.1 Introduction

In this chapter, descriptive and inferential statistics are presented in the context of how stakeholder involvement affects the implementation of off-grid micro-hydropower in Kenya. and particularly in Iriamaina Micro hydropower, located in Bomet County. The independent variables targeted in this study include stakeholders' participation in various functions, namely, decision-making, project design and installation, project financing, and market assessment. Specifically, the chapter presents findings from the data collected using a Likert scale (1-5), and further presented through means, standard deviations and proportions, and regression analysis.

### 4.2 Questionnaire Return Rate

A total of 160 respondents were conducted in the study. The response rate was 96 percent. Only a proportion of 4 percent posed unavoidable, discrepancies such as incompleteness and thus discarded during the data analysis process. However, the quality of data entered in SPSS was above average. The move led to the utilization of 153 questionnaires for further processing.

### 4.3 General Characteristics of the Respondents

#### 4.3.1 Gender of the Respondent

The results tabulated below present findings on the proportion of gender of the interviewed stakeholders. They revealed that the majority were male with a proportion of 73.9 percent. On the hand, females formed the minority with only 26.1 percent participating in the interviews.

**Table 4. 1: Gender of respondents**

| Category | Frequency | Percentage (%) |
|---|---|---|
| Male | 40 | 26.1 |
| Female | 113 | 73.9 |
| **Total** | **153** | **100.0** |

*Source (Survey, 2022)*

#### 4.3.2 Age of the Respondent

Results showed that the majority of responders (50.3%) fell into the 46–55 age group. It's important to note that 28.8% of the population has reached the age of 55. However, only a few of the stakeholders' ages ranged from 25-35 (5.2%) and 36-45 (15.7%). This depicts that most of the stakeholders are elderly and only a small proportion of respondents were at the youthful stage. In support of this, in most instances, youths are engaged in other forms of employment and barely participate in the community development projects such as hydropower generation and not to mention their limited experience.

**Table 4. 2: Age of respondents**

| Category (years) | Frequency | Percentage (%) |
|---|---|---|
| 25-35 | 8 | 5.2 |
| 36-45 | 24 | 15.7 |
| 46-55 | 77 | 50.3 |
| 55≥ | 44 | 28.8 |
| **Total** | **153** | **100.0** |

*Source (Survey, 2022)*

#### 4.3.3 Designation of the Respondents

The bar chart below (Figure 1) captures the position held by the respondents. Notably, the study targeted stakeholders from the community, government sector, members of the board, and most importantly those working with non-governmental organizations (NGOs). Results revealed that most of the respondents were locals (60.1%). This was followed by those who worked in the government sector with 29.4%. However, only a few of the respondents sat on the board (7.8%), and a marginal of stakeholders worked in the NGOs (2.6%).

**Table 4. 3: Designation of the respondents**

| Designation | Frequency | Percentage (%) |
|---|---|---|
| Board Member | 12 | 7.8 |
| Government Administrator | 92 | 60.1 |
| Community member | 45 | 29.4 |
| NGO Worker | 4 | 2.6 |
| **Total** | **153** | **100.0** |

*Source (Survey, 2022*

#### 4.3.4 Education Level of the Respondent

Figure 2 below presents finding on the level of education of the respondent. Four different categories were considered for the study which include, primary, secondary, tertiary/college, and university. Results indicated that the targeted respondents had accessed and joined different learning institutions and therefore, most of them were able to read and write50% of the respondents have completed their tertiary or college degrees. Those who had attained a secondary school education were 35%. Only a few had reached the university and primary levels with 8 and 7 percent, respectively. The proportions in the various categories depict that majority of the stakeholders would articulate issues regarding the community development projects and further give their input in the different phases of the project.

**Table 4. 4: Respondents' level of Education**

| Level | Frequency | Percentage (%) |
|---|---|---|
| Primary school | 10 | 6.5 |
| Secondary school | 54 | 35.3 |
| College | 77 | 50.3 |
| University | 12 | 7.8 |
| **Total** | **153** | **100.0** |

*Source (Survey, 2022)*

### 4.4 Involvement in Project Design on implementation of Iriamaina Micro Hydropower generation

The responders were questioned about how they felt about taking part in the project design which entails involvement during initiation of the project, technical support during planning, technical support during execution, and involvement in monitoring and evaluation to enable implementation of the project. On a Likert scale, opinions on the aforementioned subcomponent were gathered. The scale ranged from 1-5 as indicated in the brackets (1-strongly disagree, 2=disagree, 3=neutral/undecided, 4=agree, 5=strongly agree). The statements used in this section entailed stakeholders' opinions on involvement in the above-mentioned indicators. Project design findings are shown in Table 4.5.

**Table 4. 5:Data on Project Design of the Iriamaina Micro hydropower**

| **Items** | **Strongly Disagree** | **Disagree** | **Neutral** | **Agree** | **Strongly agree** | **n** | **mean** | **Sdv** |
|---|---|---|---|---|---|---|---|---|
| I am involved in technical support during Project initiation | 0 (0%) | 10 (6.5%) | 22 (14.4%) | 102(66.7%) | 19(12.4%) | 153 | 3.85 | 0.714 |
| I am involved in technical support during Planning | 0 (0%) | 6 (3.9%) | 25 (16.3%) | 103(67.3%) | 19 (12.4%) | 153 | 3.88 | 0.658 |
| I am involved in setting of performance targets for the project | 1 (0.7%) | 19 (12.4%) | 39 (25.5%) | 83 (54.2%) | 11(7.2%) | 153 | 3.55 | 0.827 |
| I am involved in technical support during Execution | 2(1.3%) | 18(11.8%) | 47(30.7%) | 75 (49%) | 11 (7.2%) | 153 | 3.49 | 0.844 |
| I am involved in Monitoring and Evaluation | 2(1.3%) | 28(18.3%) | 13(8.5%) | 90(58.8%) | 20(13.1%) | 153 | 3.64 | 0.971 |
| **Combined Mean & Sdv** | | | | | | | **3.674** | **0.794** |

From the data displayed in the table above, results indicate that the respondents agreed on their involvement during the project design, with a combined mean of **3.674** combined **with a** standard deviation of **0.794**, this represented that the respondents generally agreed on involvement during the project design. For the combined mean of **3.674**, it meant that majority of respondents more than average disagreed on participation in project design that influenced a implementation of Iriamaina Micro hydropower project. The items whose means exceeded the combined mean of **3.674**; were respondents' involvement in technical support during project initiation and respondents 'involvement in technical support during planning. The items with a means score below the combined mean were respondents' involvement in monitoring and evaluation, respondents' involvement in technical support during execution, and respondents' involvement in the setting of performance targets for the project.

When interviewed on the question regarding stakeholder participation in the project design of Iriamaina micro hydropower the project management committee gave the below summary;

*"Majority of the respondents were from the community of Iriamaina. They are the initiators of the project, they saw the need to light the community and the market to enable longer working hours and thus earn extra income. It was a way of poverty reduction and also a green and sustainable energy project. The future is hydropower. There was an initial conflict of interest by the nearby tea factory (Kapset tea factory) whereby their management wished to be the proponent of the hydropower. This move was rejected by the Iriamaina community as the project was designed for the benefit of the community. During initiation and planning, we were unable to recall all the stakeholders initially, however, they came during the implementation stage, their views and input have been captured and we anticipate no conflict of interest. Future projects ought to involve all relevant stakeholders from the word go" (Project Committee Members).*

During the focused group interview of the Iriamaina board members Iriamaina Cooperative Society, the community members participated in the analysis of their threats and opportunities and through this engagement, the need for hydropower was unanimously agreed upon and settled upon. The conflict of interest by the community was solved before the project commenced and thus the community Iriamaina cooperative society is the proponent of the project.

