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Presented by:

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**DETERMINANTS OF ACCESS TO IMPROVED WATER,
SANITATION AND HYGIENE IN UGANDA.**

**CASE STUDY: NAMATALA URBAN INFORMAL
SETTLEMENT.**

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DECLARATION.

I hereby declare that this thesis is solely my original work and has not been presented as a Master degree thesis in any other university across the globe.

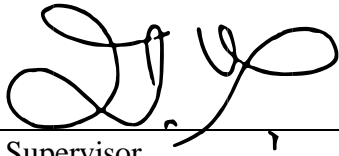
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CERTIFICATION

This thesis has been submitted for examination with my approval as the university supervisor



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DEDICATION.

This project is dedicated to my parents; Mr. Erongu Charles and Mrs. Agono Melda, and to all my siblings; Aripo Judith, Aguti Demita, Atim Martha, Achom Mary Fiona, Aruto Lucy and Asengo Rebecca. It is also dedicated to my best friend Elungat Pius and to the entire MSc. Water Policy class of 8th cohort. Thank you for your unwavering love, advice, encouragement, prayers, financial, academic and moral support throughout my study life.

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ABBREVIATION AND ACRONYMS

UN: United Nations

DWD: Directorate of Water Development

IDPs: Internally Displaced Persons.

CLTS: Community-Led Total Sanitation

VIP: Ventilated Pit-Latrine.

ECOSAN: Ecological Sanitation.

GDP: Gross Domestic Product

GoU: Government of Uganda

IWRM: Integrated Water Resources Management

DLG: District Local Government

MDG: Millennium Development Goals

MWE: Ministry of Water and Environment

MoF: Ministry of Finance

MoFPED: Ministry of Finance, Planning and Economic Development

NDP: National Development Plan.

PPP: Public Private Partnership

SDG: Sustainable Development Goals

UNDP: United Nations Development Programme

UNICEF: The United Nations Children's Fund

UN-Water: The United Nations Water Programme

UN-Habitat: The United Nations Settlement Programme

WASH: Water, Sanitation and Hygiene

WC: Water Committee

WHO: World Health Organization

WSS: Water Supply Schemes

WUC: Water User Committee

WWTP: Waste Water Treatment Plants.

mm/yr.: millimeters per year

km². Square kilometer.

DWD: Directorate of Water Development.

ADB: African Development Bank.

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Abstract.

Water, sanitation and hygiene facilities play a vital role in promoting sustainable development, improving public health, and enhancing community well-being. In developing countries including Uganda, a rapid urbanization rate has led to most of people migrating to cities in search of the economic (employment), investment and educational opportunities. This has led to rapid increment and development of urban informal settlements which is characterized by poor infrastructure, inadequate access to clean and safe water, poor/dilapidated water sanitation facilities, obsolete poverty, inadequate wastes management, inadequate social amenities and overcrowding. The lack of access to improved water sanitation and hygiene has directly and indirectly impacted most of the urban slum dwellers health, well-being and socio-economic levels. Notably, most of the urban slum dwellers suffer from water-borne diseases such as diarrhea and dysentery, acute respiratory disorders, and skin infections, due to use and contact with contaminated water, poor hygiene practices and facilities, limited access to basic WASH services, and inadequate housing. Additionally, slum dwellers have very low level of awareness and information about illness and WASH practices, which has led to poor health and dangerous protective behaviour. Therefore, this research assessed the current WASH conditions in Namatala urban slum, determining WASH accessibility and reliability rates, possible barriers to accessing improved WASH and proposed policy options to be implemented in Namatala urban slum in order to improve WASH in the area. Using random sampling method, a total of 160 households from the 24,123 were selected and interviewed during the study. Also, from purposive sampling, 34 key informants participated in the interviews and focused group discussions. Data was collected using structured household questionnaires, focused group discussions and field investigations, and was analyzed using Statistical Package for the Social Sciences (SPSS). From the results, (72% [115/160]) households have access to a sufficient quantity of water. (54% [87/160]) of the households use pipe water system while (33% [53/160]), (4% [6/160]), (4% [6/160]) and (5% [8/160]) use borehole, open well (springs and hand dug wells), stream (river Namatala) and water vendors as drinking water sources respectively. (43% [49/115]) households have unreliable water supply due to mechanical problems/failures experienced in the form of pump failures, pipe repairs and replacements a system bursts/leakages are the main factors households identified. In regards to sanitation, there were 83 toilet facilities found in Namatala urban slum, 59 private (unshared toilet facilities)

and 24 shared toilet facilities. (54% [87/160]) households have access a VIP/pit latrine with slab while (19% [34/160]) households have a pit latrine without a slab/open pit. The survey also shows that very few households have improved sanitation facility. Notably, only (14% [22/160]) households have a flush/pour flush pit latrine while (11% [18/160]) households had flush to septic tank. Only (1% [2/160]) flush to the sewer/drainage channel their fecal matter. Only (46% [38/83]) of the toilet facilities had hand washing facilities. Tipping taps made from jerrycans were the common had washing facilities installed aside of the toilet facilities. Hand washing behaviour recorded was low as only (58% [92/160]) households wash hands after visiting the toilet facility. The area also lacked a conventional sewer system for wastewater hence residents used open channels, and open gullies as sewer lines.

Using household questionnaires and focused group discussions, the study identified inadequate improved WASH facilities, limited access to safe drinking water supply, occurrence of climate change events, limited funding in the WASH sector, inadequate knowledge on the use and management of healthy WASH practices, and ineffective local community involvement in the planning and implementation as the main possible barriers hindering access to improved WASH services/facilities. These were attributed to limited space/fragmented land ownership low economic levels, and WASH funding gap, that have not favored the development of WASH in Namatala urban slum. To avert this, there is a need to upgrade and expand the current WASH infrastructure/ program in the area, Mbale City council authority to increase their lobbying for WASH funding through Grants and Loans, inclusive planning and implementation of the WASH facilities between the community and the responsible stakeholders Community-Led Total Sanitation (CLTS) programs, development and implementation of National and District WASH Investment Plans, policies and Acts for informal settlements, and enhancing awareness on basic WASH practices among the slum dwellers, and implementing integrated waste management in Namatala urban slum.

Keywords: Sanitation, Water, Urbanization, Informal settlement, Urban slums, Namatala.

Résumé.

Les installations d'eau, d'assainissement et d'hygiène jouent un rôle essentiel dans la promotion du développement durable, l'amélioration de la santé publique et l'amélioration du bien-être des communautés. Dans les pays en développement, dont l'Ouganda, un taux d'urbanisation rapide a conduit la plupart des personnes à migrer vers les villes à la recherche d'opportunités économiques (emploi), d'investissement et d'éducation. Cela a conduit à une augmentation et un développement rapides des établissements urbains informels caractérisés par des infrastructures médiocres, un accès inadéquat à l'eau propre et salubre, des installations d'assainissement de l'eau médiocres/délabrées, une pauvreté obsolète, une gestion inadéquate des déchets, des équipements sociaux inadéquats et une surpopulation. Le manque d'accès à une eau d'assainissement et à une hygiène améliorées a eu un impact direct et indirect sur la santé, le bien-être et les niveaux socio-économiques de la plupart des habitants des bidonvilles urbains. Notamment, la plupart des habitants des bidonvilles urbains souffrent de maladies d'origine hydrique telles que la diarrhée et la dysenterie, de troubles respiratoires aigus et d'infections cutanées, dues à l'utilisation et au contact avec de l'eau contaminée, à de mauvaises pratiques et installations d'hygiène, à un accès limité aux services WASH de base, et des logements inadéquats. De plus, les habitants des bidonvilles ont un niveau très faible de sensibilisation et d'information sur la maladie et les pratiques WASH, ce qui a conduit à une mauvaise santé et à des comportements de protection dangereux. Par conséquent, cette recherche a évalué les conditions WASH actuelles dans le bidonville urbain de Namatala, déterminant les taux d'accessibilité et de fiabilité du WASH, les obstacles possibles à l'accès à un WASH amélioré et proposé des options politiques à mettre en œuvre dans le bidonville urbain de Namatala afin d'améliorer le WASH dans la région. En utilisant la méthode d'échantillonnage aléatoire, un total de 160 ménages sur les 24 123 ont été sélectionnés et interrogés au cours de l'étude. De plus, à partir d'un échantillonnage raisonné, 34 informateurs clés ont participé aux entretiens et aux discussions de groupe ciblées. Les données ont été collectées à l'aide de questionnaires structurés auprès des ménages, de discussions de groupe ciblées et d'enquêtes sur le terrain, et analysées à l'aide du progiciel statistique pour les sciences sociales (SPSS). D'après les résultats, (72% [115/160]) les ménages ont accès à une quantité d'eau suffisante. (54 % [87/160]) des ménages utilisent un système d'eau courante tandis que

(33 % [53/160]), (4 % [6/160]), (4 % [6/160]) et (5 % [8/160]) utilisent respectivement des forages, des puits ouverts (sources et puits creusés à la main), des ruisseaux (rivière Namatala) et des vendeurs d'eau comme sources d'eau potable. (43 % [49/115]) les ménages ont un approvisionnement en eau peu fiable en raison de problèmes/pannes mécaniques rencontrés sous la forme de pannes de pompes, de réparations et de remplacements de canalisations. Les éclats/fuites du système sont les principaux facteurs identifiés par les ménages. En ce qui concerne l'assainissement, il y avait 83 toilettes dans le bidonville urbain de Namatala, 59 toilettes privées (toilettes non partagées) et 24 toilettes communes. (54% [87/160]) ménages ont accès à une latrine VIP/fosse avec dalle tandis que (19% [34/160]) ménages ont une latrine à fosse sans dalle/fosse à ciel ouvert. L'enquête montre également que très peu de ménages disposent d'installations sanitaires améliorées. Notamment, seuls (14 % [22/160]) les ménages disposent d'une latrine à chasse d'eau/à chasse d'eau tandis que (11 % [18/160]) les ménages avaient une chasse d'eau vers une fosse septique. Seulement (1 % [2/160]) jettent leurs matières fécales dans les égouts/canaux de drainage. Seules (46 % [38/83]) des toilettes disposaient d'installations pour le lavage des mains. Les robinets basculants fabriqués à partir de jerrycans étaient courants et des installations de lavage étaient installées à côté des toilettes. Le comportement en matière de lavage des mains enregistré était faible puisque seuls (58 % [92/160]) les ménages se lavent les mains après avoir visité les toilettes. La zone manquait également d'un système d'égouts conventionnel pour les eaux usées, c'est pourquoi les résidents utilisaient des canaux ouverts et des ravins ouverts comme conduites d'égout.

À l'aide de questionnaires destinés aux ménages et de discussions de groupe ciblées, l'étude a identifié des installations WASH améliorées inadéquates, un accès limité à l'approvisionnement en eau potable, la survenue d'événements liés au changement climatique, un financement limité dans le secteur WASH, des connaissances insuffisantes sur l'utilisation et la gestion de pratiques WASH saines, et l'implication inefficace de la communauté locale dans la planification et la mise en œuvre constitue le principal obstacle possible à l'accès aux services/installations WASH améliorés. Ces problèmes ont été attribués à l'espace limité/à la propriété foncière fragmentée, aux faibles niveaux économiques et au déficit de financement WASH, qui n'ont pas favorisé le développement du WASH dans le bidonville urbain de Namatala. Pour éviter cela, il est nécessaire de moderniser et d'étendre l'infrastructure/le

programme WASH actuel dans la région, l'autorité du conseil municipal de Mbale doit accroître son lobbying pour le financement WASH par le biais de subventions et de prêts, une planification et une mise en œuvre inclusives des installations WASH entre la communauté et les parties prenantes responsables des programmes d'assainissement total piloté par la communauté (ATPC), l'élaboration et la mise en œuvre de plans, de politiques et de lois d'investissement WASH au niveau national et au niveau des districts pour les établissements informels, et la sensibilisation aux pratiques WASH de base parmi les habitants des bidonvilles, et la mise en œuvre d'une gestion intégrée des déchets à Namatala. bidonville urbain.

Mots-clés : Assainissement, Eau, Urbanisation, Habitat informel, Bidonvilles urbains, Namatala.

CHAPTER ONE: INTRODUCTION

1.1 Introduction to the study

Globally, speedy urbanization and infrastructure development are one of the main challenges overriding the developing countries ¹. An increment in population growth has resulted into increased development of urban slums, with the highest prevalence registered in the regions of Southern and Central Asia, sub-Saharan Africa, South-Eastern and Eastern Asia ². Unlike other developed countries, where urbanization and infrastructure development has matched with strong economic growth, rural-urban migration in Africa is linked with rising rates of urban poverty ³. The speedy increase in the urban population coupled with poor planning and weak economic growth has resulted to African governments not always managing to provide adequate basic needs, services and decent living conditions at an equitable manner to the overall populace ⁴. Informal settlements, commonly referred to as slums, have thrived in many African cities ^{4,5}. As of 2014, estimated 55% of the over-all urban population in Africa lived in informal settlements (slums) ⁴. Urban informal settlers (slum dwellers) are predominantly vulnerable to water and energy resources scarcities in addition to food insecurity. The intrinsic complication of urban systems encountering numeral social and environmental challenges have led to a need for integrative management approaches. Over the ancient decade, urban sustainability and resilience are main pillars in the management of urban resources and in addressing challenges connected with urbanization and global environmental change ⁶. This is due to increased growth rate of urban informal settlements (urban slums) in developing countries, notably in Sub-Saharan Africa against the available urban infrastructure and service delivery ⁷. Furthermore, most of the world's urban informal settlements have undeveloped/ inadequate sanitation and hygiene facilities due to lack of funding, space, access and ownership of land ⁷. Inadequate WASH facilities has resulted into easy spread and outbreak of water-borne diseases such as diarrhea and dysentery, acute respiratory disorders, and skin infections, due to use and contact with contaminated water, poor hygiene practices and facilities ⁸. Additionally, slum dwellers have very low level of awareness and information about basic sustainable WASH practices ⁹.

As of 2018, 48.3% of Uganda's urban population were urban slum dwellers ¹⁰. Mbale city is the 7th largest city in Uganda harboring 76,493 people. Mbale city has survived with six (06) informal settlements namely Namakwekwe, Nabuyonga, Nkoma, Namatala, Mooni, and

Mukhubu. Notably, Namatala urban informal settlement is one of the Mbale's oldest, poorest and largest urban slums, which has developed into industrial, commercial, and residential community. The slum depicted the strongest patterns of urban infill and sprawl between 2003 and 2013. According to the Mbale city profiling report, Namatala informal settlement harbors an estimate of 24,000 people, largely attributed to rural-urban migration, and displacements from the frequent floods and landslides in Mt. Elgon region. Namatala informal settlement is characterized by inadequate medical services, an absolute poverty, dilapidated shelter, lack of essential infrastructure, inadequate waste management, and inadequate access to clean and WASH facilities, and services. This has resulted into easy spread and outbreak of infectious diseases (water borne and related diseases), increased health issues, low economic development, decreased in schooling among infants, and poor sanitary conditions. In order to eliminate these problems, an assessment of the current WASH conditions in Namatala urban slum was done since they are sought to be fundamental to good health and socioeconomic development of the area. Therefore, through cross-sectional analysis of the existing WASH facilities, this study revealed the current conditions of WASH services in Namatala urban slum, barriers to accessing improved WASH services, and proposed feasible interventions to improve the WASH conditions of the slum. The paper is structured as follows. In chapter 2, discussion defined different approaches and notions in WASH, defined an informal settlement with a provision of its characteristics. In Section 3, a description of the methods, methodology (approach), tools and Softwares that were used to execute this study. They are categorized into; research strategy, inclusion/exclusion criteria, data collection, data synthesis and analysis. In chapter 4, the final research findings are well presented in the form of household characteristics, water supply status, sanitation and hygiene conditions, possible barriers to accessing improved WASH in the area and the possible feasible interventions to improve WASH in the area. Furthermore, in chapter 5, conclusions of the study and recommendations from the study are presented while References drawn from the research are presented in chapter 6. Finally, appendices are attached in chapter 7.

1.2. Statement of the problem.

Namatata urban informal settlement is one of the Mbale's oldest, poorest and largest urban slums, which has developed into industrial, commercial, and residential community. As the urban slum population of Namatata grows, the demand for sustainable, accessible and reliable sanitation and hygiene services, and facilities is expected to increase. Currently, the slum is dominantly characterized by inadequate social amenities, poor housing units, obsolete poverty, lack basic solid waste management facilities and other essential infrastructure, in addition to inadequate access to clean water, safe sanitation and hygiene facilities. Additionally, slum dwellers have poor management of grey water, human excreta, storm water and solid wastes due to lack of conventional solid and wastewater management facilities. Inadequate WASH facilities accompanied with other unsustainable sanitation facilities and practices in the urban slum are major sources of polluting constituents (pathogens) that have continuously endangered public health and pollution of the available groundwater and surface water sources. Also, inadequate WASH facilities have resulted into easy spread and outbreak of infectious diseases (water borne and related diseases), increased health issues, low economic development, decrease in schooling, and poor sanitary conditions. To address this, the study assessed the current situation of the basic sanitation and hygiene infrastructure of Namatata urban slum.

1.3. Theoretical concerns

Most of the urban informal settlements are significantly disadvantaged in their locations, and dominantly characterized by inadequate social amenities, poor housing units, obsolete poverty, lack basic solid waste management facilities and other essential infrastructure, in addition to inadequate access to clean water, safe sanitation and hygiene facilities ¹¹. These problems are linked to slow of intervention by the government, lack of place-specific policy implementation of the national guidelines and policies as well as inappropriate regulation, and a vital lack of political will. Poor sanitation facilities and hygiene practices have become the identity of most of the urban slums. Sanitation refers to human excrete and solid wastes management in urban slum areas. The lack of improved sanitation facilities in urban informal settlements has led to emergence of unlined pit latrines, flying toilets (polythene bags directly disposed to the environment), and traditional pit latrines usually constructed in areas with a highwater table as the most predominant method of excreta disposal ¹². These sanitation and hygiene practices

have acted as sources of pollution to both surface and ground water through indirect and direct discharge of the pollutants into the environment ^{13,14}.

1.4. Research questions and the working: -

1.4.1. Central research question: -

What are the current status and barriers to access improved water, sanitation and hygiene in Namatala urban informal settlement?

1.4.2. Secondary research question: -

- i). What is the current status of water sanitation and hygiene in Namatala urban informal settlement?
- ii). What are the possible barriers to access improved water, sanitation and hygiene in Namatala urban slum?
- iii). Which feasible interventions can be implemented to improve access to clean water, adequate sanitation, and proper hygiene practices in Namatala urban slum?

1.5. Research objectives: -

1.5.1 General Objective: -

The general objective of this study was to assess the current determinants to access improved water, sanitation and hygiene in Namatala urban informal settlement.

1.5.2 Specific Objectives: -

- i). Assessing the current status of water sanitation and hygiene facilities/services in Namatala urban informal settlement.
- ii). Determining the possible barriers to accessing improved water, sanitation and hygiene in Namatala urban slum.
- iii). Proposing feasible interventions to improve access to clean water, adequate sanitation, and proper hygiene practices in Namatala urban slum.

1.6. Relevance of this study.

This research directly aligned with SDG 6 “Ensure availability and sustainable management of water and sanitation for all” and including all the targets. Additionally, the research has

enhanced achievement of Uganda Vision 2040 goal of 95% water and sanitation coverage in urban areas, more importantly, this study has added value to the literature in the field of access to improved WASH in Uganda. It has encouraged government efforts to promote community participation in sustainable water and sanitation projects, as outlined 1997 National Sanitation Policy. No similar study has previously been carried out in the specific area of Namatala informal urban settlement. Therefore, the lessons learned from this study have helped respective WASH stakeholders to better plan and implement sustainable water, sanitation and hygiene facilities and practices in Namatala urban slum. The research has also added provided detailed literature about WASH conditions which is beneficial to further researchers conducting studies related to WASH or on informal settlements

1.7. Scope of the study.

- Timewise, the study lasted for a period of four months (December/2023 to April/2023).
- Contextually, the study was limited to assessing the current water, sanitation and hygienic conditions and identifying the possible barriers to access improved WASH in the five zones (Sisye, Mvule, Wandawa, Doko and Nyanza) of Namatala urban slum.

1.8. Possible obstacles to this study.

The following were the obstacles encountered during this proposed study.

- ✓ There was partial or non-response by some correspondents to the survey
- ✓ Language barrier due to many tribes living and participating in the study.

1.9. Expected results.

The following are the results for this study.

- i). *Objective 1. Current status of water sanitation and hygiene facilities/services in Namatala urban informal settlement.*
 - ✓ The types of available water sources in Namatala urban informal settlement.
 - ✓ Reliability, affordability, quality (physical water parameters), and accessibility of the available water sources to Namatala urban slum dwellers
 - ✓ Types and status of the available sanitation and hygiene facilities in Namatala urban informal settlement.

- ✓ Reliability and accessibility of the available sanitation and hygiene facilities to Namatala urban slum dwellers
 - ✓ The current methods of human excreta, solid wastes and waste water management.
- ii). *Objective II. Determining the possible barriers to accessing improve water, sanitation and hygiene in Namatala urban slum.*
- ✓ Identified barriers by the households
 - ✓ Identified barriers from the focused group discussions.
- iii). *Objective III. Proposing feasible interventions to improve access to clean water, adequate sanitation, and proper hygiene practices in Namatala urban slum.*
- ✓ Feasible policy options to improve WASH accessibility and reliability in Namatala urban slum

1.10. conclusion

This chapter introduces the background to the research study. The chapter identified the main challenges faced by the developing countries, factors that have led to development of informal settlements, reasons for the increased emergence/development of urban slums, definition of informal settlements, and characteristics of informal settlement. Additionally, the chapter identified problems faced by urban slum dwellers, WASH characteristics in informal settlement, statistics of Uganda's national urban slum population with Namatala urban informal settlement inclusive. To understand the current WASH conditions as scribbled in the problem statement, a cross- sectional analysis of the existing WASH status was carried out in accordance to the set objectives, questions within the set scope of study. This research study provided a detailed literature useful to further researchers and implementation of feasible WASH policy interventions. During the study, language barrier and incorporation hampered the smoothness of the study.

CHAPTER TWO: LITERATURE REVIEW.

2.0. Introduction.

In this chapter, various literature was identified and analyzed. This chapter therefore defines and discusses urbanization, urbanization types and problems associated with urbanization in Uganda. Definitions, types and characteristics of various settlements in Uganda are provided in this chapter. Furthermore, the chapter provides for definitions, types, characteristics, various approaches and importance of accessing WASH in Uganda especially in informal settlements.

2.1. Urban Development in Uganda.

2.1.1. Overview on urbanization.

By definition, urbanization is defined as a population shift to urban from rural areas. Notably, it is the gradual increment of urban population and the behavioural societal adaptation change. Principally, it is defined as the process by which cities and towns are formed and become bigger due to more people living and working in these urban areas. Urbanization has led to the development of conurbation, metropolitan areas, slums, urban centres, and urban sprawls. Uganda is in the early stages of urbanization. According Uganda Population and Housing Census (2014), approximately 20% of Uganda's population live in urban areas and the remainder in rural areas. Although the rate of urbanization is relatively low, Uganda's urbanization rate is estimated at 5.2%, which is very high by international standards. According to the Uganda Population and Housing Census (2014), half of the country's population is projected to be urbanized by 2050, and in order to use urbanization as an engine of economic growth, comprehensive planning and identification/realization of the city's potential is required. Planned and effectively managed urbanization growth rate can result into a competitive and productive urban sector, stimulating socio-economic growth through job and wealth creation, while improving the quality of life of the people. Also, planned urbanization becomes an effective poverty alleviation strategy, offering potential benefits from agglomeration, improving people's access to basic services, reducing service delivery costs, and increasing demand and markets for goods and services. Uganda has already witnessed the positive effects of urbanization. Notably, urban sector as a producer with sufficient support, more jobs, incomes, housing, skills, higher value goods, knowledge, urban culture, wealth have been enhanced. However, if urbanization is not properly planned, it can result in, among other things, slums and informal settlements, poverty, environmental degradation, urban sprawl, poor

infrastructure and service delivery, urban crime, unemployment, and insecurity. To better harness the benefits of urbanization as well as adequately respond and address urban challenges, response efforts need to be guided by clearly defined policy directions, and therefore, a need to formulate an urban policy framework to provide guidance the transformation of Uganda's cities into modern and modern cities.

Map of Uganda showing major towns.



Figure 1: Map of Uganda showing major towns (World Atlas, 2015)

2.1.2. Forms of urbanization in Uganda.

Uganda is undergoing the following forms of urbanization.

- ✓ *Conurbation:* A region encompassing several large towns, urban areas and other cities, that, due to physical expansion and population growth, merging to form one incessant urban and industrially developed area. One of such places include the Kampala -Wakiso to Mukono highway development.
- ✓ *Metropolitan Area:* Metropolitan areas include a series of more than one urban area, towns, satellite cities, and superseding rural areas which are socio-economically linked to the urban core. Metropolitan areas are typically determined by the mode of commuting.
- ✓ *Slum:* A slum refers to a densely populated area with substandard housing units that are typically overcrowded and with inadequate access to basic services such as water

supply, health facilities and electricity among others. Most of the outcast settlements in Ugandan cities are in the form of slums/informal settings. With 31% of Uganda's urban population living in Uganda's capital, Kampala, the city has seen the development of 57 urban slums spread across its five divisions. Notably, Bwaise, an urban slum in Kawempe Division, is one of Kampala's oldest, largest and poorest urban slums. The development of most of the urban slums in these divisions is as the result of illegal encroachment on the wetlands, illegal housing development, commercial and industrial activities on the wetlands have thus increased the pollution rates in these slums. Also, these urban slums are characterized by poor water sanitation and hygiene services/facilities, waste management and disposal methods, leading to 75% of residents sharing toilet facilities, illegal dumping of solid waste into storm sewers. These challenges accompanied with frequent flooding and poor sanitary conditions have contributed to frequent outbreaks of infectious diseases such as typhoid fever, amebiasis, diarrhoeal, dysentery and measles in these slum areas.

