

**MAINTENANCE PRACTICES OF MANUAL WATER PUMPS IN EASTERN DRC AND ITS  
EFFECTS ON THE SUSTAINABILITY OF WATER PROJECTS IN THE COMMUNITY OF  
BUNIA CITY, DRC**

**BENJAMIN LIRINGA KOLI**

**RJ21M02/204**

**A DISSERTATION SUBMITTED TO THE SCHOOL OF BUSINESS, IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE AWARD OF A MASTER DEGREE OF ARTS IN ORGANISATIONAL  
LEADERSHIP AND MANAGEMENT OF UGANDA CHRISTIAN UNIVERSITY**

**April, 2024**



**UGANDA CHRISTIAN  
UNIVERSITY**

*A Centre of Excellence in the Heart of Africa*

## DECLARATION

I, **Benjamin Liringa Koli**, hereby declare that this is my original work and has not been submitted to any other institution for any award.

Signature:



Date: 4th April 2024

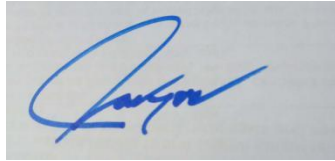
**BENJAMIN LIRINGA KOLI**

**RJ21M02/204**

## APPROVAL

I acknowledge that this Field Research Project titled: “Maintenance Practices of Manual Water Pumps in Eastern DRC and Sustainability of Water Projects in Community of Bunia City, DRC” has been under my supervision and is ready for submission.

Signature:

A handwritten signature in blue ink, appearing to read 'Joseph Owor', is shown within a rectangular frame.

**JOSEPH JAKISA OWOR, PhD**

Date: 4th April 2024

## **DEDICATION**

I dedicate this Field Research Project to my employer and family

## **ACKNOWLEDGEMENTS**

I wish to express my sincere gratitude and appreciation to my supervisor, Dr. Joseph Jakisa Owor, whose guidance was instrumental throughout this study. I would also like to extend my sincere thanks to my friends and classmates who supported and encouraged me during the study.

## TABLE OF CONTENTS

DECLARATION .....	II
APPROVAL .....	III
DEDICATION .....	IV
ACKNOWLEDGEMENTS .....	V
TABLE OF CONTENTS.....	VI
ABSTRACT.....	X
<b>CHAPTER ONE .....</b>	<b>1</b>
<b>INTRODUCTION.....</b>	<b>1</b>
1.0 Introduction.....	1
1.1 Background of the study .....	1
1.1.1 Conceptual Background.....	2
1.1.2 Contextual Background .....	3
1.1.3 Contextual Background .....	3
1.1.4 Theoretical Background.....	4
1.2 Problem statement.....	5
1.3 General objective .....	5
1.3.1 Specific Objectives .....	5
1.3.2 Research Questions.....	6
1.4 Justification of the study .....	6
1.5. Significance of the study.....	7
1.6 Scope of the study.....	7
1.6. 1 Content scope.....	7
1.6.2 Geographical scope.....	8
1.6. 3 Time scope.....	8
1.7 Definition of terms.....	8
<b>CHAPTER TWO .....</b>	<b>12</b>
<b>LITERATURE REVIEW .....</b>	<b>12</b>
2.0 Introduction.....	12

2.1 Maintenance Practices .....	12
2.2 Community involvement in maintenance .....	13
2.3 Key factors for the effectiveness and ineffectiveness of manual water pump projects. ...	15
2.4 Sustainability of the water projects.....	19
<b>CHAPTER THREE</b> .....	<b>20</b>
<b>METHODOLOGY</b> .....	<b>20</b>
3.0 Introduction.....	20
3.1 Description of the Study Area.....	20
3.1 Research Design.....	20
3.2 Target Population.....	21
3.3 Data Collection Methods and Tools .....	23
3.3.1 Questionnaire Survey.....	23
3.3.2 Interview Method.....	23
3.3.1 Documentary Review.....	23
3.4 Quality Control of Data collection.....	24
3.4.1 Validity .....	24
3.4.2 Reliability.....	24
3.5 Data Collection Procedures.....	25
3.7 Piloting of Research Instrument.....	26
3.8 Validity of Findings .....	26
3.8 Reliability of Research Instrument .....	26
3.9 Data Analysis and Presentation .....	26
3.10 Ethical Considerations .....	27
<b>CHAPTER FOUR</b> .....	<b>28</b>
<b>PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS</b> .....	<b>28</b>
4.1 Demographic Data .....	28
4.1.1 Age Distribution of Respondents.....	28
4.1.2 Gender Distribution of Respondents.....	29
4.1.3 Community Role of the Respondents .....	30
4.1.4 Duration of respondents in Commune .....	32
4.1.5 Regularity of water pump use .....	33

4.2 How different maintenance practices impact the sustainability of water projects in Eastern DRC communities (RQ1) .....	34
4.2.1 Regularity of water pump maintenance .....	34
4.2.2 Sufficiency of maintenance efforts .....	35
4.2.3 Quality of Maintenance.....	37
4.2.4 Existence of measures for quality assurance .....	38
4.2.5 Involvement in water pump Maintenance.....	40
4.2.6 Frequency of Water pumps service.....	41
<b>4.3 Key factors contributing to the effectiveness or ineffectiveness of maintenance practices in Eastern DRC in terms of water project sustainability (RQ2).....</b>	<b>42</b>
4.3.1 Moments of broken water pumps .....	42
4.3.2 Who performs water pump repairs .....	44
4.3.3 Training for maintenance staff.....	46
4.3.4 Availability of Resources/spare parts .....	47
4.3.5 Maintenance issues identified and resolved in advance?.....	48
4.3.6 Sources of Maintenance finance .....	49
4.3.6 Adequacy of current maintenance efforts .....	51
4.3.7 Sustainability of stakeholder engagement .....	52
<b>4.4 Community participation and extent it affects the sustainability of water projects in Eastern DRC (RQ3).....</b>	<b>53</b>
4.4.1 Responsibility for Water project.....	53
4.4.2 Knowledge of water pump operation.....	54
4.4.3 Community leader’s involvement in decision-making.....	55
4.4.4 Community training or awareness programs .....	57
4.4.5 Existence of Committee to oversee maintenance activities .....	58
4.4.6 Who should finance manual water projects? .....	59
4.4.7 Is Information main constraint to sustainability?.....	60
4.4.8 Any plans to upgrade water pumps?.....	61
<b>4.4.9 Summary of the findings and discussions .....</b>	<b>62</b>
<b>CHAPTER FIVE .....</b>	<b>70</b>
<b>CONCLUSION AND RECOMMENDATIONS.....</b>	<b>70</b>
<b>5.1 Summary of the study.....</b>	<b>70</b>
<b>5.2 Conclusions of the study .....</b>	<b>70</b>
<b>5.3 Recommendations of the study .....</b>	<b>71</b>
<b>REFERENCES .....</b>	<b>73</b>

<b>Appendix 1: Questionnaire</b> .....	76
<b>Appendix 2: Interview Guide</b> .....	80

## LIST OF TABLES

<a href="#"><u>Table 4.1.1 - Age Distribution of Respondents</u></a> .....	28
<a href="#"><u>Table 4.1.2 - Gender Distribution of Respondents</u></a> .....	29
<a href="#"><u>Table 4.1.3 - Community Role of the Respondents</u></a> .....	30
<a href="#"><u>Table 4.1.4 - Duration of respondents in Commune</u></a> .....	32
<a href="#"><u>Table 4.1.5 - Regularity of water pump use</u></a> .....	33
<a href="#"><u>Table 4.2.1 - Regularity of water pump maintenance</u></a> .....	34
<a href="#"><u>Table 4.2.2 - Sufficiency of maintenance efforts</u></a> .....	35
<a href="#"><u>Table 4.2.3 Quality of Maintenance</u></a> .....	37
<a href="#"><u>Table 4.2.4 - Existence of measures for quality assurance</u></a> .....	38
<a href="#"><u>Table 4.2.5 - Involvement in water pump Maintenance</u></a> .....	40
<a href="#"><u>Table 4.2.6 Frequency of Water pumps service</u></a> .....	41
<a href="#"><u>Table 4.3.1 - Moments of broken water pumps</u></a> .....	43
<a href="#"><u>Table 4.3.2 - Who performs water pump repairs</u></a> .....	44
<a href="#"><u>Table 4.3.3 Training for maintenance staff</u></a> .....	46
<a href="#"><u>Table 4.3.4 - Availability of Resources/spare parts</u></a> .....	47
<a href="#"><u>Table 4.3.5 - Maintenance issues identified and resolved in advance?</u></a> .....	48
<a href="#"><u>Table 4.3.6 - Sources of Maintenance finance</u></a> .....	49
<a href="#"><u>Table 4.3.6 - Adequacy of current maintenance efforts</u></a> .....	51
<a href="#"><u>Table 4.3.7 - Sustainability of stakeholder engagement</u></a> .....	52

## **ABSTRACT.**

The study examined the Maintenance practices of manual water pumps in Eastern DRC and its effects on the sustainability of water projects in the community of Bunia city, DRC. The objectives were; to find out how different maintenance practices, the key factors contributing to the effectiveness or ineffectiveness of maintenance practices in Eastern DRC in terms of water project sustainability and to evaluate community participation and to what extent it affects the sustainability of water projects in Eastern DRC. This study investigated the current maintenance practices of manual water pumps in Bunia City and their effects on the sustainability of water projects in the community. A mixed-methods approach combined surveys, interviews, and observational data. According to the findings, Manual water pumps are a vital source of water for many communities in Eastern Democratic Republic of Congo (DRC), including Bunia City. However, inadequate maintenance practices and inadequate funding often compromise the sustainability of these water projects. The results show that poor maintenance practices, including infrequent cleaning and repair, are prevalent, leading to frequent breakdowns and reduced water quality. The research showed that for any water project to be considered sustainable, it must be Functional, accessible, stable, and available. The study recommends training programs for community members, regular maintenance schedules, and spare parts availability to ensure the sustainability of water projects and improve the overall health and well-being of the community.

# **CHAPTER ONE**

## **INTRODUCTION**

### **1.0 Introduction**

This chapter presents an introduction to the study. It explains in detail the background information of the effect of maintenance of manual water pumps on the sustainability of manual water projects in the community of Bunia city, DRC, the problem statement, objectives, and the scope, significance of the study and the organization of the whole report.

### **1.1 Background of the study**

The practice of maintaining manual water pumps in Eastern DRC is critical for sustaining community water projects, as it directly affects access to clean and reliable water sources. Inadequate maintenance can lead to the deterioration of these essential infrastructure components, threatening the overall sustainability of water initiatives in the region. Investigating the dynamics of pump maintenance in this context is crucial for developing strategies that can enhance the long-term viability of water projects and improve water access for vulnerable communities.

Maintenance is performed to ensure that physical assets continue to function to the capacity for which they were designed (Moubray 1997). The benefits of a well-maintained water pump include a lower rate of failures and downtime, cost efficiency and higher productivity. Maintenance is regarded as a minor, but it is a very necessary aspect of running any project especially the water projects. However, increases in equipment, personnel, safety and environment have resulted in significant increase in the profile of maintenance groups within organisations and major developments in maintenance and reliability theory. In the workforce, the prevailing attitude has progressed from the simple ‘fix it when it breaks’ approach to the concept of selecting from a variety of reactive, predictive and preventative techniques depending on the reliability and economic costs of the system. Reliability is the probability that an item performs its intended function without failure for a given period of time under specified conditions (Lewis 1996).

According to studies, one-third of rural boreholes with hand pumps in Sub-Saharan Africa (SSA) are non-functional at any given moment (RWSN, 2012), with hand pump functionality considerably lower in some countries (Bank, 1997; DIWI Consult and BIDR, 1994). Despite the prevalence of source breakdowns in SSA, few sufficiently powered empirical research has looked at the factors that influence hand-pump functionality in this region. Additionally, many functional rural sources may yield dangerous drinking water due to chemical or microbial contamination (Bain et al., 2014a). Regular monitoring and inspection of each water source is important for ensuring the continuity and safety of the water it supplies, yet, in many low and middle-income communities and some high-income country settings, certain water sources are not regularly monitored and inspected. In rural sub-Saharan Africa especially Congo, the majority of those who enjoy access to water from an improved source rely on boreholes with hand-pumps (Sansom and Koestler, 2009). The total number of such boreholes in Africa is unknown, but it is estimated that as many as 60,000 new hand-pumps are installed each year. These are generally communal sources shared by multiple users within a community. However, this challenge consists not only of providing service to the more than 300 million people lacking improved drinking water facilities, but also of ensuring that the 670 million with service (WHO/UNICEF, 2015) continue to enjoy its benefits. The continuity of drinking water sources (often referred to under the rubric of “water source sustainability”) is therefore a pressing issue for governments, Non-Governmental Organizations (NGOs), and donors. However, the continuity of water sources has received far less attention than water source construction in both national and international efforts to expand access to improved water sources [Bain et al., 2013]. As a result, new water source construction continues at a rapid pace, while a substantial proportion of existing water sources remain non-functional. The challenge of ensuring that improved sources provide water of acceptable quality is also a critical one, but is outside the scope of the current work, which will focus on source functionality and continuity

### **1.1.1 Conceptual Background**

While access to safe water is a human right, water system breakdowns and the resulting extended downtimes are a public health hazard, particularly in rural, remote, and under-resourced areas. One in every four hand pumps in Sub-Saharan Africa (SSA) is believed to be inoperable at any given time. High rates of non-functionality can be linked in part to failures

in water-point management, which is dominated by community-based management models that rely on communities willingly taking responsibility for infrastructure upkeep.

Community management is now the most widely used management paradigm for community hand-pumps. Community management is characterized as "a bottom-up development approach in which community members have a say in their own development and the community assumes control - managerial, operation, and maintenance responsibility - for the water system" (Doe & Khan, 2004). The essential elements are community engagement, community control over O&M, perception of ownership, and cost-sharing (Lockwood, 2004).

### **1.1.2 Contextual Background**

The DRC is Africa's most water-rich country, with an estimated 52% of Africa's surface water reserves (rivers, lakes, and marshes). Furthermore, the Democratic Republic of the Congo accounts for an estimated 23 percent of Africa's internal renewable water resources. Rainfall is plentiful (average 1,545 mm/year) but varies in space and time (800- 1,800 mm). The DRC also has significant water autonomy, with rainfall accounting for 70% (900 km<sup>3</sup>/yr) of its entire true renewable water resources (estimated at 1,283 km<sup>3</sup>/yr). The country's abundant water resources are inextricably related to its massive forests, which cover 155.5 million hectares. Despite the abundance of surface waters, the great majority of DRC residents rely on groundwater and springs for safe drinking water. Groundwater is expected to account for over 47% (421 km<sup>3</sup> /yr) of the DRC's internal renewable water resources. Manual water pumps, often the primary source of water in Bunia city, play a pivotal role in meeting this basic need. However, the sustainability of these manual water projects is contingent upon various factors, including maintenance practices, resource availability, and the broader socio-economic context.

### **1.1.3 Contextual Background**

The Democratic Republic of Congo (DRC), located in Central Africa, is a nation marked by its vast size and rich natural resources. However, the country also faces numerous challenges, including political instability, armed conflicts, and economic hardships. Within this complex landscape, the eastern region of the DRC has borne the brunt of ongoing conflicts, leading to

the displacement of communities and the disruption of basic services, including access to clean and safe water.

Bunia city, situated in the north-eastern part of the DRC, exemplifies the struggles faced by many communities in this region. Despite its significant distance from the national capital, Kinshasa, Bunia has grappled with a myriad of socio-economic challenges, including widespread poverty, limited infrastructure development, and a history of neglect by central authorities. These factors have compounded the difficulties faced by the local population, particularly in their quest for reliable access to clean water sources.