Descriptive data indicated that participation of stakeholders in project planning improved the generation of the Iriamaina micro hydropower project. Moreso, correlation analyses found an increase in involvement in project design led to a strong increase in implementation Iriamaina micro hydropower project. These empirical findings agree with Matu, Kyalo, Mbugua et al(2020b) concluded that participation of stakeholders in planning increases the likelihood of successful completion of road projects in central Kenya.

### 4.4.1 Correlational Analysis of Stakeholder Involvement in Project Design and Implementation of Micro Hydropower.

The research aimed to establish the nature, magnitude, and direction of any link between micro-hydro power implementation and stakeholder participation in project design. A correlation was performed using Pearson's method, and the results are shown in Table 4.6.

**Table 4. 6: Correlation between Participation of Stakeholders in Project Design and Implementation of Micro Hydropower**

| | | **Implementation of Micro Hydropower** |
|---|---|---|
| **Stakeholder Participation in Project Design** | Pearson Correlation | 0.401* |
| | Sig. (2-tailed) | 0.000 |
| | n | 153 |

*Correlation is significant at the 0.05 level (2-tailed)

According to table 4.6, there is a somewhat favorable relationship between stakeholder participation in project design and implementation of micro hydropower project. This is shown by a positive Pearson correlation coefficient (r = 0.401), which is statistically significant given a p-value of 0.000 0.05. So, it's safe to say that including more stakeholders into the design process for micro-hydropower projects improves implementation. Our next goal is to evaluate how include stakeholders in the design process impacts micro-hydropower implementation.

**Table 4. 7: Regression of Participation of Stakeholders in Project Design and Implementation of Micro Hydropower**

**Model Summary**

| | | | | | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | 0.401[a] | 0.161 | 0.157 | 0.5075 | 0.161 | 28.68 9 | 1 | 151 | 0.000 |

a. Predictors: (Constant), participation of stakeholders in project design

According to the results in table 4.7, approximately 16.1% of the changes in the implementation of micro-hydro power are attributable to stakeholder involvement in project design. This is demonstrated by the R squared value, which is 0.16; this contribution is noteworthy because the corresponding p-value is 0.000, which is below the level of significance of 0.05 adopted by this study.

After integrating stakeholders in the project design, the study sought to ascertain whether the regression model was the best fit for estimating the implementation of micro-hydropower. Table 4.7 displays the regression coefficient's findings.

**Table 4.8: ANOVA of regression of stakeholder involvement in project design and Implementation of micro-hydropower.**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 10.787 | 1 | 10.787 | 28.689 | 0.000[b] |
| | Residual | 56.413 | 151 | 0.376 | | |
| | Total | 67.201 | 152 | | | |

a. Dependent Variable: Implementation of Micro Hydropower

b. Predictors: (Constant), Stakeholder Involvement in Project Design

Table 4.8's ANOVA results show an F-statistic of 1,151 = 28.689, which is significant at a p-value of 0.000 0.05. This indicates that the predictor coefficient was at least not equal to zero, and as a result, the regression model results were a better prediction of the implementation of hydropower projects after stakeholders were involved in the design of those projects.

Finally, the study aimed to determine whether stakeholder involvement in project design had an impact on the implementation of micro-hydropower power project. Table 4.8 displays the findings of the regression coefficient.

**Table 4.9: Regression Analysis of stakeholder involvement in project design and implementation of micro-hydropower.**

**Coefficient**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.748 | 0.332 | | 5.260 | 0.000 |
| | Stakeholder involvement in project design | 0.515 | 0.080 | 0.401 | 6.471 | 0.000 |

a. Dependent Variable: Implementation of Micro Hydropower

Based on the findings of a basic linear regression analysis, which are shown in Table 4.9, it depicts that stakeholder participation in project design influenced the of implementation of micro-hydropower projects. Stakeholder participation in project design and the coefficient constant terms (_0=1.748,p=0.0000.05) both achieved statistical significance. Micro-hydropower project output only marginally affected by changes in stakeholder engagement in project design (0.515 units for each unit change in stakeholder involvement in project design, according to the regression model Y=1.748+0.515X 4). Therefore, it was determined that there is a positive and linear relationship between stakeholder involvement in project design and the implementation of micro-hydropower project.

### 4.5 Involvement in Project Financing and hydropower project implementation

The respondents were questioned regarding their involvement in project financing, which comprises resource mobilization to facilitate project implementation. On a Likert scale, opinions on the aforementioned subcomponent were gathered. The scale was from 1 to 5, as shown in the brackets. (1-strongly disagree, 2=disagree, 3=neutral/undecided, 4=agree, 5=strongly agree). The statements used in this section entailed stakeholders' opinions on involvement in project funding, stake in project debt and equity, sourcing of funds, provision of collateral (security for access of funds), and involvement in fiscal accountability to the donors. Results of the project financing are presented in Table 4.10.

**Table 4. 10: Involvement in Project Financing of the Iriamaina Micro Hydropower implementation**

| Items | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree | n | mean | sdv |
|---|---|---|---|---|---|---|---|---|
| I contributed money to project funding | 4(2.6%) | 4(2.6%) | 17(11.1%) | 49(32%) | 79(51.6%) | 153 | 4.27 | 0.948 |
| I have a stake on project debt and equity | 4(2.6%) | 5(3.3%) | 29(19%) | 52(34%) | 63(41.2%) | 153 | 4.08 | 0.984 |
| I am involved in sourcing of funds to finance the project | 3(2%) | 9(5.9%) | 24(15.7%) | 46(30.1%) | 71(46.4%) | 153 | 4.13 | 1.011 |
| I am involved in Provision | 6(3.9%) | 12(7.8%) | 29(19%) | 51(33.3%) | 55(35.9%) | 153 | 3.9 | 1.101 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| of security for access of project finance | | | | | | | | |
| I am involved in Fiscal accountability to donors | 3(2%) | 9(5.9%) | 24(15.7%) | 58(37.9%) | 59(38.6%) | 153 | 4.05 | 0.979 |
| Combined mean | | | | | | | 4.086 | 1.02 |

Table 4.10 shows that there was consensus among respondents on their contribution to the project's finance, with a mean of 4.086 and a standard deviation of 1.02. The mean score of 4.86% indicates that most respondents think that stakeholders should be included in any project financing that has an impact on the hydropower project implementation. At Iriamaina Micro hydropower station. The items whose means exceeded the combined mean of **4.086**; were respondents' involvement in the sourcing of funds to finance the project and respondents 'involvement in the contribution of money to project funding. The items with a means score below the combined mean were respondents' involvement in stake on project debt and equity, respondents' involvement in fiscal accountability to donors, and stakeholder involvement in the provision of security for access to project finance.