- ✓ *Urban*: A concentration of people in a particular geographical area, having a minimum density of 1,000 people per square kilometre, and where more than 60% of non-agricultural activities take place. In Uganda, most of the town areas are urban since they have more than 1,000 people per square kilometre.
- ✓ *Urban Centre*: An Urban Centre in this policy context is referred to as, using level and hierarchy of the service delivery and access means a town council, town board, town division, municipality, metropolitan or city or area.

2.1.3. Problems associated with urbanization in Uganda.

Despite all the benefits from the current urbanization process, Uganda's urbanization nonetheless faces an extensive range of challenges including among others the following:

a) Slum and Informal Settlements development

Uganda's speedy urbanization has not been accompanied by comparable growth in the capacity of its local governments to plan and manage urban growth. This resulted into the proliferation of slums and informal settlements. Slums and informal settlements are characterized by high poverty levels and poor living conditions, including overcrowding, substandard housing, and limited access to services and facilities. Slum dwellers typically live in small single rooms,

making living conditions intolerable. More than 70% of the housing units are constructed using temporal construction materials, 27% of which are in urban areas. The economic profile of the urban poor shows that 25% of the urban poor are unemployed, the majority of whom are youths and women, who lack adequate necessary skills and education to find gainful employment.

b) Poor Solid Waste Management

Improper waste disposal is a nationwide problem in Uganda. Approximately 32% of the urban population heap their wastes along the roads and in sewer lines, 13% dispose in the gardens, 19% in pits, and the remaining 36% of the waste is disposed off in landfills (open dump sites). In informal settlements and slums, waste is disposed off usually ends up in the sewage system, leading to blockage of waterways. Disposing of waste in landfills poses significant risks to the environment and health.

c) Deteriorating Urban Environment

An increasing urban growth has undesirably impacted on the environment resulting into environmental degradation, due to conflicting land users, destruction of green belts, unsustainable waste management practices, and ecological fragile. Most of the urban areas are still vulnerable to natural calamities/hazards notably; floods, drought, and landslides.

d) Weak Urban Economy

Uganda's urban economy is defined by low productivity and competitiveness, and is mainly dominated by the informal sector. An increase in urban population growth is not accompanied by job opportunities that would foster growth. Most of the economic activities and investments are constrained by insufficient capital and skills to mobilize the necessary resources to carry out large-scale activities. Furthermore, the urban economy has not created and promoted adequate development and growth opportunities in the urban hinterland. Another challenge for urban economies is inadequacy to attract local and foreign investment and trade to create a viable economy, increase employment opportunities, and ensure sufficiency in terms of revenue and other resources.

e) Urban Sprawl

Uganda is currently undergoing unprecedented magnitude of urban sprawl (uncontrolled physical growth) which has created high cost of service and infrastructure provision,

environmental degradation and wetland encroachment for mainly agricultural productivity and production.

f) Inadequate Urban Infrastructure and Services

Rapid urbanization, inadequate financing, and unplanned development in many urban areas has led to lack of adequate capacity to meet infrastructure development and service delivery. Funding from central government to urban local governments are inadequate as compared to the daily urban service needs. The level and quality of services provided by the urban authorities do not meet the needs of the urban population. In many urban areas in Uganda, such as Kampala Capital City, faces influx of people who live outside and work in city. This has exerted an enormous pressure on the public water sanitation and hygiene facilities, environment, and transportation system in the city at daytime. While cities must meet the demands of commuters, most of the basic city services face an overwhelming pressure exerted by the daytime population, even though urban infrastructure planning and development is based on the night-time population, which is relatively much smaller than the daytime population.

2.2. Types of settlement in Uganda.

Uganda has numerous types of settlements as described below.

2.2.1. Informal settlement.

According to The United Nations Human Settlements Programme (UN-Habitat 2011), and informal settlement is defined as: - “a residential area where i) the inhabitants do not have the security of tenure of the land or dwelling unit they inhabit, with modalities ranging from casual rental housing to squatting, ii) the neighbourhoods are always cut off or lack the basic city infrastructure facilities and services and iii) the housing units always do not comply with current building and planning regulations/policies and are often located in environmentally and geographically perilous areas”¹⁵. UN-Habitat further describes slums as “the utmost excluded and deprived form of informal settlements”. Slum households referred as those “where inhabitants suffer from one or more of the following ‘household deficiencies’: lack of access to improved water supply, sanitation and hygiene facilities, lack of adequate living area, lack of housing resilience and inadequate security of tenure”. Equated to non-slum urban or rural populations, many researches have found higher morbidity and mortality rates in slum settings, predominantly among children and infants^{16–19}. The most imperative reason for a higher

burden is the physical environment since over crowding and lack of access to safe water sanitation and hygiene catalase the spread of enteric infections and mostly infectious diseases²⁰. Nevertheless, terms such as squatter settlement, slum, informal settlement, and peri-urban area are habitually, but not continuously, used interchangeably. During this study, slum and urban informal settlement was observed to be synonyms.

2.2.1.1. Characteristics of informal settlements.

Informal settlements are usually characterised by the following three main conditions: low standards of services and structure (housing), high population concentrations, and squalor experience. Nonetheless, the quality of materials and dwellings used, and the variability of tenure activities practised, within informal settlements can diverge significantly. Despite these variations, it is likely to outline the main characteristics that define a typical slum or informal settlement. According to²¹, these characteristics include: -

- ✓ *Lack of access to basic services.* Access to basic services such as safe water sources, sanitation and hygiene facilities, is life-threatening in this regard. This may sometimes be supplemented by lack of electricity supply, lack of waste collection systems, poor road network, no street lighting and lack of drainage system.
- ✓ *Inferior housing units or illicit and insufficient building infrastructures.* Informal settlements have closely concentrated inferior housing structures, built using temporal materials not suitable for housing at any given climatic conditions and location.
- ✓ *Overpopulation and high density.* Informal settlements are associated with overcrowding due to, high occupancy rates, low space per person, sharing of housing units resulting to many single-room units.
- ✓ *Unhealthy living environments and hazardous settings.* These unhealthy living conditions are as a result of a lack of access to basic services with uncontrolled dumping of waste, open sewerage network, poor road network, and polluted environments, etc. Most of the housing units are built on risky locations or land inappropriate for settlement, such as wetlands, floodplains, in propinquity to industrial plants, and waste disposal sites.
- ✓ *Insecure tenure.* Informal settlements experience insecurity, and is considered a dominant characteristic of informal settlements.

- ✓ *High poverty rate.* Poverty in informal settlements is observed as a cause of many informal settlement situations. Informal settlements are perceived to be areas with high levels of crime also areas of social exclusion that are often and other measures of social dislocation.

Other informal settlement such as those in the inner-city and estates (including public housing units that have depreciated and hostel housing) are not considered.

2.2.1.2. Types of informal settlements

There are three types of informal settlements. These are:

Large-scale and concentrated informal settlements.

These informal settlements are reflective process of residents illegally occupying dormant public land and erecting makeshift housing units. Occupation normally takes place without the permission of the government or the landowner. This type of informal settlements are large settlement areas, positioned without owner's permission on the urban margin, with homes characterized by self made housing units of tins, corrugated iron sheets, recycled products and plastica. These settlements are often of a comparatively current origin and situated on marginal land formerly viewed as existing outside of the urban city boundary, with the quality of housing units becoming more consolidated and secure as the informal settlement also becomes secure.

Scattered pockets informal settlements

Under this category of informal settlement, self made structures are also constructed without landowner's permission taken as development of dissimilar and sprinkled informal settlement pockets. People who have established dwellings in these are not considered fit for human habitation, such as steep slopes, flood prone land, and garbage landfill sites, as well as areas not generally reserved for residential habitation, such as on pavements and under bridges. This specific type of informal settlement tends to be made up of less households which are geographically spread, largely surrounded by other formal housing units and authoritatively legal land developments. Given the nature of these informal settlements being generally small, they do not have the ability to support their peculiar social infrastructure such as schools, hospitals and clinics among others. Therefore, provide they have access to, slum residents make full usage of neighbouring facilities

Illegal subdivisions and settlements.

Illegal subdivisions and settlements occur when the rightful owner of land rents, subdivides, or resells sections of his/her property or land to other additional residents, without getting formal permission. Illegal subdivisions and settlements are essential land developments in which authorisation has not been approved, even though the landowner has provided occupancy permission. These illegal subdivisions and settlements are mainly found on the peripheries of rural areas and in cities. Shack dwellings found in backyards of properties can also be included in this category of informal settlement. These forms of illegal subdivisions and settlements are not recognised by the local and state authorities, and therefore, generally have inadequate access to most of basic infrastructure. The housing structures in this category of informal settlements are constructed using more durable materials since the landowner gave permission to build, however access to most of the basic facilities such as health centers, and schools may be poor.

2.3. Water issues

Water is a unique resource with virtually no substitutes, and the need for it is rapidly increasing²². Although irreplaceable for most uses, difficult to detoxify and expensive to transport, water is a manageable natural resource that can be diverted, transported, stored and recycled²³. Commonly, socioeconomically destitute urban slums are exposed to greater public health risks from drinking water supplies²⁴. Inadequate/lack of access to safe water supply has been linked with the augmented hazard of transmitting water borne diseases, water related and infectious diseases such as typhoid, cholera, and hepatitis A²⁵. Poor water access and reliability impacts on the socio-economic development and household income due missed days from work, and has also adversely affected the women and girl child's domestic labour duties such as inability to finish daily house core duties (washing clothes, laundry, and cooking) intime because of water scarcity. Children especially girl child often miss school due to poor menstrual hygiene and water collection duties. Inadequate water supply and access has also led to poor sanitary conditions mainly in shared sanitation facilities. Also, inadequate water quantity has led to easy spread and outbreak of illnesses due to worsening of hygiene in homes, public spaces, most crucially, public toilets, which may lack constant water supplies.

2.3.1. Global water distribution.

Water resources are natural water resources that are potentially useful to humans. Water resources are very essential to the maintenance of life, life support systems, and the economic well-being of societies that use them as sources of drinking and irrigation water. The earth has approximately 1.386 billion cubic kilometres of water, with 97% being seas and oceans, containing salt water, more than 2% existing as glaciers and ice caps, and about 1% spread in the form of ground water rivers, water vapor and lakes ²⁶. Almost 97% of the water in the hydrosphere is distributed in the seas and oceans. These are all brine blobs (saline water masses)²⁷. These waters are not suitable for direct consumption such as cooking, drinking, irrigation, and industrial purposes. Freshwater constitutes to only 3% of the water available on Earth. Looking at the further distribution of freshwater alone, almost 66.7% is bound in the form of ice sheets and glaciers. Approximately 30.1% exists below the earth's surface as groundwater²⁸. Only 0.3% of surface water is available directly at the earth's surface, and the remaining 0.9% exists as water vapor and soil water. The proportion of surface water is 0.3%, which is made up of flowing water such as swamps, lakes, and rivers. Natural freshwater sources include surface water, submerged river water, groundwater, and frozen water. Artificial freshwater sources include treated wastewater (wastewater reuse) and desalinated seawater ²⁶. The ability to use water and manage it appropriately determines the quality of life and the speed and sustainability of economic growth. Similarly, the ability to predict and manage the extent of its occurrence, whether it is too little or too much, will determine the severity of the negative impact on humans and their environment. Furthermore, water is a unique resource with virtually no substitutes. It is a finite resource on earth, and the need for it is rapidly increasing. As a result, competition for its control and use becomes increasingly intense, its value also increases, and the propensity for conflict increases ²².

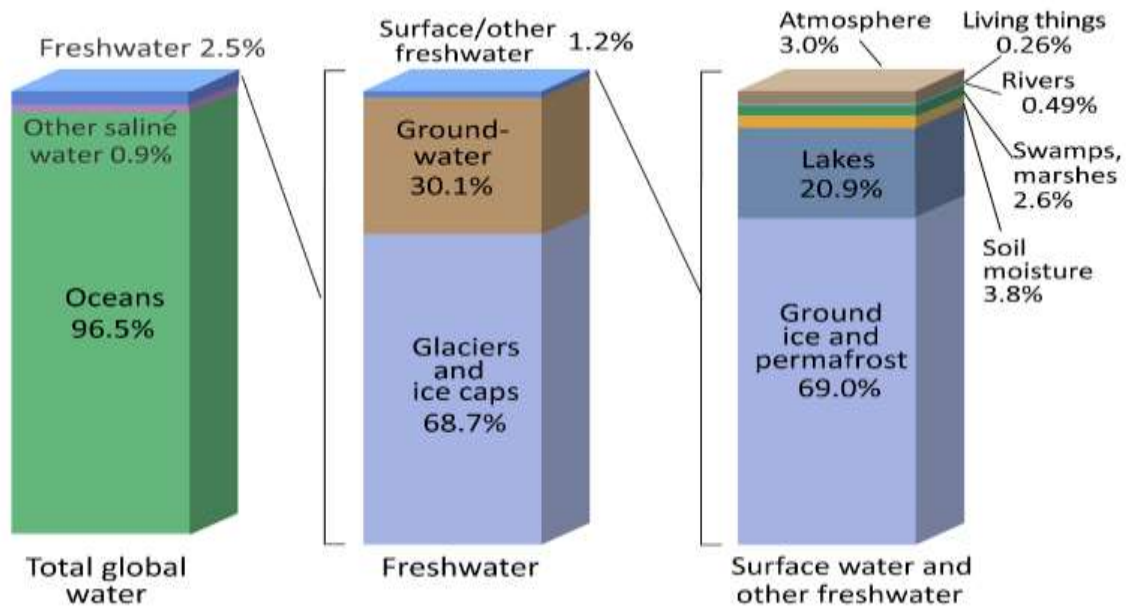


Figure 2 : The distribution of water on, in, and above the Earth

2.3.2. Water distribution in Africa.

African continent houses two large deserts (the Sahara and the Kalahari) that are noticeable geographical landmark features. Rainfall regimes are irregular, unstable and temporally and spatially variable. Drought and desertification and their devastating effects are regularly reported across the continent. High annual rainfall totals are recorded in many parts of the continent especially in the Central parts and Gulf of Guinea. In addition, some of world largest river systems such as the Nile, the Congo, the Zambezi and the Niger are found in Africa. In fact, Africa is said to have the volume of freshwater resources proportional to its share of global population ²⁹. Mean annual rainfall in Africa is estimated at 670 mm with wide temporal and spatial variability. The island countries receive the highest amounts of rainfall averaging 1,700 mm/year followed by the Central African countries and Gulf of Guinea with about 1,400 mm/year. Lowest amounts are recorded in the northern countries with an average of 70 mm/year ²⁹. With 17 big rivers (having catchment areas greater than 100,000 km²), 160 large lakes (>27 km²) extensive wetlands, and appreciable groundwater Africa would appear to have abundant water resources.

2.3.3. Water distribution in Uganda.

Among all renewable resources in the Uganda, water has an exceptional place. It is essential for sustaining all forms of life, producing food, promoting economic development, and general

well-being. Although irreplaceable for most uses, difficult to detoxify and expensive to transport, water is a manageable natural resource that can be diverted, transported, stored and recycled ²³. Uganda enjoys all the two distinct categories of water resources (surface water and groundwater) that are part of the earth's water cycle and play an important role in domestic water supply, livestock watering, industrial activities, hydroelectric power generation, agriculture, shipping, fisheries, waste management, tourism and environmental protection. Water resources in Uganda comprehended as an active segment of the hydrologic cycle are determined by physiographic, geological and climatic factors ³⁰. Also, Uganda's orography influences mainly occurrence of rainfall amidst other climatic fundamentals such as wind, temperature, and humidity that directly influence evapotranspiration, a major determinant of water resources totality ³¹. Therefore, the hydrology of Uganda is as summarized below.

Surface Water Resources in Uganda.

In Uganda, surface water resources cover 15.3% of Uganda's surface. Lakes i.e., Lake Kyoga, Lake Edward, Lake George and Lake Albert are the main surface water resources in Uganda. Lake Victoria spanning over 69,000 Km², is the second largest lake in the World and the most prominent surface water resources/hydrological feature in Uganda ³⁰. The most important water bodies include Lake Victoria, Lake Kyoga, Lake Albert, Lake George, and Lake Edward in addition, there are also 149 small lakes distributed throughout the country and covering an area of 38,500 km² ³². With all these surface water resources, around 35% of its water resources come from neighboring countries, which can lead to water availability and quality problems in upstream areas if there is heavy pollution or excessive abstraction by the neighboring countries. Agricultural production, irrigation schemes which aim to support agricultural development are the largest consumers of water resources in Uganda. Due to lack of innovative solutions, under funding in the water sector, political instability in some regions, and uneven distribution of the water resources, most of ground and surface water resources have remained undeveloped ¹³. This has caused uneven, inadequate accessibility and availability of water supply to most of the communities. Also, because of urbanization, climate change effects, climate variability, rapid growing population and improving living standards, the pressure on Uganda's water resources has increased and per capita accessibility of water resources has dropped daily. Spatial and temporal variability in precipitation is another challenge Uganda faces, which has

often resulted into floods, landslides and droughts ³³. Figure 3 below shows major surface water sources in Uganda

Map of Uganda showing surface water resources.

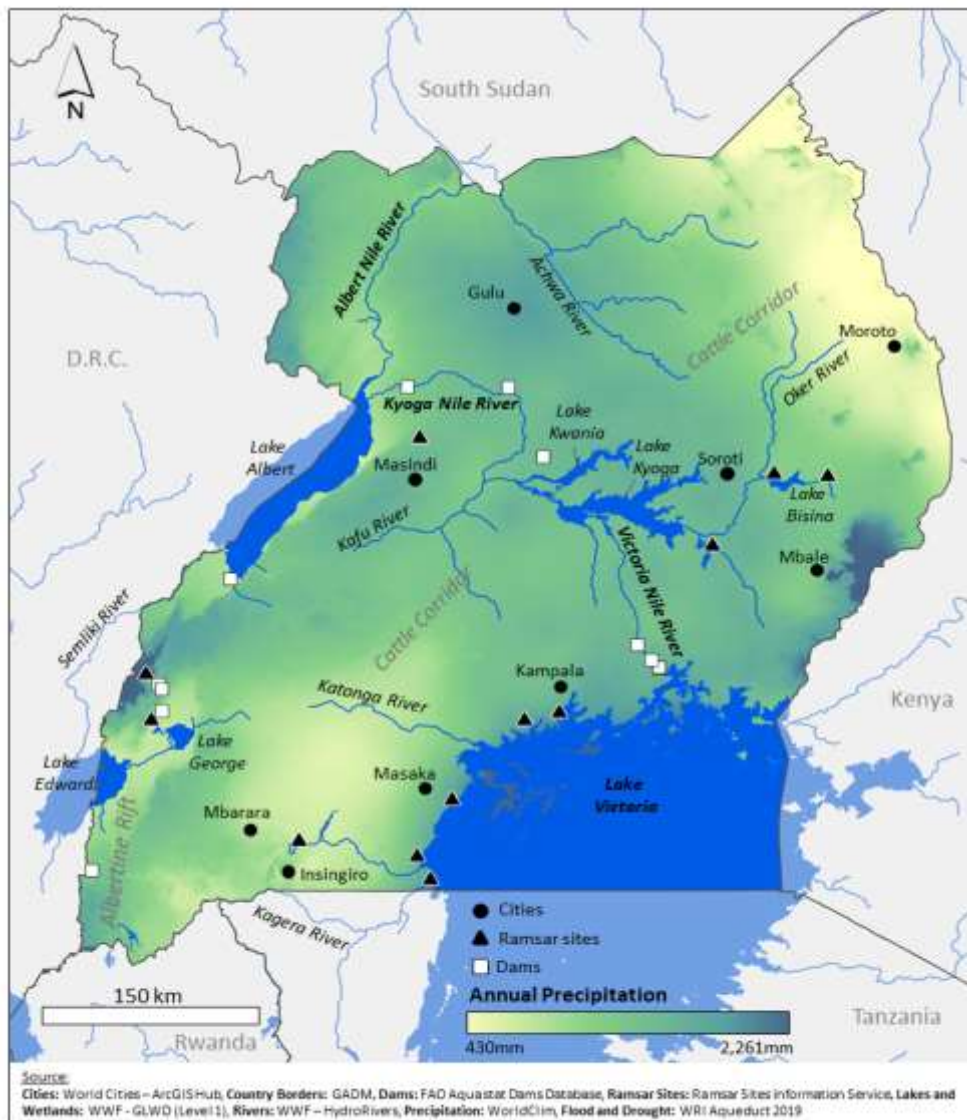


Figure 3: Major Surface Water Resources in Uganda

Source: Uganda National Water Development Report, 2005

Groundwater resources in Uganda.

Globally, the primary source of freshwater for irrigation and drinking is groundwater. In Africa, ground water supplies are estimated to be 75% of all safe sources of drinking ³³. In Uganda, approximately 90 percent of its surface area is covered by moderately low yielding hard rock aquifers. This accounts for the 61% of the country's water being from groundwater sources accessible from springs and wells around Lake Victoria and south-western Uganda. The main

extraction method of groundwater in Uganda is by use of the boreholes with yields generally low and with depths typically less than 80m, but can be also as deep as 200m. In most of the semi-arid, rural and arid areas in Uganda, groundwater is the major source of drinking water supply. Since 1930, groundwater development has been undergoing in Uganda through construction of shallow wells, deep wells and spring wells. Approximately 3,000 shallow wells, 20,000 deep wells, and 12,000 protected springs have been developed, and built primarily for domestic water supply in rural areas. In the 1990s, groundwater withdrawal was intensified to ensure the city's/urban water supply. Gradually, groundwater development has improved in order to improve access and availability of safe and sustainable water supply to communities. For example, as of June 2006, 782 small towns had tap water supply, and 70% of this water is from groundwater sources such as deep wells³³. Nationally, a total of 73 of the 98 medium scale operating water systems in Uganda rely on groundwater. This represents about 75% of all cities. In Kampala city, several industries also rely on groundwater, such as mineral water and chemical industries. Boreholes and shallow wells are usually installed using hand pumps with a capacity of 1 m³/hour and their output are usually low. Groundwater has its benefits high-quality water requires little or no treatment cost and is easily operated and managed by users, resulting in lower capital and operating costs than surface-based systems³³. Normally, boreholes with a yield of more than 3 m³/h are usually suitable for the installation of motor pumps for piped water supply. In 1996, the government of Uganda initiated a groundwater assessment study to fully understand the nature, extent, and reliability of the country's groundwater resources. This study provided information on groundwater recharge, aquifer distribution and behavior, impact of electric pumping on groundwater resources aquifer vulnerability to pollution, and developed a conceptual model of groundwater dynamics. For example, groundwater surveys in three catchments of Wamala, Rwizi, and Victoria showed that the groundwater resources were declining³⁴. According to the monitoring and evaluation section of the DWRM report, causes of decline include climate change/global warming, land use change, notably deforestation, poor catchment management, reduced rainfall, unsustainable water withdrawal and persistent drought in these catchments.

Rainfall (Rainwater Harvesting).

Although some regions have high rainfall variability, Uganda receives two sets of wet seasons. During the rainy season between March to May much of the rainfall is received with little rainfall during a shorter rainy season of October to December. Rainfall in Uganda is moderately to relatively abundant, characteristically ranging between 700 millimeters and 1,500 millimeters per year. From April to October further from the Equator in the northern direction experience rainy season with dry season from December to February. South-western and north-eastern regions are the driest areas in Uganda with precipitations dropping below 1,000 mm and 700 mm per year or even less. According to historical data analysis (1901–2016) from the World Bank Group’s Climate Change Knowledge Portal, results showed that mean annual mean temperature for Uganda was 22.8°C, with monthly temperatures of between 21.7°C (July) and 23.9°C (February). During this period, 1,197 mm was the annual average precipitation with national mean monthly precipitation varying from 39.6 mm in January to 152.7 mm in April. Figure 4 below illustrates Uganda’s most current climatology, from 1991–2016.