The DRC is Africa's most water-rich country, with an estimated 52% of Africa's surface water reserves such as rivers, lakes, and marshes (*Water / Democratic Republic of the Congo / Interactive Country Fiches*, n.d.). Furthermore, the Democratic Republic of the Congo accounts for an estimated 23 percent of Africa's internal renewable water resources (*Water, Sanitation and Hygiene*, n.d.). Rainfall is plentiful (average 1,545 mm/year) but varies in space and time (800-1,800 mm). The DRC also has significant water autonomy, with rainfall accounting for 70% (900 km<sup>3</sup>/yr) of its entire true renewable water resources (estimated at 1,283 km<sup>3</sup>/yr). The country's abundant water resources relate to its massive forests, which cover 155.5 million hectares ((*Water Crisis in the Democratic Republic of the Congo - Wikipedia*, 2016, USAID, 2021). Despite the abundance of surface waters, most DRC residents rely on groundwater and springs for safe drinking water. Groundwater is expected to account for over 47% (421 km<sup>3</sup> /yr) of the DRC's internal renewable water resources. Manual water pumps, often the primary water source in Bunia city, play a pivotal role in meeting this basic need. However, the sustainability of these manual water projects is contingent upon various factors, including maintenance practices, resource availability, and the broader socio-economic context.

#### **1.1.4 Theoretical Background**

This study used “Community-Based Natural Resource Management theory”: Community-based natural resource management (CBNRM) is a people-centered approach to the conservation of natural resource bases such as water, soil, trees, and local biodiversity, as well as development to combat poverty, hunger, and disease. For three decades, this hypothesis has been a dominant paradigm in conservation circles. CBNRM seeks collaborative management

plans that establish shared responsibilities and decision-making among all stakeholders through joint natural resource management plans, resulting in healthy communities and ecosystems. As a result, access to and control over natural resources is the ultimate measure of the sustainability of community-based natural resource management efforts. More so, Senyk (2012) states that Community-based management (CBM) is a bottom-up organizational model that can be aided by an upper government or NGO structure, but it seeks for local stakeholder participation in community-wide planning, research, development, management, and policy-making. It is relevant because when applied, it helps to understand how local communities in Eastern DRC manage and maintain their water resources, including manual water pumps, and the challenges they face in doing so.

## **1.2 Problem statement**

Access to safe drinking water is a fundamental human right, essential for health, sanitation, and overall well-being. Manual water pumps, often the primary source of water in Bunia city, play a crucial role in meeting this basic need. However, In Eastern DRC, the practice of maintaining manual water pumps within community water projects is facing persistent challenges, resulting in a high rate of pump breakdowns and reduced access to clean water. This problem threatens the long-term sustainability of these vital water initiatives and disproportionately impacts vulnerable communities. While preventative maintenance services have emerged as promising treatments to improve water service supply continuity, the operational and contextual requirements for continued functionality within maintenance models are poorly known. This study was to investigate the root causes and consequences of inadequate pump maintenance in the region, offering insights into potential solutions to enhance water project sustainability and improve water access for the local population in the Democratic Republic of Congo (DRC) specifically Bunia City.

## **1.3 General objective**

The General objective of the study was to evaluate the effect of maintenance of manual water pumps on the sustainability of manual water projects in the community of Bunia city, DRC

### **1.3.1 Specific Objectives**

2. To find out how different maintenance practices impact the sustainability of water projects in Eastern DRC communities.
3. To find the key factors contributing to the effectiveness or ineffectiveness of maintenance practices in Eastern DRC in terms of water project sustainability.
4. To evaluate community participation and to what extent it affects the sustainability of water projects in Eastern DRC.

### **1.3.2 Research Questions**

1. How do different maintenance practices impact the sustainability of water projects in Eastern DRC communities?
2. What are the key factors contributing to the effectiveness or ineffectiveness of maintenance practices in Eastern DRC in terms of water project sustainability?
3. To what extent does community participation affect the sustainability of water projects in Eastern DRC?

### **1.4 Justification of the study**

The justification of the study on the effect of maintenance of manual water pumps on the sustainability of manual water projects in the community of Bunia City, DRC lies in its relevance in ensuring the long-term viability of these water projects which directly leads to improved community quality of life and health outcomes. More so, inadequate maintenance of manual water pumps can lead to water source contamination, resulting in water-borne diseases. This study, therefore, is essential because it addresses public health concerns by investigating how maintenance practices affect water quality and, as a result, population health.

Furthermore, this study can guide methods for reducing maintenance costs by investigating the impact of maintenance on sustainability, hence, the failure of manual water pumps which causes economic consequences and cause residents to spend time and money on alternate water sources can be addressed.

Consequently, because of its ability to address significant humanitarian, public health, economic, environmental, and community empowerment challenges in Bunia City, DRC, and the rest of Africa, it contributes to local development initiatives, corresponds with international development goals, and has the ability to improve the lives of community people by ensuring their access to clean and safe drinking water.

### **1.5. Significance of the study**

This study is significant because the study findings can lead to better maintenance practices, ensuring consistent access to potable water for the community, and thus the potential to reduce water-borne diseases and improve public health, the research can contribute to a decrease in water-related illnesses, which are a major health concern in many communities, including Bunia City. Involving citizens in the upkeep and operation of manual water pumps fosters a sense of ownership and responsibility, resulting in a stronger, more self-sufficient community.

Furthermore, the study's findings may have a favourable impact on the environment by minimizing the consumption of natural water bodies in the absence of proper conservation measures. Sustainable water initiatives contribute to the preservation of local ecosystems, which is critical for the region's long-term well-being. Furthermore, the research can inform policy decisions and development initiatives at both the local and national levels, and by identifying best practices and methods for sustaining manual water projects, it can advise government and non-governmental organizations in successfully allocating resources and support.

Furthermore, Bunia City is not an isolated instance; water scarcity and access issues affect communities all over the world. The study has worldwide implications since it provides insights and lessons that may be applied to similar circumstances, contributing to the accomplishment of Sustainable Development.

### **1.6 Scope of the study**

This sub-section explains the boundaries of the study

#### **1.6.1 Content scope**

The study was limited to the effect of maintenance of manual water pumps on the sustainability of manual water projects in the community of Bunia City, DRC. The independent variable of

manual water pump maintenance is believed to have an effect on the dependent variable sustainability of manual water projects in this study. This Research looked into how different maintenance practices and amounts of maintenance spending affect the long-term viability of water projects in Bunia City, Democratic Republic of Congo. It depicts the labor and resources dedicated to the maintenance, repair, and regular service of the manual water pumps in the Bunia City neighbourhood. It also includes cleaning, part replacement, technical examinations, and community participation in maintenance.

### **1.6.2 Geographical scope**

Bunia is the capital of the Democratic Republic of the Congo (DRC)'s Ituri Province. It was a part of the Orientale Province until its breakup. It is located on a plateau about 55 kilometers west of Lake Albert in the Albertine Rift, and about 25 kilometers or 16 miles east of the Ituri Rainforest. Bunia has a tropical rainforest climate (Köppen Af) with warm, humid, and wet temperatures all year. Although rainfall is significantly reduced between December and February, these months still average around 130 millimeters (5 inches) of rain. For the rest of the year, rainfall averages over 230 millimeters (9.1 inches) every month. The city is key to the Ituri ethnic battle between the Lendu and the Hema in 2000. During the Second Congo War, the city and district saw heavy fighting and numerous civilian casualties, as well as battles between militias and Uganda-based forces. As a result, the city is home to one of the largest United Nations missions.

### **1.6.3 Time scope**

The study was limited to a period range of 4 years, from 2019 to 2023. This provided enough empirical evidence and literature on the objectives of the study. The study was also carried out from September 2023 to March 2024.

## **1.7 Definition of terms**

To ensure clarity and precision in this study on the effect of maintenance of manual water pumps on the sustainability of manual water projects in the community of Bunia City, DRC,

it's essential to provide clear definitions of important terms. Here are definitions for key terms in your research:

**Manual Water Pump:** A manual water pump is a mechanical device operated by human effort (typically hand or foot) to extract water from a water source, such as a well or borehole, and make it accessible for various purposes, including drinking, cooking, and sanitation.

**Sustainability:** Sustainability, in the context of this study, refers to the long-term viability and continued functionality of manual water projects. It includes the ability of these projects to provide reliable and safe access to clean water to meet the needs of the community over an extended period.

**Maintenance:** Maintenance encompasses a set of activities and practices aimed at preserving, repairing, and ensuring the proper functioning of manual water pumps. It includes routine tasks such as cleaning, lubrication, minor repairs, and periodic inspections.

**Community of Bunia City, DRC:** This term refers to the specific geographical area in the Democratic Republic of the Congo, namely Bunia City, where manual water projects and maintenance practices are being studied. It encompasses the local residents and stakeholders in this community.

**Water Project:** A water project is a collective term used to describe the infrastructure and initiatives aimed at providing access to clean and safe drinking water to a community. It includes the manual water pumps, wells, boreholes, storage facilities, and distribution systems that together form the water supply system.

**Water Sustainability Indicators:** These are measurable criteria or parameters used to assess the sustainability of manual water projects. Common indicators include water quality, reliability of water supply, community satisfaction, economic impact, and health outcomes.

**Community Involvement:** Community involvement refers to the active participation and engagement of local residents and community members in the planning, management, and maintenance of manual water projects. It includes their contributions in terms of labor, resources, and decision-making.

**Technical Expertise:** Technical expertise denotes the knowledge and skills required for the proper installation, repair, and maintenance of manual water pumps. It involves the understanding of the pump's mechanical components and hydraulic systems.

**Spare Parts:** Spare parts are replacement components and materials necessary for the repair and maintenance of manual water pumps. These parts may include valves, seals, handles, and other components that may wear out or break over time.

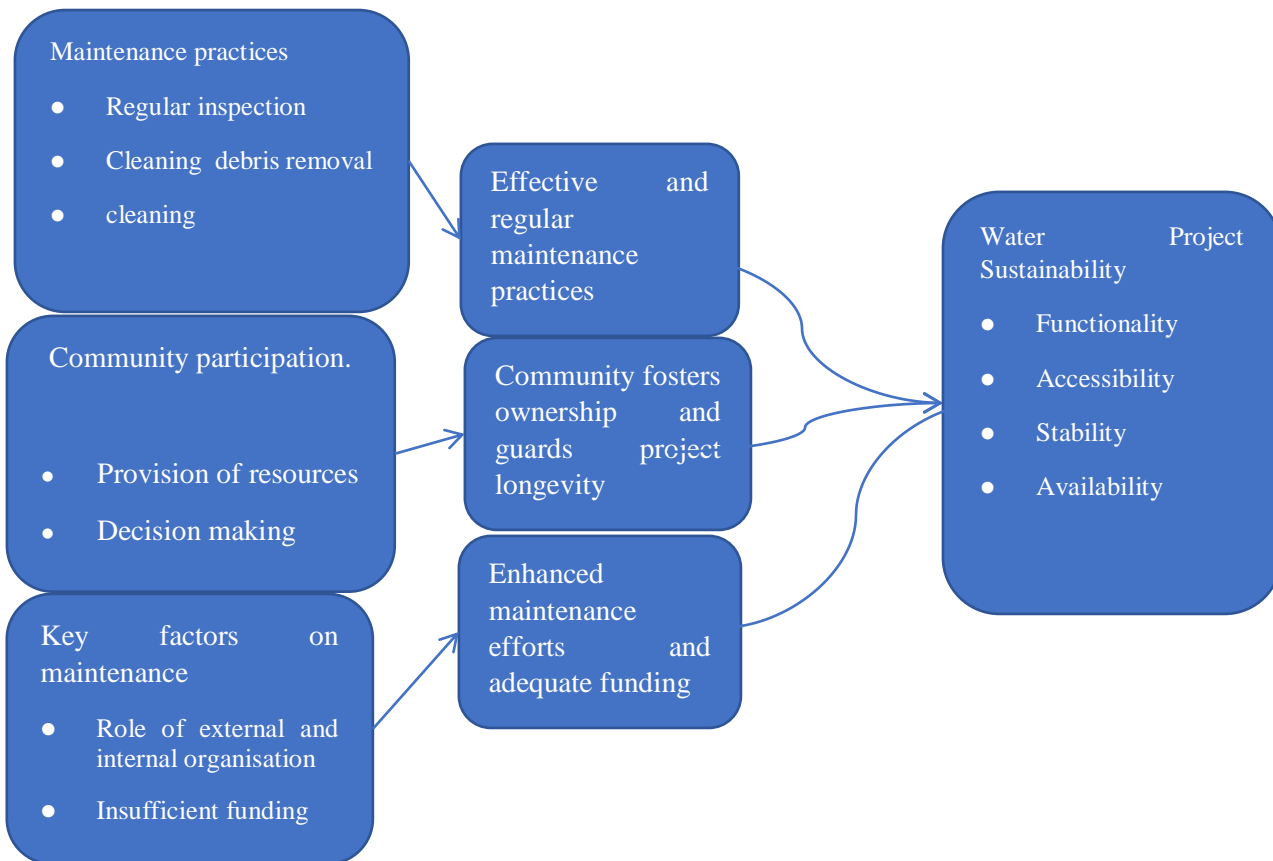
**Waterborne Diseases:** Waterborne diseases are illnesses caused by the consumption of contaminated water. These diseases are often a result of poor water quality and can include conditions like cholera, typhoid, and diarrhoea.

**Community Empowerment:** Community empowerment refers to the process of enabling and strengthening the capacity of local residents to take ownership and control of their water resources, including manual water projects. It involves providing the knowledge, skills, and confidence needed for self-reliance.

**Environmental Sustainability:** Environmental sustainability pertains to the responsible management of water resources to minimize negative impacts on the natural environment. It includes practices that conserve water sources and protect ecosystems.

**Conflict and Political Instability:** These terms describe periods of turmoil, violence, or instability within a region or country, which can disrupt infrastructure and social services, including water projects.

## 1.8 Conceptual frame work



The figure above demonstrates the relationship between the three independent variables that is, Maintenance practices, Community participation, and the factors that are hindering the effectiveness of the manual water pumps and one dependent variable, that is Sustainability. Even the highest quality, most expertly built hand pumps and water wells fail before their time if maintenance is neglected. This therefore demonstrates that maintenance is very important in sustaining manual water projects. The researcher also considers community support, and financial support or adequate funding from government and /or NGOs as a factor for effectiveness as variables that have great influence on the sustainability of manual water projects. This study is one of the many that seeks to examine the effects of maintaining manual pumps and sustainability of the water project.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This chapter discusses the findings of previous studies about related topics in line with the study objectives of this project. It further explains the knowledge gap in the existing literature and why it was important to carry out this research. The literature review for the study on the effect of manual water pump maintenance on the sustainability of manual water projects in the community of Bunia City, DRC, includes an overview of existing research, theories, and conclusions on this topic. The following is a synopsis of the literature review that highlights major points:

#### **2.1 Maintenance Practices**

Roseth et al., (2020) state that maintenance is a crucial aspect of ensuring the long-term functionality of manual water pumps. While preventive maintenance services have emerged as promising interventions to improve the continuity of water service delivery, the operational and contextual requirements for sustained functionality within maintenance models are not well understood. (Fink et al 2022), on the other hand, Regular maintenance activities, such as cleaning, lubrication, and minor repairs, can prevent breakdowns and extend the lifespan of pumps (Gumbo et al., 2016).

Maintenance, according to European Standard EN 13306, is the combination of all technical, administrative, and managerial actions taken during the life cycle of an item to keep or restore it to a state in which it can perform the needed function. Maintenance is obviously an unavoidable requirement for any system that relies on mechanical equipment, no matter how little that equipment is (Olatunji, 2003). Regular maintenance ensures that all production-related equipment operates at peak efficiency at all times. Minor faults can be recognized and remedied before they become big problems that can shut down a manufacturing line by doing short daily inspections, cleaning, lubricating, and making minor changes (Dale, 2008).

According to Cleaver (2009), in order to determine the scope of the maintenance effort, the breakdown history of 480 pumps in the twelve months preceding the study was analysed. Case studies of specific pumps offered more information about the elements that influence

maintenance. In the previous twelve months, 53% of the pumps tested had failed at least once. At the time of the investigation, 83% of the pumps were deemed to be in good working order, although 32% required some repair. Breakdowns were more common in Bush Pumps with higher technology than in Bucket and Blair Pumps with lower technology. In a similar vein, research has demonstrated that the level of community involvement in pump maintenance has a major impact on sustainability (Harvey et al., 2019).

The availability of spare parts and technical expertise also plays a crucial role in maintenance efforts (Munyambonwa et al., 2018). Forecasting the intermittent need for spare parts is difficult since it is not always possible to avoid unexpected breakdowns, which limit availability and increase the unreliability of industrial processes. The preceding necessitates a systemic approach in order to perform a criticality analysis and prioritize the spare parts required to increase the availability and reliability of a manufacturing system (Antosz, et al,2019).