When interviewed on the question regarding stakeholder participation in the project design of Iriamaina micro hydropower, the project management committee gave the below summary;

"*We learned of the project when it was ongoing, and that is when we chipped in to finance it*" *(Energy Department, County Government of Bomet).*

*"We would be glad to have successful renewable energy projects in Kenya, more specifically, hydropower. We wouldn't mind funding researchers on renewable energy"* (Renewable Energy Manager, REREC). *"There is more potential of power at Iriamaina hydropower, thus future donors could do further Feasibility, then fund expansion of the project" (UNDP Project Officer). The County Government of Bomet through the Department of Energy and REREC funded the supply and installation of hydro turbines and transmission of power lines through a government*

*program on a merger of funds. The initial financing, however, was done by UNDP after the initial feasibility study. (Project committee).*

### 4.5.1 Correlational Analysis of Stakeholder Involvement in Project Financing and Implementation of Micro Hydropower.

The goal of the study was to identify the type, strength, and direction of the relationship between micro hydropower production and stakeholder involvement in project financing. Based on Pearson's approach and the results shown in Table 4.11, a correlation was conducted.

**Table 4. 11: Correlation between Participation of Stakeholders in Project Financing and Implementation of Micro Hydropower**

| | | Implementation of Micro Hydropower Project |
|---|---|---|
| **Stakeholder Participation in Project Financing** | Pearson Correlation | 0.240* |
| | Sig. (2-tailed) | 0.001 |
| | n | 153 |

A slight positive link between stakeholder participation in project funding and micro-hydropower production was found, as shown in table 4.7. This is shown by a positive Pearson correlation coefficient (r = 0.240), which is statistically significant given that its associated p-value is 0.001. Thus, it is possible to conclude that increased stakeholder involvement in project financing has a positive impact on the implementation of micro-hydropower.

The next section examines how strongly stakeholder involvement in project financing affects the production of micro-hydropower.

**Table 4. 12: Regression of Participation of Stakeholders in Project Financing and Implementation of Micro Hydropower.**

**Model Summary**

| | | | | | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | 0.240[a] | 0.058 | 0.053 | 0.53777 | 0.058 | 13.369 | 1 | 219 | 0.000 |

a. Predictors: (Constant), participation of stakeholders in project financing

Table 4.12 of the model summary shows that there was a positive correlation (R = 0.240) between stakeholder participation in project financing and the implementation of micro-hydro-power projects. In addition, 5.8% of the variation in the implementation of micro-hydropower was explained by stakeholder participation in project financing while the remaining 94.2% is explained by other variables, not in the model.

The goal of the study was to ascertain if the regression model was the best fit for assessing micro-hydropower project implementation after including stakeholders in project financing. Table 4.12 displays the regression coefficient's findings.

**Table 4. 13: ANOVA of regression of stakeholder involvement in project financing and Implementation of micro-hydropower.**

| **Model** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| 1 | Regression | 3.866 | 1 | 3.866 | 13.369 | 0.000[b] |
| | Residual | 63.335 | 219 | 0.289 | | |
| | Total | 67.201 | 220 | | | |

a. Dependent Variable: Implementation of micro hydropower

b. Predictors: (Constant), involvement in Project financing by Stakeholders

Regression model findings were a stronger predictor of implementation of micro-hydropower projects after including stakeholders in project finance, as shown by the ANOVA results in Table 4.13, which offer F-statistic (1,219) = 13.369, which is significant at a p-value of 0.000 0.05.

Finally, the study aimed to determine whether stakeholder involvement in project finance had an impact on the implementation of micro-hydropower. Results for the regression coefficient are shown in Table 4.13.

**Table 4. 14: Regression Analysis of stakeholder involvement in project financing and Implementation of micro-hydropower.**

**Coefficient**

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 2.659 | 0.338 | | 7.878 | 0.000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Stakeholder involvement in project financing | 0.365 | 0.100 | 0.240 | 3.656 | 0.000 |

a. Dependent Variable: Implementation of Micro hydropower.

Table 4.14's findings from a simple linear regression analysis imply that stakeholder participation in project financing influenced the implementation of micro-hydropower projects. There was a statistically significant relationship between the coefficient constant; stakeholder involvement in project financing (_0=2.659,p 0.05) and implementation of Micro-hydropower project (_1=0.365,p0.05). is predicted by the regression model Y=2.659+0.365X 2. This suggests that the implementation of micro-hydropower projects is marginally transformed by 0.365 units for each unit change in stakeholder involvement in project financing. Therefore, it was determined that there is a positive and linear relationship between stakeholder engagement in project financing and implementation of micro-hydropower projects.

## 4.6 Involvement of Stakeholders in Market Assessment of the Iriamaina Micro Hydropower

Opinions were sought on their involvement in market assessment which tends to establish and the involvement of stakeholders involvement in market assessment and implementation of hydropower project. A Likert scale was used to seek opinions on the aforementioned subcomponent. The scale ranged from 1-5 as indicated in the brackets (1-strongly disagree, 2=disagree, 3=neutral/undecided, 4=agree, 5=strongly agree). The stakeholders were giving their opinion on participation in, risk assessment and mitigation analysis, warrants on project operating permits, contribution to a feasibility study, and collation of market needs and requirements.

Commented [S1]:

**Table 4.15: Data on Market Assessment of the Iriamaina Micro hydropower**

| Items | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree | n | mean | standard deviation |
|---|---|---|---|---|---|---|---|---|
| I am involved in Risk assessment and mitigation analysis (e.g., Power Purchase Agreement, Market Off-take factors) | 2(1.3%) | 7(4.6%) | 13(8.5%) | 39(25.5%) | 92(60.1%) | 153 | 4.39 | 0.919 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Am involved in obtaining project operating permits | 3(2%) | 4(2.6%) | 16(10.5%) | 37(24.2%) | 93(60.8%) | 153 | 4.39 | 0.899 |
| Am involved in feasibility study of the project | 2(1.3) | 6(3.9%) | 8(5.2%) | 50(32.7%) | 87(56.9%) | 153 | 4.4 | 0.861 |
| I am involved in collating the market needs and requirements | 1(0.7%) | 3(2%) | 20(13.1%) | 39(25.5%) | 90(58.8%) | 153 | 4.4 | 0.838 |
| combined mean & sdv | | | | | | | 4.394 | 0.85 |

From the data displayed in Table 4.15, Results showed that respondents agreed on their participation in the project market assessment; the combined mean was 4.394, and the combined standard deviation was 0.85. The respondents agreed, according to the combined mean of 4.394, that project market assessment by stakeholders had an impact on the Iriamaina Micro hydropower project implementation. The items whose Mean exceeded the combined Mean of 4.394; were respondents' involvement in the feasibility study of the project and respondents 'involvement in collating the market needs and requirements. The items with a means score that was almost similar to the combined mean were respondents' involvement in risk assessment and mitigation analysis (e.g. Power Purchase Agreement, Market Off-take factors), and respondents' involvement in obtaining project operating permits.

When interviewed on the question regarding stakeholder participation in the project design of Iriamaina micro hydropower the project management committee gave the below summary;

*"The donor (UNDP) involved the community (beneficiary), and the contractor (UNIDO), in conducting the feasibility study report of this Iriamaina micro hydropower.*

*The report found out that the Kipsonoi River had huge potential for more hydropower generation and after the first phase of the project, should the community get more funding, there is more potential for more Kilowatts. The community officials held various meetings with REREC to subcontract REREC to tender for the installation of hydro turbines. We, however, have not obtained the project operating permits from EPRA and the license as well as Power Purchase Agreements, we do plan to obtain them before transmission of hydro power."*

### 4.6.1 Correlational Analysis of Stakeholder Involvement in Market Assessment and Implementation of Micro Hydropower.

The goal of the study was to identify the kind, degree, and direction of the relationship between market assessment by stakeholders and the implementation of micro-hydropower. Based on Pearson's correlation as shown in Table 4.16.