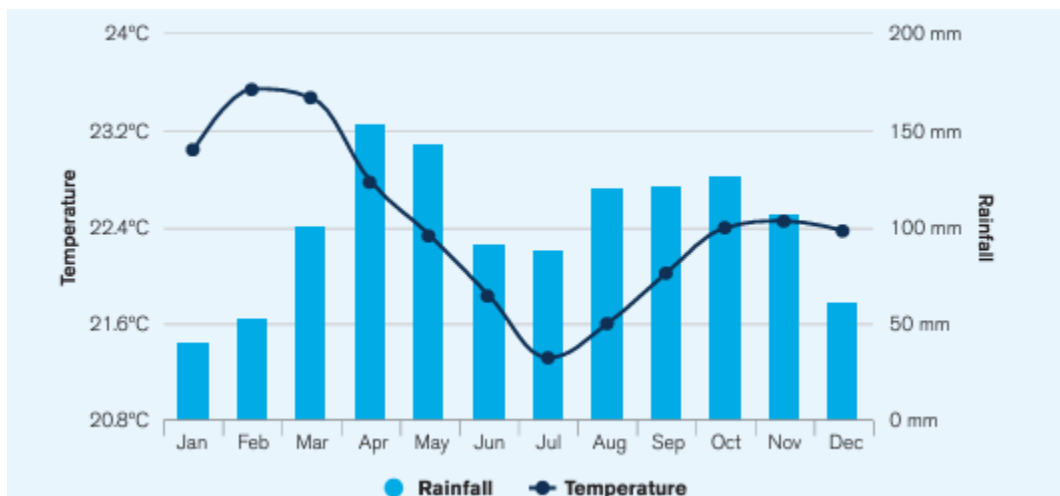


Figure 4: Uganda’s most current climatology

Rainwater is the collection or harvesting of rainwater that runs off on the roof of hard surfaces while storing in a tank. Rainfall is one of the major sources of clean water accessible to communities in most of the developing countries with inadequate infrastructure. Rainwater harvesting (RWH) technology is not a novel concept, with roof RWH the most commonly implemented. In such communities, corrugated iron roofed houses popularly provide good collection and runoff of comparatively clean rainwater mainly for domestic uses. MWE asserts

that rural population in Uganda is duly positioned to harvest and store rainwater mainly suitable for domestic uses, hence increasing accessibility to safe water at household level. Currently, RWH initiatives have been implemented particularly in areas having a long dry season, areas with polluted or facing difficulty in accessing surface water and groundwater. This source of rain water is considered to be free, relatively reliable and clean with a lower maintenance cost. Most of the rainwater harvesting in the informal settlements is from hard roofs made of slate, tiles, (corrugated) galvanised metal or equivalent.

Pipe water system.

A piped water system is a water system composed of an energy source (grid (electricity), solar), an elevated storage tanks (plastic or steel), centralized pumping station (surface or submersible pumps), transporting water through underground pipes to the target population, in private or shared spaces such as yards near houses. Most of the water supply system has either a gravity or a pumping-built abstraction, distribution and transmission system from nearby local/distant water source with sometimes with water treatment system. Most of the sanitation facilities/services and water supply/provision in rural area is piped water supply covering a scattered population in wide communities or settlements, and rural growth centers (RGCs) with populations between 1,500 and 5,000.

Water supply in informal settlements.

The following are some of the water sources accessed by slum dwellers.

- ✓ *Ground water:* Use of a tube/bore, an open well, hand pump as water sources make water available from ground for public use and application.
- ✓ *Open Well:* Where ground water is available at low depth (less than 15 meters - and water is available all year round, open well is used.
- ✓ *Hand Pump:* Where safe ground water is available up to 60 m depth, hand pump is ideal choice for a cluster or habitation.
- ✓ *Bore Well/Tube Well:* Where ground water is at greater depth and open wells or hand pumps are not viable, bore well or tube well is installed.
- ✓ *Surface Water:* River, pond, dam site are sources where surface water is available. Moreover, rain water can be harvested and stored directly in storage tanks. This water is potable after first rain and can be used for drinking purpose also.

2.3.5. Water Resources Utilization.

Over the past 50 years, freshwater withdrawals have tripled since the demand for fresh water is increasing by 64 billion cubic meters (1 cubic meter = 1,000 litres) every year ³⁵. This is attributed by the following factors.

- ✓ Population growth. The world's population increases by about 80 million people each year.
- ✓ Changes in lifestyle and eating habits in recent years require increased water consumption per person.
- ✓ Biofuel production has also increased significantly in recent years, which has a significant impact on water demand.
- ✓ It takes 1,000 to 4,000 litres of water to produce one litre of biofuel.
- ✓ Energy demand is also increasing, with a corresponding impact on water demand.

Percent distribution of water use among domestic use, industrial use, and agricultural use in the world, in high-income countries and in low- and middle-income countries

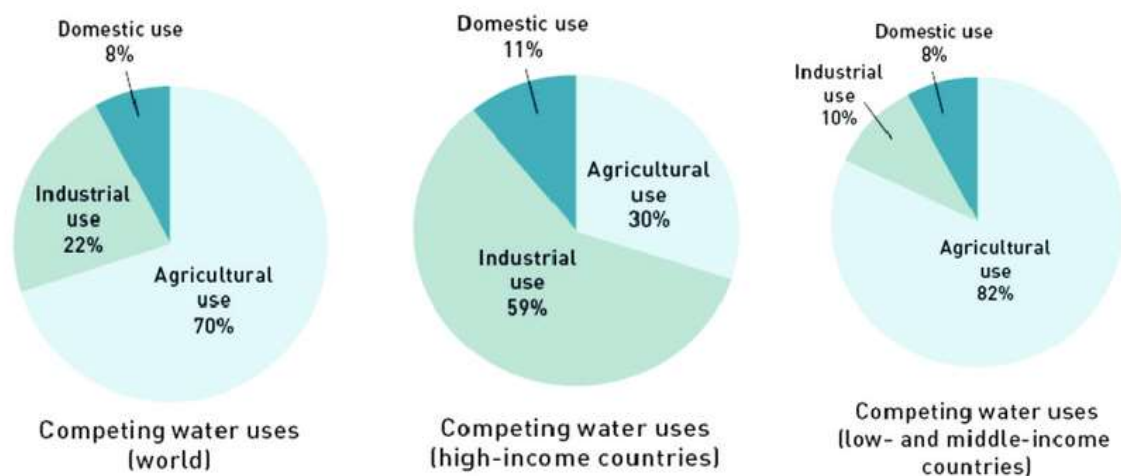


Figure 5: Percentage distribution of water use in the world.

Sectorial water uses in Uganda.

With rapid population growth, industrialization urbanization, climate change and change in water demand trends among other factors, water in Uganda is utilized in the following sectors.

- Water for agriculture/Irrigation: in Uganda, one of the most prominent land use method is rain fed agriculture. Currently, fast growing population and climate

change/variability have threatened this practice thus affecting on nationals and household food security levels. As a result, more efficient strategies on use of both water and land resources in order to improve food security have been adopted. Irrigation for example in the most widely used approach applied to increase agricultural production per unit area, in areas that do not receive enough rainfall.

- ✓ *Water for Power.* This uses the highest amount of water as directly used in Hydro-Electricity Power (HEP) generation. 2005 study by the Nile Basin Capacity Development Network (NBCBN) found that water resources have over 2,500 MW of power generation capacity, of which over 2,000 MW is concentrated mainly in the Nile River, with the rest in parts of the country presumed to be scattered throughout the country. This result shows that Uganda has a strong hydropower potential, potentially exceeding 4500 MW. In terms of the number of projects, Uganda's power plants are overwhelmingly small hydropower plants, currently accounting for 19 of the 35 grid-connected power plants. However, large hydropower plants with an installed capacity of 855 MW dominate the Ugandan power landscape.
- ✓ *Water for industry:* For example, the role of water in industry contributed 24.2% of Gross Domestic Product (GDP) in 2008/09 and increased to 26.9% in 2010/2011 ³². The construction industry uses a lot of water, especially at this time when the country is building infrastructure. These water-intensive industrial activities (construction, manufacturing, mining and quarrying) contributed 12.3%, 7.5% and 0.3% respectively to the total GDP in 2008/09. Demand for water, which is indispensable for industrial transformation and poverty eradication, is expected to continue to be high in light of the trend of economic growth.
- ✓ *Water for fish:* Water resources have helped in fish farming in diverse ways resulting to fish from aquaculture and from the inland waters. Fishing activity has directly improved the living standards of people, makes up a large part of the diet of people at home and abroad. It has also directly created employment in terms of fish processing, fish trade, boat building, industrial fish processing, net making, fish extension and administrative services to the residents around these areas.
- ✓ *Water for transport:* Used to move goods from one area to another for use and trade using boats, ferries and ships. Water transport connects Ugandans living on the island

to the mainland and those involved in cross-border trade with the Democratic Republic of the Congo, Tanzania and Kenya.

- ✓ *Water for environment, recreation and tourism:* Tourism in Uganda is a high priority area and is dependent on the natural beauty and quality of the environment, including wetlands, grasslands, lakes, rivers, and associated landscapes such as waterfalls, beaches, and rare animal species, which offer a wide range of tourism activities. Most resorts in Uganda offer water sports such as swimming, fishing, rafting and sailing.
- ✓ *Water supply:* Water supply is an integral part of production such as manufacturing, power generation, mining, construction and agriculture. Its quantity and quality are important indicators of a country's achievements in conserving its natural environment. Access to water has plateaued at 64% in rural areas and 77% in urban areas, with a target of 100% in urban areas and 77% in rural areas by 2015.
- ✓ *Water for Sanitation:* This is a public health field that is necessary for preventing, and controlling disease. It comprises of sewerage treatment, personal cleanliness, water treatment, and waste disposal systems among others. Sanitation worsens where water conditions are poor and uncertain which directly affects the wellbeing of communities. Embedded in the SDG6 and its targets, clean water supply and sanitation facilities are financed by both Uganda's government and non-governmental agencies.

2.3.6. Possible sustainable options of improving water supply.

Depending on the condition, the following are the possible options to improve or provide access to potable water,

- ✓ Improving or repairing the working condition of the failing water supply system.
- ✓ Protecting, cleaning, or disinfecting of the most frequently used unprotected water supply sources, in order to reduce exposure to (re)contamination.
- ✓ Reduction or elimination of water user fees levied by the private, public or local authority.
- ✓ Up-grading of the preferred protected (safe) water sources in order to improve supply and distribution capacity thus reduce waiting time and lines.
- ✓ Distribution of larger water storage containers to families so as to increase household storage capacity of potable water, decreasing the daily number of trips to water sources.

2.4. Sanitation issues.

Sanitation here is defined as management of, grey water, human excreta, storm water and solid wastes. According to the World Health Organization (WHO)/UNICEF Joint Monitoring Programme (2015), an estimate of 32% and 9% of the world's population lack access to safe sanitation facility and water source respectively ³⁶. More than two (02) billion people have access to an improved sanitation practices and facilities since 1990 with more than 700 million without access to improved sanitation ³⁶. This indicates that, a third (one in three) people have no access to improved sanitation, mainly in sub-Saharan Africa, Eastern and Southern Asia. In general, a fifth (one in five) people practice open defecation, a poor human excrete (urine and faeces) management method ³⁶. In urban slum areas, the most predominant method of excreta disposal is by use of unlined pit latrines, usually constructed in areas with a highwater table. Other excreta disposal practices/facilities and options include pour flush toilets and ventilated improved pit latrine for high income earners, flying toilets (polythene bags directly disposed to the environment), and traditional pit latrines ¹². Also, some of the excreta disposal systems and practices are shared by many households in the slum areas and pollute both surface and ground water through indirect and direct discharge of the pollutants into the environment ^{13,14}. Additionally, a majority of the infrastructure systems used in the urban slums are not directly connected to central sewage network, hence most of the slum dwellers intentionally discharge raw sewage into drains and streams through pipes and open waste. These unsustainable sanitation practices and facilities are considered to be major contributors of the pollution load into the environment in many urban slums, in the form of excreta, grey water and solid wastes ^{13,14}.

2.4.1 Basic sanitation.

These are facilities ensure hygienic separation of human excreta from human contact. They include:

Toilets and latrines.

Proper sanitation facilities (for example, toilets and latrines) promote health because they allow people to dispose of their waste appropriately, preventing contamination of their environment and reducing risk to themselves and their neighbors. Throughout the world, many people do not have access to sanitation facilities, resulting in improper waste disposal that safely contain

waste away from human contact and ensure that waste is properly treated prior to environmental discharge and other risks.

Types of toilets and latrine in urban informal settlements.

- ✓ *Packet Latrines.* Individual, single-use biodegradable bags for point-of-use sanitation that are buried or properly disposed. Bags typically used inside reusable buckets. This type of facility requires no infrastructure required, it is lightweight and easy to transport, and may be used where space is severely limited or in flooded areas. However, these bags are openly discarded posing health/odour risks to others.
- ✓ *Bucket Latrines or Elevated Toilets.* These are elevated temporary structure over large container or tank that can be lined with large, replaceable plastic bag. They are suitable for sites with digging of latrines not being feasible or suitable, i.e., areas with high water table or where flooding occurs.
- ✓ *Chemical toilets.* These are portable prefabricated sanitation units with water-tight excreta-holding tank, containing a chemical solution to aid digestion and reduce odor.
- ✓ *Ecological Sanitation (Eco-San) Latrines.* These are elevated structure over container or bin which stores organic waste for decomposition. Dehydrating toilets divert urine from organic waste and require bulk drying and pH additives. Non-urine diverting toilets collect all waste for decomposition and require the addition of organics. Used for accustomed populations or agricultural communities.

Sewer Systems and Wastewater

Community wastewater management and adequate sewer systems play important roles in sanitation and disease prevention. Wastewater with faecal waste (or poop) can contaminate the local environment and drinking water supply, thereby increasing the risk of disease transmission. To improve health, it is vital to develop a system to manage community wastewater and sewage. Without proper management, onsite sanitation facilities (such as pit latrines) can fill up, and the fecal waste (called fecal sludge) must be emptied by manual or motorized means and physically transported to a treatment facility. These systems present new challenges in protecting worker safety, treating the waste, and ensuring that the costs of wastewater treatment are feasible for households.

2.5. Hygiene issues.

Hygiene refers to practices that can lead to good health and cleanliness, such as frequent handwashing, face washing, and bathing with soap and water. Hygiene involves the practice of keeping one's surroundings and oneself clean to avert the spread of diseases and illnesses. Hygiene includes cleanliness of our schools, homes, the people and communities. Good hygiene is a barrier to infectious diseases including diarrhea and skin diseases since hygiene process comprises of precautions to be taken in order to reduce microorganisms. One of the most important ways to prevent the spread of illness, including diarrheal and respiratory illnesses is by keeping hands clean is. However, in many areas of the world, practicing personal hygiene is difficult due to lack of access to necessities such as clean water, soap, hand washing facilities, and knowledge of good hygiene behaviour necessary to promote sustainable hygienic conditions. Mainly in informal settlements, there is almost no or little awareness of good hygiene knowledge, practices and the role of the slum dwellers in reducing the spread of diseases caused by poor hygienic conditions. Below are forms of hygiene that are necessary to enhance sustainable hygienic conditions.

2.5.1 Forms of hygiene.

The following are forms of hygiene.

Personal hygiene.

Personal hygiene are individual practices performed in order to maintain and care cleanliness of clothing and the body in order to preserve the well-being and overall health. Personal hygiene practices include cleaning of bathing, hand washing, tooth brushing, nail cutting, hair cutting, covering of the mouth and nose with a tissue while coughing and sneezing. Personal hygiene revolves around keeping of our bodies clean, and free from germs. Maintaining hygienic conditions and practices reduces the spread of illness and risk of medical conditions caused by not taking care of yourself. It also increases self-confidence and positively impacts personal relationships. Hand washing is the most effective way of maintaining personal hygiene and stopping the spread of diseases mainly among the children. Frequent washing of hands especially after using the toilet facilities, before, during, and after preparing food, before eating

food, taking out the garbage, blowing your nose, after touching an animal, animal feed, or animal waste, help to reduce the risks of spreading or aiding the spread of diseases.

General environment.

This form of hygiene involves the community cleaning their surroundings so as to promote health. These practices involve compound slashing, compound sweeping, establishment of the rubbish pit, and compound weeding among others. Also, better drainage in the compound helps to prevent pests and vector borne diseases through destruction of mosquito breeding grounds. Proper disposal of rubbish and cleaning of the bushes around the compound controls and prevents the breeding and spread of pests and insects. Rubbish/wastes when not disposed properly, provide breeding sites for animals and insects and animals, such as mosquitoes, flies, rodents and cockroaches which can be harmful or aid the spread of sicknesses and diseases in communities

2.6. WASH issues.

WASH referred to Water, Sanitation and Hygiene – refers to access to safe and clean water, improved sanitation facilities and the maintenance of a basic level of sanitation. The notions of WASH is based on access to improved water supply, good hygiene practice, and improved sanitation, which are critical to reduce environmental health menaces for population's well-being at the global level ³⁷. The lack of access to improved water and sanitation has greatly affected marginalized and vulnerable people with extreme poverty levels ³⁸. Most of the urban slum dwellers live in destitute urban areas and in underprivileged urban fringes or rural areas. Today, the progress related to enhancing WASH is steered by the Sustainable Development Goal six (SDG6) and its targets 6.1 and 6.2 which aim to realize, universal and equitable access to safely managed drinking water, sanitation and hygiene and end open defecation by 2030 ³⁹. The availability of adequate, accessible, reliable and affordable WASH facilities is key to good health, human well-being and socioeconomic development of any community ⁴⁰. Without WASH, well-being, dignity and human opportunities are seriously compromised, especially for women and girls. Consequently, the world's poorest people have faced the heaviest burden from lack of proper water, sanitation and hygiene facilities. However, provision of water sanitation and hygiene services and facilities in the world's urban slums is extremely challenging due to lack of funding, space, access and ownership ⁷. Diarrhea, as one of the

significances of inadequate water supply, sanitation and hygiene facilities, is the foremost cause of demise among children in Africa and the second globally ⁴¹. Also, inadequate water supply has led to approximately 90% of all diarrheal cases.

2.6.1. Current WASH approaches implemented in Uganda:

Solutions /approaches below have led to a significant progress in the WASH sector in Uganda.

- ✓ *Community-led total sanitation (CLTS) approach:* CLTS approach has been highly used by most of the Non-Governmental Organizations (NGOs) to focus on community behavior change and empowerment to end open defecation in Uganda. In Uganda, this approach has promoted innovation of more sustainable human excreta management solutions, construction and use of latrines in informal settlements, and in rural areas.
- ✓ *Improved sanitation infrastructure:* Uganda has invested in the development and provision of sustainable sanitation infrastructure, inclusive of sewage networks and wastewater treatment plants. As of 2015, approximately 19% of the overall population had access to 'at least basic sanitation'. 28% access rate was recorded in urban areas while 17% in rural areas ⁴².
- ✓ *Formation and capacity building of water user committees:* To ensure sustainable use of water supply sources across the country, water user committees have been established, trained and equipped to operate and manage water resources. Mostly in rural areas, these committees have been contributory in operation and management of small-scale water supply systems, ensuring equitable access and distribution of water.
- ✓ *Rainwater harvesting:* In areas with inadequate access to water, rainwater harvesting facilities have been established in order to increase accessibility and reliability of water supply for agriculture and domestic uses.
- ✓ *Integrated water resource management:* In Uganda, implementation of integrated water resource management involving coordinated management of available water resources and sustainable use has helped to enhance water security thus reducing water scarcity risks.
- ✓ *Education and awareness-raising:* Using both print and digital media, responsible stakeholders in WASH sector have continuously implemented awareness-raising and education campaigns in order to promote proper sanitation and hygiene practices and

their importance. These campaigns have facilitated to increase knowledge, practices, attitudes, and awareness of WASH issues within Ugandan populace.

2.7. Barriers to access improved WASH.

There are many that affect access to improved WASH practices and services. These barriers include but not limited to: -

- ✓ *Limited funding for WASH infrastructure:* The funding for WASH infrastructure development in Uganda is very limited ⁴³. This limited funding has made it difficult to design, implement and maintain adequate water sanitation and hygiene facilities across the country. Also due to inadequate funding, it has resulted to poor/no maintenance services on dilapidated WASH which has negatively affected access to improved WASH facilities. Inadequate funding is also responsible for inadequate WASH facilities especially in rural areas and informal settlements ^{44,45}. Due to a lack of adequate WASH infrastructure, both water quality and supply in various countries are compromised.
- ✓ *Population growth.* Rapid population growth in urban areas has exerted an increasing pressure on WASH services due to predominant demands for sustainable WASH facilities ^{46,47}. For example, in some countries the inability to efficiently and effectively provide clean water sanitation and hygiene services for the increasing informal settlements is mainly due to the challenge with increasing population growth. Furthermore, rapid population growth results into overcrowding thereby sustainable sanitation and hygiene practices are compromised especially in communities where sanitation and hygiene facilities were shared. Overcrowded spaces contribute to large scale pollution rates, poor sanitation and hygiene practices, due to lack of or inadequate space/land to develop new or replacing used up pit latrines owing to population growth.
- ✓ *Inadequate knowledge on healthy WASH practices.* People's knowledge, perceptions, practices, and reported attitudes regarding use, adoption and management of WASH facilities such as pit latrines, sewerage systems, wastes disposal sites reflect the extent of their healthy WASH practices. Some people are unenthusiastic in changing their behavior or learn use and management of WASH facilities due to inadequate knowledge

and skills on the importance, operation and maintenance of improved WASH ^{45,46,48}. This is evident in most of the communities that practice open defecation.

- ✓ *Ineffective local community engagement.* Effective and efficient local community (beneficiary) engagement in the given WASH interventions is critical for the success of the WASH program. Ineffective and inefficient local community engagement in WASH interventions has resulted into lack of awareness and monitoring ^{44,49}. In Uganda, CLTS implementation is successful due to engagement of local community (beneficiary) members from the design of the WASH interventions to implementation.
- ✓ *Climate change.* Climate change manifested in the form of drought and flooding has hindered effective planning for and implementation of sustainable water supply systems, sanitation and hygiene facilities. Climate change has exacerbated the general public health issues linked with poor sanitation and hygienic practices and conditions. Drought is one of the major influencers to the barriers to improved WASH facilities and practices as it constrains improved hygiene including practice of handwashing ⁵⁰. Notably, different Southern African countries experience compromised WASH practices due to climate change in the form of drought. In addition to other challenges, drought spells experienced in Southern African countries contributes to the already existing challenge of disease prevention and control in the endemic areas where improved WASH practices and facilities are utmost needed ^{47,49}.
- ✓ *Limited investment in WASH infrastructure.* WASH infrastructure massive investment is vital for improved WASH practices and services. WASH investments not only improve accessibility to improved WASH facilities and practices but also improve safe water supply and storage thereby minimizing contamination ⁴⁶.
- ✓ *Limited access to safe drinking water:* Notwithstanding the efforts to improve accessibility and reliability to safe drinking water in Uganda, many communities still lack access to safe and clean water. As of 2015, rural areas in Uganda had a 32% access rate to safe drinking water as compared to approximately 73% in urban area. According to the Ministry of Water and Environment (2022) report, it was reported that drinking water standards compliance in urban areas stood at 81.2% as compared to 67% for rural areas. Comparatively, approximately 18.8% of urban population and 33% of rural population had access to unsafe drinking water ⁴².

- ✓ *Inadequate sanitation and hygiene facilities:* In many parts of Uganda, access to sustainable sanitation facilities is still limited. As of 2015, approximately 19% of the overall population had access to 'at least basic sanitation'. 28% access rate was recorded in urban areas while 17% in rural areas. This lack of access to sustainable sanitation and hygiene facilities has led to rampant open defecation, which postures a significant health risk to the population and environment, contributing to easy spread and outbreak of waterborne diseases. The Human Rights Measurement Initiative gave Uganda a score of 22.9% for basic sanitation and 9.5% for water supply (WASHwatch.org-Uganda, 2017). The United Nations Joint Monitoring Program on Water Supply and Sanitation (JMP), estimated that access to 'improved sanitation' increased slightly from 27% in 1990 to 34% in 2010 (WASHwatch.org-Uganda, 2017).
- ✓ *Geographical challenges:* Uganda's topography, hinders access and provision of sustainable WASH services and practices by many rural and urban communities in Uganda. Also, water sources in Uganda are unevenly distributed across the country thereby affecting equitable supply of safe and clean water across the nation.
- ✓ *Water pollution:* Uganda's water sources are frequently contaminated by the growing mining, agricultural and industrial activities, which poses a greater risk to both the environment and public health. Across the country, consumption of polluted water has eased the spread and outbreak of various water related and water borne diseases such as typhoid, cholera, and dysentery. According to the Ministry of Water and Environment (2022) report, national compliance to wastewater was 55%; demonstrating disposal of unsafe water (wastewater) into the environment.
- ✓ *Limited technical capacity:* Lack of adequate technical capacity in many institutions responsible for WASH in Uganda is limited, has affected effective maintenance, implementation, management of water, sanitation and hygiene facilities. The lack of enough skilled personnel and well-equipped laboratory compromises water quality and water supply services due to insufficient funding ⁵¹. Inadequate funding of WASH sector greatly compromises clean and safe water supply, resulting into poor sanitation and hygiene practices ^{51,52}.

- ✓ *Low enforcement of legal and regulatory frameworks:* The current WASH legal and regulatory frameworks in Uganda are weak, and old hence making it difficult to enforce and ensure compliance to these legal and regulatory frameworks.

2.8. Conclusion.

In the above chapter, various literatures were identified and analyzed. This chapter therefore defined and discussed urbanization, urbanization types and problems associated with urbanization in Uganda. Definitions, types and characteristics of various settlements in Uganda are provided in this chapter. Furthermore, the chapter provided for definitions, types, characteristics, various approaches and importance of accessing WASH in Uganda especially in informal settlements.

CHAPTER THREE: METHODOLOGY

3.1. Introduction.

Under this chapter, the characteristics of the study area in terms of location, population, the existing conditions of water, sanitation and hygiene in Namatala urban informal settlement are discussed. Both methods, tools, approach and materials used in during the study are discussed. These are categorized as target population, population sampling design, data collection, data analysis and data interpretation method.