Furthermore, Studies indicate that there is a positive correlation between effective maintenance practices and the sustainability of manual water projects (Foster et al., 2017). when the manual water pumps are maintained, they will serve the purpose. Hence, Proper maintenance can lead to increased pump reliability, improved water quality, and reduced downtime (Roseth et al., 2020). therefore, pumps should be maintained to successfully improve sustainability (Bisung et al., 2018).

Swan et al. (2018) explains the consequences of broken water pipes. As a result, considering the amount of maintenance issues and associated expenditures caused by the poor maintenance system used, a maintenance system would be very beneficial for the water utility company. Condition monitoring also confirms that it provides the possibility to uncover flaws weeks before a technician may find them, and it has advantages over performing maintenance at only manufacturer-recommended intervals (preventive maintenance). A sufficient warning of an approaching breakdown provides an opportunity to maximise resources, downtime, and materials.

## **2.2 Community involvement in maintenance**

According to Hassan et al (2020) in his study “Determinants of sustainability for community based water projects in coastal Kenya” he states, number of elements have been identified as critical for the long-term viability of development programs. Community involvement is the

most important thing though during the planning and design of community-based water projects, technical and financial variables have a considerable impact on sustainability. (Hassan et al., 2020) Major development organizations, including multilateral agencies such as the World Bank (WB) and the International Monetary Fund (IMF), have reached a near-unanimous conclusion that projects cannot be sustainable and long-lasting unless community participation is central to project planning and management (Kumar, 2002). Various researchers agree that when local communities plan their own water delivery systems, those systems are more likely to be sustainable than those imposed by the government or donor organizations (Barnes and Ashbolt, 2010). To achieve sustainable development, the community must be included in project planning, budgeting, and resource allocation.

According to Foster & Hope, (2017) Sustainability of manual water projects is a complex issue and can be influenced by factors such as technical functionality, community involvement, and maintenance. This therefore becomes a challenge in water pump sustainability. Furthermore, many manual water projects in developing regions not only in Bunia City face challenges related to pump breakdowns, leading to disrupted water access (Foster et al., 2019).

Harvey et al., (2020), in their study, present a financial and institutional solution to the persistent dilemma of inadequate functionality of rural water sources in Africa and other developing countries. He further describes the outcomes of a learning journey undertaken since 2011 by Wave Solutions, a Ugandan rural water maintenance provider and advocacy body working in close collaboration with communities, local governments, and the Ministry of Water and Environment. The report describes the core issues of poor rural water delivery and how these have been solved through grass roots collective action. In rural Sub-Saharan Africa, the majority of persons who have access to improved water sources rely on boreholes with hand-pumps, (Sansom and Koestler, 2009) and according to Munyambonwa (2018) Bunia City, DRC, manual water pumps are often the primary source of water for residents due to their simplicity and affordability.

Furthermore, political instability and conflict have had a negative impact on water infrastructure and upkeep in the region (Rosenberg et al., 2017). As a result, it is vital to allow the community to maintain the manual water pumps, because community engagement and ownership are critical for long-term maintenance efforts (Hope et al., 2016). According to Nzabakurikiza et al., (2015), literature reveals special issues connected to maintenance in the DRC, such as inadequate access to replacement parts and technical help. As a result,

empowering local populations to assume responsibility for pump maintenance can lead to more resilient water projects (Roseth et al., 2020).

The majority of traditional maintenance strategies have relied on volunteer community-based management (CBM), in which communities shoulder the majority of the costs of upkeep with little to no assistance from outside organisations or local government. With "fix on failure" becoming the norm in most situations, this CBM model has struggled to ensuring that rural water delivery infrastructure is effectively maintained. Long downtimes, extra expenses, and eventually a failure to achieve the full effects and intended benefits that access to dependable sources of water can offer have all been the results of this. For instance, a recent Ethiopian study shows that 26% of rural households with upgraded water sources as their primary water point receive less than 6 hours of service each day (Tincani et al., 2016).

Ennis and Banjevic,(1998) and Christer and Whitelaw (1983), states that it is frequently difficult to finish a study into the efficiency of maintenance when the information gathered and available is insufficient in relation to the real information that is necessary. There is rarely a mismatch between the information required for reliability analysis and that which is actually obtained. Work order records are typically incomplete in the authors' experience. This is due to, among other things, a lack of desire to record information, insufficient or improper failure codes, and a lack of training in the use of failure codes. Without procedures in place and enforced for starting, tracking, and documenting defects, data is lost and reliability analysis cannot be performed confidently, hence need for the community to provide reliable information in order to find solutions for existing problems.

Finally, the literature analysis emphasizes the crucial importance of maintenance in the sustainability of manual water projects in poor locations such as Bunia City, DRC. It emphasizes the need for community involvement, access to spare parts and technical experience, and the necessity for context-specific research to meet the region's issues and potential. The study intends to add to this body of knowledge by studying the impact of maintenance practices on water project sustainability in Bunia City.

### **2.3 Key factors for the effectiveness and ineffectiveness of manual water pump projects.**

In Africa, a number of factors affect how effective manual water pumps are. According to Lynn (2022), the functionality of water points can be enhanced by having a quicker reaction time, being close to urban areas, and being next to other hand pumps. Conflict and insecurity, however, continue to be major obstacles. Harvey (2006) cited poverty, poor pump density, rigid technology choices, and the division of the supply of spare parts and pumps as the main obstacles. Foster (2013) identified three risk factors for non-functionality: system age, distance from the county or district headquarters, and lack of user fee collection. The study also underlined how diverse conditions are necessary for sustainability. Finally, Harvey (2006) recommended using locally produced rope pumps as an easier-to-maintain and less expensive substitute for traditional hand pumps.

Data from Tanzania's Water Point Mapping project from 2015 show that roughly 29% of all water points are non-functional, with 20% of them failing in the first year. According to (Joseph, 2019), water stations run by village committees were far more likely to fail than those run by water authorities or private operators. Water point failure in the first year following installation is mostly determined by immutable elements like hydrogeological characteristics. But in the short and medium run, technology, pump type, and management style are far more important. Additionally, In Nigeria and Tanzania, respectively, the predicted functionality increased from 68% to 89% and from 53% to 68% under the best observed conditions, according to data analyzed by Bayesian networks (BNs). and robust relationships between system type, functionality, and administrative unit (districts or communes). Therefore, identifying opportunities for improving water service and guiding evidence-based decision-making for better management, policy, programming, and practice may benefit from improvements to water system monitoring and monitoring data analysis using various modelling techniques ( Bartram, 2017)

Although preventative maintenance services have become a viable means of enhancing the continuity of water service delivery, Lynn (2022) contends that there is a lack of understanding of the operational and contextual requirements for continuous functionality within maintenance models. Even with the circuit rider model's flexibility and resilience, insecurity and violence continue to be obstacles to the Central African Republic's ability to maintain service delivery.

Technical aspects and regular follow-ups should be made fundamental features of any water project for sustainability by local governments, sponsors, and communities (Chumbula &

Massawe, 2018) Many project-related issues have been linked to a lack of sustainability in the water supply. These issues include the community's disapproval of the intervention, the capital and/or ongoing costs being too high for the community, the lack of ownership leading to maintenance and repair neglect, the failure of the promised benefits to materialise, and the short duration of education programmes that cause the community's trained members to leave or lose interest (Carter et al., 1999). A lack of dynamic operations and maintenance, as well as inadequate local finance and cost recovery, are some of the other factors mentioned (Montgomery et al., 2009). All of these factors add up to a lack of supportive conditions for the viability of water projects. Therefore, funding from governmental organizations, NGOs, private donors, or international agencies is crucial for initiating and sustaining water projects. Financial aid can cover infrastructure costs, equipment, and ongoing maintenance. Working with policy-makers and advocacy groups can help in creating supportive policies and regulations for water management and sustainability.

Additionally, lack of supportive external contacts are limiting project continuity and sustainable local water management. (Spaling et al., 2014), collaboration with engineering firms, environmental consultants, and water specialists can provide technical knowledge for designing, implementing, and maintaining water projects. (Bakalian & Wakeman, 2008). Through these partnerships NGOs, government bodies, and private sector organizations can help in resource sharing, knowledge exchange, and shared responsibility for sustaining water projects. This can be done by training the capacity building, hence ensuring the proper operation and maintenance of water infrastructure thus promoting sustainability

External support often includes mechanisms for monitoring and evaluating the project's progress. Regular assessments are crucial for identifying challenges, adjusting strategies, and maintaining the long-term success of the project, however according to (Mgulo & Kamazima, 2022) reporting on the sustainability of projects in rural areas of Limpopo Province, South Africa, they state that projects cannot be implemented and sustained without active community participation. Similarly, Joselyne & Hilary, (2022) states community participation is believed to be central to ensuring project sustainability in the development realm. Project developers, implementers, development partners, government officials and communities need to be aware of the role a community plays in making projects in their environments work better from both the theoretical and practical perspectives.

According to the Danish Refugee Council (DRC), participation is critical in any humanitarian or development action, both in terms of value and effectiveness (DRC, 2018). Guy (1983) proposes that community participation theory holds that people may and should play a vital role in the planning and execution of development projects in their communities. Community involvement resulted in a comprehensive grasp of the local conditions, which leads to project success. Perhaps community participation in management of water projects can be the appropriate tool for achieving sustainability of water projects and can be used as a pedagogic tool for scaling up service provision in rural areas due to its flexibility and suitability. However, due to the fact that rural communities are poor and living in a diverse and rapidly changing physical and social environment, it is impossible to meet the needs of all (Schonten and Morriarty, 2004). Hence external and institutional support the community and locally determine and tailor-made solutions that are the right match between costs and benefits, resources and needs be made. Thus aiding in creating long-term plans for sustainability. They can assist in developing strategies that ensure the project's functionality beyond the initial implementation phase, considering factors like climate change, population growth, and technological advancements.

Communities cannot carry out all of these actions on their own, but they do require assistance to improve their performance functions. Communities must be enabled to manage water projects in terms of governance and provision functions such as spare part availability and delivery, as well as maintenance. Management skills in dealing with group dynamics, institutional frameworks, and system monitoring and evaluation are critical for the effectiveness and sustainability of community-managed water supply and sanitation services (Schonten and Morriarty, 2004; IRC, 2003). However, even if communities are effectively taught and organised to operate the system, sustainable community control of water supply services requires ongoing support and supervision (Harvey and Reed, 2004; Lockwood, 2001). Local governments, non-governmental organisations, and the private sector are critical institutions for ensuring institutional support for the long-term sustainability of water supply and sanitation services under the CM strategy. Figure 1 depicts motivation, maintenance, cost recovery, and continual support as the pillars of water and sanitation service sustainability (Carter and Howsam, 1999).

## **2.4 Sustainability of the water projects**

The sustainability of manual water projects is a challenging problem that calls for a diversified strategy. Makoye (2009) underscores the significance of community engagement and appointing an operations manager, whilst Mwamila (2016) stresses the part that locally produced labour and materials play in guaranteeing sustainability. Effective management strategies, combining structural, non-structural, and managerial approaches, are essential, as Bixio (2008) emphasizes. Gross (2001) underlines once more how crucial it is for community-managed water supply programs to take demand, gender, and poverty into account. All of these studies point to a number of elements that are necessary for manual water projects to be sustainable, such as community involvement, efficient management, and careful consideration of the local context.

The principles of sustainability and cost recovery in water supply and sanitation projects are explained in "Water Supply and Sanitation: Handbook of Financial Principles and Methods" (WHO, 1990) by the WHO Working Group on Cost Recovery, which also serves as a useful manual for organizing projects in accordance with these principles. The manual covers sanitation and water supply initiatives in general, with a concentration on piped methods for water supply. It emphasizes that in order to attain sustainability, a cooperative approach is necessary.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.0 Introduction**

Maintaining manual water pumps is critical for the long-term viability of water infrastructure in Bunia City, Democratic Republic of Congo (DRC). Proper maintenance ensures that these water sources remain operational and accessible to the community in the long run. This chapter includes examples of data collection strategies used to address the study topic. The discussion includes a description of the study region, research methodology, sampling procedures, and statistical techniques used to evaluate the collected data.

#### **3.1 Description of the Study Area**

The study was conducted from Bunia City in Democratic Republic of Congo. Bunia is the capital of the Democratic Republic of the Congo (DRC)'s Ituri Province. It was a part of the Orientale Province until its breakup. It is located on a plateau about 55 kilometres west of Lake Albert in the Albertine Rift, and about 25 kilometres or 16 miles east of the Ituri Rainforest. Bunia has a tropical rainforest climate (Köppen Af) with warm, humid, and wet temperatures all year. Although rainfall is significantly reduced between December and February, these months still average around 130 millimetres (5 inches) of rain. For the rest of the year, rainfall averages over 230 millimetres (9.1 inches) every month.

#### **3.1 Research Design**

The study employed both quantitative and qualitative research methods and descriptive to gather valuable insights into the impact of maintenance on the sustainability of manual water projects in Bunia City, DRC, and contribute to the improvement of water access and infrastructure in the community.

A descriptive study design seeks to deliberately collect data in order to describe a phenomenon, circumstance, or population. More specifically, it aids in answering the research problem's what, when, where, and how questions as opposed to its significance (Siedlecki,2020). As a result, the goal of the descriptive analysis will be to summarise survey responses and observational data in order to define the current level of water pump maintenance and sustainability in the community. Data from well-kept and badly maintained water pumps

are compared to find discrepancies in functioning and sustainability. Furthermore, Qualitative Analysis will conduct qualitative interviews to better understand the issues, perspectives, and community dynamics surrounding maintenance and sustainability. According to Kothari (2011), a researcher should perform their study in a more comfortable and familiar setting. This refers to the policies and processes that are specific to the area. Furthermore, Kombo and Tromp (2006) remark that this reduces respondents' resistance to data collection as well as any concerns about how the data was used. As a result, the researcher is more familiar with Bunia City in the Democratic Republic of the Congo.

### 3.2 Target Population

A target demographic, according to Kothari (2012), is critical since it impacts the researcher's conclusions and responses to their research questions. Bunia city , DRC, is comprised of three communes that is, Mbunya commune, Nyakasanza commune and Nshari. Bunia's 2023 population according to the recent UN World Urbanization prospects (Bunia population, 2023) is now estimated at **812,090**. In order to make the desired statistical results, a sample size of 383 will be considered. According to the table from a population of 812,090, the researcher selected 383 respondents into the sampling frame. Therefore, the sample size for the study will be 383 respondents as distributed in the table below;

<b>Respondents</b>	<b>Estimated Population</b>	<b>Category</b>	<b>Sample</b>
Mbunya commune	270,676	Common people	80
		Technical people and project manager	15
		Local leaders	10
		External& internal organisations	5
		<b>Total( Mbuya)</b>	<b>110</b>

Nyakasanza commune	270,696	Common people	80
		Technical people and project manager	15
		Local leaders	10
		External& internal Organisations	5
		<b>Total (Nyakasanza)</b>	<b>110</b>
Nshari commune	270,718	Common people	80
		Technical &project managers	15
		Local leaders	10
		External & internal organisations	5
		<b>Total (Nshari)</b>	<b>110</b>
<b>Total</b>	<b>812,090</b>	<b>Total Sample (Bunia City)</b>	<b>330</b>

The target groups in each commune was be a least ( 80) common people using the manual water pumps, ten(15-) technical people and project managers involved in the manual water pumps, ten (10 )local leaders and five (5) external and internal organisations that have supported and worked directly with the manual water pumps from each of the three communes that make up Bunia City, DRC, hence totalling up to 330 population sample of Bunia city. The study's sample included both men and women in Bunia City that use hand water pumps, as well as elderly citizens from Bunia City and other elements of society. Project managers and Technical people from external institutions that are involved in the water pump projects was also be targeted.

### **3.3 Data Collection Methods and Tools**

In this study, both primary and secondary data was collected using the questionnaire survey method, interview method and document review.

#### **3.3.1 Questionnaire Survey**

The researcher used the survey tool to collect quantitative data from the respondents who included the beneficiaries of the hand water pump projects. The questionnaire method is considered for its practicability in collecting large amounts of information, can be easily quantified, its affordability, and ability to collect data from a large group of respondents within a short time (Bill, 2011). A semi-structured survey tool will be designed with both close-ended and open-ended research questions on the study objectives (whose variables are measured on a 5-point Likert scale (5 Strongly Agree, 4 Agree, 3 Not sure, 2 Disagree and 1 Strongly Disagree)). The 5 point Likert scale is the most appropriate way to formulate the different questions for measuring different items from different variables. Each variable had a set of questions drawn on the basis of the indicators as illustrated in the conceptual framework in chapter one. The questionnaire will be self-administered to the members of the community and local leaders.

