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# COPING STRATEGIES FOR ACCESS TO POTABLE WATER IN URBAN AREAS: THE CASE OF YAOUNDE VI SUB-DIVISION, CAMEROON.
# A CONTRIBUTION TO MEDICAL ANTHROPOLOGY

**A Dissertation Submitted in Partial Fulfilment of the Requirements for the Award of a Doctorate / PHD in Anthropology**

Specialisation: **Medical Anthropology**



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*Academic year 2021-2022*

*To*

*My father, Njila Samuel Tanto*

*and*

*My mother, Ndi Helen Mayaah*

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## ABSTRACT

Our work is entitled: “Coping startegies for access to Potable Water in Urban Areas: the Case Study of Yaoundé VI Sub-Division, Cameroon. A contribution to Medical Anthropology”. The work examines the strategies put in place by the inhabitants to get access to potable water in their environment. The main research question is: what are the coping strategies, put in place by the inhabitants of Yaoundé VI Sub-Division to cope with water problems. The main research hypothesis is, the population uses different strategies like drilling of boreholes, local springs and treatment of their water before drinking. The main research objective is to identify the different coping strategies put in place by the population to overcome water crisis. In order to collect data, we used qualitative and quantitative research methods with research: The study design was ethnographic with technics such as; technics such as interviews, participant observation, focus group discussion, life history, questionnaire just to name a few.

We used Cultural ecology theory by Julian (1955) and Anderson (1992), studies how humans adapt in their environment. It looks at man as a cause to negative things happening in the environment and the solution still lies on what the human being can do to survive in the environment. Cultural interpretative theory was used as it views people as a being entangled in webs (toiles) of meaning that are of their own making. Culture, according to Geertz (1973), is embodied in the person who acts out of and in a certain context, and this culture is revealed in this person's actions and his interpretation of their meaning.

This study reveals that getting access to potable water is a difficult issue in Yaoundé VI council area. We find out that the council workers do not actually know the quarters that are really in need of potable water. The inhabitants revealed using strategies like, boiling water, filtering, chlorine tablets, proper disposal of waste materials by the population and visiting the hospital in case of illnesses. Lastly, the socio-economic status of the population does not permit some to have access to potable water.


**Key words**: adaptation, coping strategies, culture, ecology, environment, health, potable water, Yaoundé VI.

# RÉSUMÉ

Notre travail est intitulé : « Les stratègie d'adaptation accès à l'eau potable en milieux urbains : le cas de la commune de l'arrondissement de Yaoundé VI, Cameroun. Une contribution à l'anthropologie Medicale ». Ce travail examine les stratégies mises en place par les habitants de la commune de Yaoundé VI pour accéder à l'eau potable. La principale question de recherche est : quelles sont les stratégies d'adaptation mises en place par les habitants de l'arrondissement de Yaoundé VI pour faire face aux problèmes d'eau? La principale hypothèse est que la population utilise différentes strategies comme le forage, sources locales et le traitement de leur eau avant de la boire. L'objectif principal de cette étude est d'identifier les différentes stratégies d'adaptation mises en place par la population pour surmonter les crises liées à l'accès à l'eau potable. Pour recueillir les données, nous avons utilisé des méthodes de recherche qualitative et quantitative. Ainsi, la conception de cette étude était ethnographique, employant les techniques telles que : entretiens, observation participante, discussion de groupe, questionnaire, histoire de vie, pour n'en nommer que quelques-unes.

Nous avons utilisé la théorie de l'écologie culturelle de Julian (1955) et Anderson (1992) qui étudie comment les humains s'adaptent à leur environnement. Ils considèrent que l'homme est à l'origine des évènements négatifs qui se produisent dans l'environnement et la solution réside toujours dans ce que les êtres humains peuvent faire pour survivre dans leur environnement. La théorie de l'interprétation culturelle de Geertz (1973) a aussi été utilisée. Elle considère l'homme comme un être enchevêtré dans des toiles de sens qui sont de leur propre fabrication. La culture, selon Geertz, s'incarne dans la personne qui agit hors et dans un contexte précis, et cette culture se révèle dans les actions de cette personne et de son interprétation de sa signification.