3.2. Description of the study area.

Namatala informal settlement (Urban slum) is located in the industrial division of Mbale Municipality, in Mbale City, at latitude 01 5N, longitude 034 11E. Namatala informal settlement is the largest urban slum of the six (06) informal settlements in Mbale city namely Namakwekwe, Nabuyonga, Nkoma, Namatala, Mooni, and Mukhubu. According to Uganda Bureau of Statistics 2016, Namatala informal settlement is believed to harbor an estimate of 24,123 households ¹¹. Originally, the area was a wetland connected to the existing Namatala river to which the area drains to. However, the slum area evolved due to illegal encroachment on the wetland by internally displaced persons (IDPs), largely attributed to rural-urban migration, and displacements from the frequent floods and landslides. As a result, provision of the basic sanitation and hygiene services is difficult due to lack of legal ownership of the area by the slum dwellers. Recently, an extensive study on place centered social-economic, cultural and environmental influence in the making of Namatala slum in Mbale Municipality, Uganda ¹¹, concluded that Namatala urban slum is dominantly characterized by inadequate social amenities, poor housing units, obsolete poverty, lack basic solid waste management facilities and other essential infrastructure, in addition to inadequate access to clean water, safe sanitation and hygiene facilities. Therefore, this study shall focus on the water, sanitation and hygiene situation in Namatala urban slum by analyzing the current situation, identifying the possible barriers hindering access to improved sustainable water, sanitation and hygiene facilities in Namatala urban slum while also identifying areas of further research. Water supply and human excreta (urine and fecal) management shall be the main focus of this investigation.

Map of Namatala urban slum showing its divisions

Using ArcGIS software version, I mapped out Namatala urban slum showing all the five zones that were considered during the study. This is as shown in the Figure 6 below.



Figure 6: Namatala slum by Cells. Source: Field data

3.3. Target population and sampling

3.3.1 Sample size random selection

In this study a descriptive design was adopted. This involved data collection in order to answer the set research questions. A cross sectional survey research design was used to collect responses/opinions of the correspondents in respect to the study. Accessible/target population for this study comprised of the 24,123 people living within the five zones of Namatala urban informal settlement. In this case, therefore, all the 24,123 slum dwellers constituted the sampling frame of this study. According to ⁵³, a good sample must be logically between 10% to 30% of the study population. Modest random sampling technique helps to eradicate biasness in the selection of sample elements. Therefore, because of the large size of the accessible population (24,123), Nassiuma's (2000) formula was adopted in calculation of the exact sample size. In many literature reviews, Nassiuma's (2000) used a coefficient of variation in a range

of $21\% \leq C \leq 30\%$ and an acceptable standard error of $2\% \leq e \leq 5\%$. The study therefore, adopted coefficient variation of 25% and a standard error of 2%. Therefore, sample size (n) was calculated using Nassiuma's (2000) equation stated below.

$$n = \frac{Nc^2}{c^2 + (N-1) \times (e)^2} \dots \dots \dots (1)$$

Where;

N = Target/Accessible population

c= Coefficient of Variation (0.25), and

e= Desired confidence level tolerance (0.02) at 98% confidence level (standard error)

Therefore,

$$n = \frac{24,123 \times 0.25^2}{0.25^2 + (24,123 - 1) \times (0.02)^2} = 155.25 \text{ households}$$

Using stratified random sampling technique, a proportionate sample size of 160 respondents was drawn from the target/accessible population

3.3.2 Target population

This study targeted 160 respondents in the five zones of Namatala urban informal settlement namely; 32 Doko, 32 Sisye, 32 Mvule, 32 Nyanza and 32 Wandawa. Only heads of household, spouses and persons above the age of 18 years responded to the household questionnaires.

3.3.3. Sampling framework for the research.

The framework used in this study is as shown in Table 1 below.

Table 1: Sampling framework used in research

S/N	Target Population	Total Population	Sample size	Sampling method
1.	Households	24,123	160	Random sampling
2.	Health personnel	-	09	Purposive sampling
3.	Water user committees	-	08	Purposive sampling
4.	Local administration	-	04	Purposive sampling
5.	Local NGOs officials	-	05	Purposive sampling
6.	MWE officials	-	04	Purposive sampling

7.	Institutions heads (schools etc.).	-	04	Purposive sampling
	TOTAL		194	

3.3.4. Namatala urban informal settlement survey participation.

Table 2: Zonal population distribution in data collection

S/N	Namatala urban informal Zone	Sample size
1	Doko	32
2	Sisye	32
3	Mvule	32
4	Nyanza	32
5	Wandawa	32
	TOTAL	160

3.3.5. Data collection process.

Five zones in Namatala urban informal settlement were considered in this study. From the total sample population of 160 households, (20%, [32/160]) households were interviewed using household questionnaires while focused group discussions were held with the key informants that were identified as summarized in Table 2. The data was collected both manually using hard copy questionnaires and electronically using Kobo collect tool. The data from the Kobo collect tool was easily synchronized from the mobile phone into the computer and downloaded as an excel file ready for analysis using SPSS software. Other raw data (from the hard copy) was manually entered into the SPSS software for analysis. Discussions were also held with identified stakeholders to collect some qualitative data on WASH conditions in Namatala urban slum.

3.4. Methodology

This research involved two main types of research methods. First, the positivist paradigm via use of household structured questionnaires was used for quantitative data collection. Lastly, the interpretivists that involved the interpretation of the problem through the mind was used in qualitative data collection. Quantitative method mainly focused on quantifiable data expressed in numbers and measures that were statistically analysed. Qualitative method gave an emphasis

on the qualities of data entities that were not experimentally analyzed, examined measured, or expressed in numbers, quantity, intensity, amount, or frequency.

Therefore, this research applied both the qualitative and quantitative approaches while also complementing each other in data collection, analysis and interpretation in order to describe the current status of water, sanitation and hygiene (WASH) services in Namatala urban slum.

3.4.1. Research design.

The breakdown of the research design and its rationale for each objective is shown below.

Qualitative approach. Through the organized focused group discussions and key informant interviews, qualitative approach was used to achieve both objective I and II of the study. i.e., assessing the current WASH conditions and barriers to access improved WASH facilities in Namatala urban informal settlement. In order to gain a comprehensive knowledge of the current WASH conditions in Namatala urban slum, I conducted in-depth interviews with key informants, household surveys, and focused group discussions with various WASH stakeholders in Namatala urban slum and Mbale city. Selection of the key informants and focused groups was based on professional and personal experiences, attitudes, perceptions and beliefs related to the status of sanitation and hygiene facilities and services within Namatala informal settlement. The mobile phone was employed to record the audio information in response to the set questions related to the current status of water sanitation and hygiene facilities in Namatala informal settlement, and barriers to access improved WASH facilities/practices. The collected information was manually transcribed, changing the audio recordings into text.

Quantitative approach. This approach was used during household survey interviews held to achieve both objective 1 and 2. The data obtained from the representative sample of Namatala urban slum using structured questionnaires was quantified.

3.5. Data collection methods and instruments

Both secondary and primary data were collected involving the application of several methods in data collection which included; Document/Literature review, administering of household survey questionnaires, key informant interviews, focus group discussions, and observation schedules.

3.5.1. Data Collection Framework.

Data collection for this research followed the following framework.

Table 3: Framework used in data collection during research.

S/N	Area of interest	General research questions	Collection method	Source of information
1	Namatala urban informal settlement	What is population size in Namatala urban informal settlement? What is the population distribution in terms of age, religion, tribe and number of people per household?	Household survey	Residents
2	Water supply	What are the main types of water sources in Namatala urban informal settlement? What is the reliability and accessibility rates of the water sources to the residents in Namatala urban informal settlement?	Household survey FGD Key informants' interviews Observation	Residents Water users Mbale DLG
3	Sanitation and hygiene facilities/practices	What are the main types of sanitation and hygiene practices/facilities in Namatala urban slum? What is the reliability and accessibility rates of the sanitation and	Household survey FGD Key informants' interviews Observation	Residents Mbale DLG

		hygiene facilities in Namatala urban informal settlement?		
4	Factors/barriers to improved WASH services/facilities	What are the possible barriers to access improve water, sanitation and hygiene in Namatala urban slum?	Household survey FGD Key informants' interviews Observation	Residents Mbale DLG

3.5.2. Data collection tools.

The following methods and tools were used in data collection.

Questionnaires

Structured, un-structured and Semi- structured questionnaires were used to collect primary data from the different households in the five zones in Namatala urban informal settlement. ⁵⁴ defines questionnaire as the most appropriate instrument due to its capacity to collect a lot of data within a shortest range of time. Questionnaires are considered to guarantee confidentiality of the source of information via anonymity while guaranteeing standardization ⁵⁵. It is because of the above reasons that use of questionnaire was adopted as the most suitable instrument in this study. Questionnaires were formulated to include 03 sections with a mix of questions i.e., household demographic characteristics WASH status and barriers to accessing improved WASH in Namatala urban slum. The questionnaires allowed both specific and open-ended responses to a comprehensive range of questions and were in line with the specific objectives of the study. The open-ended questions gave freedom to the informant/respondent to freely express his/herself without any limits of closed ended questions. Household questionnaire surveys (closed ended questions), and semi-structured in-depth interviews were used to collect open-ended data, to explore participant thoughts, feelings and beliefs about the status of water, sanitation and hygiene facilities of Namatala urban slum. Initial baseline surveys were done in order to check the validity of the questionnaires. Improvements on the questionnaires were made before being employed for data collection across the entire Namatala urban slum. To have improved/accurate data collection, investigations were done either in the early morning

or in the late evening hours since most of the responsible household heads/key informants are frequently out in pursuit for the day's incomes throughout working hours.

Field investigations and interviews

The study also adopted a field assessment of the current water sanitation and hygiene situation in the study area. Various key Informant Interviews were done on a structured schedule with the focal people directly involved in the implementation of various types of WASH projects and policies. Key informants included officials from private sector, government institutions (sub-county/division/zone officials, Mbale DLG, Mbale city, Village Health Teams (VHTs), Health Centers in charge, and Ministry of Water and Environment (MWE) regional office) and non-governmental organizations.

Focus Group Discussions

Each FGD participant was chosen depending on his/her readiness to participate and his/her continued engrossment in community services. FGDs followed the following procedures.

Identification of participants.

FGD participants were identified from any of the following WASH stakeholders in the area: -

- Mbale District Local Government administrators;
- Namatala division administrators and zone local councillors
- Health centre medical personnel;
- Community elders;
- Village health team
- Ministry of Water and Environment Officials
- Members of Non-governmental organizations in Namatala urban informal settlement.

Goal of the discussions.

The main goal of these set discussions was to understand participants' feelings, knowledge, attitudes, practices and opinions about the following:

- i. Accessibility and reliability to potable water.
- ii. Accessibility and reliability to sanitation and hygiene facilities.
- iii. Outbreak and spread of waterborne diseases and related diseases.

- iv. Possible barriers to accessing improve water, sanitation and hygiene facilities/services in Namatala urban informal settlement.

Focus group discussion participants were identified across the five zones of Namatala urban informal settlement. With the assistance from the zonal and local government administration, two (02) FDGs were organized and conducted at MWE-Facility East boardroom. The invited participants are as shown in Table 2 above. The discussion revolved around sources of water supply, their availability and reliability, sanitation and hygienic conditions of the area, service and facilities in the area for sanitation and hygiene promotion, possible barriers to improved water sanitation and hygiene in Namatala urban informal settlement, community involvement in WASH promotion, reliability and accessibility to sanitation facilities/services in the study area.

Procedure used.

During the focused group discussions, all the relevant key informants were identified as above. The following steps were followed during the discussion.

- Mobilization of key informants. With the help of the local administration, and MWE officials, two sets of WASH stakeholders were identified. Invitation letters for FDGs were drafted, and sent to them on 31/Jan/2024 to participate on the FDGs that were held on 09/February/2024 and 22/February/2024 respectively. The letter is as attached in the appendix 7.4
- Venue identification and organization. A 20-seater boardroom within MWE-Facility East headquarters requested and booked no cost implication.
- Procurement of materials. Pens, manilla papers, flip charts and notebooks among other items were procured.
- As a moderator, I facilitated the discussion in reference to the topic of discussion and as per the set guidelines. Notes and responses made by the key informants were well noted. The report of the findings and discussions were generated as per below.
- Each discussion lasted for between 1-2 hours.

Rules and guidelines during the discussion.

The following rules of procedure were presented to the participants.

- Be audible and precise to the point.

- Only one participant speaks at a time.
- Individual opinions are allowed.
- Confidentiality is guaranteed.

Literature review.

This involved the review of available literature about sanitation and hygiene in informal settlements, from government publications, websites, books, journal articles, internal records were thoroughly done.

Observation checklist

This was used to gather firsthand field data without a second party embellishing facts. The observation checklist used in this study is attached on the appendix 3.

3.5.3. Research considerations.

The following considerations were adhered to during research.

Ethical considerations.

During this research, the following ethical issues were put into consideration:

- ✓ Participation was totally voluntary
- ✓ Individuals had the freedom of stopping their participation in this study at any time without being punished
- ✓ No actual danger was caused by obliging to take part in the study.
- ✓ The scholarly reason for this study was let known to all the respondents.
- ✓ All data given was treated with most extreme secrecy.
- ✓ Official permission/ authority to conduct the study was sought local council, district administration and respective village elders to give any necessary help in this study.

Inclusion criteria.

Respondents of the age above 18 years and had lived in the study area (Namatala urban slum) for at least five years were interviewed during this study.

Validity of the Research Instruments

Content legitimacy was established by the supervisors; who carefully checked, assessed, analyzed and featured blunders in the research instruments. The validity of the research is

defined by how much a test estimate what it implies to quantify. All in all, validity is how much outcomes got from the investigation of the information really address the peculiarities under study. According to Borg and Gall (1989), validity of an instrument is improved through master

3.6. Data analysis.

3.6.1 Quantitative data entry into the analysis software

Data from the questionnaire was manually entered into the Statistical Package for Social Sciences (SPSS). Single transfer coding method was used for all the questionnaires. Each variable in the data was represented in each column in the data view window. Labelling and definition of each kind of data entered in each column was done. Apiece row in the data view window epitomised a record. Cleaning of the data was done manually.

3.6.2. Frequency distributions and graphical displays of the data.

In order to analyse the data, frequency distributions were done. This denoted the numeral of times the given variable had happened and this information was represented on the graph or in a table. Robinson (2002) advocates that frequency distributions display makes data to be quickly and easily understood by a large audience.

3.6.3. Summary Statistics

This research employed a number of ways in representing important aspects of the obtained data set by a single numerical value. This was done through describing the distribution level of the data by means of measures of central tendency. In this research, measures of central tendency were; the median, mean, and mode. The median is the mid value obtained when all the scores are set in order of their ascending size. The mean is an average value obtained after summing all the scores and dividing by the number of scores. The mode is the highest frequent score. Descriptive statistics, inferential statistics, correlation, regression, and T-test was done, the analysis was run and the output continuously checked, while customized output options, such as tables, charts, graphs, or reports were developed. Descriptive analysis was done to determine the percentage of households with access to water and sanitation. The output was carefully examined, while any errors, warnings, or messages indicating any problem with the data or analysis were identified. Using SPSS software, causal relationship and correlation were done in order to assess the independent association between the identified individual factors and access to clean water, sanitation and hygiene in Namatala urban slum. The confounding

factors describing the socio-economic characteristics of the sampled population were collected during the cross-sectional survey.

3.7. Conclusion

Under this chapter, the characteristics of the study area in terms of location, population, the existing conditions of water, sanitation and hygiene in Namatala urban informal settlement were discussed. In chapter 3, the sample size was calculated, data collection tools and methods were identified, data analysis approaches and research consideration were also identified.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0. Introduction.

Under this chapter, results and discussions from quantitative and qualitative data analysis in regards to households' characteristics, WASH status, and possible barriers to access improved WASH shall be provided. The chapter also provides the possible feasible interventions to access improved WASH facilities in Namatala urban slum.

4.1. Quantitative data analysis.

The results are presented without any reference to values as found by each section (in this case, each zone in Namatala urban slum). For some indicators, 95 percent confidence interval was used.

4.1.1. Objective 1: Determining the current status of WASH in Namatala urban slum.

Surveyed Communities

The survey was conducted in the five (05) zones of Namatala urban informal settlement, as shown in the table below:

Surveyed households by zone

Table 4: Number of surveyed households by zone

Zone	Number of Households Surveyed	Percentage of the Sample
Doko	32	20%
Sisye	32	20%
Mvule	32	20%
Nyanza	32	20%
Wandawa	32	20%
TOTAL	160	100%

An equal number (20% [32/160]) of households were surveyed in each of the five zones in Namatala urban informal settlement. This was to have an equal representation of each zone in the study.

Surveyed households' characteristics.

Percentage of females and males in Namatala urban informal settlement.

The table below presents the distribution of gender representation (women and men) in the surveyed households:

Gender distribution in the surveyed households by zone.

Table 5: Percentage of women and men in surveyed households by zone.

Zone	Male		Female		Total
	Number of people	Percentage	Number of people	Percentage	
Doko	84	53%	74	47%	158
Sisye	75	43%	101	57%	176
Mvule	63	42%	86	58%	149
Nyanza	100	49%	106	51%	206
Wandawa	88	47%	99	53%	187
TOTAL	410	47%	466	53%	876

The sex ratio in Namatala urban informal settlement was (47% [410/876]) males as compared to (53% [466/876]) females.

Number of people and children aged 0-5years by zone

Table 6: Average number of people per household.

Zone	Number of Households	Total number of people in the Households	Children under the age of five years	
			Number	Average
Doko	32	158	62	0.39
Sisye	32	176	47	0.27
Mvule	32	149	54	0.36
Nyanza	32	206	65	0.32
Wandawa	32	187	59	0.32
TOTAL	160	876	287	0.33

In the 160 households surveyed in Namatala urban informal settlement, there were 876 people. The average number of people per household in Namatala urban informal settlement was 5.475. The variance analysis test (ANOVA) showed that there was no significant difference in the average number of people per community. The average number of people per household in

Namatata urban informal settlement was almost equal to an average of six (06) people per household as observed during the 2019/2020 Uganda National Household Survey.

An average number of children under the age of five (05) years was 0.33 cross the five zones in Namatata urban informal settlement. Thus, contributed to thirty-three (33% [287/876]) of the population in Namatata urban informal settlement.

Female and male survey respondents

As in most African community settings and households, the male is always the head of household. This was also noted in Namatata urban informal settlement; None the less, most of the correspondents to the household interviews were women. Therefore, the survey constituted (55% [88/160]) women as compared to (45% [72/160]) men. Gender distribution in Namatata urban slum is illustrated in Table 7 below.

Gender distribution of the respondents.

Table 7: Gender distribution of the respondents by zone

Zone	Number of Households	Male		Female	
		Frequency	Percentage	Frequency	Percentage
Doko	32	17	53%	15	47%
Sisye	32	14	44%	18	56%
Mvule	32	18	56%	14	44%
Nyanza	32	11	34%	21	66%
Wandawa	32	12	38%	20	63%
TOTAL	160	72	45%	88	55%

Length of time (stay) in the zone.

Out of all the households surveyed in the five zones of Namatata urban slum, forty-six (46) percent had lived in this urban slum for eleven or more years while twenty-three (23) percent and thirty-one (31) percent had lived in Namatata urban slum for five (05) or less year and between six to ten (6-10) years respectively.

Length of stay in the zone by the households.

Table 8: Distribution of households according length of time stayed in the zone

Zone	0-5 Years	6-10Years	11 Years and above
Doko	5%	4%	11%
Sisye	4%	6%	9%
Mvule	3%	5%	12%
Nyanza	6%	7%	8%
Wandawa	5%	8%	7%
TOTAL	23%	31%	46%

Households by tribe

Out of all households surveyed in the five zones of Namatala urban informal settlement, twenty-five percent were Itesots, twenty-nine percent were Bagisu, twenty-four percent were Acholi's while twenty-two percent belong to other tribes among others (Sabiny, Baganda, Basoga, Jopadhola). Ethnic distribution in Namatala urban informal settlement is represented in Figure 7 below.

Ethnic distribution in Namatala urban informal settlement

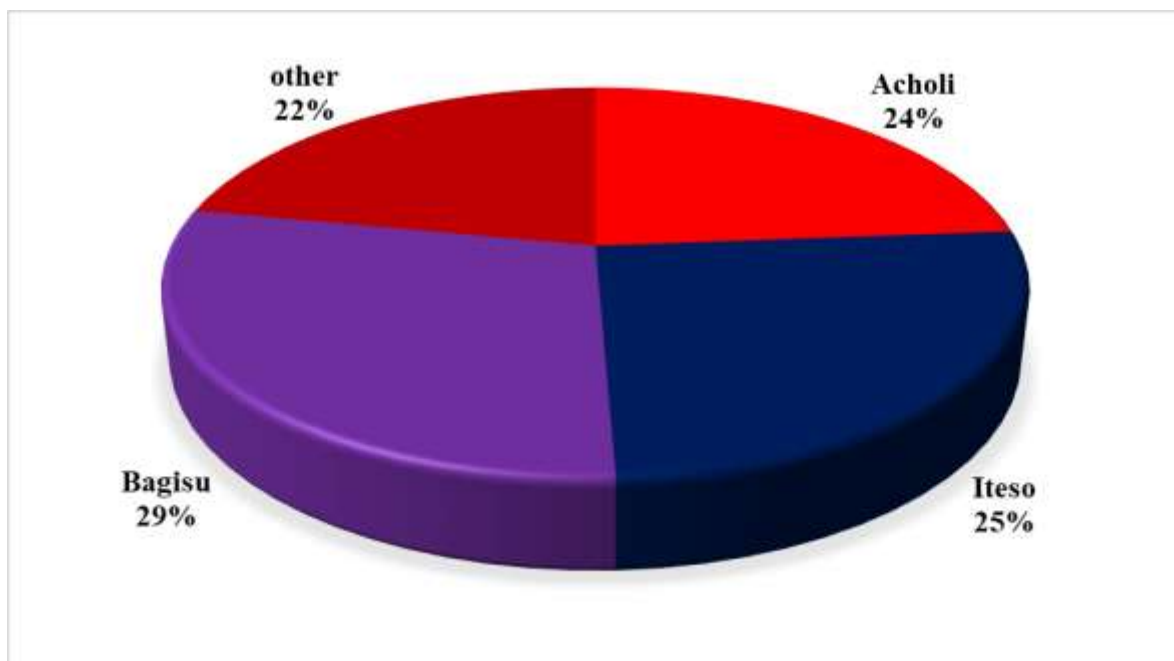


Figure 7: Distribution of households by tribe

Home ownership by zone

Across the five zones in Namatala urban informal settlement, (37% (59/160)) owned their homes, (58% [92/160]) rented or were tenants while (6% [9/160]) kept other people's homes. This is well represented in the table below.

Mode of home ownership by zone

Table 9: Home ownership by zone

Zone	No. of HHs	Rent		Own		Other (Keeper)	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Doko	32	18	56%	11	34%	3	9%
Sisye	32	21	66%	10	31%	1	3%
Mvule	32	17	53%	13	41%	2	6%
Nyanza	32	22	69%	8	25%	2	6%
Wandawa	32	14	44%	17	53%	1	3%
TOTAL	160	92	58%	59	37%	9	6%

Primary source of household Income

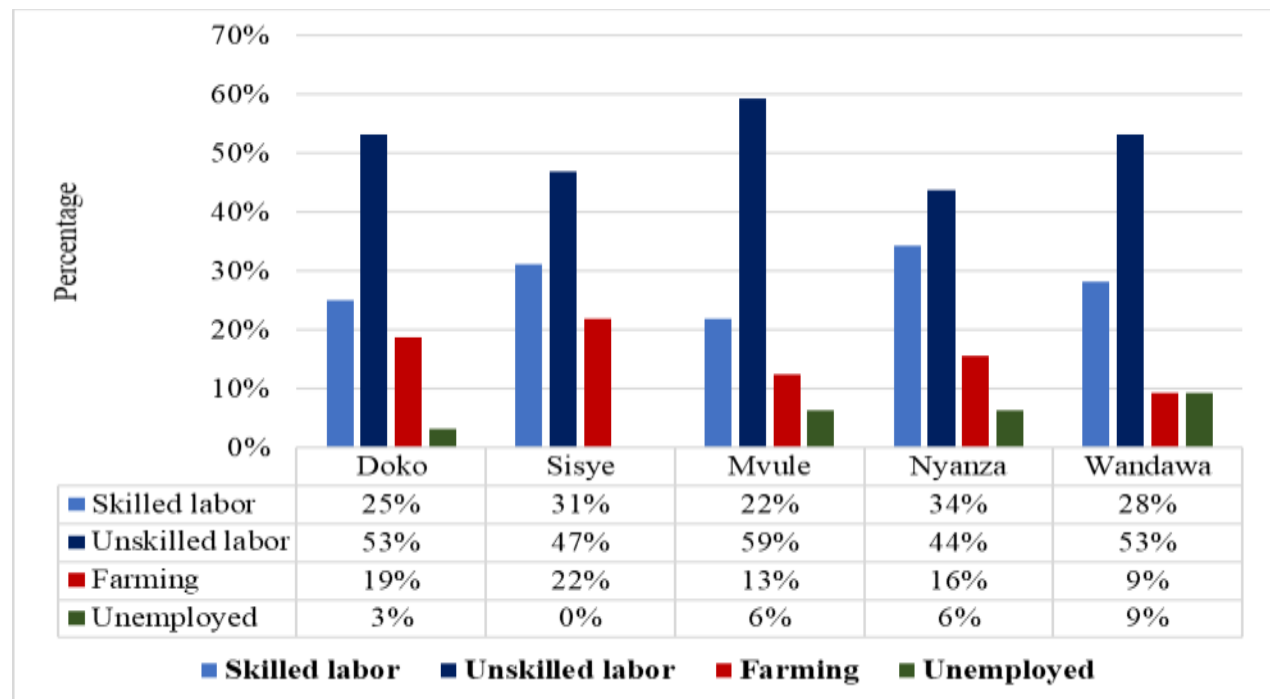


Figure 8: Distribution of primary sources of income by zone

Unskilled labor related activity was the primary occupation and major source of income for 44 percent to 59 percent of the households in the five zones of Namatala urban informal settlement. Agriculture/farming was the third primary occupation or source of income for 9 percent to 22 percent of households due to non-ownership of land and limited space in between the households as shown on the above graph.