#### **3.3.2 Interview Method**

Oral Interviews was used on the key respondents who include local leaders, elderly and key members of the community. Interviews was used because they have the advantage of ensuring probing for more information, clarification and capturing facial expression of the interviewees (Somekh and Lewin, 2015). In addition they also give an opportunity to the researcher to revisit some of the issues that have been an over-sight in the survey and yet they are considered vital for the study. The researcher avoided biased questions by simply asking questions and giving the respondents freedom to express themselves. A semi-structured interview guide was used because it has the advantage of ensuring probing for more information, clarification and capturing facial expression of the interviewees (Ragin, 2018).

#### **3.3.1 Documentary Review**

Secondary data was gathered through the use of published and unpublished documents and reports on the influence of manual water pump maintenance on the sustainability of manual

water projects in the Bunia city community, DRC. Documents, according to Somekh and Lewin (2005), are useful in the research design of following primary research and can give a baseline against which the outcomes of acquired primary data can be compared to other methodologies. The documentary review approach allowed access to prior reports and evaluation records that the researcher thought would be useful in presenting the study findings. A document check-list was created and utilised to identify the documents that were related to the study objectives.

### **3.4 Quality Control of Data collection**

Data control techniques ensured that data collected was valid and reliable; the instruments were first tested to ensure validity and reliability.

#### **3.4.1 Validity**

Validity refers to the truthfulness of findings or the extent to which the instrument is relevant in measuring what it is supposed to measure (Ear-Babbie, 2013). The validity of the instruments was tested using the Content Validity Index (CVI) using expert judgement, taking only variables scoring above 0.7 as accepted for social sciences (Amin, 2005). The researcher will first pre-test the instruments to some respondents who shall not be part of the study. The researcher presented the questionnaires to the expert in the field to get an opinion, the data collection tools will also be tested for completeness before data is analysed. The researcher used the Content Validity Index calculated as follows;

$$\text{CVI} = \frac{\text{Number of relevant items}}{\text{Total Number of items}}$$

#### **3.4.2 Reliability**

Reliability refers to the consistency, stability and repeatability of results (Hair *et al* (2007). Quantitatively, the reliability of the instruments were established through a pilot test of the questionnaire to ensure consistency and dependability and its ability to tap data that would answer the objectives of the study. The results of the findings was then subjected to a reliability

analysis. Reliability was established using Cronbach's Alpha Reliability Coefficient test by applying the formula below.

The formula of Cronbach's Alpha Coefficient (K) is

$$\alpha = \frac{K}{K-1} \left( 1 - \frac{\sum SD^2_i}{SD^2_t} \right)$$

$\alpha$  = Alpha coefficient

K = Number of items in the instrument

$\sum$  = Sum

$SD^2_i$  = Individual item variance

$SD^2_t$  = Variance of total score

Upon performing the test, if the values attained are 0.7 and above, the items in the instrument will be regarded as reliable and the instruments will be applied to collect data.

### 3.5 Data Collection Procedures

The study's data collection included both primary and secondary sources. As a researcher, I will collect primary data primarily by administering questionnaires to 50 respondents. The surveys included both structured and open-ended questions. The structured questions' objective is to encourage uniformity in the responses of the respondents. The questionnaire was utilized primarily by the researcher because, in comparison to other instruments, it is a speedy method of gathering data (Mugenda & Mugenda, 1999). Another rationale is the questionnaires' ability to ask questions more consistently. As a result, more compatibility in replies is achieved. The structured questions used a five-point non-comparative Likert scale. Because the statements indicate several facets of the same mindset, the Likert scale has this advantage. The use of a Likert scale was chosen because it makes it straightforward to develop questions that respondents can understand and answer. Another benefit of using the Likert scale was that it produces accurate findings for analyses. The researcher will also use secondary sources in the form of textbooks, journal articles, and reports on the subject matter under study.

### **3.6 Piloting of Research Instrument**

The questionnaire was a pilot test. Ten respondents were picked from the total of 80 targeted respondents and were given a questionnaire. The pilot study's comments were used to reduce double-barrelled questions, clarify tough questions, and eliminate ambiguous questions. The data acquired was adequate to provide the desired responses to the research questions, which the researcher next validated. The fact that pilot research is an integral component of a good study design emphasizes the importance of doing one. Although conducting a pilot test increases the likelihood of success, it does not ensure success. The pilot study provides critical information for the broader survey.

### **3.7 Validity of Findings**

Validity refers to how well an instrument measures what it promises to measure (Saunders, 2007). A pilot study was done with 7 respondents from the 80-person target sample to assess the validity of the research instrument. Validity assesses how likely the tool is to demonstrate the connecting relationship of the variables in the study. The findings assisted the researcher in evaluating the questionnaire to ensure that it covered the objectives and scope of the study.

### **3.8 Reliability of Research Instrument**

A pilot study was conducted to pre-test the validity and reliability of the data collection instrument. A pilot study is required, in accordance with (Orodho, 2003), to evaluate the dependability of data-gathering tools. The Cronbach's Alpha test, which determines whether the items on a scale measure the same construct, will be used to assess the questionnaire's reliability.

### **3.9 Data Analysis and Presentation**

This study included both quantitative and qualitative data analysis techniques. According to Babbie (2012), quantitative analysis is the numerical description and manipulation of data with the goal of characterizing and interpreting the phenomena, those observations reflect. The accuracy and completeness of the information received from the questionnaires will be checked. To ensure accuracy during analysis and to reduce the margin of error, the questionnaire was coded according to each study variable. To investigate the coded data, both

quantitative and qualitative analysis methods were be applied. On the basis of primary data collected through interviews, qualitative data was collected. Secondary data involving textual examination of textbooks, journal articles, and reports were used to administer qualitative data. Descriptive statistics, which included the mean, frequency, percentages, and standard deviations, were utilized as a quantitative approach, whereas content analysis was employed as a qualitative tool. The Statistical Package for Social Sciences (SPSS) was used to analyze the data. Tables were used to graphically depict the data.

### **3.10 Ethical Considerations**

The research followed the ethical protocols as stipulated in the Uganda Christian University Post post-graduate research manual. These guidelines included adhering to the respondent's voluntary participation, informed consent, anonymity, confidentiality, potential for harm, and results communication

## CHAPTER FOUR

### PRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

#### 4.1 Demographic Data

##### 4.1.1 Age Distribution of Respondents

Table 4.1.1 - Age Distribution of Respondents

Age	Commune /Shari(80)	Commune /Mbunya(84)	Commune /Nyakasanza (88)	Total (252)	Percent (%)
15- 25	12	14	33	59	23
25-35	32	21	30	83	33
35-45	10	21	8	39	15
45-55	14	14	8	36	14
55 - above	12	14	9	35	14
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- In all three communes, the largest age group is 25-35, comprising 33%, 25%, and 34% of respondents in Commune /SHARI, Commune /MBUNYA, and Commune /NYAKASANZA respectively. This suggests that individuals in this age range are well-represented across the communes.
- The second-largest age group varies between 15-25 and 45-55 across the three communes, indicating a diverse representation of younger and middle-aged individuals.
- The proportion of respondents beyond 55 years old is relatively consistent across the communes, ranging from 12% to 14%.

The data indicates a diverse age distribution among respondents across different communes in Eastern DRC. Getting information from every member of a larger, more dispersed group can frequently be challenging or impossible. It is typically not feasible to examine the entire population due to its size or accessibility, so using a sample is essential whether your community is huge in size, geographically spread, or challenging to contact. Obtaining data

from a sample is more effective and straightforward. Additionally, managing smaller datasets is more straightforward and dependable when it comes to storing and doing statistical analysis.

Mishra (2020) highlights the significance of the population sample in research and its role in establishing the study's power, significance level, and reliability of the findings. Nayak (2010), who emphasizes the significance of sample size computation in research projects, lends additional credence to this by highlighting about how research samples should represent the diversity of the population, especially when it comes to treatment effects and subgroup analysis. Allmark (2004) introduces another level of complexity. The need of taking both scientific and ethical factors into account when choosing the right sample size for a study is further highlighted by Andrade (2020). All of these studies highlight the importance of the population sample in research, from its size and diversity to its consequences for science and ethics and hence coming up with the best recommendation that can help in the sustainability of the water projects.

#### 4.1.2 Gender Distribution of Respondents

**Table 4.1.2 - Gender Distribution of Respondents**

Gender	Commune /Shari (80)	Commune /Mbunya (84)	Commune /Nyakasanza (88)	Total (252)	Percent (%)
Female	44	49	52	145	58
Male	36	35	36	107	42
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- Across all three communes, females represent the majority of respondents, comprising 58% of the total respondents, while males comprise 42%.
- The gender distribution is relatively consistent across the three communes, with females consistently outnumbering males in each commune.

The data indicates a higher representation of females compared to males among respondents in Eastern DRC communities. When it comes to the management, access, and use of water, different genders frequently have different needs. In many cultures, women are usually the

ones who are primarily responsible for managing and collecting water. Their viewpoints may provide insight into the real-world obstacles people encounter, like the time and distance required to get to water sources, the effects on their economic and health-related activities, and so forth. Conversely, men may be more interested in matters such as the technical details of water projects and infrastructure development. It is possible to develop and carry out water projects that satisfy the various needs of every member of the community by taking into account both viewpoints.

The power structures and gender roles in a community have a big impact on how well water projects work. Men typically have more official authority and decision-making power in many countries, while women may only have restricted access to resources and places where decisions are made. To guarantee that water projects are inclusive and meet the demands of every community member, it is essential to comprehend these dynamics. In addition, women's economic and social empowerment through project development and execution can increase community cohesion and project ownership. The minimal involvement of women in the administration of water resources and the necessity of their engagement in decision-making processes are both highlighted by Khandker (2020).

Therefore, Since women are frequently the main family water consumers, it is important for them to be included in water projects to ensure their sustainability. For these programs to be successful in the long run, they must be involved in maintenance tasks like monitoring water distribution systems or fixing infrastructure. Women's views on the operation and usability of water facilities can also be used to spot possible maintenance problems early on, avoiding expensive repairs and guaranteeing continued access to clean water.

#### 4.1.3 Community Role of the Respondents

**Table 4.1.3 - Community Role of the Respondents**

<b>Role in Community</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Community member	18	49	55	<b>122</b>	<b>48</b>
Local leader	14	28	16	<b>58</b>	<b>23</b>
Project Manager	8	0	9	<b>17</b>	<b>7</b>
Other (specify)	40	7	8	<b>55</b>	<b>22</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- Across all three communes, the majority of respondents are categorized as "Community members," comprising 48% of the total respondents.
- "Local leaders" represent the second-largest group, comprising 23% of the total respondents.
- "Project Managers" and "Other" roles make up smaller percentages of the total respondents, comprising 7% and 22%, respectively.

The data indicates a diverse distribution of roles within the community, with community members being the most prevalent group. The Eastern Democratic Republic of Congo's water projects depend heavily on the roles and duties of many community members for their sustainability and maintenance. Mandara (2013) highlights the importance of precisely defining these roles, especially when it comes to decentralized water supply. Senbeta (2019), demonstrates that community-managed initiatives can result in greater sustainability outcomes, lends more support to the concept, these studies demonstrate how important community empowerment and involvement are to the long-term viability of water projects.

More so, regarding the upkeep and management of water projects, various community members frequently have distinct duties. Men might handle the actual construction work, for instance, while women would handle tasks like maintaining water points or collecting water consumption fees. To ensure fair participation and sustainable maintenance methods, it is imperative to comprehend these gendered divides of labor and duties. Involving community members in maintenance tasks from the start can also foster a sense of accountability and ownership for the project's long-term viability.

Additionally, Communities that already experience social tensions or conflicts may find that water projects make them worse, especially if the projects are not carried out in a way that is inclusive and participatory. It can be helpful to identify possible sources of conflict and establish tactics for conflict resolution and consensus-building by considering the roles and connections among various community members. Water management techniques and attitudes toward water projects can be strongly influenced by cultural norms and customs. It is possible to identify solutions that are culturally appropriate and incorporate traditional knowledge and practices into project design and implementation by having a thorough understanding of the responsibilities played by the various community members. To ensure the project's cultural relevance and acceptance, for example, involving local religious or traditional authorities might help build community support.

#### 4.1.4 Duration of respondents in Commune

**Table 4.1.4 - Duration of respondents in Commune**

<b>Duration in Commune</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
1- 8 months	4	14	11	<b>29</b>	<b>12</b>
1-2 years	6	28	16	<b>50</b>	<b>20</b>
3-5 years	24	14	31	<b>69</b>	<b>27</b>
others specify)	46	28	30	<b>104</b>	<b>41</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes fall into the category of "others specify," comprising 41% of the total respondents. This category likely includes individuals with varying durations of residency beyond the specified time-frames.
- The next most common duration category is "3-5 years," comprising 27% of the total respondents.
- "1-2 years" and "1-8 months" categories make up 20% and 12% of the total respondents, respectively.

The data indicates a diverse distribution of durations of residency within the communes, with a significant portion falling into the category of "others specify." Long-term residents of a community act as guardians of institutional memory, maintaining information regarding previous water projects and their results. Building on effective strategies, preventing mistakes from being made again, and learning from the past can all be facilitated by this institutional memory. Long-term inhabitants also help maintain continuity in leadership roles and decision-making processes within the community, which guarantees that water projects are carried out in a manner that eventually reflects the interests and goals of the community. However, due to fighting in the eastern Democratic Republic of the Congo the population has been hampered making the “others specify” to occupy the three communes of Bunia city. This is a crisis that is fuelled by conflicting armed groups, resource conflicts, and long-standing geopolitical tensions.

#### 4.1.5 Regularity of water pump use

**Table 4.1.5 - Regularity of water pump use**

Regularity of water pump use	Commune /SHARI(80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Daily	60	63	38	161	<b>64</b>
Weekly	8	7	8	23	<b>9</b>
Monthly	2	7	24	33	<b>13</b>
Rare	10	7	18	35	<b>14</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes indicate daily water pump use, comprising 64% of the total respondents.
- Weekly usage patterns are less common, representing only 9% of the total respondents.
- Monthly and rare usage patterns make up 13% and 14% of the total respondents, respectively.

Overall, the data indicates a predominant reliance on daily water pump use among respondents in Eastern DRC communities. An important way to gauge the success and performance of a project is to keep an eye on how frequently water pumps are used. When the pumps are used consistently and dependably, the project is fulfilling the community's water needs and performing as planned. Conversely, inconsistent or decreasing usage could be an indication of deeper problems, such as operational difficulties, technological breakdowns, or alienation from the community, which need to be addressed right once to guarantee project viability.

Studies on the sustainability and upkeep of water pumps in rural areas discovered that factors such as source age, administration, tariff collection, number of other sources in the community, and district all affect functionality. (Fisher, 2015). According to Foster (2018) location, water quality, ownership, and hand-pump type affect operational results are important factors in sustainability of water projects. Mankad (2014) offered a psychological viewpoint, demonstrating how fundamental psychological requirements like relatedness, competence, and autonomy affect the regular upkeep of rainwater tanks, this can reduce the over population of the manual water pumps and hence avoiding the high risks of breakages.

More so, the frequency of use of water pumps can help project implementers allocate resources more effectively. In order to maximize the overall impact of limited resources and ensure equitable access to water services throughout the community, resources such as maintenance staff or spare parts can be prioritized for pumps experiencing heavier usage, for example, if certain pumps are used less frequently than others. The frequency of water pump use might also reveal important information about maintenance requirements. Regular or regular use may suggest increased equipment wear and tear, raising the possibility of malfunctions or breakdowns. Project managers can minimize downtime and guarantee continuous access to water by anticipating maintenance needs, such as regular service or repairs, through the monitoring of usage trends.