**Table 4. 16: Correlation between Participation of Stakeholders in Market Assessment and Implementation of Micro Hydropower**

| | | Implementation of Micro Hydropower Project |
|---|---|---|
| **Stakeholder Participation in Market Assessment** | Pearson Correlation | 0.145* |
| | Sig. (2-tailed) | 0.032 |
| | n | 153 |

*Correlation is significant at the 0.05 level (2-tailed)

The findings in table 4.12 indicate the existence of a weak positive correlation between stakeholder involvement in market assessment and the implementation of micro-hydropower. This is shown by a positive value of the Pearson correlation coefficient (r = 0.145) which is significant since the p-value is 0.032 < 0.05. Hence it can be concluded that a positive change in stakeholder participation in market assessment positively influences the implementation of micro-hydropower.

The purpose of the next section is to analyze the degree to which market assessment by stakeholders has an impact on the production of micro-hydropower.

**Table 4. 17: Regression of Participation of Stakeholders in Market Assessment and Implementation of Micro Hydropower**

**Model Summary**

| | | | | | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | 0.145[a] | .021 | 0.016 | 0.54812 | 0.021 | 3.225 | 1 | 151 | 0.032 |

a. Predictors: (Constant), participation of stakeholders in market assessment

According to the results in table 4.13, approximately 2.1% of the changes in the implementation of micro-hydropower are attributable to stakeholder involvement in market assessment. This is indicated by the value of R squared which is 0.021, this contribution is significant since the p-value corresponding to it is 0.032 which is not greater than the level of significance of 0.05 adapted by this research study.

After enlisting stakeholders in a market assessment, the study sought to ascertain whether the regression model was the best fit for forecasting the implementation of micro-hydropower. Table 4.17 displays the regression coefficient's findings.

**Table 4. 18: ANOVA of regression of stakeholder involvement in market assessment and Implementation of micro-hydropower.**

| **Model** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| 1 | Regression | 1.406 | 1 | 1.406 | 3.225 | 0.032[b] |
| | Residual | 65.795 | 151 | 0.436 | | |
| | Total | 67.201 | 152 | | | |

a. Dependent Variable:Implementation of Micro Hydropower

b. Predictors: (Constant), Stakeholder Involvement in Market Assessment

In Table 4.18, the ANOVA results show that F-statistic (1,151) = 3.225, which is significant at a p-value of 0.032 0.05. This means that the predictor coefficient was at least not equal to zero, so the regression model results were a better way to predict the amount of power that micro-hydropower projects after stakeholders were involved in the market assessment.

Finally, the study aimed to determine whether stakeholder participation in market assessment had an impact on the impact of micro hydropower projects. Results for the regression coefficient are shown in Table 4.18.

**Table 4. 19: Regression Analysis of stakeholder involvement in market assessment and Implementation of micro-hydropower.**

**Coefficient**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 3.427 | 0.216 | | 15.900 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| | Stakeholder involvement in market assessment | 0.171 | 0.079 | 0.145 | 2.163 | 0.032 |

a. Dependent Variable: Implementation of Micro Hydropower

Table 4.15 shows that there is a correlation between stakeholder participation in market assessment and the implementation of micro-hydropower projects using a simple linear regression analysis. Stakeholder participation in market assessment (_1=0.171,p=0.0320.05) and the implementation of hydropower project (_0=3.427,p0.05) both reached statistical significance. For each unit change in stakeholder engagement in market assessment, the output of micro-hydropower project is slightly modified by 0.171 units, as shown by the regression model Y=3.427+0.171X 2. Thus, it was concluded that the implementation of micro-hydropower projects is proportional to the involvement of stakeholders in market assessment.

## 4.7 Involvement of stakeholders participation in Decision making and Implementation of Micro hydropower project

The stakeholders were interviewed on their opinion on the decision-making process. A Likert scale was used to seek opinions on the aforementioned subcomponent. The scale ranged from 1-5 as indicated in the brackets (1-strongly disagree, 2=disagree, 3=neutral/undecided, 4=agree, 5=strongly agree). The various items covered in this subcomponent included involvement in needs and opportunities assessment, creation of awareness and capacity building, acquisition of land for energy infrastructure development, and soliciting for partnerships to the project.

**Table 4. 20: Decision Making for the Implementation of Micro Hydropower project**

| Items | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree | n | mean | standard deviation |
|---|---|---|---|---|---|---|---|---|
| I am involved in creation of awareness and capacity building | 3(2%) | 17(11.1%) | 18(11.8%) | 86(56.2%) | 29(19%) | 153 | 3.79 | 0.943 |
| I am involved in ensuring that power needs of Iriamaina | 0(0%) | 2(1.3%) | 12(7.8%) | 105(68.6%) | 34(22.2%) | 153 | 4.12 | 0.584 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| residents are prioritized | | | | | | | | |
| I am in involved in acquisition of land for Energy infrastructure development | 0(0%) | 4(2.6%) | 7(4.6%) | 107(69.9%) | 35(22.9%) | | 4.13 | 0.604 |
| I am involved in ensuring that the project received support of everyone involved | 0(0%) | 2(1.3%) | 18(11.8%) | 111(72.5%) | 22(14.4%) | 153 | 4 | 0.562 |
| I am involved in choosing the implementation strategy of the power project | 0(0%) | 10(6.5%) | 22(14.4%) | 102(66.7%) | 19(12.4%) | 153 | 4.02 | 0.683 |
| combined mean &sdv | | | | | | | 4.011 | 0.71 |

Table 4.20 shows that, overall, respondents' opinions on their level of participation in the project's decision-making were consistent, with a mean score of 4.011 and a standard deviation of 0.71. The respondents, as shown by a mean score of 4.011, all agreed that the implementation of Iriamaina Micro hydropower plant was affected by the decisions made by project stakeholders. The items whose Mean exceeded the combined mean of **4.011**; were respondents' involvement in choosing the implementation strategy of the power project and respondents 'involvement in ensuring that the power needs of Iriamaina residents were prioritized and involvement in the acquisition of land for energy infrastructure development. The items that were less than the means score were respondents' involvement in ensuring that the project received the support of everyone involved and respondents' involvement in the creation of awareness and capacity building.

When interviewed on the question regarding stakeholder participation in project decision-making of Iriamaina micro hydropower the project management committee gave the below summary;

*"We got initial financing from the county Government of Bomet during the first regime, the office of the Governor in 2014 assisted to allocate funding for buying*

*land on the hydropower site. This was a good move as the Energy Act (2019) gives provision for the County Governments to provide land for energy infrastructure.*

*The community also ensured that the power needs of the Iriamaina residents were prioritized. The project received support from some of the stakeholders during different phases of the project. We would still appreciate having more training and capacity building on the hydropower technology before full commissioning and operation*" (Project Committee).

### 4.7.1 Correlational Analysis of Stakeholder Involvement in Project Decision Making and Implementation of Micro Hydropower.

The goal of the study was to identify the kind, degree, and direction of the relationship between micro-hydropower implementation and stakeholder participation in project decision-making. Based on Pearson's correlation model; the results are as shown in Table 4.21.