Average household income

From the household survey, sixty-one percent households lived on less than \$1 per person per day while forty-nine percent lived on \$1 or more per person per day.

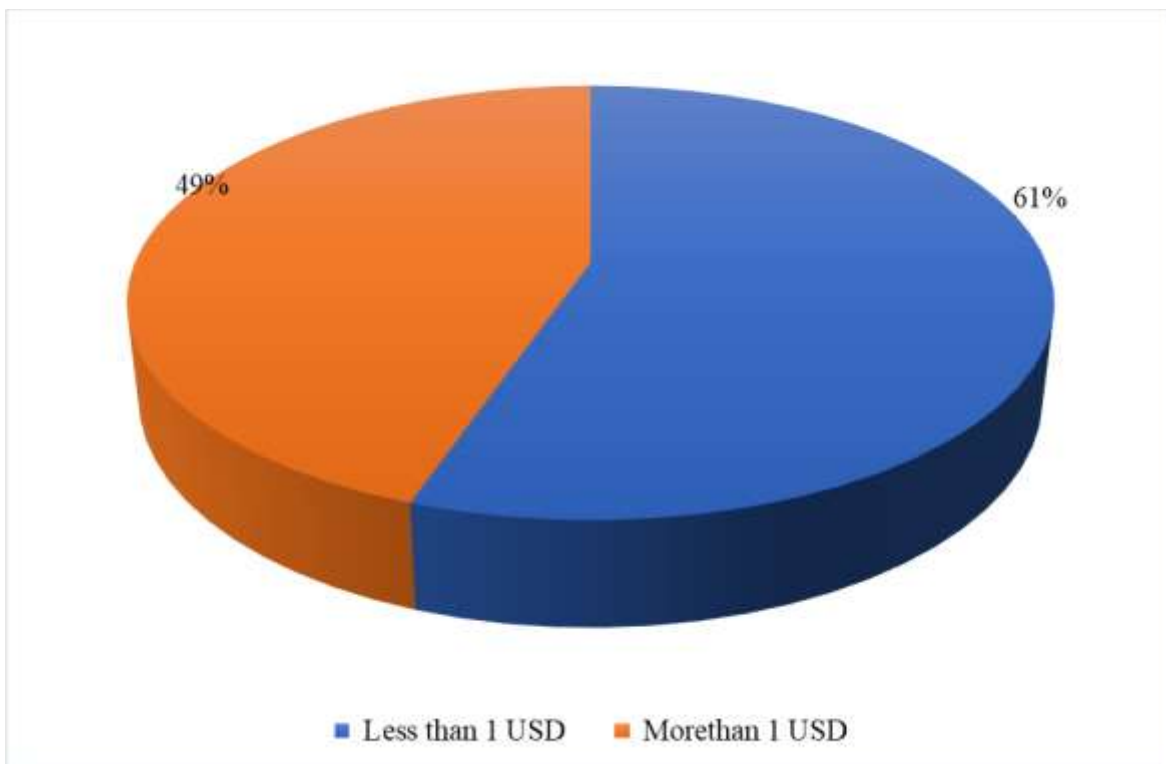


Figure 9: Daily cost of living per household in Namatala urban informal settlement

Education level of the respondents.

The education level of the respondents is as summarized below.

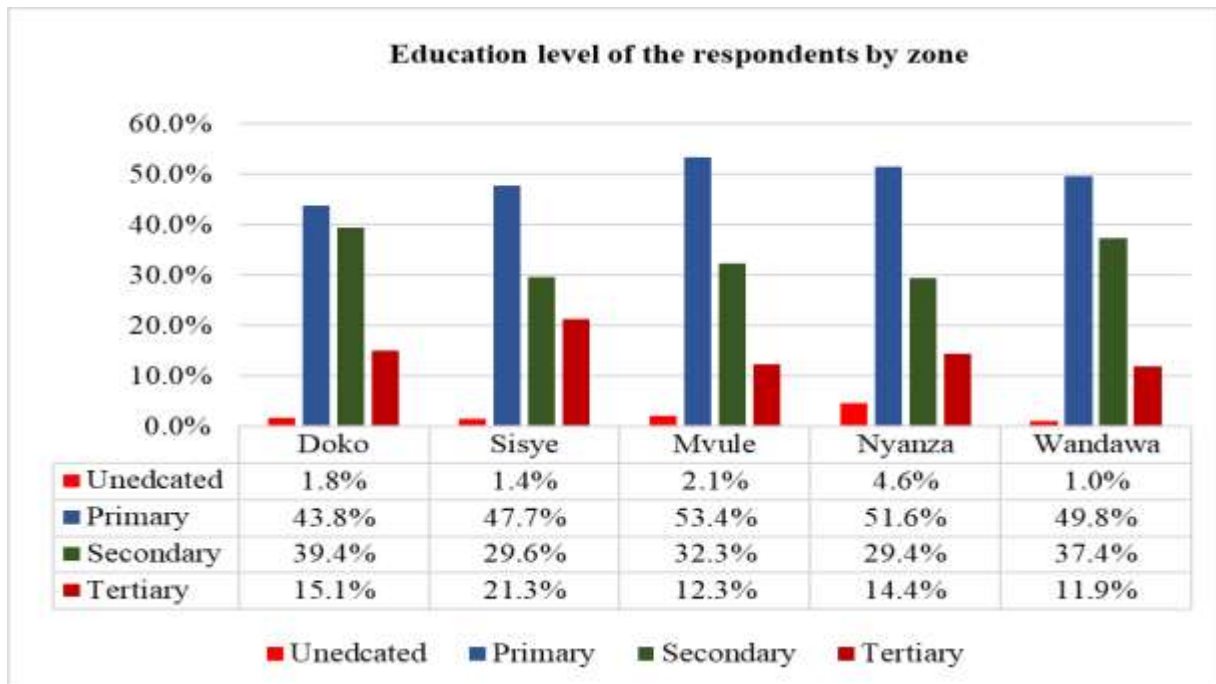


Figure 10: Education levels of the respondents

Across the five zones in Namatala urban informal settlement, primary education (43.8 percent to 53.4 percent) was the most dominant attained education level by the respondents of the interviewed households in the five zones of Namatala urban informal settlement. This indicated the highest level of unskilled labour in the area. Secondary (29.4 to 39.4 percent) and tertiary (11.9 percent to 21.3 percent) education levels, were second and third education levels attained respondents of the households in the five zones of Namatala urban informal settlement. This related to the skilled labour occupational activities in the area as the second source of income in the area. 1.0 percent to 4.6 percent of respondents of the interviewed households in the five zones of Namatala urban informal settlement were uneducated.

Objective I: Current Water, Sanitation and Hygiene (WASH) accessibility and reliability.

Water is a vital resource in sustaining life, maintaining ecosystem, controlling and preventing spread/outbreak of diseases. In Uganda, there are set regulations, standards and recommendations governing water in terms of both quality and quantity supplied to the communities. These have served as benchmarks in the development of water supply systems.

Table 10: Distance to the water source.

Distance to the water source in Namatala urban slum		
Distance (meters)	Frequency	Percentage
0-100	58	37%
100-200	87	54%
More than 200	15	9%

According to the survey, fifty-eight households representing thirty-seven percent of households in the surveyed zones of Namatala urban informal settlement had source of water within 100-meter distance. This is because of the piped water supply system in the area having both public stand posts and domestic yard tap connections that provide drinking water to these households. Only percent of households in the surveyed zones of Namatala urban informal settlement have the source of water in a distance of more than 200-meter.

Time spent in fetching water.

Five out of ten households (52 percent) households spend 30 minutes or less to reach and collect water from the nearby water source. Water accessibility (72 percent) is high in these zones due to water extension works done by NWSC, the local NGOs within this informal settlement.

Table 11: Average time spent in water collection.

Zone	Percentage of HH spending less than 30 minutes to collect water from a nearby water source	Percentage of HH spending more than 30 minutes to reach a water source
Doko	53%	47%
Sisye	44%	56%
Mvule	56%	44%
Nyanza	69%	31%
Wandawa	41%	59%
AVERAGE	52%	48%

On average, 48 percent of households in Namatala urban informal settlement take more than 30 minutes to reach and collect water from a nearby water source as compared to 52 percent that spend more than 30 minutes to reach and fetch water from a nearby water source

Quantity of water supplied.

Without water, life is not possible. Inadequate supply of water has resulted into easy spread and outbreaks of infectious diseases (water borne and related diseases), and increased health issues due increased transmission of germs and poor hygiene. Poor water supply is also closely linked to low economic development, decrease in schooling, and poor sanitary conditions. According to WHO, the standard quantity of water for use/consumption is twenty (20) litres per person per day. In life-threatening circumstances, this amount is at five litres per person per day.

Accessibility to sufficient water

Table 12: Proportion of households by zone with access to water

Zone	Number of HHs interviewed	Households with access to sufficient quantity of water	
		Frequency	Percentage
Doko	32	23	72%
Sisye	32	21	66%
Mvule	32	25	78%
Nyanza	32	27	84%
Wandawa	32	19	59%
TOTAL	160	115	72%

On average, (72% [115/160]) of the surveyed households in Namatala urban informal settlement have access to a sufficient quantity of water. It is noted that in Nyanza, (84% [27/32]) of the households have adequate access to water as compared to other zones. This is because the piped water supply systems (yard tap water and public taps). Similarly, (78% [25/32]) and (72% [23/32]) of the surveyed households in Mvule and Doko zones respectively have access to sufficient water.

Water consumption by household.

Table 13: Average amount of water consumed per household/day and per person/day

Zone	Number of HHs	Total No of HH's members	Average No of people per HH	Average amount of water per HH per day	Standard deviation in Litres	Average amount of water consumed per person per day
Doko	32	176	5.50	78	19	14

Sisye	32	206	6.44	56	22	9
Mvule	32	187	5.84	89	23	15
Nyanza	32	149	4.66	95	26	20
Wandawa	32	158	4.94	44	20	9
TOTAL	160	876	5.475	72.4	22	13

A significant difference of ($p < 0.0001$) between the average daily consumption rate of water per household in the surveyed households in the five zones of Namatala urban slum was recorded. Correspondingly, a significant difference ($p < 0.0001$) between the average daily consumption rate of water per person in the surveyed communities was recorded. An average amount of water consumed per person per day recorded was 13 Liters across the 05 zones of Namatala urban informal settlement. This is lower than the daily per capita water consumption quantity of 20 liters minimum as per WHO standards. Hence, this puts Namatala urban informal settlement at a higher risk of spread and outbreak of waterborne and related disease in the targeted zones.

Source of drinking water.

Table 14: Distribution of drinking water sources in Namatala urban informal settlement.

Source of drinking water	Frequency	Percentage
Pipe water system (Tap)	87	54%
Open well (springs & hand dug)	6	4%
Borehole	53	33%
Stream (Namatala river)	6	4%
Water venders	8	5%

According to the survey, (54% [87/160]) of households in the surveyed zones of Namatala urban informal settlement use pipe water system as a drinking source of water. The piped water system in the area has both public stand posts and domestic yard tap connections that provide drinking water to these households. Piped water is distributed across these 05 zones but Nyanza zone has a high pipe water system network. (33% [53/160]) use borehole as a drinking water source. (4% [6/160]) use open well (springs and hand dug wells) as drinking water source,

while (4% [6/160]) and (5% [8/160]) percent of the households use stream (river Namatala) and water vendors for drinking water sources respectively.

Daily water tariffs incurred by the households in Namatala urban informal settlement.

Having different sources of water and household income levels in Namatala urban informal settlement, the cost incurred by each household in accessing water per day was determined. The table summarizes the question asked by the researcher; “How much does your Household pay for water per day, if any?”

Table 15: Distribution of daily water tariffs.

Cost of water/HH/day (UGX)	Frequency	Percentage
0-4,000	146	91%
4,000-8,000	9	6%
Above 8,000	5	3%

From the survey, (91%, [146/160]) incur a daily cost of (0-4,000 Ugx approximately 1USD) purchasing water for domestic use. 9 out of 160 households (14 percent) incur a daily cost of (4,000-8,000 Ugx approximately 1-2 USD) purchasing water for domestic use while 3 percent use above 2 USD to purchase water.

Sharing a water source with livestock.

Due to the various water sources in the study area, more so non-point water sources (mainly the shallow wells, and streams), I had to determine how many households share these sources of water with livestock. This is summarized in Figure 12 below.

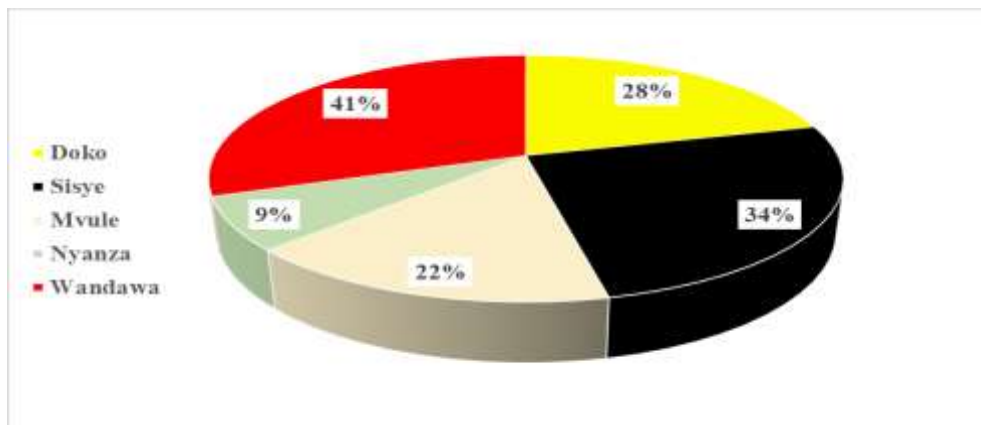


Figure 11: Percentage of households in each zone sharing water source with animals

As shown in the Figure 12 above, approximately four out of ten households (41 percent of the households) in Wandawa zone shared a water source with animals. Twenty-eight percent, thirty-four, twenty-two percent and nine percent shared a water source with animals in Doko, Sisye, Mvule and Nyanza zones.

Reliability of the drinking water source.

Due to the diversity of water sources accessed by households in the study area, reliability rate of the available water sources in the area was determined. Response to “Are there some months/days where your household cannot use the main source of drinking water?” is summarized in Table 16 below.

Response for sources of water not working in some days/month (N=160)

Table 16: Response for sources of water not working in some days/month

Response for sources of water not working in some days/month (N=160)	Frequency	Percentage
Yes	115	71%
No	45	29%

From the survey, (71% [115/160]) experience inability to use their main source of drinking water in some days while (29% [45/160]) households have reliable water sources.

Reason for non-use of the water source.

To better understand why the drinking water sources are sometimes unused by the 115 households, I had to determine the reasons behind it. Table 17 below summarized responses to the question, “Why is the drinking water source sometimes unused?”

Table 17: Response for non-use of the water source in some days or months

Reason	Frequency	Percentage
Mechanical problem	49	43%
User fee	14	12%
Weather problems (Flooding and drying up of the source)	8	7%
Conflicts with the owner	15	13%
Overcrowding at the source	7	6%
Distance	17	15%

Bad quality of water	5	4%
TOTAL	115	

(43% [49/115]) households attributed non-reliability of the drinking water sources in some months/days to mechanical problems/failures. Pump failures, pipe repairs and replacements a system bursts/leakages are the main factors households identified.

Household water management practices.

Current household water management practices in Namatala urban slum were identified. This included determining the number of households with drinking water containers as summarized in Table 18.

Table 18: Households with containers for drinking water.

Zone	Sample	Frequency	Percentage
Doko	32	27	84%
Sisye	32	19	59%
Mvule	32	26	81%
Nyanza	32	27	84%
Wandawa	32	13	41%
TOTAL	160	112	70%

As indicated in Table 18 above, an average of seventy percent (112 households) of households in the surveyed zones of Namatala urban informal settlement have containers specifically used for storing drinking water. Clay pots and 20-litre jerrycans are the main containers used for storing drinking water in these households of Namatala urban informal settlement.

Cleaning/washing of the drinking water container.

Table 19: Cleaning behavior for drinking water containers in Namatala urban slum

Cleaning practice	Frequency	Percentage
Daily	14	9%
Weekly	96	60%
After 2 weeks (Fortnight)	27	17%
Monthly	12	8%
More than a month	11	6%

From the data shown above, (60% [96/160]) households clean drinking water containers weekly. It is also noted that 9,17, and 8, percent of the households clean their drinking water containers on daily, fortnight and monthly basis. 6 percent take more than a month to clean their drinking water container.

Quality of Water.

The water quality parameters among the different sources of water accessible to the households in Namatala urban informal settlement were determined. The chemical and biological parameters were not measured. The parameters considered in this research were limited to smell (odor), clarity (sediment load), color, and taste. This helped in evaluating the suitability and safety of the water for drinking and other domestic uses.

Table 20: Ranking of physical quality of water by households

Parameter	Good	Slightly good	Poor
Smell (odour)	73%	19%	8%
Clarity (Sediment load)	82%	13%	5%
Colour	76%	17%	7%
Taste	83%	8%	9%
Average	79%	14%	7%

On average, 79, 14 and 7 percent of the above parameters are good, slightly good and poor to the households in Namatala urban informal settlement.

Water Treatment.

Table 21: Proportion of households treating drinking water.

Zone	Sample (n)	Frequency	Percentage
Doko	32	21	66%
Sisye	32	19	59%
Mvule	32	20	63%
Nyanza	32	24	75%
Wandawa	32	17	53%
TOTAL	160	101	63%

From Table 21 above, (64% [101/160]) households treat/make their drinking water safe. In Nyanza zone, (75% [24/32]) treat their drinking water as compared (53% [17/32]) households in Wandawa zone which has the lowest households treating their drinking water.

Methods of treating drinking water.

Since 101 out of 160 households treat their drinking water in Namatala urban informal settlement, I then inquired to rationalize the different methods the households use in making their drinking water safe. The table figure summarizes the question; “How does your household make the water safer to drink?”

Table 22: Methods of treating/making safe drinking water

Zones	No. of HHs	Boiling drinking water		Chlorination (tablet)		Filtering water	
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Doko	21	13	61.9%	6	28.6%	2	9.5%
Sisye	19	8	42.1%	7	36.8%	4	21.1%
Mvule	20	13	65.0%	4	20.0%	3	15.0%
Nyanza	24	16	66.7%	6	25.0%	2	8.3%
Wandawa	17	9	52.9%	5	29.4%	3	17.6%
TOTAL	101	59	58.4%	28	27.7%	14	13.9%

Boiling of water is the most used method of making the water safe for drinking in Namatala urban informal settlement. On average, approximately 58 percent of the households Namatala urban informal settlement boil their drinking water while 28 percent and 14 percent of the households that treat water in Namatala urban informal settlement use chlorination and filtering methods in making water safe or treating their drinking water. In Nyanza, approximately 67 percent of the households boil their drinking water.

Sanitation and Hygienic conditions in Namatala urban slum.

Availability of Latrines

The availability of latrines in good working conditions was the key concern in the targeted zones. All the surveyed households in Namatala urban slum have access to a toilet facility with (54% [87/160]), households having access to a VIP/pit latrine with slab. Most of the latrines in

Namatata urban informal settlement had a shutter/door (76% [63/83]), a roof (93% [77/83]) and with a depth of more than 1.5 meter (46% [38/83]). Also, by the time of the study, nearly all of the surveyed households in Namatata urban informal settlement were found within 300 meters to a toilet facility. The survey also revealed the privacy status and cleanliness levels of the toilet facilities. Therefore, the survey presents the following results.

Types of toilet facilities accessed by households in Namatata urban informal settlement.

Table 23: : Toilet facilities in Namatata urban slum

Type of toilet facility used by the HH	Frequency	Percentage
VIP/pit latrine with a slab	87	54%
Pit latrine without a slab/open pit	34	19%
Flush/pour flush to soak/septic pit	22	14%
Flush to septic tank	18	11%
Flush to the sewer/drainage channel	2	1%

(54% [87/160]) households access a VIP/pit latrine with slab while (19% [34/160]) households have a pit latrine without a slab/open pit. The survey also shows that very few households have improved sanitation facility. Notably, only (14% [22/160]) households have a flush/pour flush pit latrine while (11% [18/160]) households had flush to septic tank. Only (1% [2/160]) flush to the sewer/drainage channel their fecal matter.

A squat pan toilet in Mvule zone



Figure 12: Squat pan toilet in Mvule zone in Namatata urban slum

Privacy with the toilet facility.

Due to different mode of home ownership in Namatala urban informal settlement, privacy in-terms of sharing toilet facilities in Namatala urban slum were determined. Privacy of the toilet facilities determine the cleanliness, and other hygiene related conditions of these facilities. The findings below answered the question “*Is the toilet private (one household), shared (more than one household) or public?*”.

Table 24: Privacy status of toilet facilities in Namatala urban informal settlement

Type	Frequency	Percentage
Private (one household)	59	37%
Private (Shared)	87	54%
Public (Shared)	14	9%

As shown above, only (37%, [59/160]) households had private toilet facilities while (63% [101/160]) households share toilet facilities. Most of the of the private shared toilet facilities are found in rental homesteads. The public shared toilet facilities belonged to schools and health care facilities around the study area.

Sharing of the toilet facility.

Using toilet facility privacy status determined above, number of households that shared the toilet facility in Namatala urban slum were determined as shown in Table 25 below.

Mode of sharing the toilet facility in in Namatala urban informal settlement (N=101)

Table 25: Mode of sharing toilet facilities in Namatala urban slum

Sharing mode per toilet facility	Frequency	Percentage
1-4 households	53	52%
5-8 households	37	37%
Above 8 households	11	11%

The survey showed that most of the shared toilet facilities were found in rental units harboring more than one household with less toilet facilities. Statistically, (52% [53/101]) of the shared toilet facilities are shared by households of between 1-4 households.

Cleanliness of Latrines

Table 26: Status of latrine cleanliness by zone.

Zone	Number of toilet facilities	Status of cleanliness				
		Very dirty	Dirty	Fairly clean	Clean	Very clean
Doko	12	2	4	3	1	2
Sisye	17	1	4	5	2	5
Mvule	13	3	2	4	1	3
Nyanza	19	2	6	3	3	5
Wandawa	22	1	7	5	3	6
Total.	83	9	23	20	10	21

Eighty-three toilet facilities were found in 160 surveyed households in Namatala urban informal settlement. 32 of the households surveyed have a dirty or very dirty latrines, 20 households with fairly clean toilets while 10 and 21 households have clean and very clean latrines/ toilet facilities. Measure of cleanliness is based on dryness (no water and urine on the toilet facility), no fecal matter on top of the toilet facility, being swept, smoked or washed (scrubbing) by the household(s) using it. Structurally, most of the toilet facilities are made of mud and wattle, burnt clay bricks with hard roofs. They have squat pans and slabs.

Methods of cleaning: The toilet facilities found in Namatala urban informal settlement were cleaned using one or more methods listed in Table 27.

Table 27: Status of latrine cleanliness by zone.

Method	Frequency	Percentage
Sweeping	42	51%
Smoking	22	27%
Mopping/scrabbing	15	18%
Chemical treatment	4	5%

By the end of the survey, (51% [42/83]) toilets were cleaned by sweeping while (27% [22/83]), (18% [15/83]) and (5% [4/83]) toilet facilities were cleaned by smoking, mopping/scrabbing and use of chemicals respectively.

Method of empty or decommissioning the toilet facility.

Due to the location of Namatala urban slum within Namatala wetland, (78% [65/83]) of the toilet facilities have a depth of less than 1.5 meters. Therefore, there is a greatest chance of these toilet facilities getting filled up. Methods used by the households to empty/decommission the filled-up toilet facilities in Namatala urban slum were determined as shown below.

Methods used by households for emptying toilet facilities.

Table 28: Methods used by households for emptying toilet facilities.

Method	Frequency	Percentage
Chemical use	6	9%
Buried and construct another one	18	27%
Use of seas pool truck	43	64%

As presented above, (81% [67/83]) of the toilet facilities in Namatala had even been full and emptied. (64% [43/67]) were emptied using a seas pool truck while (9% [6/67]) were chemically emptied. (27% [18/67]) replaced toilet facilities that were buried after getting full.

Children's fecal matter disposal.

From the survey, (46% [73/160]) households had children aged 0-5 years. Hence, assessment of current disposal/management methods used for children's fecal matter by the households was done. Below is the summary of findings.