## 4.2 How different maintenance practices impact the sustainability of water projects in Eastern DRC communities (RQ1)

### 4.2.1 Regularity of water pump maintenance

Table 4.2.1 - Regularity of water pump maintenance

Regularity of maintenance	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Daily	4	7	10	21	8
Weekly	6	0	9	15	6
Monthly	4	14	42	60	24
Quarterly	50	0	10	60	24
Others (specify)	16	63	17	96	38
<b>Total</b>	80	84	88	252	100

- The most common maintenance schedule reported is "Others (others specify)," representing 38% of the total respondents. This category likely includes various maintenance schedules beyond the specified options.
- Quarterly and monthly maintenance schedules are equally prevalent, each representing 24% of the total respondents.

- Daily and weekly maintenance schedules are less common, comprising 8% and 6% of the total respondents, respectively.

Overall, the data indicates a diverse range of maintenance schedules among respondents in Eastern DRC communities, with the majority falling into the "Others (others specify)" category. To keep water projects operating at peak efficiency, regular maintenance procedures are crucial. Project managers can evaluate the overall performance and health of water infrastructure by keeping an eye on the frequency of maintenance activities. Maintaining equipment in a timely and consistent manner extends its longevity, minimizes malfunctions, and guarantees a steady supply of water. Project managers can maximize operational efficiency and dependability by identifying any deviations from the intended performance criteria and taking corrective action by monitoring maintenance practices. However, according to the data collected, there is no regular maintenance practices which put the water projects at the risk of malfunctioning. This is because maintenance procedures' regularity might draw attention to the difficulties and obstacles local water project managers confront. Maintenance schedule regularity may be impacted by variables including restricted access to spare parts, insufficient technical know-how, financial limitations, or security issues. Project managers can guarantee the sustainability of water projects in spite of the current limitations by developing focused interventions and methods to overcome maintenance barriers.

Additionally, for water projects to be sustainable, it is essential to comprehend how often maintenance procedures are carried out. Olaerts (2019) emphasizes how crucial elements like robust water user committees, the public's perception of the quality of the water, and continuous support are to guaranteeing regular maintenance payments. However, Koestler (2008) emphasizes the beneficial effect that routine monitoring has on local communities' incentive to keep their water supply systems in good working order. In order to ensure sustainability, these insights together highlight the necessity of having a thorough awareness of the tactics and difficulties involved in maintaining water projects.

#### **4.2.2 Sufficiency of maintenance efforts**

**Table 4.2.2 - Sufficiency of maintenance efforts**

<b>Maintenance efforts enough?</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Yes	24	35	61	120	<b>48</b>
No	42	35	13	90	<b>36</b>
No sure	14	14	14	42	<b>17</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes answered "Yes," indicating that they believe maintenance efforts are enough. This response represents 48% of the total respondents.
- The "No" response is the next most common, representing 36% of the total respondents.
- The "Not sure" response comprises 17% of the total respondents.

Overall, the data indicates varying perceptions of maintenance sufficiency among respondents in Eastern DRC communities. In order to pinpoint opportunities for development and guarantee long-term success, perceptions of sustainability in water projects are essential. This is especially true for programs that are community-based, where financial and technical indicators are important (Hassan, 2020). In the context of water project management, perceptions regarding maintenance procedures are vital in fostering accountability and openness. Encouraging trust and accountability among project stakeholders, such as community members, funders, and implementing agencies, is facilitated by transparent communication about maintenance efforts and outcomes. Project managers can foster trust, improve community engagement, and guarantee that maintenance practices are in line with community priorities and expectations by transparently addressing community perceptions and concerns. This will ultimately help to ensure the long-term sustainability of water projects in the area. Hence, good communication techniques, such as multi-stakeholder discussions, are crucial for improving sustainability and governance in water projects (Haas, 2010).

More so, Project stakeholders' perceptions of maintenance procedures can be used to determine which ones require capacity building. For instance, it indicates the need for focused capacity building programs to improve the abilities of local maintenance teams or community members

in charge of managing water projects if members of the community believe that maintenance practices are insufficient because they lack technical skills or knowledge. Project managers can ensure the long-term sustainability of water projects beyond the project lifespan by empowering local stakeholders to assume responsibility of maintenance activities through investments in capacity building initiatives.

### 4.2.3 Quality of Maintenance

**Table 4.2.3 Quality of Maintenance**

Quality of Maintenance	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Excellent	0	0	8	8	3
Good	12	7	53	72	29
Satisfactory	18	0	7	25	10
Needs improvement	50	77	20	147	58
<b>Total</b>	80	84	88	252	100

- The majority of respondents across all three communes perceive maintenance quality as needing improvement, representing 58% of the total respondents.
- The next most common perception is that maintenance quality is good, comprising 29% of the total respondents.
- A smaller proportion of respondents perceive maintenance quality as satisfactory, representing 10% of the total respondents.
- Only respondents from Commune /NYAKASANZA perceive maintenance quality as excellent, representing 3% of the total respondents.

Overall, the data indicates varying perceptions of maintenance quality among respondents in Eastern DRC communities, with the majority believing that improvement is needed. Perceptions are a good indicator of how involved and invested the community is in water initiatives. Project managers can find ways to increase community participation and involvement by learning how the community views the sustainability and upkeep of water

projects. This could include activities that increase community ownership and support the projects' long-term sustainability, including community-led maintenance programs or participatory decision-making procedures. Consequently, or project implementers, perceptions are a useful source of feedback. While unfavorable impressions draw attention to areas that need development, positive perceptions show that the project is meeting the needs and expectations of the community. Project managers may improve the sustainability of water projects by aggressively seeking out and listening to community opinions, identifying problem areas, and putting corrective measures in place to address them. To ensure the long-term sustainability of projects in the area, it is imperative to comprehend perceptions surrounding the sustainability of water projects and maintenance procedures. This will help identify areas that require improvement. Project managers can improve community participation, identify challenges, target interventions, build capacity, and promote accountability by actively interacting with the community, soliciting their feedback, and addressing concerns. This will ultimately help to ensure the success and longevity of water projects in Bunia city, Democratic Republic of the Congo. Addressing stakeholder-associated issues and their interactions is necessary to achieve sustainability in public-private partnership initiatives in the water sector (He, 2020). Ultimately, minimizing environmental effects and guaranteeing long-term sustainability depend on bringing people's views of water quality into line with real data (Prouty, 2016).

#### 4.2.4 Existence of measures for quality assurance

**Table 4.2.4 - Existence of measures for quality assurance**

Measure for quality assurance	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Yes	18	21	25	64	<b>26</b>
No	48	43	31	122	<b>50</b>
Not sure	14	21	22	57	<b>23</b>
<b>Total</b>	80	85	78	<b>243</b>	<b>100</b>

- The majority of respondents across all three communes answered "No," indicating that there is no measure for quality assurance in place. This response represents 50% of the total respondents.
- The "Yes" response is the next most common, representing 26% of the total respondents.
- A smaller proportion of respondents answered "Not sure," comprising 23% of the total respondents.

The data indicates that the majority of respondents perceive the absence of a measure for quality assurance in Eastern DRC communities. Gaining an understanding of community attitudes promotes increased community ownership and participation in water initiatives. Project managers can guarantee that the project aligns with local objectives, values, and aspirations by pro-actively including community members in the planning, execution, and monitoring stages of the project. As a result, there will be more community ownership and dedication to the project, which will eventually boost resilience and participation in maintenance tasks.

Therefore, to ensure the long-term sustainability of water projects in the region and identify areas for development, it is imperative to comprehend views around these projects. Project managers may improve the efficacy, resilience, and impact of water projects by actively interacting with community members, seeking feedback, and resolving concerns. This will ultimately benefit the communities they serve and foster their growth.

Many scholarly investigations have emphasised the significance of comprehending perceptions within the framework of water initiatives. According to Clay (2007), there is a need for educational initiatives that clarify the connection between natural resource management practices and water quality. The necessity of assessing sustainability principles' acceptability in waste-water treatment operations especially with regard to their social, environmental, and economic implications is covered by Radhakrishanan (2012). All of these studies highlight how critical it is to comprehend and deal with perceptions in water projects in order to guarantee their long-term viability.

#### 4.2.5 Involvement in water pump Maintenance

**Table 4.2.5 - Involvement in water pump Maintenance**

<b>Involvement in Maintenance</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
·Yes	20	14	34	68	<b>27</b>
·No	60	70	54	184	<b>73</b>
<b>Total</b>	80	84	88	<b>252</b>	<b>100</b>

- Across all three communes, the majority of respondents answered "No," indicating that they are not involved in maintenance activities. This response represents 73% of the total respondents.
- The "Yes" response, indicating involvement in maintenance, is less common, representing 27% of the total respondents.

Overall, the data indicates that the majority of respondents perceive limited involvement in maintenance activities among Eastern DRC communities. Opinions could point to hidden obstacles that prevent community involvement and engagement in maintenance initiatives. Project managers may build settings that facilitate greater participation by identifying these hurdles and devising focused ways to overcome them. In order to actively engage community members in maintenance operations, it may be necessary to address challenges including lack of understanding, access to resources, or cultural barriers. Maximizing community involvement and guaranteeing the long-term viability of water projects require removing these obstacles.

Yami (2013) emphasized the significance of community engagement and participation in the long-term sustainability of water projects, specifically pertaining to irrigation systems in Ethiopia. Black (2017) pointed out that structural problems frequently impede this participation in the case of Indigenous involvement in water and wastewater management. while Mwakila (2008) highlights the necessity of early consideration of sustainability factors and capacity building in community participation. In order to improve community engagement and participation in water project maintenance, these studies collectively highlight the necessity for

a comprehensive strategy that addresses systemic concerns, early consideration of sustainability features, and stakeholder perceptions.

Finally, in order to find ways to improve community involvement and participation in maintenance activities and, eventually, the long-term sustainability of water projects in the area, it is critical to comprehend how the public views water projects. Project managers may promote meaningful community engagement and guarantee the continuing success of water projects for years to come by customizing engagement tactics, fostering trust and confidence, empowering local leadership, resolving participation barriers, and encouraging sustainable practices.

#### 4.2.6 Frequency of Water pumps service

**Table 4.2.6 Frequency of Water pumps service**

Frequency of Water pumps service	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Regularly (monthly)	24	7	9	40	<b>41</b>
Occasionally (annually)	6	7	5	18	<b>18</b>
Rarely (sometimes in a few years)	12	0	28	40	<b>41</b>
<b>Total</b>	<b>42</b>	<b>14</b>	<b>42</b>	<b>98</b>	<b>100</b>

- The most common frequency of water pump service reported is "Regularly (monthly)" and "Rarely (sometimes in a few years)," each representing 41% of the total responses.
- The next most common frequency is "Occasionally (annually)," representing 18% of the total responses.
- Notably, in Commune /MBUNYA, there are no respondents reporting "Rarely (sometimes in a few years)" as the frequency of water pump service.

Overall, the data suggests that maintenance practices regarding water pump service vary across the surveyed communities, with a significant portion reporting either regular monthly service or infrequent service over multiple years. Studies conducted in Ghana, Uganda, and South Africa have shown that good maintenance techniques are essential to the long-term viability of water projects in the Eastern Democratic Republic of the Congo. Burleson (2018) emphasizes the significance of long-term maintenance planning and stakeholder participation, whereas Braimah (2016) emphasizes the necessity of community-based management strategies being effectively motivated and accountable. Hay (2012) underscores the significance of appropriate operation and maintenance in mitigating water scarcity and guaranteeing the durability of water supply alternatives. All of these results highlight how important maintenance procedures are to the long-term viability of water systems, especially when considering the Eastern Democratic Republic.

Water projects' operational performance is directly impacted by maintenance procedures. Maintaining infrastructure and equipment on a regular basis keeps them in top shape and increases both their lifespan and efficiency. Through comprehension of maintenance procedures, project managers may evaluate whether water projects are fulfilling performance goals and providing communities with dependable and secure water supplies.

Water service satisfaction in the community is directly impacted by maintenance procedures. Increased community trust and confidence in the project is a result of dependable and well-maintained water infrastructure, which increases support and satisfaction. On the other hand, poor upkeep can result in problems with water quality, interruptions in services, and unhappiness among the neighbourhood. Project managers in the Eastern Democratic Republic can evaluate community satisfaction levels and identify areas that require improvement to improve the overall experience of water service consumers by having a thorough understanding of maintenance methods.

### **4.3 Key factors contributing to the effectiveness or ineffectiveness of maintenance practices in Eastern DRC in terms of water project sustainability (RQ2)**

#### **4.3.1 Moments of broken water pumps**

**Table 4.3.1 - Moments of broken water pumps**

Moments of broken water pumps?	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Yes	64	84	62	210	<b>83</b>
No	16	0	26	42	<b>17</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes reported instances of broken water pumps, accounting for 83% of the total responses.
- In Commune /MBUNYA, all respondents reported broken water pumps, indicating a significant issue in that area.
- In Commune /SHARI, there are fewer reports of broken water pumps compared to the other two communes, but it still comprises a considerable portion of the responses.

Overall, the data suggests that broken water pumps are a prevalent issue in Eastern DRC communities, with a majority of respondents reporting instances of pump failure. Project managers can create focused maintenance plans that concentrate resources and efforts on resolving the most frequent causes of failures by understanding the frequency of breakdowns. This makes it possible to allocate resources more effectively, ensuring that maintenance efforts are focused where they are most required to stop future malfunctions and maintain the ongoing operation of water projects. Implementing efficient maintenance techniques to guarantee sustainability requires an understanding of the frequency and causes of water project breakdowns (Grigg, 2013).

#### 4.3.2 Who performs water pump repairs

**Table 4.3.2 - Who performs water pump repairs**

Who performs repairs?	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Community volunteers	16	0	3	19	<b>8</b>

Local government	0	0	11	11	<b>4</b>
NGO	44	14	5	63	<b>25</b>
External Technicians	6	0	57	63	<b>25</b>
Others (specify) Other technicians	14	70	12	96	<b>38</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of repairs are performed by "Others (specify)" category, particularly by other technicians, comprising 38% of the total responses. This category includes technicians other than community volunteers, local government, NGOs, and external technicians.
- External technicians and NGOs both contribute significantly to repairs, each representing 25% of the total responses.
- Community volunteers, although fewer in number, also play a role in repairs, representing 8% of the total responses.
- In Commune /NYAKASANZA, external technicians are prominently involved in repairs, with the highest number of respondents indicating their involvement.

Overall, the data indicates a diverse range of actors involved in performing repairs for water pumps in Eastern DRC communities. In order to implement efficient maintenance plans and guarantee the sustainability of water projects in the area, it is essential to comprehend the responsibilities and contributions of each player. Project managers can enhance the efficacy of maintenance endeavours and maintain water projects for the advantage of local communities by delineating roles and responsibilities, streamlining resource allocation, encouraging community participation and ownership, streamlining coordination and collaboration, and fostering accountability and transparency.

More so, to ensure the sustainability of water projects in the region and to develop effective maintenance strategies, it is imperative to comprehend the roles and contributions of each actor.

Strong local institutions are necessary to foster an environment that supports the sustainability of water projects, as stressed by Chumbula (2018) and Knüppe (2014), who also emphasize the importance of actor networks and multi-level structures in water governance and management systems. Finally, Otieno (2002) emphasizes the significance of appropriate financial structures and the community's primary role in choosing and hiring suppliers of products and services. Together, these studies show how financial players, communities, and institutions may ensure the sustainability of water projects.

### 4.3.3 Training for maintenance staff

**Table 4.3.3 Training for maintenance staff**

<b>Training for maintenance staff?</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Yes	10	0	28	38	<b>15</b>
No	50	63	27	140	<b>56</b>
No sure	20	21	33	74	<b>29</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes reported no training for maintenance staff, accounting for 56% of the total responses.
- A significant portion of respondents answered "Not sure," comprising 29% of the total responses.
- A smaller proportion of respondents indicated that training for maintenance staff exists, representing 15% of the total responses.

Overall, the data suggests that training for maintenance staff is not widespread in Eastern DRC communities, with the majority of respondents reporting either a lack of training or uncertainty about its existence.

The upkeep of water projects may involve various actors, such as members of the community, local government, NGOs, and government organizations, each of whom may have specific tasks and duties. Project managers may guarantee that all actors are aware of their roles in the maintenance process and can clarify duties by having a clear grasp of these roles. This makes

it easier to avoid misunderstandings and redundancies, guaranteeing that maintenance tasks are efficiently planned and completed on schedule.