**Table 4. 21: Correlation between Participation of Stakeholders in Project Decision Making and Implementation of Micro Hydropower**

| | | **Implementation of Micro Hydropower Project** |
|---|---|---|
| **Stakeholder Participation in project decision making** | Pearson Correlation | 0.323* |
| | Sig. (2-tailed) | 0.000 |
| | n | 153 |

*Correlation is significant at the 0.05 level (2-tailed)

Table 4.21 shows that there is a somewhat favorable link between stakeholder participation in project decision-making and implementation of micro hydropower. This is shown by a positive value of the Pearson correlation coefficient (r = 0.323) which is significant since the p-value is 0.000 < 0.05. Hence it can be concluded that a positive change in stakeholder participation in project decision-making positively influences the implementation of micro hydropower project.

The purpose of the following section is to assess the degree to which stakeholder involvement in project decision-making affects the implementation of micro-hydropower.

**Table 4. 22: Regression of Participation of Stakeholders in Project Decision Making and Implementation of Micro Hydropower**

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | 0.323[a] | 0.104 | 0.100 | 0.52424 | 0.104 | 17.579 | 1 | 151 | 0.000 |

a. Predictors: (Constant), participation of stakeholders in project decision making

According to the results in table 4.22, approximately 10.4% of the changes in the implementation of micro hydropower are attributable to stakeholder involvement in project decision-making. This is indicated by the value of R squared which is 0.104, this contribution is significant since the p-value corresponding to it is 0.000 which is less than the level of significance of 0.05 adapted by this research study.

After including stakeholders in project decision-making, the study sought to ascertain whether the regression model was the best fit for assessing implementation of micro hydropower. Table 4.22 displays the regression coefficient's findings.

**Table 4. 23: ANOVA of regression of stakeholder involvement in project decision making and implementation of micro-hydropower.**

| **Model** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** |
|---|---|---|---|---|---|---|
| 1 | Regression | 7.014 | 1 | 7.014 | 17.579 | 0.000[b] |
| | Residual | 60.187 | 151 | 0.399 | | |
| | Total | 67.201 | 152 | | | |

a. Dependent Variable: Implementation of Micro Hydropower

b. Predictors: (Constant), Stakeholder Involvement in Project Decision Making

Table 4.23's ANOVA results reveal an F-statistic of (1,151) = 17.579, which is statistically significant at the 0.000 0.05 level, indicating that the predictor coefficient was greater than or equal to zero, and thus the regression model results were a more accurate prediction of micro-hydroelectric power implementation and involvement in stakeholder participation in project decision making.

Finally, the study aimed to determine whether stakeholder participation in project decision-making had an impact on the production of micro power. The regression coefficient results are presented in Table 4.23.

**Table 4. 24: Regression Analysis of stakeholder involvement in project decision making and implementation of micro-hydro power project.**

**Coefficient**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2.193 | 0.337 | | 6.508 | 0.000 |
| | Stakeholder involvement in project decision making | 0.472 | 0.093 | 0.323 | 5.052 | 0.000 |

a. Dependent Variable: Implementation of off grid Micro Hydropower
b. b. Predictors: (Constant), Decision Making

Involvement of stakeholders in project decision-making was associated with better implementation of off grid micro hydropower, as shown by the results of a simple linear regression analysis in Table 4.24. Both the coefficient constant terms (_0=2.193,p=0.0000.05) and the importance of stakeholders in decision-making (_1=0.472,p=0.0000.05) were found to be statistically significant. Micro-hydropower project implementation is regressed on stakeholder involvement in project decision-making as Y=2.193+0.472X 2, where X 2 is the number of stakeholders involved in the project decision making, and Y is the implementation of mcro hydropower So, it was concluded that there is a direct and positive relationship between stakeholder participation in project decision-making and the emergence of micro-hydro power projects.

### 4.8 Overall overview of Stakeholders' Influence on the implementation of off-grid micro hydropower

In general, the stakeholders were requested to express their general views on the four components that framed the study. They included the aspect of project completion within the allocated time frame, project execution within the allocated budget, if the project quality satisfied the respondents and if the standards of the project were met.

**Table 4.25:Overview of Stakeholders' Influence on Implementation of Off-grid Micro Hydropower**

| Items | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree | n | mean | standard deviation |
|---|---|---|---|---|---|---|---|---|
| The project was completed within specified time | 55 (35.9%) | 82 (53.6%) | 16 (10.4%) | 0(0.0%) | 0(0.0%) | 153 | 1.75 | 0.41 |
| The project was executed within the allocated budget | 30 (19.6%) | 79 (51.6%) | 25 (16.3%) | 19(12.4%) | 0(0.0%) | 153 | 2.21 | 0.74 |
| I was satisfied with the quality of the project | 1 (0.7%) | 19 (12.4%) | 39 (25.5%) | 83 (54.2%) | 11(7.2%) | 153 | 3.54 | 0.62 |
| The project meets the required standards | 0(0.0%) | 11(7.1%) | 111(72.5%) | 24(15.7%) | 7(4.6%) | 153 | 3.18 | 0.57 |
| combined mean & standard deviation | | | | | | | 2.67 | 0.65 |

From the data displayed in Table 4.25, results revealed that the respondents were neutral and thus had mixed reactions in regards to project time frame, quality, standards and budget for implementation of Iriamaina Micro hydropower. Specifically, respondents agreed on being satisfied with the quality of the project with a mean of **3.54** which was above the average combined mean, the respondents were also neutral that the project met the required standards as the mean of **3.18 was** above the combined average mean**,** the respondents also disagreed with the aspect of the project being executed within the allocated budget with a mean of **2.21** the which was below the average combined mean. Finally, the majority of respondents disagreed on the project being completed within the specified time with an average mean of **1.75**, this highlighted that the project stalled and took too long to be completed.

When respondents were interviewed on the aspect of implementation of Iriamaina Micro hydropower,

Below was the response;

*"This project was identified through feasibility done by UNDP and they contracted UNIDO, the budgetary allocation was exceeded and would later require the community representatives to seek further funding from the county Government of Bomet and REREC. This could have been the probable reason why the project stalled. Regarding the quality of the project, we are generally satisfied as the supply and installation of the hydro turbines have been supplied and installed through competitive bidding done by REREC. The beneficiaries are satisfied with the project, however, there are aspects of delay which in turn have delayed the intended purpose of income generation and economic growth of the area. We look forward to being able to transmit power to community and market places nearby as well as the Tea factories who mostly use wood fuel as the main source of energy"(Project committee).*

#### 4.8.1 Regression Analysis of Implementation of Off grid Micro Hydro Power.

A regression model that describes the association between stakeholder involvement and the implementation of micro hydropower was created through additional inferential analysis. The following sub-themes go into deeper detail on each of these.

#### 4.8.2 Regression summary for Implementation of Off grid Micro Hydropower.

The model summary aimed to show whether the implementation of micro hydropower was considerably or insignificantly predicted by stakeholder involvement as a predictor variable. Table 4.26 presents the summary findings from the regression model.