Table 29: Methods used by households for children's fecal disposal

Children's fecal matter disposal.	Frequency	Percentage
Used a potty	16	22%
Latrine	27	37%
Used diapers	22	30%
Went outside the premise (buried in the bush)	8	11%

From the survey, most of the households used latrine or diapers for management/collection of children's fecal matter in Namatala urban informal settlement. Statistically, (37% [27/73]) and (30% [22/73]) households had children aged 0-5 year, use a latrine (toilet facility) and diapers

respectively to collect children’s fecal matter. (22% [16/73]) households used a potty method while (11% [8/73]) households allowed children to defecate around the compound or buried the fecal matter around the compound/bush.

Hand washing.

Toilet facility with a hand washing facility.

(46% [38/83]) of the toilet facilities had hand washing facilities. Tipping taps made from jerrycans were the common had washing facilities installed aside of the toilet facilities.

Hand washing behaviour.

The behaviour of handwashing (*When do you wash your hands*) by the residents in Namatala urban slum was determined. Response to handwashing behaviour is as summarized below..

Table 30: Response to when do you wash hands?

When do you wash hands?	Frequency	Percentage
Before and after eating	160	100%
When hands are dirty	74	46%
After using the toilet	92	58%
Before preparing/serving food	78	49%
Before and after feeding children	67	42%

Form the survey, (100% [160/160]) households washed hands before and after eating while (46% [74/160]) households washed hands while dirty. (58% [92/160]) households washed hands after visiting the toilet facility while (49% [78/160]) washed hands before preparing and serving food. In response to what the households used in washing hands, (68% [108/160]) of the respondents said they used water and soap, 30 percent used water only while 3 percent used other detergents and water (ash)

Disposal of wastes and wastewater.

Wastewater (grey water) disposal methods.

Different methods used by the households to dispose/manage generated wastewater (grey water) were determined. Below is the summary of the finding to the question “*How does your*

household usually dispose of sed water, i.e., used water from washing, bathing and in the kitchen.?

Table 31: Wastewater disposal method

Wastewater disposal method	Frequency	Percentage
Around the surrounding/ compound	120	75%
Flush to the pipe sewer network	19	12%
Flush to the septic tank	8	5%
Water body (river and stream) around	13	8%

From the survey, unsustainable wastewater disposal methods of pouring to the compound and to the nearby water body (river/stream) were the most used methods by the households in Namatala urban slum. It is noted that (75% [120/160]) households poured wastewater (gray water) to the compound while (12% [19/160]), (5% [8/160]) and (8% [13/160]) respectively flushed wastewater to the pipe sewer network, septic tank and to the nearby water body (river and stream) around.



Figure 13: Waste water flowing in an open channel

Solid wastes disposal methods.

Table 32: Summary of Solid wastes disposal methods.

Solid waste disposal method used by the HHs	Frequency	Percentage
Anywhere around the surrounding	89	56%
To the waste disposal pit	44	28%
In the bush	27	17%

As presented above, unsustainable solid wastes disposal methods of pouring around the surrounding and to the nearby bush were the most used methods by the households in Namatala urban slum. It is noted that (56% [89/160]) households poured solid wastes around the surrounding, while (28% [44/160]), and (17% [27/160]) disposed solid wastes in the disposal pit and in the bush.

Occurrence of sanitation related diseases.

Occurrence of WASH related diseases in the past two months was determined. The graph below is the summary of the responses to “*In the last 2 months, is there any occurrence of water borne related disease in this household? (Diarrhoea, dysentery, scabies, trachoma, malaria and worm infections) such as Diarrhoea, dysentery*”

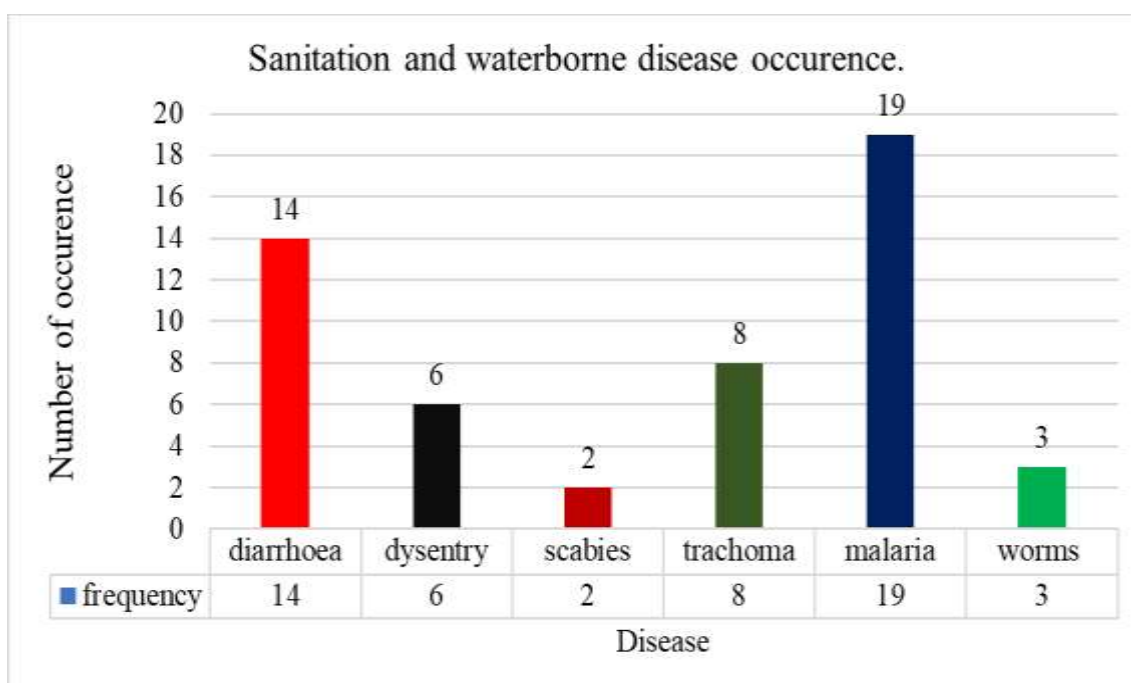


Figure 14: Occurrence of sanitation related diseases

(12% [19/160]) of the households had at least one case of malaria in the last 2 months prior to the survey. While the respondents reported this occurrence during the survey, these statistics should not be considered as an official diagnosis for malarial cases in Namatala urban slum.

Testing for normality of the data.

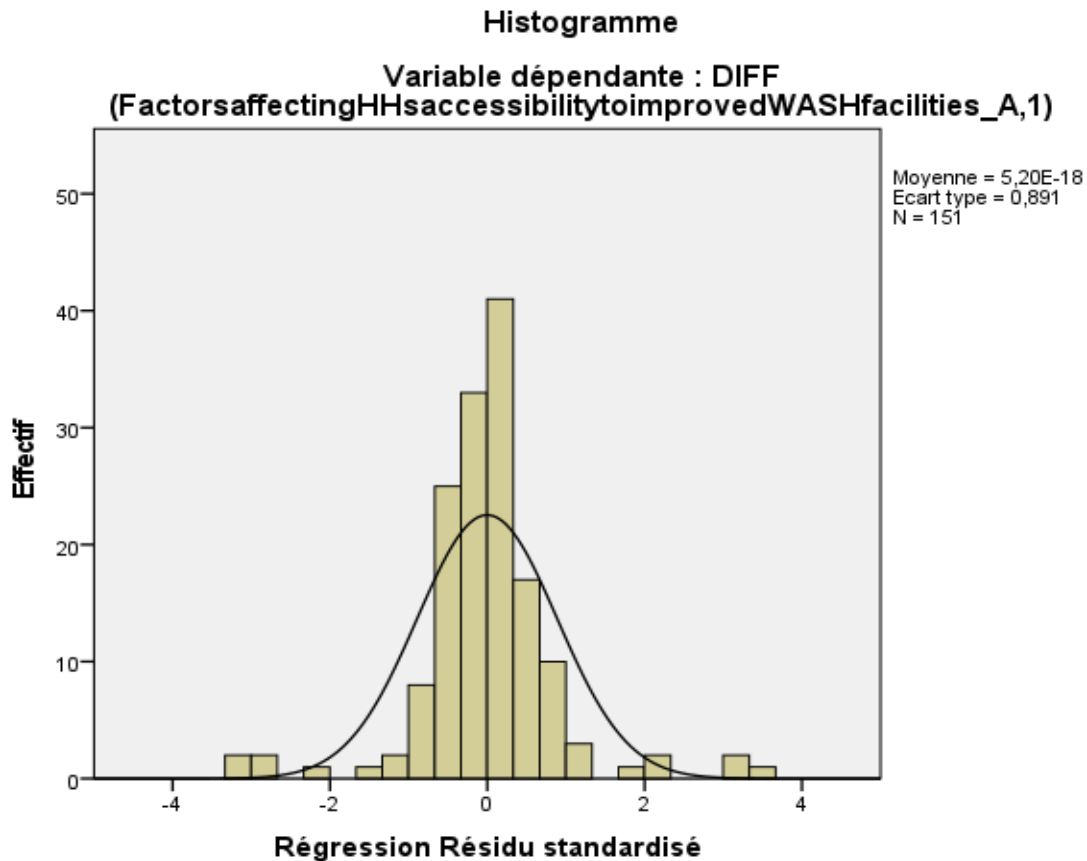


Figure 15: Normal distribution of the constant variables

In order to check the relationship or impact of the variables against each other (between independent and dependent variables) was determined. In Figure 16, all independent variables were observed to be normally distributed hence predicted an impact on the dependent variable (accessibility to improved WASH in Namatala urban slum). The data was then further analyzed to determine their impacts as summarized below.

Correlation analysis.

The nature and the magnitude of the relationship between the variables was determined. From the 95% confidence interval, most of the variables had a positive correlation or impact against

each other hence they positively impacted on the access to improved WASH in Namatala urban informal settlement. Variables such as; presence of water user committee, water source unavailability, presence of a handwashing facility around the toilet facility, number of persons in each household, privacy of the toilet facility (sharing of the toilet facility), quantity of water used by the household per day, education level, attendance of any WASH training/workshop positively impact on the access to improved WASH in Namatala urban slum.

Only pay per day for WASH services and religious distribution negatively impacted on the access to improved WASH. Therefore, any change in these variables does not affect access to improved WASH in Namatala urban slum.

Causal relationship.

Regression analysis was performed to determine the relationship between variables. Bivariate (binary) regression analysis was done to ascertain the influence of constant variables (independent) such as presence of water user committee, water source unavailability, presence of a handwashing facility around the toilet facility, number of persons in each household, privacy of the toilet facility (sharing of the toilet facility), quantity of water used by the household per day, education level, attendance of any WASH training/workshop, pay per day for WASH services and religious distribution on the dependent variable (access to improved WASH). Binary regression was done since dependent variable was dichotomous in nature, and the study showed the relationship between dependent and independent and vice versa. The results are as summarized below.

Summary of the model.

Modèle	R	R-deux	R-deux ajusté	Erreur standard de l'estimation	Changement dans les statistiques					Durbin-Watson
					Variation de R-deux	Variation de F	ddl1	ddl2	Sig. Variation de F	
1	,549 ^a	,302	,120	,2653	,302	1,659	31	119	,028	2,712

Figure 16: Summary of the models

Predictors: all constant variables.

From Figure 17 above, only 01 model was performed. The regression analysis of the normal data gave R=0.549 and R² of 0.302 which were far less than 1 hence they were rejected.

Therefore, first order differentiation of the normal variables was done. This was because the coefficients of the model were very low (far less than 1) to be used for further analysis. First order differentiation of the variables gave a variation F of 1.659 which is greater than 1, hence the model was statically accepted.

Summary of the coefficients

Coefficients ^a										
Modèle	Coefficients non standardisés		Coefficients standardisés		Sig.	95.0% % intervalles de confiance pour B		Statistiques de colinéarité		
	A	Erreur standard	Bêta	t		Borne inférieure	Limite supérieure	Tolérance	VIF	
1	(Constante)	,003	,022							
	DIFF(sexoftherespondent_A,1)	,008	,035	,020	,220	,827	-0,061	,076	,721	1,387
	DIFF(NumberofPeopleintheHH,1)	,004	,008	,043	,473	,637	-0,012	,020	,693	1,444
	DIFF(Ethnicdistribution_A,1)	-,017	,049	-,032	-,355	,723	-,115	,080	,728	1,373
	DIFF(Religiousdistribution_A,1)	-,030	,037	-,070	-,796	,428	-,104	,044	,751	1,331
	DIFF(Homeownerhipmode_A,1)	-,007	,040	-,016	-,164	,870	-,086	,072	,641	1,560
	DIFF(Lengthofstayinthezone_A,1)	-,045	,042	-,114	-,1067	,288	-,127	,038	,512	1,953
	DIFF(Occupationincomesource_A,1)	-,019	,056	-,035	-,336	,737	-,129	,092	,540	1,851
	DIFF(Educationleveloftherespondent_A,1)	,032	,086	,038	,376	,707	-,137	,202	,566	1,767
	DIFF(Incomelevel_A,1)	,056	,068	,081	,827	,410	-,079	,191	,605	1,652
	DIFF(Sourceofdrinkingwater_A,1)	,093	,052	,220	1,795	,075	-,010	,196	,392	2,553
	DIFF(Payperdayforwater_A,1)	-,001	,045	-,003	-,027	,978	-,090	,088	,590	1,696
	DIFF(HHdistancetothewatersource_A,1)	-,079	,055	-,183	-,1428	,156	-,189	,031	,359	2,789
	DIFF(Quantityofwaterperday_A,1)	-,020	,043	-,050	-,475	,636	-,105	,064	,531	1,884
	DIFF(Sufficiencyofwater_A,1)	,039	,052	,074	,755	,452	-,064	,142	,607	1,648
	DIFF(Watersourcereliability_A,1)	-,082	,049	-,153	-,1673	,097	-,179	,015	,702	1,424
	DIFF(Reasonforwatersourceunavailability_A,1)	,044	,034	,109	1,278	,204	-,024	,112	,814	1,229
	DIFF(Timespentinflectingwater_A,1)	-,036	,047	-,093	-,763	,447	-,130	,058	,394	2,539
	DIFF(Waterusercommitteeforthesource_A,1)	-,069	,059	-,112	-,1171	,244	-,185	,048	,639	1,566
	DIFF(Frequencyofwatertreatment_A,1)	-,085	,043	-,201	-,1976	,050	-,170	,000	,567	1,763
	DIFF(Methodused_A,1)	,018	,041	,044	,438	,662	-,063	,099	,572	1,749
	DIFF(HHwithwaterstoargecontainer_A,1)	-,171	,062	-,252	-,2778	,006	-,293	-,049	,714	1,401
	DIFF(Frequencyofcleaningthedrinkingwaterstoragecontainer_A,1)	-,048	,058	-,085	-,829	,408	-,164	,067	,561	1,782
	DIFF(HHwithtoilethandwashingfacility_A,1)	-,045	,090	-,050	-,499	,619	-,223	,133	,581	1,720
	DIFF(Modeoftoiletfacility_A,1)	,192	,080	,222	2,389	,018	,033	,351	,682	1,467
	DIFF(Sharedornotsharedtoiletfacility_A,1)	-,048	,045	-,099	-,1061	,291	-,136	,041	,673	1,486
	DIFF(NumberofHHssharingtoiletfacility_A,1)	,010	,059	,016	,168	,867	-,106	,126	,639	1,565
	DIFF(Managementofchildrenseacalmatter_A,1)	,023	,046	,049	,496	,621	-,068	,114	,607	1,648
	DIFF(Frequencyoftoiletfacilitycleaning_A,1)	,129	,065	,214	1,984	,050	,000	,258	,505	1,982
	DIFF(Wastewatergraywaterdiposalmethod_A,1)	,019	,046	,038	,416	,678	-,072	,110	,697	1,434
	DIFF(Occuranceofwaterbornerelateddiseases_A,1)	-,043	,059	-,062	-,730	,467	-,160	,074	,812	1,232
	DIFF(@14DoesyourhouseholdtreatormakeitsafetodrinkYes,1)	,099	,052	,174	1,922	,057	-,003	,201	,717	1,395

a. Variable dépendante : DIFF (FactorsaffectingHHsaccessibilitytoimprovedWASHfacilities_A,1)

Figure 17: Summary results for regression analysis of the differentiated variables.

From figure 18 above shows the results of the analysis. The Beta column indicates whether the constant/independent variables have a positive or negative influence on the dependent variable. The sex of the household's head was a significant factor that positively influences access to improved WASH in Namatala urban slum ($\beta= 0.20$, $p= 0.827$). This means that female headed households can easily access improved WASH facilities due to adverse effects the female gender face due to inadequate WASH services, and their powerful decisions on the choice of the drinking water source, sanitation and hygiene facilities. This finding is similar to the results by ⁵⁶ which revealed that female-headed households were more likely to access basic WASH services compared to their male counterparts. Also, education level of the household head showed a significant association with access to improved WASH services in Namatala urban slum ($\beta= 0.0430$, $p= 0.707$), due to their ability to practice and adopt improved WASH practices. A monotonically growing association was noted between accessing improved WASH facilities and household head education level. This finding is similar to the results by ⁵⁶ which found that the education level of the household head has a significant association with accessibility to basic WASH facilities/services. The income level also had a positive impact on improved WASH services in Namatala urban informal settlement ($\beta= 0.081$, $p= 0.41$). This is because households with high income levels have the potential and ability to access basic WASH services as compared with households with low-income levels. This is in line with findings for the research done by ⁵⁶ which affirms that wealth index has a significant correlation with the use of basic WASH service. Richest households had a higher likelihood to have an improved drinking water source, sanitation and hygiene facilities as opposed to the poorest households. Management of the children's fecal matter ($\beta= 0.081$, $p= 0.41$), sharing of the toilet facilities ($\beta= 0.081$, $p= 0.41$), wastewater disposal and management methods ($\beta= 0.081$, $p= 0.41$), and frequency of toilet facility cleaning ($\beta= 0.081$, $p= 0.41$) showed significant associations with access to improved WASH services in Namatala urban slum. This is evidenced in the histogram plot below.

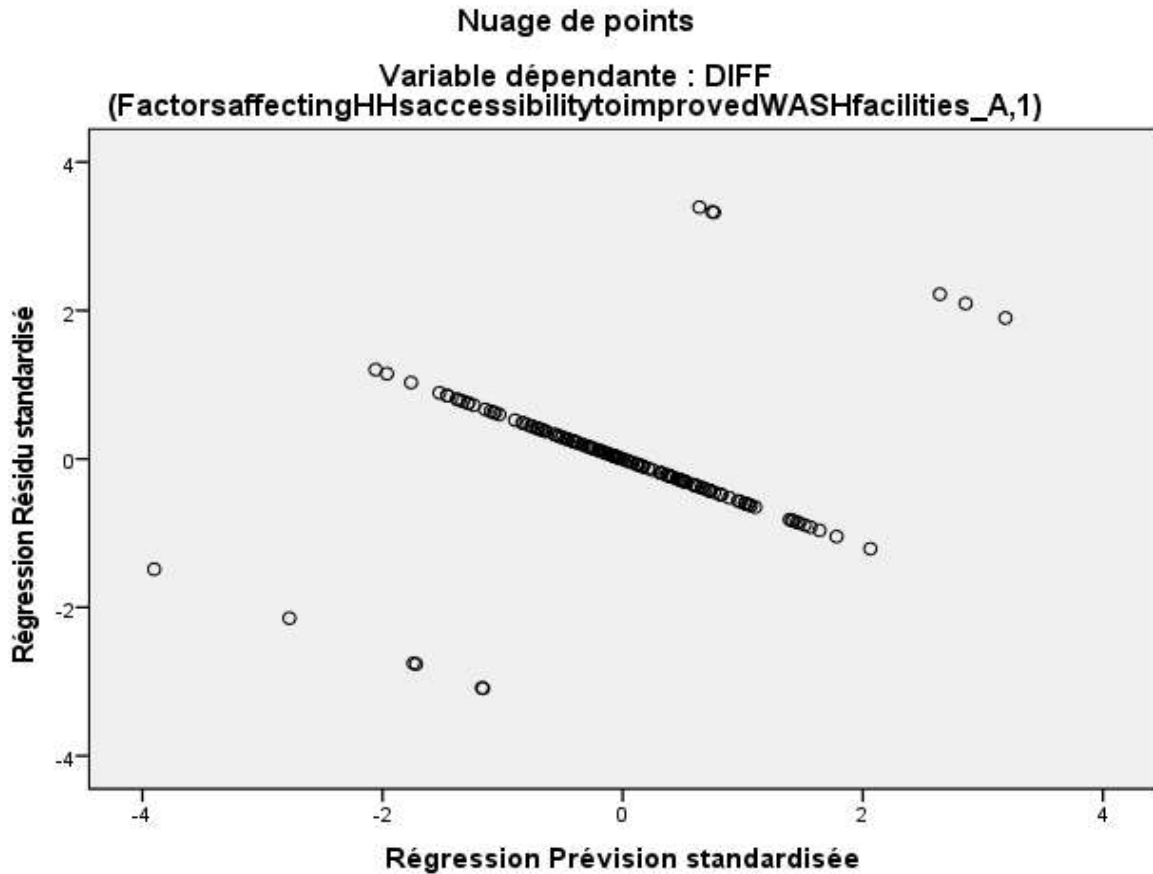


Figure 18: Causal relation between the variables

The scatter plot above show most of the point closely related/ closer to the gradient line hence have a high significance in access to improved WASH in Namatala urban informal settlement. A few variables were seen to have a less significance in access to improved WASH in Namatala urban informal settlement.

Objective II: Possible barriers to accessing improve WASH in Namatala urban slum.

After understanding the current WASH status in Namatala urban slum various barriers were identified by the respondents and were tallied. Therefore, the table below shows the response to the question “What do you think is problem affecting your accessibility to improved water sanitation and hygiene facilities?”

Table 33: Summary of barriers to improved WASH in Namatala urban slum

Barrier	Number of HHs	Percentage
Inadequate improved WASH facilities/infrastructure	97	61%
Limited access to safe drinking water	69	43%
Climate change (Floods and drought)	23	14%
Limited funding for WASH infrastructure	74	46%
Low enforcement of legal and regulatory frameworks	9	6%
Limited technical capacity	7	4%
Inadequate knowledge/training on healthy WASH practices	101	63%
Ineffective local community engagement	48	9%
Water source failures	29	30%
Conflicts and social taboos	6	4%
WASH tariffs	38	24%

From Table 33 above, inadequate improved WASH facility(ies) in Namatala urban slum hindered (61%, [97/160]) households to access improved WASH practices. Other notable barriers were; limited access to safe drinking water, Limited funding for WASH infrastructure, inadequate knowledge/training on improved WASH practices and Water source failures have respectively hindered (43%, [69/160]), (46%, [74/160]), (63%, [101/160]), and (30%, [29/160]) households to access improved WASH practices.

Analysis of the possible barriers to improved WASH in Namatala urban slum.

The above identified possible barriers were further screened by the 34 key informants who participated in 02 focused group discussions. Key informant identified, selected and ranked the possible barriers to improved WASH in Namatala urban slum. Technical information on WASH was established to include water access and reliability, sanitation was a viewed to be a system compromising of storage, collection, treatment, and disposal/reuse. Selected barriers to improved WASH in Namatala urban slum socio-culture (conflicts and social taboos, Ineffective local community engagement), technical (inadequate improved WASH facilities/infrastructure, Limited technical capacity, limited access to safe drinking water, inadequate knowledge/training on healthy WASH practices, water source failures), economics (WASH

tariffs, limited funding for WASH infrastructure) and institutional (low enforcement of legal and regulatory frameworks,) health and environment (climate change (Floods and drought)). Ranking of the possible barriers to improved access to WASH in Namatala urban informal settlement based on the total count for each option is as shown in Table 34.

Table 34: Rating of the possible barriers to access improved WASH in Namatala urban informal settlement

Possible barrier	Count for the possible barrier by 2 FGDs		Sum of the counts	Ranking
	FGD 1 (N=18)	FGD 2 (N=16)		
Inadequate improved WASH facilities/infrastructure	17	15	32	2
Limited access to safe drinking water	15	13	28	5
Climate change (Floods and drought)	13	14	27	6
Limited funding for WASH infrastructure	18	15	33	1
Limited technical capacity	12	11	23	7
Inadequate knowledge/training on healthy WASH practices	15	14	29	4
Ineffective local community engagement	18	12	30	3
Water source failures	09	10	19	9
WASH tariffs	08	12	20	8

As shown above, the most possible barrier was limited funding for the WASH infrastructural development followed by inadequate improved WASH facilities/infrastructure. The latter was also a barrier because its directly due to limited funding to the WASH sector. It could also be attributed to limited space/fragmented land ownership and low economic levels that have not favored the development of WASH in Namatala urban slum. All these findings are centered directly to the knowledge and the experience the key informants have in the development of the WASH infrastructure in Mbale city, particularly Namatala urban informal settlement. Additionally, WASH tariffs such as water user fees was the least possible barrier limiting access to improved WASH in Namatala urban informal settlement. This is because people can

afford these facilities. Consequently, involvement of stakeholders enabled better identification of the possible barriers to accessing WASH in Namatala urban informal settlement.

Participation in any WASH training/ workshop.