Ces résultats ont révélé que l'accès à l'eau potable est un problème dans la commune de l'arrondissement de Yaoundé VI. Nous avons découvert que les employés municipaux ne connaissent pas réellement les quartiers qui ont vraiment besoin d'eau potable. Les résultats révèlent aussi que le statut socio-économique et environnemental de la population ne les permet pas d'avoir accès à l'eau potable. Par conséquent, Les habitants ont affirmé qu'ils utilisent des stratégies telles que l'ébullition de l'eau, le filtrage, les comprimés de chlore, l'élimination appropriée des déchets par la population et la visite de l'hôpital en cas de maladie.

**Mots clés** : adaptation, culture, eau potable, écologie médicale, environnement, santé, stratégies d'adaptation, Yaoundé VI

# LIST OF ACRONYMS AND SIGLAS

## ACRONYMS

| | |
|---|---|
| **AIDS:** | Acquired Immune Deficiency Syndrom |
| **CAFO:** | Concentrated Animal Feeding Operation |
| **CAMTEL:** | Cameroon Telecommunications |
| **CAMWATER:** | Cameroon Water Utilities Corporation |
| **CFAF:** | Communauté Financière Africaine Franc |
| **Covid-19:** | Corona Virus |
| **DEAU:** | Direction de l'Eau et de l'Assainissement Urbain |
| **DWAF:** | Department of Water Affairs and Forestry |
| **ECAM:** | National household survey |
| **FAO:** | Food and Agriculture Organization |
| **GOES:** | Global Oceanic Environmental Survey Organization for Economic Cooperation and Development |
| **HABs:** | Harmful Algal Blooms |
| **HEPA:** | High Efficiency Particulate Air |
| **HYSACAM:** | Hygiene and Sanitation Company Cameroun |
| **IBRD:** | International Bank for Reconstruction and Development |
| **ICSID:** | International Centre for Settlement of Investment Disputes |
| **IDA:** | International Development Association |
| **MENA:** | Middle East and North Africa |
| **MIC:** | Middle-Income Countries |
| **MINDUH:** | Ministère du Développement Urbain et de l'habitat |
| **MINEE:** | Ministère de l'Energie et de l'Eau |
| **SNEC:** | Societe Nationale des Eaux du Cameroun |
| **SODIS:** | Solar Water Disinfection |
| **UNESCO:** | United Nations Educational, Scientific and Cultural Organization |
| **UNICEF:** | United Nation Childrens Fund |
| **USDA:** | United States Department of Agriculture |
| **VOCs:** | Volatile organic compound |
| **WASH:** | Water, Hygiene and Sanitation |
| **WHO:** | World Health Organization |