**Table 4. 26: Model Summary of Stakeholder Involvement and Implementation of Off grid Micro Hydropower**

**Model Summary**

| | | | | | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | R Square Change | F Change | df1 | df2 | Sig. F Change |
| 1 | 0.506[a] | 0.256 | 0246 | 0.47987 | 0.256 | 12.746 | 4 | 148 | 0.000 |

a. Predictors: (Constant), Project Finance, Market Assessment, Project Design, Decision Making

Table 4.26 gives the summary of the regression model. It indicates that the strength of association between stakeholder involvement and implementation of micro-hydropower is significantly strong positive as shown by $r = 0.506$. Additionally, the table shows that the amount of changes in the implementation of micro-hydropower that is explained by the team diversity is approximately 25.6%, and the remaining 74.4% of the changes are explained by other factors that were not considered in this study. The values are also significant as shown by$p - value = 0.0000 < 0.05$.

### 4.8.3 ANOVA of Regression of Stakeholder Involvement and Implementation of Micro Hydropower

The objective of the study was to determine whether the regression model was the most accurate in predicting the implementation of off grid micro hydropower after using stakeholder involvement. Table 4.27 displays the regression coefficient's findings.

**Table 4. 27: ANOVA of Regression of Stakeholder Involvement and Implementation of Off grid Micro Hydropower.**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 17.231 | 4 | 4.308 | 12.746 | 0.000[b] |
| | Residual | 49.970 | 148 | 0.338 | | |
| | Total | 67.201 | 152 | | | |

a. Dependent Variable: Implementation of off grid micro hydropower

b. Predictors: (Constant), Project Finance, Market Assessment, Project Design, Decision Making

Table 4.27 shows that there exists a significant relationship between stakeholder involvement and the implementation of micro-hydropower as shown by $F = 12.746$ and a $p - value =$

0.000 which is less than 0.05. This implies that the regression model developed is significantly a better predictor of the implementation of micro-hydropower.

### 4.8.4 Regression Coefficient of Stakeholder Involvement and Implementation of Micro Hydro Power.

The objective of the research was to determine whether stakeholder involvement affected the implementation of micro-hydro power. The results of the multiple linear regression used are shown in Table 4.28.

**Table 4. 28: Regression Coefficient of Combined stakeholders' participation and Implementation of Hydropower**

**Coefficient**

| Model | | Unstandardized Coefficients B | Unstandardized Coefficients Std. Error | Standardized Coefficients Beta | t | Sig. |
|---|---|---|---|---|---|---|
| 1 | (Constant) | 0.069 | 0.456 | | 0.151 | 0.880 |
| | Project Finance | 0.312 | 0.089 | 0.243 | 4.610 | 0.000 |
| | Market Assessment | 0.108 | 0.096 | 0.071 | 1.132 | 0.259 |
| | Project Design | 0.475 | 0.077 | 0.369 | 6.141 | 0.000 |
| | Decision Making | 0.381 | 0.103 | 0.294 | 3.168 | 0.000 |

a. Dependent Variable: Implementation of Micro Hydro Power

b. b. Predictors: (Constant), Project Finance, Market Assessment, Project Design, Decision Making

Table 4.28 shows that when put together, three independent variables of stakeholder involvement were significant predictors of the implementation of hydropower but the stakeholder involvement in market assessment was not significant. Project finance gives a contribution of 0.212 ($p = 0.000 < 0.05$), market assessment gives a contribution of 0.108 ($p = 0.259 < 0.05$), showing that the contribution is not statistically significant, project design contributes 0.475 ($p = 0.000 < 0.05$), and lastly, decision making gives a contribution of 0.381 ($p = 0.000 < 0.05$). The findings also showed that in the absence of all four indicators for stakeholder involvement, the implementation of micro-hydropower would still increase by

0.069 units. The results in Table 4.28 led to the development of the following model. $Y = 0.069 + 0.412X_1 + 0.108X_2 + 0.475X_3$.

# CHAPTER 5

## SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

### 5.1 Introduction

This study focused on Iriamaina off grid micro hydropower in Bomet County, Kenya, to explore the influence of stakeholder involvement on the implementation of off-grid micro-hydropower in Bomet. The chapter's recommendations and conclusion are presented.

### 5.2 Summary of Findings

Below are the findings of this research paper in a summarized form.

#### 5.2.1 Influence of participation of stakeholders on Project Design and Implementation of Iriamaina micro Hydropower Project.

According to the descriptive data, the Iriamaina Micro hydropower project's combined mean for stakeholder participation in project design was 3.674. Thus, the majority of those surveyed generally were neutral on being involved on project design for the implementation of Iriamaina micro hydro power. The correlation of coefficient was $r=0.401$ which implied that participation of stakeholders in project design had a moderate positive relationship with the implementation of the Iriamaina micro hydropower project (for $p=0.00 <0.05$). As a result, there is a considerable, moderately positive association between the implementation of the Iriamaina micro hydropower project and the involvement of stakeholders in project design. The regression model indicated that for each unit change in stakeholder involvement in project design, the implementation of a micro hydropower project is marginally transformed by 0.515 units.

#### 5.2.2 Influence of participation of stakeholders on Project Financing and Implementation of Iriamaina micro Hydropower Project.

According to the descriptive data, the Iriamaina Micro hydropower project's combined mean for stakeholder participation in project financing was 4.086. Therefore, the majority of respondents agreed that they were involved in project financing for Iriamaina micro hydropower project. The relationship between involvement by stakeholders on financing of the project and implementation of Iriamaina micro hydropower was slight. This is demonstrated by a positive Pearson correlation coefficient (r = 0.240), which is significant because the p-value is less than the threshold level of significance of 0.05 and is 0.001. Therefore it can be stated that a positive change in stakeholder participation in project financing, that is, involving stakeholders more in project financing positively influenced the implementation of micro-hydropower. The regression model indicated that for each unit change in stakeholder involvement in project financing, the implementation of micro hydropower projects is marginally transformed by 0.365 units.

#### 5.2.3 Influence of participation of stakeholders on Market Assessment of the project and Implementation of Iriamaina micro Hydropower Project.

According to the descriptive data, the Iriamaina Micro hydropower project's combined mean for stakeholder participation in project market assessment and implementation was 4.394. Thus, the majority of respondents agreed that they were involved in market assessment for implementation of Iriamaina micro hydropower. Additionally, there was a significant positive association between micro hydropower production and stakeholder participation in project market assessment. According to the findings in Chapter 4, there was a marginally favorable correlation between stakeholder participation in market assessment and the implementation of micro-hydro power. A positive Pearson correlation coefficient (r = 0.145), which is significant given that the p-value is 0.032 0.05, demonstrates this. Thus, it can be said that an increase in stakeholder involvement in market assessment has a favorable impact on the production of micro hydropower. The regression model indicated that for each unit change in stakeholder involvement in market assessment, the implementation of micro-hydropower projects is marginally transformed by 0.171 units.

#### 5.2.4 Influence of participation of Sstakeholders' on Decision Making of the project and Implementation of Iriamaina micro Hydropower Project.

According to the descriptive data, the Iriamaina Micro hydropower project's combined mean for stakeholder participation in project decision-making and generation was 4.011. Therefore, the majority of respondents agreed that they were involved in decision making for implementation of Iriamaina micro hydropower. Additionally, there was a significant positive association between micro hydropower implementation and stakeholder participation in project decision making. The findings in Chapter 4 suggest a relationship between stakeholder participation in project decision-making and the impleentation of micro-hydropower. This is demonstrated by a Pearson correlation coefficient value that is positive (r = 0.323), which is significant because the p-value is 0.000 to 0.05. Consequently, it can be stated that an increase in stakeholder involvement in project decision-making has a favorable impact on the production of micro-hydropower. The regression model indicated that with each unit change in stakeholder involvement in project decision-making, the implementation of micro-hydropower projects is marginally transformed by 0.472 units.