I also determined how many households had ever attended any workshop/training or seminar in the last six months in Namatala urban informal settlement. In summary, only (23% [37/160]) households had ever attended/ participated in any training, workshop, seminar teaching basic water sanitation and hygiene practices. This signifies the low level of improved WASH practices among the households in Namatala urban slum.

Objective III. Proposing feasible interventions to improve access to clean water, adequate sanitation, and proper hygiene practices in Namatala urban slum.

Analysis of the possible barriers to access improved WASH, the following are the possible policy interventions that can be implemented in Namatala urban slum. They include.

- ✓ *Community-Led Total Sanitation (CLTS) programs:* From the research findings, inadequate improved WASH facilities/infrastructure was the main barrier to access improved WASH in Namatala urban slum, implementation of CLTS approach can help improve the WASH conditions in households, schools and health care facilities in Namatala urban slum. Implementing CLTS programs can empower households in Namatala urban slum zones to take ownership of their sanitation facilities, promoting behavior change and sustainable practices. These programs would involve community mobilization, mapping of sanitation needs, and collective action to build and maintain sanitation infrastructure such as toilet facilities, waste management facilities and water supply systems.
- ✓ *Upgrade and expand water infrastructure:* Limited access to safe drinking water being ranked as the fifth barrier to access of improved WASH in Namatala urban slum, NGOs and government agencies should priorities be investing in upgrading and repairing existing water infrastructure and expanding access to piped water networks in Namatala urban slum. This may involve laying new pipes, repairing existing ones, and installing communal water points within the slum.

- ✓ *Enhanced public toilets:* Constructing well-maintained public toilet facilities equipped with proper sanitation amenities can improve hygiene and reduce open defecation. These facilities should be strategically located throughout the slum for easy access.
- ✓ *Awareness creation:* Due to inadequate knowledge/training on healthy WASH practices among households in Namatala urban slum, responsible stakeholders should organize and hold regular WASH campaigns, trainings and workshops to raise awareness about the importance of proper hygiene practices, such as handwashing with soap, safe water storage, and waste disposal. Stakeholders should prioritize utilizing the various local communication channels, including community meetings, posters, radio broadcasts, and mobile messaging documented both in official and local dialects.
- ✓ *Implementing integrated waste management:* Due to absence of national wastewater sewer line and landfill in the slum, there is a need to implement sustainable waste management systems that include collection, recycling, and proper disposal of solid waste and wastewater. The households need to be encouraged on waste segregation at the source and support community-based initiatives for waste management and recycling.
- ✓ *Collaboration with NGOs and Community-Based Organizations (CBOs):* Partner with NGOs and CBOs that have experience working in urban slums to leverage their expertise and resources. These organizations can facilitate community engagement, provide technical assistance, and support capacity-building efforts.
- ✓ *Legal Framework and Regulation:* Enforce regulations related to WASH services to ensure compliance with standards and promote accountability among service providers. This may involve establishing licensing requirements for water vendors and sanitation businesses, as well as monitoring and enforcement mechanisms.
- ✓ *Inclusive planning and participation:* There a need to involve residents, particularly women and marginalized groups, in decision-making processes related to WASH interventions. This shall ensure that their perspectives and needs are taken into account during planning, implementation, and monitoring phases.
- ✓ *Subsidize WASH tariffs:* There is a need to promote affordable, sustianble and equitable access to WASH among the households in Namatala urban slum. These essential services are pillars in improving public health, and advancing social and economic

development. Subsidizing WASH programs helps to maximize their impact and ensure long-term sustainability.

4.2. Presentation of the key findings from the FGDs and KIs.

The findings of the discussion are presented as per the topic of discussion.

Water accessibility and reliability to the households.

a. Accessibility to drinking water.

There are different sources of drinking water accessible to the households with the mostly used one being piped water supply.

b. Geographical accessibility

There is no geographical problem in drinking water accessibility since all the households are located within 1000 meters to the water source.

c. Water quality

The participants noted that deteriorating water quality is due to poor solid wastes, wastewater management coupled with poor sanitation and hygienic conditions in the area. Lack of sustainable emptying of the filled-up toilet facilities and channeling of wastewater to the stream flow were identified as key sources of pollution.

d. Water treatment

The most used method recorded was by boiling drinking water.

4.2.1. WASH knowledge.

Ignorance on the basic WASH practices by the community is high. This was attributed to low sensitization and teachings about WASH by the relevant stakeholders. Participants also noted that the population knows WASH issues, but are economically incapable and not able to solve most of the WASH related problems. All participants expressed concerns on the knowledge levels related to WASH related diseases and accepted that failure to use sustainable and proper improved WASH practices promotes and easily spreads diseases such as malaria, dysentery, diarrhoeal.

4.2.2. Sanitation and diseases related to hygiene

The participants acknowledge the rampant occurrence of sanitation and waterborne related diseases due to the poor sanitation and hygiene practices. The participants said the population are more exposed to this epidemic due to; lack of private toilet facilities, or poorly managed and maintained toilet facilities, despair houses, poor solid wastes and wastewater management practices.

4.3. Conclusion

This chapter provided Statistical distribution of gender, home ownership, and income levels among surveyed households in Namatala urban slum. It also listed the different types of water sources, accessibility, reliability, affordability, quality (physical water parameters), and the various household water management practices. In the section for sanitation and hygiene, the number of toilet facilities accessed by the surveyed households, toilet facility privacy, and hygiene practices. Analysis of the nature and magnitude of the relationship between the variables.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1. Summary.

5.1.1. Introduction.

This chapter presents summary of the study findings based on survey (interviews), research questions, observations and finally recommendations are highlighted. The purpose of this study was to assess the current water sanitation and hygienic conditions in Namatala urban slum. The specific objectives of the study were to determine the current status of water supply (accessibility and reliability) in Namatala urban slum, to determine the current sanitation and hygienic conditions in Namatala urban slum, and to determine the possible barriers to improved WASH facilities/services in Namatala urban slum. At the end of the study, the following is the summary of the findings.

5.1.2. Current status of water sanitation and hygiene in Namatala urban informal settlement.

Current status of water supply, accessibility and reliability.

The current water accessibility rate in the five zones of Namatala urban informal settlement is at 72 percent. This translates to 7 out of 10 people have access to water. This high-water accessibility rate is due to existence of the piped water supply system, and the on-going pipe water supply system extension works done by NWSC, the local NGOs within this informal settlement. (91%, [145/160]) of the households have a water source within a distance of 200meters. The commonest drinking water source observed in Namatala urban slum is piped water supply constituting to (54% [87/160]) of the supply to the households. Boreholes (33%, [53/160]), and open wells in the form of springs and hand dug wells also give (6%, [4/160]) of the drinking water supply. (91%, [146/160]) households spend less than 1 USD as a daily cost of water. Though with 72 percent water accessibility rate, (71% [115/160]) households experience non-use of the main source of drinking water in some days or months due to mainly; inability to aptly pay user fees, mechanical failures of the system, weather problems in th form of floods and conflicts with the owner of the water sources since most of the households share water sources. The water source physical parameters are good enough for domestic consumption of water with (63%, [101/160]) households treating or making their drinking water safe through mainly boiling. Although the current status water supply accessibility and reliability in Namatala urban slum is good, there are no in place sustainable operation and

maintenance strategies employed in these water supply systems. Notably, non-existence of the water user committees has resulted into breakdown, poor operation and maintenance of these water sources leading to also deterioration of the water quality standards. Water supply situation in Namatala urban slum is further

Current status of sanitation and hygiene services accessibility and reliability.

In general, all the surveyed households in Namatala urban slum have access to a toilet facility. There were 83 toilet facilities recorded in Namatala urban slum. In most cases, (76% [63/83]) of the observed toilet facilities in Namatala urban informal settlement had a shutter/door with (93% [77/83]) having a roof structure and (22% [18/83]) with a depth of more than 1.5 meter. (63% [101/160]) households share toilet facilities while (37%, [59/160]) households have private toilet facilities. The shared toilet facilities are mainly found in rental units and public institutions such as schools, health centers. Notably, (52% [53/101]) of between 1-4 households share one toilet facility while (48%, [48/101]) more than 4 households share one toilet facility. Because of differences in cultural, sanitation and hygienic behaviors within the households sharing these facilities, it has been attributed to [32/83] of toilet facilities being dirty. To keep the toilet facilities clean, (51%, [42/83]) are being swept while (27%, [22/83]), (18%, [15/83]), (5%, [4/83]) are respectively smoked, scrubbed or chemically treated. (46% [38/83]) of the toilet facilities had hand washing facilities. Tipping taps made from jerrycans were the commonest hand washing facilities installed aside of the toilet facilities. All households wash hands before and after eating while only (58%, [92/160]), wash hands after visiting the toilet facility. There is no proper management of the wastewater (gray water from washing, bathing and in the kitchen is poured the surrounding/compound. The slum dwellers also have unsustainable solid wastes disposal methods of pouring around the surrounding and to the nearby bush were the most used methods by the households in Namatala urban slum. Notably, (56% [89/160]) households pour solid wastes around the surrounding, while (28% [44/160]), and (17% [27/160]) dispose solid wastes in the disposal pit and in the bush.

5.1.3. Possible barriers to access improve WASH in Namatala urban slum

There are a number of policies and regulations addressing hygiene and sanitation at different levels. However, inadequate enforcement on policy implementation, the gaps between policy execution and results remain a major reason to worry in most of the developing Sub-Saharan Africa (SSA) being no special case. Various Sub-Saharan African countries have no capacity

to effectively execute their sanitation and hygiene projects and policies due to inadequate financial capacity and human technical resources. Irregular and unequal policy attention paid towards providing WASH service falls behind water supply (UNICEF W. &., 2012). In Namatala urban slum, inadequate improved WASH facility(ies)/infrastructure has hindered (61%, [97/160]) households to access improved WASH practices while limited access to safe drinking water, Limited funding for WASH infrastructure, inadequate knowledge/training on improved WASH practices and Water source failures have respectively hindered (43%, [69/160]), (46%, [74/160]), (63%, [101/160]), and (30%, [29/160]) households to access improved WASH practices. In summary, only (23% [37/160]) households had ever attended/participated in any training, workshop, seminar teaching basic water sanitation and hygiene practices. This signifies the low level of knowledge and skills by the slum dwellers in using improved WASH practices in their households.

5.2. Conclusion.

The research assessed the current waster sanitation and hygienic conditions in Namatala urban slum and identifying the current barriers to improved WASH services/facilities in Namatala urban slum. Therefore, below is the conclusion to this study.

- i. From the research findings, it is noted that Namatala urban slum has relatively good water supply (accessibility and reliability) status. (87%, [140/160]) surveyed households access improved water supply systems as drinking water sources i.e., piped water supply and borehole. These water sources at sometimes (days or months) are unavailable for the households due to the electro-mechanical operation and maintenance required attracting both tariffs and component/system failures. The physical water parameters from most of the water sources in Namatala urban slum are good and acceptable for human consumption with some households treating or making their water safe before drinking.
- ii. Although all households access toilet facilities, the surveyed households had only 83 toilet facilities with only (37%, [59/160]) households having private toilet facilities and the rest of the households sharing either private or public toilet facilities. These shared facilities are mainly found in rental units in which there are mainly housing units with unequal toilet facilities. Most of the uncleanliness of the toilet facilities is attributed to

difference in cultural, religious, sanitation and hygiene households' practices. Children of age below the age of 5 years who are unable to correctly use the toilet facility are considered to be the main agents of darkening of the toilet facilities in these households. To keep the toilet facilities clean, the practices of sweeping, smoking, and scrubbing of the toilet facilities is being used while few households chemically treat theirs. Forty-six percent of the toilet facilities had hand washing facilities enabling fifty-eight percent of the households to wash/clean their hands immediately after visiting the toilet facility. Furthermore, there is no proper management of the wastewater (gray water from washing, bathing and in the kitchen is poured the surrounding/compound. The slum dwellers also have unsustainable solid wastes disposal methods of pouring around the surrounding and to the nearby bush were the most used methods by the households in Namatala urban slum. Notably, (56% [89/160]) households pour solid wastes around the surrounding, while (28% [44/160]), and (17% [27/160]) dispose solid wastes in the disposal pit and in the bush.

- iii. From the study, inadequate improved WASH facility(ies)/infrastructure, limited access to safe drinking water, Limited funding for WASH infrastructure, inadequate knowledge/training on improved WASH practices and Water source failures are the main barriers preventing Namatala urban slum dwellers to access improved WASH services/ facilities. In summary, only (23% [37/160]) households had ever attended/participated in any training, workshop, seminar teaching basic water sanitation and hygiene practices.

5.3. Recommendations.

In the household survey conducted in Namatala urban slum, various observations and suggestions were collected from 160 respondents and the identified key informants. These are listed prior to the other recommendations based the findings from the study.

5.3.1. Recommendations from the households and key informants.

- i. Government, and other stakeholders should design and implement sustainable solid wastes and wastewater management systems.
- ii. Subsidizing of the WASH facilities/services in the area
- iii. Provide materials or construct toilet facilities for this community

- iv. NWSC to reduce the price of water
- v. Provide materials or construct housing units for this community.
- vi. Provide free water supply
- vii. Construct a sewer network for both runoff and wastewater in the area
- viii. Government, and other stakeholders should provide households with containers for collecting and storing drinking water.

5.3.2. From the researcher.

- i. Government, and other stakeholders should design and implement sustainable WASH programs in the area such as Community Led Total Sanitation (CLTS) among others so as to improve WASH knowledge and skills among the slum dwellers.
- ii. Government, and other stakeholders should allocate funds and construct sustainable WASH facilities in the area especially solid wastes and wastewater management systems.
- iii. Responsible stakeholders should ensure that all water points in the area continuously work.
- iv. Continuous sensitization of the community on the importance of proper sanitation and hygiene practices such as hand washing, proper waste disposal among others.
- v. A proper health record system /data base should be established by health centres and other stakeholders around the slum area in order to track spread and outbreak of waterborne or water related diseases. This can be done at household or zone level.
- vi. Forming and empowering the water user committees on the sustainable, technical operation and maintenance of the water sources around the slum.
- vii. Encourage and implement sustainable solid wastes and wastewater recycling approaches in Namatala urban slum

CHAPTER SIX: REFERENCES

1. Moghaddam AA, Mirzahosseini H, Guzik R. Comparing Inequality in Future Urban Transport Modes by Doughnut Economy Concept. *Sustain.* 2022;14(21). doi:10.3390/su142114462
2. Yadav V, Rajak R, Yadav AK. Growing slums in Indian towns: Insights from Census data 2001-11. *Demogr India.* 2021;50(2).
3. Greif MJ, Dadoo FNA, Jayaraman A. Urbanisation, poverty and sexual behaviour: The tale of five African cities. *Urban Stud.* 2011;48(5). doi:10.1177/0042098010368575
4. Kimani-Murage EW, Schofield L, Wekesah F, et al. Vulnerability to Food Insecurity in Urban Slums: Experiences from Nairobi, Kenya. *J Urban Heal.* 2014;91(6). doi:10.1007/s11524-014-9894-3
5. Tacoli C. Food (In)security in rapidly urbanising, low-income contexts. *Int J Environ Res Public Health.* 2017;14(12). doi:10.3390/ijerph14121554
6. Romero-Lankao P, Gnatz DM, Wilhelmi O, Hayden M. Urban sustainability and resilience: From theory to practice. *Sustain.* 2016;8(12). doi:10.3390/su8121224
7. Isunju JB, Schwartz K, Schouten MA, Johnson WP, van Dijk MP. Socio-economic aspects of improved sanitation in slums: A review. *Public Health.* 2011;125(6). doi:10.1016/j.puhe.2011.03.008
8. Konteh FH. Urban sanitation and health in the developing world: Reminiscing the nineteenth century industrial nations. *Heal Place.* 2009;15(1). doi:10.1016/j.healthplace.2008.02.003
9. Dangour AD, Watson L, Cumming O, et al. Interventions to improve water quality and supply, sanitation and hygiene practices, and their effects on the nutritional status of children. *Cochrane Database Syst Rev.* 2013;2013(8). doi:10.1002/14651858.CD009382.pub2
10. Kasaija P, Nkhonjera M. Affordable housing in Uganda: Market shaping indicators. Published online 2020:1-17. <https://housingfinanceafrica.org/resources/yearbook/>
11. Gichuki Manana MN. Place Centered Social-Economic, Cultural and Environmental Influence in the Making of Namatala Slums in Mbale Municipality, Uganda. *East African J Humanit Soc Sci.* 2023;2(1):46-62. doi:10.58721/eajhss.v1i1.161
12. Kulabako NR, Roger T. Characterization of Peri-Urban Anthropogenic Pollution in

- Kampala , Uganda. Published online 2004:474-482.
13. Nayebare JG, Owor MM, Kulabako R, Campos LC, Fottrell E, Taylor RG. WASH conditions in a small town in Uganda: How safe are on-site facilities? *J Water Sanit Hyg Dev.* 2020;10(1). doi:10.2166/washdev.2019.070
 14. Taylor RG, Howard KWF. Groundwater recharge in the Victoria Nile basin of east Africa: Support for the soil moisture balance approach using stable isotope tracers and flow modelling. *J Hydrol.* 1996;180(1-4). doi:10.1016/0022-1694(95)02899-4
 15. Synergy I, Increasing FOR, For S, National G, Greater O, Ownership N. *ACTIVITIES REPORT ACTIVITIES UN-HABITAT GLOBAL ACTIVITIES REPORT 2015.*; 2015.
 16. Mberu BU, Haregu TN, Kyobutungi C, Ezeh AC. Health and health-related indicators in slum, rural, and urban communities: A comparative analysis. *Glob Health Action.* 2016;9(1). doi:10.3402/GHA.V9.33163
 17. Behera DK, Samant K, Dehury RK. Assessment of Water, Sanitation, and Hygiene in South-East Asia: A Systematic Review. *J Clin DIAGNOSTIC Res.* Published online 2022. doi:10.7860/jcdr/2022/55225.17080
 18. Garenne M. Urbanisation and child health in resource poor settings with special reference to under-five mortality in Africa. *Arch Dis Child.* 2010;95(6). doi:10.1136/adc.2009.172585
 19. Ezeh A, Oyebode O, Satterthwaite D, et al. The history, geography, and sociology of slums and the health problems of people who live in slums. *Lancet.* 2017;389(10068). doi:10.1016/S0140-6736(16)31650-6
 20. Hawkins P, Blackett I, Heymans C, et al. Poor-Inclusive Urban Sanitation: An Overview. *Water Sanit Progr.* 2013;(August).
 21. Simelane S, Masiteng K. Demography of poverty and inequality in South Africa. In: *Social Demography of South Africa: Advances and Emerging Issues.* ; 2015. doi:10.4324/9781315818818-22
 22. Cain NL, Gleick PH. The global water crisis. *Issues Sci Technol.* 2005;21(4). doi:10.1215/01636545-1965880
 23. Kumar R, Singh RD, Sharma KD. Water resources of India. *Curr Sci.* 2005;89(5). doi:10.1002/047147844x.wr243
 24. Hales S, Black W, Skelly C, Salmond C, Weinstein P. Social deprivation and the public

- health risks of community drinking water supplies in New Zealand. *J Epidemiol Community Health*. 2003;57(8). doi:10.1136/jech.57.8.581
25. Stanaway JD, Reiner RC, Blacker BF, et al. The global burden of typhoid and paratyphoid fevers: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet Infect Dis*. 2019;19(4). doi:10.1016/S1473-3099(18)30685-6
 26. Gleick PH. Transitions to freshwater sustainability. *Proc Natl Acad Sci U S A*. 2018;115(36). doi:10.1073/pnas.1808893115
 27. Gleick PH. Water in crisis: Paths to sustainable water use. *Ecol Appl*. 1998;8(3). doi:10.1890/1051-0761(1998)008[0571:WICPTS]2.0.CO;2
 28. Gleick P, Iceland C. Water, Security, and Conflict. *World Resour Inst*. 2018;(Brief Issue).
 29. Graw V, Oldenburg C, Dubovyk O. Bush Encroachment Mapping for Africa: Multi-Scale Analysis with Remote Sensing and GIS. *SSRN Electron J*. Published online 2018. doi:10.2139/ssrn.2807811
 30. Anyah RO, Semazzi FHM. Simulation of the sensitivity of Lake Victoria basin climate to lake surface temperatures. *Theor Appl Climatol*. 2004;79(1-2). doi:10.1007/s00704-004-0057-4
 31. Mackay A. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. *J Environ Qual*. 2008;37(6). doi:10.2134/jeq2008.0015br
 32. Nsubuga FNW, Namutebi EN, Nsubuga-Ssenfuma M. Water Resources of Uganda: An Assessment and Review. *J Water Resour Prot*. 2014;06(14):1297-1315. doi:10.4236/jwarp.2014.614120
 33. Mileham L, Taylor RG, Todd M, Tindimugaya C, Thompson J. The impact of climate change on groundwater recharge and runoff in a humid, equatorial catchment: Sensitivity of projections to rainfall intensity. *Hydrol Sci J*. 2009;54(4). doi:10.1623/hysj.54.4.727
 34. Mölg T, Georges C, Kaser G. The contribution of increased incoming shortwave radiation to the retreat of the Rwenzori glaciers, East Africa, during the 20th century. *Int J Climatol*. 2003;23(3). doi:10.1002/joc.877
 35. Cleemput O Van, Saso L. Manual on Scientific Communication for Postgraduate

- Students and Young Researchers in Technical , Natural , and Life Sciences A practical guide for the preparation of theses , papers ,... Manual on Scientific Communication for Postgraduate Students and Yo. 2017;(August). doi:10.5772/intechopen.69870
36. Kamau N, Njiru H. Water, Sanitation and Hygiene Situation in Kenya's Urban Slums. 2019;29(1):321-336.
 37. Price R, Inglis A. Training in anaesthesia is also an issue for nurses. 2005;82(11):608-610. doi:10.1136/emj.2004.016154
 38. Perez E, Coombes Y, Devine J, et al. *What Does It Take to Scale up Rural Sanitation ?*; 2012.
 39. Watanabe M, Takano T, Nakata K, Nakamura K. *Effect of Ethanol on Nitrite Oxidation in the Perfused Rat Liver*. Vol 33.; 1995. doi:10.1016/0278-6915(95)00065-A
 40. Mara D, Lane J, Scott B, Trouba D. Sanitation and Health. 2010;7(11). doi:10.1371/journal.pmed.1000363
 41. Pr A, Neira M, Stocks M, Wolf J. Burden of disease from inadequate water , sanitation and hygiene in low- and middle-income settings : a retrospective analysis of data from 145 countries. 2014;19(8):894-905. doi:10.1111/tmi.12329
 42. UNICEF. Investing in Water, Sanitation and Hygiene in Madagascar. 2016;(May). https://www.unicef.org/madagascar/eng/Business_Case_-_Investing_in_WASH-final-July_2016_archive_copy.pdf
 43. Study WB, Tsimpo C, Wodon Q. *Water and Sanitation in Uganda*.
 44. Gwimbi P, George M, Ramphalile M. Bacterial contamination of drinking water sources in rural villages of Mohale Basin, Lesotho: Exposures through neighbourhood sanitation and hygiene practices. *Environ Health Prev Med*. 2019;24(1). doi:10.1186/s12199-019-0790-z
 45. Sibiyi JE, Gumbo JR. Knowledge, attitude and practices (KAP) survey on water, sanitation and hygiene in selected schools in Vhembe district, Limpopo, South Africa. *Int J Environ Res Public Health*. 2013;10(6). doi:10.3390/ijerph10062282
 46. Lewis EW, Siyambango N, Lendelvo S. Assessment of accessibility of safe drinking water: A case study of the goreangab informal settlement, Windhoek, Namibia. *Water Pract Technol*. 2018;13(4). doi:10.2166/wpt.2018.096
 47. McGill BM, Altchenko Y, Hamilton SK, Kenabatho PK, Sylvester SR, Villholth KG.

- Complex interactions between climate change, sanitation, and groundwater quality: a case study from Ramotswa, Botswana. *Hydrogeol J.* 2019;27(3). doi:10.1007/s10040-018-1901-4
48. Chunga RM, Ensink JHJ, Jenkins MW, Brown J. Adopt or adapt: Sanitation technology choices in urbanizing Malawi. *PLoS One.* 2016;11(8). doi:10.1371/journal.pone.0161262
 49. Hodges Mlenga D, Mlenga DH. Towards Community Resilience, Focus on a Rural Water Supply, Sanitation and Hygiene Project in Swaziland. *Am J Rural Dev.* 2016;4(4).
 50. McMichael C. Toilet Talk: Eliminating Open Defecation and Improved Sanitation in Nepal. *Med Anthropol Cross Cult Stud Heal Illn.* 2018;37(4). doi:10.1080/01459740.2017.1371150
 51. Nefale AD, Kamika I, Obi CL, Momba MNB. The limpopo non-metropolitan drinking water supplier response to a diagnostic tool for technical compliance. *Int J Environ Res Public Health.* 2017;14(7). doi:10.3390/ijerph14070810
 52. Tidwell JB, Chipungu J, Bosomprah S, Aunger R, Curtis V, Chilengi R. Effect of a behaviour change intervention on the quality of peri-urban sanitation in Lusaka, Zambia: a randomised controlled trial. *Lancet Planet Heal.* 2019;3(4). doi:10.1016/S2542-5196(19)30036-1
 53. Mugenda MO, Mugenda GA. Research Methods: Qualitative and Quantitative Approaches by Olive M. Mugenda and Abel G. Mugenda. African Centre for Technology Studies (Acts) Press, Nairobi – Kenya. *J Co-op Bus Stud.* 2009;1(1).
 54. Kothari SP, Warner JB. Econometrics of Event Studies. In: *Handbook of Empirical Corporate Finance SET.* Vol 2. ; 2007. doi:10.1016/B978-0-444-53265-7.50015-9
 55. Kothari SP, Warner JB. The Econometrics of Event Studies. *SSRN Electron J.* Published online 2011. doi:10.2139/ssrn.608601
 56. Rahut DB, Singh A, Sonobe T. WASH facilities prevalence and determinants: Evidence from 42 developing countries. *Front Environ Sci.* 2022;10. doi:10.3389/fenvs.2022.1013657

CHAPTER SEVEN: APPENDIX.