To ensure the sustainability of water projects and to increase capacity, effective training programs are essential (Wolfson, 2015). However, organizational inflexibility and a lack of resources may restrict the efficacy of training initiatives (Crocker, 2016). In order to overcome obstacles and enhance results, it is crucial to design and assess training programs that specifically target the needs of water experts and end users.

#### 4.3.4 Availability of Resources/spare parts

**Table 4.3.4 - Availability of Resources/spare parts**

Availability of Resources/spare parts	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Readily available	46	14	11	71	28
Moderately available	12	0	3	15	6
Rare	14	0	17	31	12
No applicable	8	70	57	135	54
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes reported "No applicable," indicating that resources and spare parts are not applicable or not available in their communities, accounting for 54% of the total responses.
- Among the applicable responses:
  - "Readily available" resources and spare parts are reported by 28% of the total responses, indicating a significant portion of communities where these resources are accessible.
  - "Rare" availability of resources and spare parts is reported by 12% of the total responses, indicating some challenges in access.

- "Moderately available" resources and spare parts are reported by 6% of the total responses, suggesting a limited but present availability.

The data suggests that while some communities have readily available resources and spare parts, a significant portion faces challenges in accessing them. For water initiatives in Eastern DRC communities to be maintained and sustained over time, it is essential to comprehend the resources' accessibility and availability. Hay (2012) supports this by stressing that in order to create water-reconciliation strategies, comprehensive documentation, investigation, and analysis of the material at hand are necessary.

Effective resource planning and allocation depend on having a thorough understanding of the resources that are available, including finance, materials, and labor. Project managers can create practical maintenance plans that fit the resources at their disposal by evaluating resource availability. By doing this, you can minimize delays and disturbances in the delivery of services by ensuring that maintenance tasks are sufficiently resourced. This is due to the fact that putting preventative maintenance measures into place, which can help stop malfunctions and increase the lifespan of water infrastructure, requires the availability of money. When equipped with adequate resources, project managers may perform routine equipment and infrastructure inspections, repairs, and replacements, resolving possible problems before they become more serious ones. The dependability and sustainability of water projects in the Eastern Democratic Republic of the Congo are enhanced by this proactive maintenance strategy.

#### 4.3.5 Maintenance issues identified and resolved in advance?

**Table 4.3.5 - Maintenance issues identified and resolved in advance?**

Maintenance issues identified and resolved in advance?	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Yes	10	7	13	30	<b>12</b>
No	60	56	12	128	<b>51</b>
No sure	10	21	63	94	<b>37</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes reported "No," indicating that maintenance issues are not identified and resolved in advance, accounting for 51% of the total responses.
- A significant portion of respondents answered "Not sure," comprising 37% of the total responses, indicating uncertainty about whether maintenance issues are addressed proactively.
- A smaller proportion of respondents indicated that maintenance issues are identified and resolved in advance, representing 12% of the total responses.

Overall, the data suggests that proactive identification and resolution of maintenance issues are not common practices in Eastern DRC communities, with the majority reporting either a lack of proactive measures or uncertainty about their implementation. Understanding the current practices and challenges in addressing maintenance issues is crucial for improving the sustainability of water projects in the region.

#### 4.3.6 Sources of Maintenance finance

**Table 4.3.6 - Sources of Maintenance finance**

Sources of Maintenance finance	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Community contribution	56	12	0	68	<b>27</b>
Local government	0	0	3	3	<b>1</b>
NGO	0	0	39	39	<b>15</b>
I don't know	20	24	2	46	<b>18</b>
Other (good Samaritan)	4	48	44	96	<b>38</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The most common source of maintenance finance reported is "Other (good Samaritan)," which includes contributions from individuals acting as good Samaritans or benefactors, comprising 38% of the total responses.
- Community contribution is also a significant source of maintenance finance, representing 27% of the total responses.
- NGO contributions constitute 15% of the total responses, indicating the involvement of non-governmental organizations in financing maintenance activities.
- Local government contributions are the least reported source, comprising only 1% of the total responses.
- A notable portion of respondents indicated uncertainty about the sources of maintenance finance, with 18% answering "I don't know."

The data suggests that maintenance finance in Eastern DRC communities comes from a variety of sources, including community contributions, NGOs, and individual benefactors

For safe and dependable water supplies to remain available over time, water projects must be sustainable (Contos, 2011). According to Kinyua (2013), financial management plays a crucial role in the sustainability of community water supply projects. It is imperative to maintain transparency and identify the expenses associated with operation and maintenance. Requiring current demands to be met while taking future generations into consideration emphasizes the concept of sustainability in water supply projects (Hutson, 2012).

Project managers can more efficiently manage and distribute water resources by having a thorough understanding of the region's water sources, including lakes, rivers, groundwater, and rainwater harvesting systems. They can also create plans to maximize resource utilization and guarantee long-term sustainable management of these resources. Furthermore, evaluating the dependability of water sources aids project managers in foreseeing any difficulties and weak points in the water supply. Certain water sources may be less dependable and less readily available due to their increased susceptibility to variations in rainfall, seasonal variations, or environmental changes. Project managers may create resilience strategies and backup plans to reduce the risks of water shortages and guarantee that communities in the area always have access to water by knowing how reliable various water sources are.

In summary, making sure that water projects in the area are sustainable requires an awareness of the water sources and their dependability. The availability and accessibility of water for communities in Eastern DRC can be guaranteed by project managers through effective management of water resources, evaluation of water sources' dependability, mitigation of climate change effects, promotion of environmental sustainability, building community resilience, and long-term planning.

#### 4.3.6 Adequacy of current maintenance efforts

**Table 4.3.6 - Adequacy of current maintenance efforts**

<b>Adequacy of Current maintenance efforts</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
· Yes	22	42	17	81	<b>32</b>
· No	58	42	71	171	<b>68</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents across all three communes reported "No," indicating that they do not find current maintenance efforts adequate, accounting for 68% of the total responses.
- A significant portion of respondents, comprising 32% of the total responses, indicated that they find current maintenance efforts adequate.

The data suggests that there is a widespread perception among respondents that current maintenance efforts are not adequate in Eastern DRC communities.

A number of problems prevent water projects in underdeveloped countries from becoming sustainable. Stakeholder sensitization and improved technology selection are critical, as noted by Barnes (2014), while extended support and community capacity building are emphasized by Huby (2003).

Conclusively, comprehending the causes of insufficiency in water projects and identifying opportunities for enhancement are essential to augmenting their sustainability within the area. Project managers can guarantee that water projects continue to meet the needs of communities

in the region in an efficient and sustainable manner by addressing deficiencies, allocating resources optimally, involving communities, encouraging learning and innovation, and establishing confidence and trust among stakeholders.

#### 4.3.7 Sustainability of stakeholder engagement

**Table 4.3.7 - Sustainability of stakeholder engagement**

Sustainability of stakeholder engagement	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Yes	54	70	88	212	<b>84</b>
No	26	14	0	40	<b>16</b>
<b>Total</b>	80	84	88	<b>252</b>	<b>100</b>

- The majority of respondents, accounting for 84% of the total responses, reported "Yes," indicating that they perceive stakeholder engagement to be sustainable in their communities.
- A smaller portion of respondents, comprising 16% of the total responses, reported "No," suggesting that they do not perceive stakeholder engagement to be sustainable.

Overall, the data suggests that a significant majority of respondents believe that stakeholder engagement is sustainable in Eastern DRC communities. This indicates a positive perception regarding the ongoing involvement and commitment of stakeholders in the context of water projects.

Water projects are sustainable due to a variety of elements, including institutional, financial, social, and technical considerations (Peter, 2012).. Financial and technical metrics have a special bearing on community-based water initiatives (Hassan, 2020). Assessing and enhancing the sustainability of water environment treatment PPP projects can be facilitated by a thorough assessment indicator system that incorporates economic, social, environmental, engineering, and project management components (Li, 2019).

In summary, improving the sustainability of water projects in the area requires an awareness of the causes of their inadequacy as well as the identification of areas that require improvement. Project managers can make sure that water projects continue to meet the needs of communities

in the area in an efficient and sustainable manner by addressing deficiencies, allocating resources optimally, involving communities, encouraging learning and innovation, and fostering stakeholder confidence.

#### 4.4 Community participation and extent it affects the sustainability of water projects in Eastern DRC (RQ3)

##### 4.4.1 Responsibility for Water project

**Table 4.4.1 - Responsibility for Water project**

<b>Responsibility for Water project</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Government	16	0	15	31	<b>12</b>
Local Community	44	56	28	128	<b>51</b>
NGO	10	7	14	31	<b>12</b>
I don't know	10	21	25	56	<b>22</b>
Other (specify)	0	0	6	6	<b>2</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The responsibility for water projects is perceived differently among respondents:
  - The majority of respondents, representing 51% of the total responses, attribute responsibility to the local community.
  - A smaller proportion of respondents, comprising 12% each, attribute responsibility to the government and NGOs.
  - A notable portion of respondents, accounting for 22% of the total responses, indicated uncertainty about the responsible entity.
  - Only a small percentage of respondents specified other entities as responsible for water projects.

Overall, the data suggests a varied understanding of responsibility for water projects among respondents in Eastern DRC communities. Water projects are sustainable due to a variety of

factors, including institutional, financial, social, and technical considerations (Peter, 2012). Critical components of sustainability in public-private partnership (PPP) projects are ecological consciousness, construction quality, ecological designs, and project management skills (He, 2020). Financial and technical metrics have a special bearing on community-based water initiatives (Hassan, 2020). Assessing and enhancing the sustainability of water environment treatment PPP projects can be facilitated by a thorough assessment indicator system that incorporates economic, social, environmental, engineering, and project management components (Li, 2019).

Therefore, for the management of water projects in the region to be successful and sustainable, duties and responsibilities must be made clear. Project managers are able to optimize the long-term sustainability and impact of water projects in the region through the effective management of risks, unambiguous accountability, efficient resource allocation, effective coordination, ownership and participation, and community empowerment.

#### 4.4.2 Knowledge of water pump operation

**Table 4.4.2 - Knowledge of water pump operation**

<b>Knowledge of water pump operation</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Yes	22	35	42	99	<b>39</b>
No	58	49	46	153	<b>61</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The majority of respondents, comprising 61% of the total responses, reported that they do not have knowledge of water pump operation.
- A smaller proportion of respondents, representing 39% of the total responses, reported having knowledge of water pump operation.

Overall, the data suggests that there is a significant lack of knowledge regarding water pump operation among respondents in Eastern DRC communities.

A number of studies highlight how important training and education are to the management of water infrastructure. In the Latin American and Caribbean region, peer-to-peer mentoring and

higher educational standards are essential, according to Lyon (2019). Heath (2002) emphasizes that education is crucial for advancing water efficiency projects, and Hughes (2011) and Gumbo (2004) emphasize the necessity of formal education and training programs in sub-Saharan Africa and Southern Africa, respectively. All of these research point to the necessity of continual training and education programs to enhance comprehension and guarantee efficient administration and upkeep of water infrastructure.

Further, Initiatives pertaining to education and training are undoubtedly essential in enhancing comprehension and guaranteeing the efficient administration and upkeep of water infrastructure in the area. since Project personnel, local government officials, and community members are among the stakeholders who benefit from education and training programs by gaining the technical know-how and abilities required for efficient management and upkeep of water infrastructure. This involves carrying out routine inspections, diagnosing common problems, and providing instruction on operation and maintenance practices. Building technical competence enables stakeholders to more effectively recognize issues, put solutions in place, and guarantee the continuous operation of water infrastructure.

The dissemination of best practices in water management and maintenance is facilitated by education and training programs. Through the exchange of knowledge gleaned from case studies and successful initiatives, stakeholders can acquire insights into practical methods and strategies for manual water pump maintenance and sustainability

#### 4.4.3 Community leader’s involvement in decision-making

**Table 4.4.3 Community leader’s involvement in decision-making**

<b>Community leader’s involvement in decision-making</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Actively involved	10	35	16	61	<b>24</b>
Moderately involved	50	0	20	70	<b>28</b>

Little involved	18	7	14	39	<b>15</b>
Not involved	2	42	38	82	<b>33</b>
<b>Total</b>	80	84	88	<b>252</b>	<b>100</b>

- The distribution of community leaders' involvement in decision-making varies among respondents:
  - The highest percentage of respondents, accounting for 33%, reported that community leaders are not involved in decision-making.
  - A significant portion of respondents, comprising 28%, reported that community leaders are moderately involved in decision-making.
  - 24% of respondents indicated that community leaders are actively involved in decision-making.
  - 15% of respondents reported that community leaders are only little involved in decision-making.

The data suggests that there is a range of involvement levels of community leaders in decision-making processes across Eastern DRC communities. Lazarova (2012) used the example of water reuse in Bora Bora to show how important community involvement is to the success of water projects. Isham (2001) highlights social capital's impact on community-based water service performance even further, pointing to the necessity for focused investment in communities with lower social capital levels. The difficulties and possibilities in community engagement are both emphasized by Thwala (2010) and Black (2017), especially in rural and Indigenous areas, respectively. While Black (2017) highlights the need to address systemic challenges and recognize Indigenous rights in order to promote engagement in water and waste water management, Thwala (2010) emphasizes the importance of community involvement in decision-making.

Subsequently in order to effectively engage the community and guarantee the success of water projects in the area, it is critical to recognize and address the elements impacting community involvement. In order to empower communities to actively participate in water projects and achieve more sustainable and significant outcomes for all stakeholders involved, project managers should take into account the local context, highlight project benefits, foster

transparent communication, build community capacity, promote inclusive decision-making, and respect local knowledge.

#### 4.4.4 Community training or awareness programs

**Table 4.4.4- Community training or awareness programs**

<b>Community training or awareness programs</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Yes	16	7	27	50	<b>20</b>
No	48	70	16	134	<b>53</b>
Not sure	16	7	45	68	<b>27</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- Only 20% of respondents reported having community training or awareness programs.
- The majority of respondents, accounting for 53%, reported not having such programs.
- 27% of respondents were not sure about the existence of community training or awareness programs.

Overall, the data indicates that there is a significant lack of community training or awareness programs in Eastern DRC communities. Studies have indicated that the dissemination of knowledge can result in water projects that are both efficient and long-lasting (Baker, 2008). The effectiveness of an education program on water conservation, which had a favourable influence on water conservation practices, supports this (Thompson, 2011). Additionally, it has been discovered that game-based instructional initiatives are successful in encouraging water use that is sustainable (Bilancini, 2021). But there is a need for educational strategies that help kids grasp sustainability issues more deeply and provide them the tools they need to contribute toward a sustainable future (Ampartzaki, 2021).

There are several advantages to putting in place initiatives that work to increase understanding, encourage participation, and guarantee the sustainability of water projects in the area. The long-term success and impact of water projects in the region are influenced by these programs, which ultimately improve access to safe and reliable water for everyone by enhancing knowledge and

awareness, encouraging community engagement, building capacity and empowerment, promoting sustainable practices, strengthening resilience, and encouraging collaboration.

#### 4.4.5 Existence of Committee to oversee maintenance activities

**Table 4.4.5 - Existence of Committee to oversee maintenance activities**

<b>Committee to oversee maintenance activities</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Yes	16	35	21	72	<b>29</b>
No	62	35	21	118	<b>47</b>
Not sure	2	14	46	62	<b>25</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- 29% of respondents reported the existence of committees to oversee maintenance activities.
- 47% of respondents reported that there are no such committees.
- 25% of respondents were not sure about the existence of these committees.

The data suggests that while some communities have committees in place to oversee maintenance activities, a significant portion either lack such committees or are uncertain about their existence. Sustainability requires community participation in the management and upkeep of water systems (Braimah, 2016). According to Senbeta (2019), community-managed projects have been found to be more successful in guaranteeing sustainable water services. Nevertheless, households' financial contributions and lack of accountability limit the effectiveness of these programs (Etongo, 2018). For these reasons, it is advised that maintenance oversight committees be established in order to improve accountability and efficacy in the upkeep of water projects (Hay, 2012). The establishment and empowerment of maintenance oversight committees can greatly improve the efficacy and accountability of water project maintenance in the communities of the Eastern Democratic Republic. These committees enhance the long-term sustainability and impact of water projects in the region by fostering local ownership and engagement, accountability and transparency, technical expertise and knowledge sharing, coordination and collaboration, empowerment and capacity building, and ongoing

improvement and adaptation. Ultimately, this improves everyone's access to safe and dependable water.