### 5.3 Conclusions from the Findings

The initial goal was to ascertain how the Iriamaina hydropower in Bomet County, Kenya implementation was impacted by stakeholders' participation in project design. The inclusion of project stakeholders in project design had a moderately favorable influence on the implementation of the Micro hydropower project in Bomet County, Kenya, according to both descriptive and correlation results.

The second goal was to ascertain how stakeholders' involvement in project finance affected the production of a micro hydropower project in Kenya's Bomet County. The inclusion of project stakeholders in project design had a weak positive effect on the implementation of the Micro hydropower project in Bomet County, Kenya, according to both descriptive and correlation results.

The third goal was to ascertain how stakeholders' input into the market assessment affected the implementation of micro hydropower project in Kenya's Bomet County. The inclusion of stakeholders in market assessment had a weakly favorable influence on the implementation of the Micro hydropower project in Bomet County, Kenya, according to both the descriptive and correlation results.

The fourth goal was to ascertain how Iriamaina micro hydropower project was influenced by stakeholders' involvement in decision-making. The inclusion of stakeholders in decision-making had a moderately favorable influence on the implementation of the Micro hydropower project in Bomet County, Kenya, according to both the descriptive and correlation results.

### 5.4 Recommendations from the Findings

The following recommendations are provided to the government, practitioners, and future studies based on the findings and conclusions.

### 5.4.1 Recommendation for Practice

The results of this study can be used by project managers and practitioners to improve the operationalization of upcoming initiatives. Participation of all stakeholders before the commencement of a project, various indicators were found to have differing effects on the implementation of Iriamaina micro hydropower. Therefore, project planners and managers can emphasize to stakeholders' on importance of their prior participation in various aspects of the project.

### 5.4.2 Recommendation for Policy

The recommendation is made to the government, through REREC and as a commitment to the Energy Act (2019) to fund more research on renewable energy and especially on the implementation of community-owned off-grid hydropower projects in Kenya. This paper would also inform the Ministry of Environment and Forestry on Climate Change action plan for future such projects.  Further recommendation on the government to build more capacity for implementation and operationalization of community off-grid hydropower in Kenya. This research also advises on a clear policy on operationalization of community off grid projects as there is great need for a different entity or company to manage hydropower projects. The community might not necessarily have capacity to manage in terms of maintenance of hydropower and management of financial resources from the hydropower project. Thus a need for an independent entity.

### 5.4.3 Recommendation for Methodology

Both qualitative and quantitative data were collected and analyzed by descriptive and inferential statistics as part of this study's descriptive research approach. It is possible that data was lost during inferential analysis because the Likert-type answers were converted from ordinal to interval format. An interval-based comparison research is advised so that data may be collected and analyzed precisely.

## 5.5 Suggestions for Further Study

The study suggests additional research on the following topics;

1. It was notable that there was room for research on other indicators of the independent variables as this current study only focused on limited indicators.
2. There is also room for further research on Mega hydropower projects that are intended to

be off-grid, this specific study was micro hydropower thus the findings could be different.

3. The study further gives room for research on Government initiatives to fund off-grid community hydropower projects as this study was NGO based initiative that initiated the idea through a CDM program.
4. Future researchers could also explore privatized off-grid hydropower projects in the country and their performance versus community-owned off-grid hydropower projects.

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# APPENDICES

## Appendix I: Survey Questionnaire for residents of Iriamaina community

This was a questionnaire for partial fulfillment of Master of Arts Degree in Project Planning and Management at The University of Nairobi for **Chepngetich Koech Valerie, L50/6569/2017.**

The study was on **Influence of stakeholder participation on generation of off grid micro hydropower in Kenya, a case of Iriamaina Micro hydropower in Bomet County.**

The data was filled in the spaces provided below each question. In case of any additional information, written statement was to be attached.

Do not write your name.

NB: Ethical consideration is highly regarded in this research.

**Section A: Personal details of the respondent.**
This section gave the researcher some background information about the respondents

1. Gender

| Gender | a) Male | b) Female |
|---|---|---|
| Tick (√) | | |

2. What is your highest academic qualification?

| Qualification | a) Certificate | b) Degree | c) Masters and above | d) Other (specify) |
|---|---|---|---|---|
| Tick (√) | | | | |

3. Tick on your age bracket (years)?

| Bracket | a) 25-35 | b) 35-45 | c) 45-60 | d) 60 and above |
|---|---|---|---|---|
| Tick (√) | | | | |

4. Please tick below the respondent type that most closely matches your position.

| a) Resident | b) Consumer | c) Member of Iriamaina Cooperative society | d) Official of Iriamaina cooperative society | e) Other (specify) |
|---|---|---|---|---|
| | | | | |

**Section B**: **Generation of off grid power for Iriamaina off grid Micro hydropower project**

Indicate by a tick, your level of agreement with the following statements on influence of stakeholder participation on generation of Mini hydropower projects, on a scale of 1-5 where 1. Strongly disagree, 2. Disagree 3.Undecided 4. Agree 5. Strongly agree

| **INDICATORS** | **1. Strongly disagree** | **2. Disagree e** | **3.Undecid ed** | **4. Agree** | **5. Strongly agree** |
|---|---|---|---|---|---|
| The project was completed within specified time | | | | | |
| The project was executed within the allocated budget | | | | | |
| I was satisfied with the quality of the project | | | | | |
| The project meets the required standards | | | | | |

**Section C**: **Stakeholder involvement in project financing for Iriamaina off grid Micro hydropower project**

Indicate by a tick, your level of agreement with the following statements on influence of stakeholder participation in project financing of the Iriamaina micro hydropower, on a scale of 1-5 where 1. Strongly disagree, 2. Disagree 3.Undecided 4. Agree 5. Strongly agree

| **INDICATORS** | **1. Strongly disagree** | **2. Disagree** | **3.Undecided** | **4. Agree** | **5. Strongly agree** |
|---|---|---|---|---|---|
| Involving stakeholders in project funding contributes to the project success | | | | | |
| I am involved in Funding | | | | | |
| I have a Stake on project debt and equity | | | | | |
| Stakeholders are encouraged to acquire stake on project debt and equity | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Involving stakeholders in sourcing of funds for the project contributes to the project's performance | | | | | |
| I am involved in sourcing of funds to finance the project | | | | | |
| Stakeholders should be encouraged to provide security for the access of project finance | | | | | |
| I am involved in Provision of security for access of project finance | | | | | |
| Stakeholders should hold donors fiscally accountable | | | | | |
| I am involved in Fiscal accountability to donors | | | | | |

**Section D**: **Stakeholder participation in market assessment for Iriamaina off grid Micro hydropower project**

Indicate by a tick, your level of agreement with the following statements on influence of stakeholder participation in market assessment for Iriamaina micro hydropower, on a scale of 1-5 where 1. Strongly disagree, 2. Disagree 3.Undecided 4. Agree 5. Strongly agree

| INDICATORS | 1. Strongly disagree | 2. Disagree | 3.Undecided | 4. Agree | 5. Strongly agree |
|---|---|---|---|---|---|
| I am involved in obtaining project operating permits | | | | | |
| I participated in the identification of target consumers | | | | | |
| I am involved in collating the market needs and requirements | | | | | |
| I am involved in Risk assessment and mitigation analysis ( e.g. Power Purchase Agreement, Market Off-take factors) | | | | | |
| Iriamaina microhydropower project will solve power related problems of the Iriamaina Community | | | | | |
| Iriamaina microhydropower project received support from all the community members | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| The main challenge that Iriamaina residents are facing is access to electricity. | | | | | |