7.1. Work plan

Table 35: Work plan of the research.

S/N	Activities	YEAR							
		2023			2024				
		Oct	Nov	Dec	Jan	Feb	March	April	
1	Final Year Thesis research								
2	Concept note generation, proposal writing & budget defense								
4	Data collection methods preparation (questionnaires).								
5	Data collection (administering interviews, Focused group discussions).								
6	Data analysis and interpretation								
7	Literature review, Final report writing, Compiling and submitting the Thesis								
8	Thesis defense								

7.2. Budget breakdown

Table 36: Estimated cost of the research expenses

S/No.	Item	Unit	Quantity	Rate (Unit price) USD	Amount* USD	Link to Research Activity**	Comment*** (For Evaluator Only)
(A) Material and Supplies							
1	Internet recharge (up to \$200 total)	Month	4	50	200.00	For sending and receiving relevant materials as well internet search for relevant materials. Downloading (data papers, articles, tutorials and software) and Communications with the supervisor(s).	
2	Printing of colored copies	Pages	400	0.15	60.00	For photocopying, printing and scanning of necessary research work and related materials.	
3	Printing (black and white copies)	Pages	2,800	0.05	140.00		
4	Photocopying	Pages	500	0.05	25.00		
5	Scanning	Pages	200	0.08	16.00		
6	Binding	Booklet	10	5.50	55.00		

7	Consumables such as note books mark pens, manillas and cello tape forFGD	Lumpsum	1	50	50.00	Used for data collection during focused group discussions, interviews and surveys	
8	Face masks	dozens	2	10	20.00		

9	Hand sanitizers	Liters	10	2.40	24.00	Used for recording and transcription of the qualitative data collected from the survey.	
Sub Total					590.00		

(B) Equipment

1	IBM Statistical Package for the Social Sciences Statistics	Package	1	200.00	200.00	Software for data analysis	
2	Water points map Datasets (point water sources)	Data set	2	50.00	100.00	For examining past and current datasets maps of water sources (points) in the study area	
4	Public sanitation and hygiene facilities data set.	Data set	2	50.00	100.00	For examining past and current datasets maps of sanitation and hygiene facilities in the study area	
5	128GB USB Flash Drive	Data set	1	25.00	20.00	For storing, transferring and collecting data related to the research	
6	Socio-Economic dataset from the previous census	Data set	1	45.00	45.00	For analyzing the previous and current predominant socio-economic status of the households in	

	Sub Total				470.00		
(C) Travel + Visa Costs.							
1	Algerian travel Airport taxi	Trip	2	55	110.00	Mobility expenditures to and from Tlemcen to the Airport, for research and internship.	
2	International flight travel Algiers to Entebbe (Return ticket)	Trip	2	600	1200.00	Travel to the research study, from Algiers to Entebbe International Airport, Uganda (Round Trip)	
3	Uganda's Airport taxi	Trip	2	65.00	130.00	Mobility expenditures to and from Entebbe International Airport.	
5	Field transport. Transport by taxi(s) to and from Namatala urban informal settlement for data collection	Lumpsum	1	300.00	300.00	Transport for data collection in the five zones found in Namatala urban informal settlement.	
	Sub Total				1,740.00		
(D) Special Activities e.g., course, etc....							
1					0.00	N/A	
	Sub Total				0.00		
(E) Contingencies (%) (reserve at least \$100 from which eventual bank transfer fees will be taken from					200.00	Unexpected cost may arise during the research	

	Sub Total				200.00		
TOTAL							
A	Personnel				0.00		
B	Material & Supplies				590.00		
C	Equipment				470.00		
D	Travel				1,740		
E	Special Activities				0.00		
F	Contingencies (%)				200.00		
	Grand Total				3,000.00		

7.3: HOUSEHOLD QUESTIONNAIRE.

WATER SUPPLY, SANITATION AND HYGIENE HOUSEHOLD SURVEY:

Location. Namatala Urban Informal Settlement

By:	OTIM Sam Kizito	Household ID/.....
Zone		Start Time
Correspondent		Date:/...../.....

Introduction

Good morning/afternoon/evening. My name is OTIM Sam Kizito, a student from PAUWES-Algeria, conducting an independent study research. I would like to speak to an adult female member of the household, who is living in this household on a permanent basis. The aim of the research is to assess the barriers to improved WASH and the current status of WASH facilities and related issues in Namatala slum. All the information your give remains strictly confidential.

Would you agree to participate in the interview?

Yes No.....

(If **YES**, continue with the interview, if **NO**, move to the next Household)

HOUSEHOLD CHARACTERISTICS

Q1. What is the sex of the correspondent?

Male.....Female.....

Q2. Are you the household head?

Yes..... **(Go to Q4)** No.....

Q3. What is your relationship to the head of household?

Wife.....Husband.....Mother.....Father.....
 Grandmother.....Grandfather..... child.....Other (write down.....)

Q4. How many people are in this household?

0-5.....5-10.....10-15.....15>.....

Q5. What is the name of your tribe?

Bagisu.....Baganda.....Iteso.....Other (Name).....

Q6. What is your religion?

Christianity.....Islam.....others

Q7. Do you own or rent this home?

Own..... Rent.....

Q8. How many females and males are in this household?

MalesFemales.....

Q8. How long have you lived in this community?

0-5 Years5-10 Years>10 Years

Q9. How many people live in this household permanently including you are?

0-4 Yrs.....5-10Yrs..... 11-15 Yrs.....15 Yrs. and above.....

Q10. What has been [name]'s main employment during the last 7 days?

Skilled labour.....unskilled labourFarmerUnemployed.....

Q11. What is the highest educational level completed by [name]?

UneducatedPrimary.....Secondary.....Tertiary

Q12. What is the total monthly income of the household? From all HH members.

0-200,000 Ugx.....200,00-400,000 Ugx.....above 400,000Ugx.....

WATER SUPPLY

Q1. What is the main source of drinking water for members of your household?

- i. Piped water
 - ii. Rainwater
 - iii. Bottled water
 - iv. Tube well/borehole
 - v. Small-scale vendor
 - vi. Protected dug well
 - vii. Unprotected dug well
 - viii. Surface water (river dam, lake, pond, stream, channels).
-

Q2. How much does your Household pay for water per day, if any?

.....

Q3. Does your household use the same water sources of water for other purposes?

- i. Yes
- ii. No

If **YES**, skip Q4 otherwise ask Q4 if **NO**

Q4. Please state the main source and other sources for each use of water?

- i. Drinking
- ii. Cooking

- iii. Washing clothes
- iv. House cleaning
- v. Bathing/washing your bodies
- vi. Domestic agriculture

Q5. How far is that water sources from the household?

0-100m.....100-500m.....500m>.....

Q6. How much water does your household use daily?

0-20 Liters.....20-50Ltrs.....50Ltrs>.....

Q7. Is this water enough for your household?

Yes..... **(Go to Q9)** No.....

Q8. Why is the water you use not enough?

(i).....**(ii)**

Q9. How frequently is that source available to your household?

- i. Daily (24 Hrs.) Number of hours.....
- ii. Weekly (07 days) Number of days

Q10. Are there some months/days where your household cannot use the main source of drinking water?

YesNo

Q11. Which months/days?

.....

Q12. What was the (main) reason you were unable to access sufficient quantities of water when needed?

SpoiltNo flow.....Flooding/Drought.....User fee.....Other.....

Q13. Do you share the water source with animals?

Yes.....No

Q14. How long does it take to go there, get water and come back?

0-30minutes.....30-60minutes.....>60minutes.....

Q15. Do your water sources have a water user committee?

YesNo

Q16. Does your household treat or make it safer to drink?

YesNo

Q17. When was the last time your household treated the water using this method?

Hours Days Weeks Months

Q18. What does your household do to make the water safer to drink?

Boil.....Add bleach/chlorine..... filter it..... Let it stand and settle

Q19. How would you rate the quality of your drinking water service now (coming from the primary source)? Tick where appropriate.

S/N	Parameter	State		
		Good	Acceptable	Poor
1	Clarity (no sediments in the water).			
2	Color			
3	Smell			
4	Taste			

Q20. Does your household have a water storage container for drinking water? Which size?

YesQty.....No

Q21. How often does your household usually clean the drinking water storage container?

Daily Weekly..... Monthly..... Others

PERSONAL HYGIENE AND HOUSEHOLD CLEANLINESS.

Q1. Do you have a toilet handwashing facility?

YesNo

Q2. Do you have soap that you use for hand washing in your household?

YesNo

Q3. When do you wash your hands?

Options	Tick	Options	Tick
Before and after eating		Before preparing food	
When hands are dirty		Never or rarely	
When washing the face		Before and after feeding children	

Q4. I would like to observe how you wash your hands. Observations

Water only Water plus soap (detergent)..... Handwashing facility.....

Q5. Does your household have, use or access a toilet facility?

YesNo

Q6. What kind of toilet does your household use? Tick the chosen option

S/N	Options	Tick
1	Flush to piped sewer system	
2	Flush to septic tank	
3	Flush/pour flush to pit	
4	VIP/pit latrine with slab	
5	Bucket	
6	Pit latrine without slab/open pit	
7	Open air/bush/field	
8	Others (Specify)	

Q7. Is the toilet private (one household), shared (more than one household) or public? Private (one household)Public.....Shared (more than one household)

Q8. How many households in total use this toilet facility, including your own household?

Number of householdsDon't know

Q5. The last time [name of youngest child] passed stools, where did she/he defecate? Tick the chosen option.

Options	Tick	Options	Tick
Used the sanitation facility		Used diapers	
Went outside the premises		Went in yard	
Used potty		Used a bucket	
Went in her/his clothes		Used a plastic bag	

Q9. How often do you always clean the toilet facility?

Daily Weekly (07 days) Number of days Never

Q10. How many years ago was your pit latrine/septic tank last emptied?

Number of Years Don't know

Q11. How does your household usually dispose of sed water, i.e. used water from washing, bathing and in the kitchen.?

S/N	Options	Tick
1	Flush to piped sewer system	
2	Flush to septic tank	
3	Open channel	

4	Water body (river, stream around)	
5	Open space (compound garden)	

Q12. In the last 2 months, is there any occurrence of water borne related disease in this household? (Diarrhoea, dysentery, scabies, trachoma, malaria and worm infections)
 YesNo

Q13. Have you ever participated in any training, workshop, seminar teaching basic water sanitation and hygiene practices?
 YesNo

Q14. What do you think is problem affecting your accessibility to improved water sanitation and hygiene facilities?

- i).
- ii).
- iii).
- iv).
- v).
- vi).
- vii).

THANK YOU FOR YOUR HELP IN THIS RESEARCH

I confirm that this interview is completely confidential

End Time: /.....

7.4. INVITATION LETTER TO PARTICIPATE IN THE FGDs

OTIM SAM KIZITO

Address: PAUWES B.P. 119 | Pôle Chetouane, Tlemcen 13000. Algeria.

WhatsApp Tel: +256 765163840 **Email:** skizito.timam@gmail.com

January 31, 2024

To;

Dear Sir/Madam

RE: REQUEST TO ATTEND WATER SANITATION AND HYGIENE SURVEY.

I hope this letter finds you well. I am OTIM Sam Kizito, a graduate student, pursuing Masters of Science in Water Policy degree from Pan African Institute of Water and Energy sciences including Climate Change (PAUWES)-Algeria. I am currently doing data collection for my Research Thesis/Dissertation titled “Determinants of improved access to water, sanitation and hygienic conditions in Uganda, a case study of Namatala urban informal settlement in Mbale City.

It is in this regard that I have identified you/your office/institution/organization to participate in the incoming Focused Group Discussion to be held at the Ministry of Water and Environment Facility East Headquarters boardroom RM17 on 09/February/2024 and 22/February/2024 respectively. Please share with me the appropriate date of your participation not later than 04/February/2024.

I have attached an agenda for your consideration. I look forward to hearing and meeting you.

Thank You



OTIM SAM KIZITO.

CC: The Directorate of Water Resources Management (DWRM),

CC: Directorate of Water Development (DWD)

CC: Ministry of Water and Environment-Facility East

CC: NGOs and CBOs in Namatala urban slum

CC: Mbale City-Works Department

CC: Local Council (s) in Namatala urban slum

CC: Water user committees, Health centers Village Health Teams in Namatala urban slum.

7.5. AGENDA FOR THE FGDs

The following agenda was adopted during the two (02) FGDs.

Table 37: FGDs agenda

S/N	ITEM	DESCRIPTION	TIME ALLOCATION
1.	Arrival	By all participants	9:00 am
2.	Prayer	By all participants	9:00-9:05 am
3.	Introduction of participants	Name, address and position	9:05-9:15 am
4.	Welcome remarks by the host institution	Manager-Umbrella of Water and Sanitation-Facility East	9:15-9:30 am
5.	Brief overview of the Exercise	Otim Sam Kizito	9:30-9:40 am
6.	Main discussion	Participants to express their knowledge, practices, attitudes and experience towards the current WASH conditions in Namatala urban slum. Notably discuss the following: - <ul style="list-style-type: none"> ▪ Accessibility and reliability to potable water. ▪ Accessibility and reliability to sanitation and hygiene facilities. ▪ Outbreak and spread of waterborne diseases and related diseases. ▪ Possible barriers to accessing improve WASH facilities/services. ▪ Any recommendations / interventions that can be adopted 	9:40-10:25 am
7.	Rating of the HH possible barriers	By all participants	10:25-10:45 am
8.	Closing remarks	Manager-Umbrella of Water and Sanitation-Facility East	10:45-10:55 am
9.	Departure	By all participants	10:55-11:00 am

7.6: FIELD PHOTOS



Figure 19: Housing units' conditions in Namatala urban slum



Figure 20: Tap water supply within 100 meters to the households

7.7. CURRICULUM VITAE (CV)

Proposed position.	Water Engineer.
Employing Organization.	<i>ENGINEERS WITHOUT BORDERS EAST AFRICA</i>
Name:	OTIM Sam Kizito
Sex:	Male
Telephone No.	+256 (0) 765 163840
E-mail:	skizito.timam@gmail.com .

EDUCATION:

S/N	Dates attended	Institution	Degree/diploma obtained
1	2022-2024	Pan African University Institute of Water and Energy Sciences incl Climate Change- Tlemcen University- Algeria.	MSc. Water Policy
2	2014-2018	Busitema University	BSc. Water Resources Engineering

PROFESSIONAL SKILLS

S/N	Skill	Software/Tools
1	Data collection and analysis, Monitoring and Evaluation of WASH facilities	R, Stata, Kobo collect & SPSS
2	Climate change modeling and simulation and forecasting	SDSM, GCMs
3	IWRM, watershed management	RS, GIS
4	Irrigation systems design and implementation (hose pipe, drip, sprinkler, surface systems)	GPS, Google Earth Pro, IrriPro, CROPWAT
5	WASH promotion	CLTs
6	Report writing, Policy brief and framework writing, proposal writing	MS packages, internet use

7	Design and implementation of climate change resilient and adaptation approaches and technologies such Rainfall water harvesting, valley tanks/dams, solar powered systems	AutoCAD, WATERGEMS
8	Design and implementation of water supply systems. (Solar powered, grid and hybrid systems)	WaterCAD, Groundfos, and Lorentz Compass pump sizing interfaces, AutoCAD, GPS survey skills

SHORT TIME TRAINING

- I. SDG Action Project on Climate response to celebrate Youth Day of service (YDoS) organized by Leadership, Effectiveness, Accountability & Professionalism (LEAP) Africa.
- II. Adaptation of Optimized Water Resources Management for Sustainable Development, by African-Asian Rural Development Organization.
- III. Certificate in Planning & Feasibility, Design, Procurement & Installation, Technical Operation & Maintenance of the Solar Powered Water & Irrigation Systems, organized by Embassy of Denmark, MAAIF & GGGI
- IV. Training on Real Water Savings in Agriculture (REWAS), organized by The Food and Agricultural Organization | Future Water.

EXPERIENCE SUMMARY

S/N	Position	Institution	Period
1	Volunteer. Water Engineer	Engineers Without Borders East Africa (EWB-EA) in partnership with Engineers Without Borders-USA	December/2023-Date
2	Water / Projects Engineer	BAATA Engineering Company Limited	July/2021- 14/June/2022
3	Water Engineer	SWAT Engineering	June/2019- May/2021

4	Land Surveying Field Assistant	Geostatic Surveys and Engineering Company Limited, (GEOSEC)-Tororo (U)	June/2018-March/2019
5	Internee	Bududa District Local Government	May- Aug 2017
		Uganda Peoples Defense Forces (UPDF)- Water Regiment-Bombo Military Barracks.	May- Aug 2016

EMPLOYMENT HISTORY/ EXPERIENCE

1. December/2023 -Date. Water Engineer (Volunteer). Engineers Without Borders East Africa (EWB-EA) in partnership with Engineers Without Borders-USA

Key Duties & Responsibilities.

- Technical Assistance in the development of a Training Manual for; Water supply design, and Solar Water Pumping Design Standards for Ministry of water and Environment-Uganda.
- Design and supervision of construction works for Rwabahinda Solar-Powered Water Project in Nakivale Refugee Settlement. Technical training of the operation and maintenance team, water user committee.
- Provided a comprehensive assessment of the Water, Sanitation and Hygiene (WASH) in institutions (schools and health care facilities) in Uganda.
- Took part in the comprehensive field Assessment of 250 institutions (schools and health care facilities) in Uganda. Data analysis and development of detailed reports of findings with recommendations for improvement submitted to the World Bank.

2. Water/Projects Engineer. BAATA Engineering Company Limited. (2021-14/June/2022)

Key Duties & Responsibilities.

- Design, Supply and Installation works for of UgIFT Micro-scale irrigation systems of approximately 3 billion Uganda shillings in the central cluster districts of Luwero, Nakaseke, Butambala, Masaka, Mityana, Wakiso, Mukono, Mpigi and Bugiri.
- Design, sizing and installation of energy packages (Solar PV array, pumps and their assorted fittings), pipe, irrigation and assorted fittings for (drip, sprinkler or drag hosepipe) for of UgIFT Micro-scale irrigation

systems of approximately 3 billion Uganda shillings in Luwero, Nakaseke, Butambala, Masaka, Mityana, Wakiso, Mukono, Mpigi and Bugiri.

- Design and supervision of construction works for solar powered water supply systems, sanitation and hygiene facilities (lined pit latrines, hand washing facilities, and restroom facilities).
- Construction and installation work for 3no. Mini irrigation schemes under AVCP project 1 Lot3 Namalere maize, Construction of Mini Irrigation Schemes at Kanjobe Kabanyonyi- Kabale District under Lot 1, (Land clearance, test pumping and production well development, chain link and barbed wire fencing, design and installation of solar powered drip and sprinkler irrigation system, design and sizing of solar PV modules, solar PV support structure, and nursery bed development).
- Design, Supply and Installation works of a Solar Powered Sprinkler irrigation system on 30 Acres at S4S seed farm in Kigumba.
- Supervision of topographic, cadastral and geotechnical surveys, designing, earthworks (excavation) and alignment of the drainage channel profile, stone pitching of bottom and the sides of the drainage channels for valley tanks, siltation chamber, inlets and outlet channels for Loborokocha, Kigumba (Kiryandongo DLG), Lwemiyaga (Sembabule DLG),
- Organizing and facilitating project progress meetings, and pre-bid meetings and also conducting training of water user communities, about the ownership, operation, and maintenance of these infrastructure projects.
- Preparing and submitting; bidding documents, Bills of Quantities, monthly Project progress reports, payment certificates, As-built drawings, after-sales service manuals, Operation and Maintenance manuals of various projects to the Manager.
- Contract signing, management and resource management (funds and personnel).
- Demarcation, Demolition, Clearing and Protection of the SGR right of way on the Eastern Route, MoWT/WORKS/2020-21/00497 (Demolition and clearing of the paid – up structures within the surveyed corridor and clearing all the Vegetation 300 mm of top soil approximately 6 – 7m width along the corridor ROW boundary of SGR Station in Tororo, Iganga and Namatumba Municipal Councils, and Slashing and Planting boundary marker plants along the SGR corridor boundary in Tororo and Butaleja Districts).
- Consultancy Services for Detailed Designs and Preparation of Tender Documents for: - Lot 1: Valley Tanks in Isingiro District (1 No.) and Sembabule District (2 No.) Livestock Watering System in Sembabule

District (1 No.) and Lot 3: Valley Dam in Lyantonde District (1 No.). (Siting of the valley tanks, livestock watering points and irrigation structures, hydrological and hydrogeological data collection and analysis, topographic surveys, geotechnical assessments, water supply demand analysis, EIA, catchment assessment and development of catchment management plan and waterpoint Protection Plan, and preparation of detailed designs of the valley tank, solar powered water abstraction system, livestock watering structures and small-scale irrigation/nursery infrastructure.

- Supply, delivery and installation of a solar powered irrigation system complete with a pumping unit, elevated plastic storage tank and hydrant offtake system on a thirty (30) Acre command area. (An inlet canal channel, siltation basin, pump sump, photovoltaic modules on a platform, pump control system and house, rising main, main conveyance and lateral pipelines with hydrant, performing water quality testing, soil quality testing, training on operations and maintenance of the system and after-sale servicing).

3. Water Engineer. SWAT Engineering-Uganda (2019/2021)

Key Duties & Responsibilities.

- Supervision of installation works in Nabweya Gravity Flow Scheme water supply system (trenching activities, pipe laying and joining (riveting), intake works, drainable pit latrines, and spring wells)
- Trained Water user committees, for all the water points in Nabweya Gravity Flow Scheme both hand pumps, motorized tap stands, and water trucking tap stand.
- Conducted supervision of survey works /Vertical Electrical Sounding for underground water, drilling works and pump testing for production wells, and hand pump borehole casting and installation for Bumwalukani and Bulucheke point water sources.
- Testing of items to be installed (pumps, solar PV modules, Solar PV support frame, Petrol Engines, Submersible Pumps, transmission lines, HDPE pipes, fittings, concrete mixes, storage tanks) and identifying deficiencies

4. Land Surveying Field Assistant. Geostatic Surveys and Engineering Company Limited, (GEOSEC)-Tororo (U) (2018/2019)

Key Achievements.

- Successfully supervised siting of reliable (02) production wells, drilling works, pump testing, their Motorization, and complete installation of a solar-powered water supply system.
- Conducted surveys for civil and environmental engineering projects (08 for land, 02 for building, 07 for irrigation, 01 energy and 10 for drainage) using GPS, Total station devices while assisting in its data generation, interpretation and explanation of the reports.
- Studied blueprints and project specifications and inspected work sites to assess project size and scope

5. Internee. Bududa District Local Government- Uganda (U) (2017)

Key Duties & Responsibilities.

- Conducted reliable production well identification through active participation in the groundwater prospecting/Vertical Electrical Sounding, drilling tasks, pump testing, and installation for Bududa Town Council water supply system.
- Facilitated sustainable access to safe water supply, sanitation and hygiene in rural areas and landslide-affected communities in Bududa for the landslide-affected communities in Bududa through effecting new water points connections, construction of sanitation and hygiene emergency facilities and training of the internally displaced persons on the basic sanitation and hygiene practices.
- Mobilized and trained communities on Operation & Maintenance of Water Sanitation and Hygiene infrastructure projects.

6. Internee. Uganda Peoples Defense Forces-Water Regiment (2016)

Key Duties & Responsibilities.

- Conducted reliable production well identification through active participation in the groundwater prospecting/Vertical Electrical Sounding, drilling tasks, pump testing, and installation for Kole Water

Supply System and effecting new water connections for the Uganda Peoples Defense Forces staff and surrounding communities.

LANGUAGE PROFICIENCY

Languages	Spoken	Written
Ateso	Excellent	Excellent
English	Excellent	Excellent
French	Fair	Fair

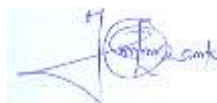
REFEREES

- 1. Joash Bwambale.** Manager Technical Services. Engineers Without Borders East Africa (EWB-EA) in partnership with Engineers Without Borders-USA. **Email:** joash.bwambale@ewb-usa.org
Tel: +256 778212050
- 2. Prof. Chérifa ABDELBAKI.** Water Program Coordinator-Pan African University- Institute for Water and Energy Sciences, incl. Climate change (PAUWES) University of Tlemcen- Algeria
Email: cherifa.abdelbaki@pauwes.dz **Tél:** +213 552 833 383
- 3. Prof. ADELEGAN Joseph, PhD.** Senior Lecturer Missional University, USA/PAUWES. **Email:** jadelegan@missional.university / dr.joseph.adelegan@gmail.com
Tel: +18036181328 / +35 8403704549

DECLARATION

I Otim Sam Kizito do certify that the information provided above is a true account and representation of my skills, character, and experience over the years.

Sign



Date: February, 2024.