#### 4.4.6 Who should finance manual water projects?

**Table 4.4.6 - Who should finance manual water projects?**

Who should finance manual water projects?	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Government	58	56	11	125	<b>50</b>
Local Community	2	0	24	26	<b>10</b>
NGO	14	21	14	49	<b>19</b>
I don't know	6	7	8	21	<b>8</b>
Other(specify)	0	0	31	31	<b>12</b>
<b>Total</b>	<b>80</b>	<b>84</b>	<b>88</b>	<b>252</b>	<b>100</b>

- The most common choice for financing manual water projects is the government, with 50% of respondents indicating this option.
- The local community is mentioned by 10% of respondents as the preferred financier.
- NGOs are suggested by 19% of respondents as potential financiers.
- 8% of respondents indicated uncertainty regarding who should finance manual water projects.
- Other specified entities, possibly including private donors or international organizations, were mentioned by 12% of respondents.

Overall, the data suggests a variety of perspectives on who should finance manual water projects in Eastern DRC communities. Government involvement appears to be the most favoured option, followed by NGOs and the local community. Obtaining money for water projects can be difficult in areas with limited resources, such as the Eastern Democratic Republic of the Congo. Water projects may not receive enough funding from traditional sources, such as donor grants or government budgets, or they may not receive enough support

at all. Long-term financing of water projects can be challenging due to a variety of factors, including political unrest, economic volatility, and conflicting objectives. However, Water projects require continuous operating and maintenance expenses in addition to the initial capital expenditure to guarantee their sustainability. Nevertheless, operating and maintenance budgets are frequently overlooked or underfunded, which results in aging infrastructure, worse service quality, and eventually project failure. To ensure the long-term viability of water projects, creative financing methods incorporating user fees, public-private partnerships, community contributions, and sustainable funding mechanisms are needed to close the operation and maintenance financial gap.

#### 4.4.7 Is Information main constraint to sustainability?

**Table 4.4.7 - Is Information main constraint to sustainability?**

Is Information main constraint to sustainability?	Commune /SHARI (80)	Commune /MBUNYA (84)	Commune /NYAKASANZA (88)	TOTAL (252)	Percent (%)
Yes	26	63	53	142	56
No	54	21	35	110	44
<b>Total</b>	80	84	88	252	100

- 56% of respondents indicated that information is the main constraint to sustainability.
- 44% of respondents disagreed, stating that information is not the main constraint to sustainability.

Overall, the data suggests that there is a considerable perception among respondents that information serves as a significant constraint to sustainability. Encouraging the sustainability of water projects in Eastern DRC villages requires improved information availability and dissemination since it encourages a greater understanding and comprehension of the significance of water projects, their advantages, and the roles they play in guaranteeing access to clean and consistent water is made possible by information access, which also benefits stakeholders and members of the community. Water projects can be made more sustainable by empowering people to take charge of them, engage in meaningful ways, and make educated decisions based on the facts provided about their goals, features, and operation.

Since they make efficient management and monitoring possible, local institutions are essential to the sustainability of water projects (Chumbula, 2018). According to Admassu (2003), waiting times, community involvement, and project coordination are some of the factors that impact how well water projects are used and function in rural Ethiopia. Consequently, to address these issues and improve the sustainability of water projects in Eastern DRC communities, better information access and distribution are crucial.

#### 4.4.8 Any plans to upgrade water pumps?

**Table 4.4.8 - Any plans to upgrade water pumps?**

<b>Any plans to upgrade water pumps?</b>	<b>Commune /SHARI (80)</b>	<b>Commune /MBUNYA (84)</b>	<b>Commune /NYAKASANZA (88)</b>	<b>TOTAL (252)</b>	<b>Percent (%)</b>
Yes	14	28	25	67	<b>27</b>
No	66	56	63	185	<b>73</b>
<b>Total</b>	80	84	88	<b>252</b>	<b>100</b>

- 27% of respondents indicated that there are plans to upgrade water pumps.
- 73% of respondents reported that there are no plans to upgrade water pumps.

Overall, the data suggests that a significant majority of respondents do not have plans to upgrade water pumps in Eastern DRC communities.

The absence of planning and the requirement to upgrade water pumps in rural regions are caused by a number of causes. Barnes (2014) highlights the significance of educating stakeholders about sustainability standards and integrating technology into its institutional and social environment. For better post-construction monitoring, Swan (2018) recommends the adoption of smart pumps, which could aid stakeholders by requiring less time and resources. According to Huby (2003), community development and sustained support are essential for ensuring the sustainability of water projects. These observations draw attention to the many institutional, social, and technical issues that need to be resolved in order to increase rural communities' access to clean water and the long-term viability of water projects.

To improve access to clean water and ensure the sustainability of water projects in the area, it is imperative to investigate prospective solutions for pump upgrades and comprehend the reasons behind the absence of maintenance plans for water pumps. Project managers can create

strong maintenance plans that support the long-term viability of water projects and the welfare of local communities by addressing technical capacity gaps, encouraging community engagement, mobilizing resources, and putting in place efficient monitoring and evaluation mechanisms.

#### **4.4.9 Summary of the findings and discussions**

##### **Maintenance practices and the sustainability of water projects in Eastern DRC communities**

The results indicated that when the community is more involved it makes more impact on the manual water pump projects. When the community takes up ownership and are supported by the NGOs, the manual water projects will be sustained. The findings are complemented by the qualitative interviews with key informants and Focus Group Discussions (FGDs) who correctly live in Bunia city and know something about the manual water projects and how maintenance is carried out. According to the results, majority of the people believe that community involvement and taking ownership of the manual water projects in Bunia city will greatly bring about a positive outcome in terms of sustainability of the manual water projects.

Bunia City's water sources are less dependable. The characteristics of this include low water quality ratings, discontent with water sources, limited water availability, and frequent water source failures. The key informant interviews provide additional support for the theoretical hypothesis that water projects with the aforementioned characteristics experience dis-functionality issues as well. As demonstrated in Bunia City, this can involve generating water that is hard and tastes strange, making it unfit for human consumption, and harvesting less water than what is needed in the community to be trucked in. Thus, the sustainability of the water project can be understood as follows:

*“the maintenance program has saved our health from water-borne diseases. I have lived here for more than 7 years and this is the only maintenance program I have seen with one of the National NGOs, which saved our lives. I wish all communities would sign maintenance contract as it helps us to have water all the time;”* (Chantal Ndroi de la Commune Shari/Av Kasegwa)

It is therefore important that regular water infrastructure inspections guarantee that possible problems are found early on. By acting pro-actively, minor issues are kept from growing into significant malfunctions that can make the water supply useless. The community will always have access to clean water if problems are immediately resolved, prolonging the water project's lifespan.

In addition, Water projects in Eastern DRC communities are not as sustainable due to a variety of maintenance procedures. According to Burleson (2018), long-term maintenance planning is crucial, and successful projects include it from the beginning. In order to ensure sustainability, Bhandari (2005) emphasizes the need of gender equality and management techniques, with projects placed by NGOs demonstrating superior performance. Senbeta (2019) emphasizes the value of community involvement even more, pointing out that initiatives administered by the community have better sustainability results. According to these results, the longevity of water projects in communities in the Eastern Democratic Republic of the Congo depends on a trifecta of long-term maintenance planning, gender equality, and community involvement.

Further, the local population in water project upkeep encourages a sense of accountability and ownership. Participating in decision-making processes, providing basic maintenance training, and encouraging timely reporting of faults are ways to increase community members' likelihood of maintaining the infrastructure and ensuring its long-term viability. This can be done through giving community members instruction on water infrastructure upkeep and repair gives them the tools they need to handle small problems on their own. Furthermore, by creating maintenance committees or educating local technicians, you can guarantee that there are people with the know-how to tackle more complicated repairs, which will decrease the project's need on outside assistance and increase its sustainability.

To summarize, the sustainability of water projects in Eastern DRC villages is dependent upon the implementation of efficient maintenance practices, such as collaborative efforts, capacity building, regular inspections, community involvement, sustainable funding, adaptive management, and high-quality construction. Stakeholders may optimize the long-term effects and advantages of water infrastructure investments for the communities they serve by emphasizing upkeep and utilizing comprehensive approaches.

### **Factors contributing to the effectiveness of maintenance practices in Eastern DRC**

Many important elements affect how well maintenance procedures work in the water projects in the Eastern Democratic Republic of the Congo. Burleson (2018) highlights the significance of stakeholder participation and long-term maintenance planning, which are frequently absent from technology-based projects. In order to ensure service reliability, Jimenez-Redal (2018) emphasizes the importance of perceived ownership, willingness to pay for maintenance, and faith in the water committee. Admassu (2003) highlights the significance of community involvement, water point functionality, and project coordination in maintaining water supply initiatives. The success or ineffectiveness of maintenance procedures in the water projects of the Eastern Democratic Republic is influenced by a combination of several elements.

According to the data collected, insufficient funding is the major hindrance in the sustainability of water projects. The Nshari hand pumps were operating significantly more efficiently than those in the Mbunya and Yakasanza communes in Bunia City. The respondents reported that there is insufficient money available for repairs and replacement parts, depending on the nature of the defect. Furthermore, it was disclosed that the abandoned hand pumps malfunctioned and the towns involved were unable to pay for the necessary spare parts to fix them.

The study found that community involvement has a considerable but weak impact on the sustainability of water projects in Bunia City. This finding supports the conclusions of Otieno and Mumo (2017) that there is a strong and positive correlation between community participation and the sustainability of water projects, and that encouraging community participation has a major impact on the degree of sustainability of water projects in the community. Nevertheless, our study indicates a limited influence, in contrast to their findings. DRC (2019) has observed that community involvement has a context-specific impact on programs that affect the lives of refugees, which may help to understand how the respondents' impressions were formed.

In Eastern Democratic Republic of the Congo (DRC), a number of critical factors influence how effective or ineffective maintenance practices are when it comes to the sustainability of water projects. To address these critical factors, a comprehensive strategy that incorporates technical, institutional, social, and economic considerations is needed to promote sustainable maintenance practices and guarantee the long-term viability of water projects in Eastern DRC communities.

## **Community participation and sustainability of water projects in Eastern DRC**

Key informant interviews revealed that water project developers just inform the community that a water project would be implemented without inviting them to fully participate in activities such as site selection, design, choice of infrastructure, appointment of water committees or other decisions related to the implementation of the project. This approach does not enable local voices to travel from the fringes of the system to the center as expected (DRC, 2018). Further, it does not help identify community capacity (Haines, 2009; Cunningham et al., 2012) or build on internal strength (Kretzman et al., 2005; Syrafuddin & Amir, 2017). This situation does not motivate the communities to participate meaningfully in the development and implementation of the project. Further, it was revealed that there is limited effort to empower the community to take a meaningful part in the development process of the water projects. Though water officials in the area interviewed claimed to invite the community to participate, consistent with the claims of Paul (1987), Gitonga (2015), Otieno and Muno (2017), when the community does not feel genuinely invited to participate, they will withdraw their participation and have a low regard of such a project.

Additionally, in order to achieve sustainability in water projects, levels of community engagement show how much the project's beneficiaries should be involved. All individuals or representatives must fully participate in all project management stages. According to current research findings, restricted community participation is more likely to result from deep participation than from broad participation (Kasiaka, 2017). As a result, the level of involvement matters more for a community's water initiatives to be sustainable. The level of community involvement in planning and decision-making directly and favourably affects how satisfied the community is with the project. But for a variety of reasons, success can prove to be a challenging task, especially in developing nations like the Democratic Republic of the Congo.

Consequently, stakeholder engagement and stakeholder management are not the same. A project for the community's benefit without their input is known as stakeholder management. Engaging stakeholders, on the other hand, demonstrates how organizations may work with them to enhance advancements and benefits, which fosters greater community collaboration. Ineffective engagement, on the other hand, leads to more serious issues that could regress the community, such as manual labor disputes over projects that can be addressed from both a political and cultural standpoint.

*“ our manual water pumps are getting broken and no one is there to maintain them, from local level to government authorities, we do hope one day good people will come to maintain and rescue us, ... more than that, its seems even the spare part are not easy to get them locally here”* (Adorace Honorine, Commune Mbunya

We are aware that three key success factors long-term maintenance, appropriate training, and community involvement are required to effectively address the difficulties that water scarcity poses. The difficulties around water access, community dynamics, and development levels vary depending on the community and geographic area in which we operate. For this reason, in order to make sure that the water project offers them long-term solutions that satisfy their needs, we rely on our partner community members to accept us into their fold.

Furthermore, Water project sustainability has been systematically correlated with community participation (Olajuyigbe, 2016). This is especially clear in the domains of monitoring and evaluation, capacity building, and project planning. As demonstrated by the Ikaram Millennium Village, inadequate funding, however, can make these projects less sustainable (Olajuyigbe, 2016). For water projects to be successful over the long run, community involvement is therefore essential but needs sufficient finance to support it.

More so, Donors and non-governmental organizations absolved themselves of accountability for water projects, all the while advocating for community empowerment. However, communities rarely take full ownership of a system because they believe that the implementing government or donor bears the obligation, and they usually view costs as "someone else's problem."

The establishment of a community revolving loan fund funded by water user fees is one tactic to lessen the risk associated with manually maintained financial reserves for water projects. The community's perception of adequate funding would also be enhanced by a small loan revolving fund, which would increase their authority to run water stations and collect fees. A portion of the money collected from water users might be loaned to locals to be used for profitable endeavours including buying supplies for farming, establishing small-scale chicken businesses, opening small bicycle and motorbike repair shops, and other micro-enterprise opportunities. Following their repayment of loans at low interest rates, community members would lend money to other community members. The manual water projects community fund is rotating, which encourages return even when there is a chance that it won't be paid back.

Because the manual water projects community fund is revolving, it promotes communal enforcement of repayment since future loan applicants put pressure on existing borrowers to honour payback terms. The likelihood of theft by community members would be reduced with similar social pressure. The possibility of informal taxes is further reduced by having several community borrowers and smaller WMC cash-on-hand.

The majority of WMCs' poor performance is an example of a traditional collective action issue. Consumers frequently refuse to pay their "fair share" of upkeep and repair expenditures because they view the availability of water as a public asset. The general administration of the majority of WMCs questioned is appalling due to open access, a lack of enforcement of non-payment policies, local governments who refuse to pay for water, and Water Management Committees that function without explicit community directives. Governance is a larger notion that encompasses community mandates of WMCs, enabling assistance and actions of local authorities, and the spirit with which WMCs perform their everyday business, even if it is tied to organizational capability and transparency.

In order to fortify the spare parts supply chain, it is also possible to foster the establishment of autonomous, profit-driven maintenance service providers. District centers would be the perfect location for these small service enterprises. By maintaining and improving the technical knowledge of technicians through practice and gaining experience with a wider variety of hand pump failure and repair types, this model offers several advantages over based repair and maintenance. It can service dozens or even hundreds of hand pumps in a particular geographic area. In order to reduce the possibility of making needless repairs or replacing functional parts, Water Management Committees will nevertheless require the presence of one or two pump technicians to validate the diagnostics performed by Maintenance Service Providers personnel and the suggested repair actions.

In addition, a participation strategy should be put in place, this is because only results in a water project that is sustainable and when project sustainability factors are considered early on, then sustainability is guaranteed. These factors included the cost of upkeep and operations, employee participation, and demand-drivenness. It was discovered that capacity building was also important, and this included forming local community-based committees or water user groups to continue the project's activities as well as training community water attendants. It is suggested that communities should focus on immediate areas for intervention, such as organizing joint efforts during the project planning phase, training Water Committee members,

and holding sensitization seminars on finished projects to empower the communities to operate and maintain water systems and to employ trained water attendants.

Out of this research, the maintenance of manual pump water is the main topic to be address and to be taken seriously regarding the amount of water project many NGO are pouring millions of Dollars in new water projects every day without considering any past investment and its impact for more sustainability , what we are seeing in the field , its horrible, every stakeholder want to do what he want ,anyhow without considering any the effort from others. Therefore, the non-big integration of community in projects process have a huge negative impact as any success of community project such water, must take serious integration of community as water belong to them and their generations, without them considering the project as their own, it's just a waste of time.

The potential use of technology, such as IT devices or mobile applications, in enhancing the efficiency and effectiveness of manual water pump maintenance in Eastern DRC.