**Section E**: **Stakeholder participation in decision making for Iriamaina off grid Micro hydropower project**

Indicate by a tick, your level of agreement with the following statements on influence of stakeholder participation in decision making for Iriamaina micro hydropower, on a scale of 1-5 where 1. Strongly disagree, 2. Disagree 3.Undecided 4. Agree 5. Strongly agree

| **INDICATORS** | **1. Strongly disagree** | **2. Disagree** | **3.Undecided** | **4. Agree** | **5. Strongly agree** |
|---|---|---|---|---|---|
| I am involved in needs and opportunities assessment | | | | | |
| I am involved in the analysis of the project need | | | | | |
| I am involved in creation of awareness and capacity building | | | | | |
| I am involved in ensuring that power needs of Iriamaina residents are prioritized | | | | | |
| I am in involved in acquisition of land for Energy infrastructure development | | | | | |
| I am involved in ensuring that the project received support of everyone involved | | | | | |
| I am involved in choosing the implementation strategy of the power project | | | | | |
| I am involved in setting of the goals of the power project | | | | | |

**Section F**: **Stakeholder involvement in project design for Iriamaina off grid Micro hydropower project**

Indicate by a tick, your level of agreement with the following statements on influence of stakeholder participation in project design of the Iriamaina micro hydropower, on a scale of 1-5 where 1. Strongly disagree, 2. Disagree 3.Undecided 4. Agree 5. Strongly agree

| INDICATORS | 1. Strongly disagree | 2. Disagree | 3.Undecided | 4. Agree | 5. Strongly agree |
|---|---|---|---|---|---|
| I am involved in technical support during Project initiation | | | | | |
| I am involved in designing of the project requirements | | | | | |
| I am involved in technical support during Planning | | | | | |
| I am involved in setting of performance targets for the project | | | | | |
| I am involved in technical support during Execution | | | | | |
| I am involved in choosing the implementation strategy | | | | | |
| I am involved in Monitoring and Evaluation | | | | | |
| I am involved in monitoring and evaluating findings so as to keeptrack of project progress | | | | | |

**Section G**: **Stakeholder involvement in project planning for Iriamaina off grid Mini hydropower project**

Rate the extent to which the following aspects are implemented for the Iriamaina micro hydropower project on a scale of 1-5 where 1. Strongly disagree, 2. Disagree 3.Undecided 4. Agree 5. Strongly agree. Please tick (√) where appropriate.

| Indicators | 1. Strongly disagreed | 2. Disagree | 3. Undecided | 4. Agree | 5. Strongly Agree |
|---|---|---|---|---|---|
| a) The project was implemented with the stipulated duration | | | | | |
| b) The delivery schedule was met | | | | | |
| c) The technology, materials and machinery used are up to date | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| d) The resources (finance/human/equipment) available are enough for implementation of the project | | | | | |
| e) Stakeholder participation is prioritized in the power project | | | | | |
| f) Project implementation meets the intended quality | | | | | |
| g) The Cost and budget of the project are well within the projected estimates | | | | | |

## Appendix II: Structured Interview Guide for Government and Non-government officers

**SECTION ONE: INSTRUCTIONS**

The structured interview questions collected data from officers on the Influence of stakeholder participation on generation of off grid micro hydropower in Kenya, a case of Iriamaina Micro hydropower in Bomet County, Kenya. Kindly, write your answers in the spaces provided.

**SECTION TWO: BACKGROUND INFORMATION**

1. Please indicate your gender

   ( ) Male ( ) Female

2. Which government/non-government agency do you represent?

   ……………………………………………………………………………………………
   …………………………………………………………………………………………

**SECTION THREE: THEMATIC QUESTIONS**

3. Do you think stakeholder participation influences generation of off grid micro hydropower in Kenya? Please expound your answer.

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………
   ……………………………………………………………………………………………

4. Which areas did you have with stakeholders that boosted project design?

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………

5. How do you coordinate stakeholders so as to achieve required project financing?

   ……………………………………………………………………………………………
   ……………………………………………………………………………………………

6. Which area do you focus on so as to coordinate stakeholders to undertake market assessment?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………..

7. What are the roles of stakeholders during project implementation that would ensure good performance of the project?

……………………………………………………………………………………………………
……………………………………………………………………………………………………
………………………..

## Appendix III: Letter of Transmittal

**CHEPNGETICH KOECH VALERIE**

**UNIVERSITY OF NAIROBI**
**P.O. BOX 30197**
**NAIROBI**
**DATE: 10/08/2021**

**DEAR SIR/MADAM,**

**RE: REQUEST FOR INFORMATION**
I am a Masters student at the University of Nairobi and as part of my course requirement, I am currently conducting a study on "Influence of stakeholders' participation on the generation of Micro hydropower, a case of Iriamaina Micro hydropower in Bomet County, Kenya

You are requested to currently participate in the survey. The information you will provide is for academic purposes only and shall be treated with the utmost confidentiality.
Thank you in advance for your cooperation and active participation in this academic effort.
Sincerely

**Chepngetich Koech Valerie**

**Appendix IV: University Letter to NACOSTI**

# UNIVERSITY OF NAIROBI

## FACULTY OF BUSINESS AND MANAGEMENT SCIENCES

***OFFICE OF THE DEAN***


Telegrams: "Varsity",
Telephone: 020 491 0000
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P.O. Box 30197-00100, G.P.O.
Nairobi, Kenya
Email: *fob-graduatestudents@uonbi.ac.ke*
Website: ***business.uonbi.ac.ke***


Our Ref: **L50/6569/2017** March 22, 2022

National Commission for Science, Technology, and Innovation

NACOSTI Headquarters

Upper Kabete, Off Waiyaki Way

P. O. Box 30623- 00100

**NAIROBI**

**RE: INTRODUCTION LETTER: VALERIE KOECH**

The above-named is a registered Master of Project Planning and Management Student at the Faculty of Business and Management Sciences, University of Nairobi. She is researching ***"Influence of stakeholders on the generation of off-grid micro-hydropower: a case of IriaMaina micro hydropower in Bomet County, Kenya."***

The purpose of this letter is to kindly request you to assist and facilitate the student with the necessary data which forms an integral part of the Project.

The information and data required are needed for academic purposes only and will be treated in **Strict-Confidence**.

Your co-operation will be highly appreciated.

**PROF. JAMES NJIHIA**

**ASSOCIATE DEAN,**

**FACULTY OF BUSINESS AND MANAGEMENT SCIENCES**

## Appendix V: NACOSTI Permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **414012**

Date of Issue: **31/March/2022**

**RESEARCH LICENSE**

**This is to Certify that Ms.. Valerie chepngetich koech of University of Nairobi, has been licensed to conduct research in Bomet, Nairobi on the topic: Influence of stakeholders on generation of micro hydropower a case of Iriamaina Micro hydropower in Bomet County ,Kenya. for the period ending : 31/March/2023.**

License No: **NACOSTI/P/22/16582**

**414012**

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.