These research topics address various aspects of manual water pump maintenance in Eastern DRC, with a specific focus on Bunia City, and can contribute to a comprehensive understanding of the factors influencing the sustainability of water projects



## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATIONS**

#### **5.1 Summary of the study**

The study delves into the demographic data and maintenance practices impacting water project sustainability in Eastern DRC communities. The demographic analysis reveals a diverse age distribution, with the 25-35 age group being the largest across all communes. Females represent the majority of respondents, indicating their significant role in water management. Community members dominate roles, emphasizing community involvement in project sustainability.

Regarding maintenance practices, daily water pump use is prevalent, but maintenance schedules vary. The majority perceive maintenance sufficiency, yet there are mixed perceptions about maintenance quality, with most suggesting improvement. Quality assurance measures are perceived as lacking, and community involvement in maintenance activities is limited.

Understanding perceptions is crucial for fostering community ownership and participation in water initiatives. Scholarly studies emphasize the importance of comprehending community attitudes and addressing systemic issues to enhance sustainability. Project managers can facilitate this by actively engaging with communities, seeking feedback, and addressing concerns to ensure the long-term success of water projects.

Challenges such as limited community involvement, lack of quality assurance measures, and varied perceptions about maintenance quality highlight areas for improvement. By addressing these challenges through tailored strategies, project managers can enhance community engagement, promote sustainable practices, and ultimately ensure the longevity of water projects in Eastern DRC communities.

#### **5.2 Conclusions of the study**

**Community Involvement and Ownership:** The study highlights the positive impact of community involvement and ownership on the sustainability of manual water pump projects in Bunia City. When communities take ownership and are supported by NGOs, the projects are more likely to be sustained.

**Maintenance Practices:** Effective maintenance practices, including regular inspections and immediate resolution of issues, are crucial for prolonging the lifespan of water projects. Early detection and proactive maintenance help prevent minor issues from escalating into significant malfunctions.

**Challenges in Sustainability:** The study identifies insufficient funding as a major hindrance to the sustainability of water projects in Eastern DRC communities. Lack of financial resources leads to difficulties in repairing and replacing essential parts, resulting in malfunctioning or abandoned water pumps.

**Community Participation:** While community involvement is essential for project sustainability, the level of engagement matters. Limited community participation can undermine the success of water initiatives, emphasizing the need for meaningful involvement in all project management stages.

**Stakeholder Engagement:** Effective stakeholder engagement goes beyond project implementation to foster community collaboration and accountability. Donors and NGOs must involve communities in decision-making processes and empower them to take ownership of the projects.

**Capacity Building and Training:** Capacity building initiatives, including training programs for community members and water attendants, are vital for ensuring the long-term viability of water projects. Empowering communities to operate and maintain water systems is essential for sustainability.

**Technology Integration:** The potential use of technology, such as IT devices or mobile applications, can enhance the efficiency and effectiveness of manual water pump maintenance in Eastern DRC. Incorporating technological solutions can improve maintenance practices and contribute to project sustainability.

### **5.3 Recommendations of the study**

1. **Enhance Community Participation:** Stakeholders should prioritize meaningful community involvement in all stages of water project development, including decision-making and capacity building initiatives.
2. **Sustainable Funding Mechanisms:** Establishing community revolving loan funds funded by water user fees can mitigate the financial challenges associated with maintenance. This approach empowers communities to take ownership of funding and ensures the availability of resources for repairs and replacements.
3. **Capacity Building:** Implement comprehensive capacity building programs to train community members and water attendants in maintenance practices. Empowering communities to operate and maintain water systems will increase project sustainability.
4. **Proactive Maintenance:** Implement regular inspection schedules and proactive maintenance practices to detect and address issues early on. Timely resolution of problems will prevent minor issues from escalating into major malfunctions.
5. **Technology Integration:** Explore the potential use of technology, such as IT devices or mobile applications, to enhance maintenance efficiency. Leveraging technology can improve monitoring, diagnostics, and reporting of maintenance activities.
6. **Stakeholder Engagement:** Foster effective stakeholder engagement by involving communities in decision-making processes and promoting accountability among donors and NGOs. Collaborative efforts are essential for ensuring project sustainability.
7. **Long-Term Planning:** Prioritize long-term maintenance planning from the inception of water projects. Incorporate stakeholder participation and sustainability considerations into project planning to maximize long-term benefits for communities.

Addressing the challenges of water project sustainability in Eastern DRC requires a comprehensive approach that integrates community participation, sustainable funding mechanisms, capacity building, proactive maintenance practices, technology integration, and effective stakeholder engagement. By implementing these recommendations, stakeholders can enhance the sustainability and effectiveness of water projects, ultimately improving access to clean and reliable water for communities in the region.

## REFERENCES

- Aboagye, et al (2016). Dealing with hand pump maintenance problems for sustainable rural water systems in ahafo ano south district.
- Antosz, et al . (2019). Spare parts' criticality assessment and prioritization for enhancing manufacturing systems' availability and reliability. *Journal of Manufacturing Systems*. 50. 212-225. 10.1016/j.jmsy.2019.01.003
- Bartram, J. (2015). Understanding hand pump sustainability: Determinants of rural water source functionality in the Greater Afram Plains region of Ghana. *Water Resources Research*,
- Chumbula, J. J., & Massawe, F. A. (2018, December 1). The role of local institutions in the creation of an enabling environment for water project sustainability in Iringa District, Tanzania. *Environmental & Socio-Economic Studies*, 6(4), 1–10. <https://doi.org/10.2478/environ-2018-0023>
- Cleaver, F. (2009). Maintenance of rural water supplies in Zimbabwe by Frances Cleaver User participation in Zimbabwe through Waterpoint Committees promotes hand pump sustainability.doi:10.1002/2014wr016770
- DAY, S. J. (2009). Community-based water resources management. *Waterlines*, 28(1), 47–62. <http://www.jstor.org/stable/24686845>
- Fink EL, Chintalapati P, Lane A, Wester A, Javernick-Will A, et al. (2022) Determinants of rural hand-pump functionality through maintenance provision in the Central African Republic. *PLOS Water* 1(6): e0000024.
- Fink EL, Chintalapati P, Lane A, Wester A, Javernick-Will A, et al. (2022) Determinants of rural hand-pump functionality through maintenance provision in the Central African Republic. *PLOS Water* 1(6): e0000024. <https://doi.org/10.1371/journal.pwat.0000024>
- Gill, L.W., & Flachenberg, F. (2015). Sustainability of hand-dug wells in Tanzania: results from a post-evaluation.
- Harvey, A. (2020, July 1). Rural water service delivery: addressing the hidden development crisis. *Waterlines*, 39(2–3), 180–218.

Hassan, F. A., Osore, M. K., & Ong'ayo, H. A. (2020, October 29). Determinants of sustainability for community based water projects: the case of Hazina ya Maendeleo ya Pwani in coastal Kenya. *Western Indian Ocean Journal of Marine Science*, 19(1), 99–112. <https://doi.org/10.4314/wiojms.v19i1.8>

Lynn, E.M., FinkID, Pranav, ChintalapatiID, Lane, A., Wester, A., AmyJavernick, -, WillID, Karl, & LindenID (2022). Determinants of rural hand-pump functionality through maintenance provision in the Central African Republic.

Manzini, et al (2009). The strategic role of spare parts availability and facility location on maintenance in industrial systems. Proceedings - 15th ISSAT International Conference on Reliability and Quality in Design. 410-416.

McKee et al. (2011). A review of major centrifugal pump failure modes with application to the water supply and sewerage industries.

Mgulo, R., & Kamazima, S. R. (2022, March 29). Community Participation and Non-Governmental Organizations-Funded Rural Water Projects' Sustainability: A Case of Chamwino District, Dodoma Region, Tanzania. *European Journal of Medical and Health Sciences*, 4(2), 51–56. <https://doi.org/10.24018/ejmed.2022.4.2.1166>

Mudege, N. (1993). Handpump maintenance in Zimbabwe. *Waterlines*, 11, 9-12.

Mwanza, B.G., & Mbohwa, C. (2016). The Impact of Maintenance Systems on Water Supply: A case Study of a Utility Company.

Nilsson, K., Rubeis, M.L., & Melloni, G.M. (2018). Community management of water points in the Democratic Republic of the Congo: identifying success factors.

Njalam'mano, J.B. (2007). Current Status and Management of Hand Pump Equipped Water Facilities in Blantyre Rural District, Malawi : Case Study of Kapeni and Lundu Traditional Authorities.

Saravanan V. S. (2006). Integrated Water Resource Management: A Response. *Economic and Political Weekly*, 41(38), 4086–4087. <http://www.jstor.org/stable/4418732>

Senbeta, F., & Shu, Y. (2019, March 20). Project Implementation Management Modalities and Their Implications on Sustainability of Water Services in Rural Areas in Ethiopia: Are Community-Managed Projects More Effective? *Sustainability*, 11(6), 1675. <https://doi.org/10.3390/su11061675>

Spaling, H., Brouwer, G., & Njoka, J. (2014, September 30). Factors affecting the sustainability of a community water supply project in Kenya. *Development in Practice*, 24(7), 797–811. <https://doi.org/10.1080/09614524.2014.944485>

Swan A, Cooper N, Gamble W and Pritchard M (2018) Using smart pumps to help deliver universal access to safe and affordable drinking water. *Proceedings of the Institution of Civil Engineers Engineering Sustainability* 171(6): 277–285,

Water / Democratic Republic of the Congo | Interactive Country Fiches. (n.d.). Water / Democratic Republic of the Congo | Interactive Country Fiches. <https://dicf.unepgrid.ch/democratic-republic-congo/water>

*Water crisis in the Democratic Republic of the Congo - Wikipedia.* (2016, May 27). Water Crisis in the Democratic Republic of the Congo - Wikipedia. [https://en.wikipedia.org/wiki/Water\\_crisis\\_in\\_the\\_Democratic\\_Republic\\_of\\_the\\_Congo](https://en.wikipedia.org/wiki/Water_crisis_in_the_Democratic_Republic_of_the_Congo)

Лазарова, Sturny, V., & Sang, G. T. (2012, March 1). The role of the community engagement towards the success of water reuse in isolated islands and tourist areas. *Journal of Water Reuse and Desalination.* <https://doi.org/10.2166/wrd.2012.057>

## Appendix 1: Questionnaire

### Assessment of the sustainability of Water Projects in Bunia

#### Demographic Information:

**Location:** .....

**Respondent's name (optional):** .....

**Contact Information (Optional):** .....

1. Age (Tick appropriately)

15- 25 yrs

25-35 yrs

35-45 yrs

45-55 yrs

Above 55 yrs

2. Gender: Female  Male

3. Position/Role in the Community?

Community member

Local leader

Project leader

Other (please specify) .....

4. How long have you lived in this community?

1- 8 months

1-2 years

3-5years

Other (please specify) .....

5. How often do you use the manual water pump?

Daily

Weekly

Monthly

Rarely

#### Maintenance Practices

6. How frequently is maintenance carried out on the water project in your community?
  - Daily
  - Weekly
  - Monthly
  - Quarterly
  - Other (please specify) .....
7. Do you think the current maintenance efforts are sufficient to keep the manual water pump are sustainable?
  - Yes
  - No
  - Not sure
8. How would you rate the overall quality of maintenance conducted on the water project?
  - Excellent
  - Good
  - Satisfactory
  - Needs Improvement
9. Are there any specific measures to ensure the quality of maintenance work?
  - Yes
  - No
  - Not sure
10. (a) Have you or your community been involved in the maintenance of the manual water pump?
  - Yes
  - No
- (b) If yes, how often is the manual water pump maintained?
  - Regularly ( monthly)
  - Occasionally ( yearly)
  - Rarely ( every few years)

**Key Factors related to Maintenance**

11. Have there been instances when the manual water pump was out of order and unavailable?
  - Yes
  - No
12. Who typically performs maintenance and repairs on the manual water pump?
  - Community volunteers
  - Local government
  - NGO
  - Outsourced technicians
  - Others (please specify) .....
13. Are there any training initiatives in place for maintenance personnel?
  - Yes
  - No
  - Not sure
14. How would you rate the availability of necessary resources and spare parts for maintenance activities?

- Easily Available
  - Moderately Available
  - Scarce
  - Not Applicable
15. Are maintenance issues identified and addressed before they escalate?
- Yes
  - No
  - Not sure
16. Are maintenance plans proactive or reactive?
- Yes
  - No
  - Not sure
17. Apart from paying, what are other sources of funds for water facility operation and maintenance?
- Community contribution
  - Local government
  - NGO
  - I do not know
  - Other (specify) .....
18. Do you think the current maintenance efforts are sufficient to keep the manual water pump are sustainable?
- Yes
  - No
19. In your opinion will the Project stakeholders' engagement and cooperation likely to continue (either on a national, sub-regional)
- Yes
  - No

**Community Participation and Involvement**

20. To whom do you think the water facility belongs?
- Government
  - Local community
  - NGO
  - I do not know
  - Other (specify)
21. Do you know how to operate the water facility correctly?
- Yes
  - No
22. To what extent are community leaders involved in decision-making regarding water project maintenance?
- Actively Involved
  - Moderately Involved
  - Minimally Involved
  - Not Involved
23. Have there been any community training or awareness programs related to water project maintenance?
- Yes

- No
- Not sure

24. Is there an established committee within the community responsible for overseeing maintenance activities?

- Yes
- No
- Not sure

**Sustainability**

25. Most of the sustainable measures require funding, who do you think should fund the manual water projects to ensure sustainability

- Government
- Local community
- NGO
- I do not know
- Other (specify)

26. Do you think lack of information on how to manage and maintain the water pumps is the major factor hindering sustainability?

- Yes
- No

27. Are there plans for future upgrades or replacements of the manual water pump to ensure continued functionality?

- Yes
- No

28. Do you have any suggestions or recommendations for further support in the area of equitable access to water and sanitation small scale water supply and sanitation systems in your commune and the city

- Yes
- No

If Yes, please explain

.....

.....

.....

.....

.....

**Thank you for your valuable input! Your insights will contribute to the improvement and sustainability of the water project in our community.**

## Appendix 2: Interview Guide

### Assessment of the sustainability Water Projects in Bunia

**Introduction:** Welcome the interviewee, explain the purpose of the interview, and express gratitude for their participation.

#### Maintenance Practices

1. Can you provide more details about the current maintenance procedures followed for the water project?
2. How would you describe the challenges or successes encountered in recent maintenance activities?
3. Are there training programs in place to build the capacity of individuals responsible for water pump maintenance?
4. What maintenance practices are in place to ensure the continued functionality of the water pumps?
5. In your opinion, how can the overall quality of maintenance be further improved?

#### Key Factors related to maintenance

6. Are there any challenges in obtaining the necessary resources for maintenance activities?
7. Are there any community-based initiatives related to pump upkeep?
8. How is the capacity of maintenance staff assessed and improved?
9. Could you elaborate on the training initiatives in place for maintenance personnel?
10. How do you assess the availability of necessary resources and spare parts for maintenance activities?
11. Is there a budget allocated towards maintenance? Is it adequate?
12. Is there a proactive maintenance plan in place? and how are potential issues identified and addressed before they escalate?

#### Community Participation and Involvement

13. In what ways are community leaders actively involved in decision-making regarding water project maintenance?
14. Have there been any measures taken by the community to ensure the long-term sustainability of the projects?
15. How effective have community training or awareness programs been in fostering understanding and participation in maintenance activities?
16. Can you provide insights into the role and effectiveness of the committee responsible for overseeing maintenance activities within the community?
17. Have there been any measures taken to ensure the long-term sustainability of the projects?

18. How are community members involved in the ongoing maintenance and sustainability of water pumps? Have there been any community-led initiatives to support the sustainability of water pumps?
19. What advice would you give to other communities looking to implement similar manual water pump projects?

### **Sustainability**

20. Are there any challenges or obstacles hindering the long-term sustainability of the water project?
21. How are climate and environmental factors considered in ensuring the sustainability of water pumps?
22. How do you envision addressing challenges to ensure the sustainability of the water project over the next five years?
23. What improvements or initiatives do you believe would have the most significant impact on enhancing the overall sustainability of the water project?
24. Please share any additional comments or thoughts you have regarding manual water pumps and their maintenance in Bunia City.
25. What advice would you give to other communities looking to implement similar manual water pump projects?

**Thank the interviewee for their time and valuable insights.**