## INITIALS

**AFD:** Area forecast Discussion

**C2Ds:** Debt Reduction-Development Contracts

**CDC:** Centre for Disease Control

**CDE:** Camerounaise des Eaux

**CHU :** Centre Hospitalier Universitaire

**CSO2:** Scorecard

**DCD:** Developmental Coordination Disorder

**DDT:** Dichloro-diphenyl trichloroethane

**DNA:** Dirhibonuclic Acid

**EPA:** Environmental Protection Agency

**GDP:** Gross Domestic Product

**HIV:** Human Immune Virus

**HPV:** Human Papillomavirus

**ICF:** Informed Conscent Form

**IDB:** Inter- American Bank

**ILO:** International Labour Organization

**IMF:** International Monetary Fund

**IPCC :** Intergovernmental Panel on Climate Change

**IPIN:** Institute Pasteur International Network

**JMP:** Joint Monitory Program

**KFW:** Kreditanstalt Fur Wiederaufbau ( Credit Institute for Reconstruction)

**LLC:** Low Level Countries

**MHM:** Menstrual Hygiene Management

**MSW:** Municipal Solid Waste

**MTN :** Mobile Telephone Network

**NTD:** Neglected Tropical Diseases

**NWRS:** National Water Resources Strategy

**O and M:** Operation and Maintenance

**OCED:** Organisation for Economic Co-operation and Development

**PHC** Primary Health Care

**PPP :** Partenariat Public-Prive

**PVC:** Polyvinyl Chloride

**RO:** Reverse Osmosis

**SDGs:** Sustainabel Development Goals

**STIs:** Sexually Transmitted Diseases

**UCS :** Union of Concerned Scientists

**UN:** United Nations

**UNDFW:** United Nation Development Fund for Women

**UNDP:** United Nation Development Program

**UNEP :** United Nation Environmental Program

**UNSD:** United Nation Statistics Division

**UPC :** Union of the People of Cameroon

**USEPA:** United State Environmental Protection

**USGS:** United State Geological Survey

**UV:** Ultra Violet

**UTI:** Urinary Track Infection

**VPD:** Vapour Pressure Deficit,

**WBDs:** Water-Borne Diseases

**WFD:** Water Framework Directive

**WQRF:** Water Quality Research Foundation

**WSS:** Water Supply and Sanitation

**WWD** World Water Day

**Ca:** Calcium

**CO2:** Carbondioxide

**CO3:** Carbonmono-oxide

**$H_2O$:** Water

**K:** Potassium

**Mg:** Magnessium

**Na:** Sodium

**OH:** Hydrogenoxide

**Ph:** Acid level

**SO4:** Sulphurdioxde

# ILLUSTRATIONS

## FIGURES

**TABLES**

# GENERAL INTRODUCTION

# INTRODUCTION

## CONTEXT OF STUDY

In this study context, we are presenting the situation of potable water in the world, Africa, Cameroon and Yaoundé in general.

### 0.1 The situation of potable water in the world

The rapid growth of the world in population has been identified as one of the most visible and dramatic changes in the world over the last hundred years. Population growth is one of the most significant trends of the 21st Century, affecting global economic development, energy consumption, natural resource use, and human well-being (Brown et al., 2009; McDonald, 2008; Montgomery, 2008). This unexpected rise has mounted additional pressure on accessible potable water resources, reduced per capita availability and increased the number of those without access to water. The poor and vulnerable are forced to look for alternative sources of water for their socio-economic activities and wellbeing. Water, which is a major source of life, is now reducing or taking away life because of its shortage and contaminated nature in the world. Fresh water is a renewable resource, yet the supply of ground water is steadily decreasing, with depletion occurring due to the increase in population.

According to Gleick (1993), it is estimated that 80% of worldwide water is used for domestic purposes, including drinking, bathing, cooking, toilet flushing, cleaning, laundering and gardening. Practices like the disposal of used water and other wastes can increase the risk of water-borne diseases. To this effect, sanitary sewage disposal, safe water piping materials and storage, and education on hygienic behaviours are worth encouraging.

According to the World Health Organisation (2004) (WHO) and United Nations Children Emergency Fund (UNICEF) Joint Monitoring Programme for Water Supply and waste management, there are 2.3 billion people worldwide who still do not have access to basic sanitation facilities such as toilets or latrines. The same report projects that at least 1.8 billion people world-wide are estimated to drink water that is not protected against contamination from faeces. An even greater number drinks water, which is delivered through a system without adequate protection against sanitary hazards. Water-borne diseases are linked to a significant disease worldwide like diarrhoea. Diarrhoea is estimated to cause 1.5 million child deaths per year, mostly among children under five living in developing countries (Thompson 2012).

The 1996 United Nations (UN) report assessing freshwater resources of the world concludes that water demand and use has been growing at more than twice the rate of the population increase during this century and already a number of regions are chronically water short. Sources of fresh water such as streams, rain, rivers, lakes, oceans are naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, evapotranspiration and ground water recharge. Human beings need water for farming and this requires a large storage capacity to collect water, as it is the issue during the farming period. Other users such as power plants need water for cooling which necessitates a large capacity for a normal flow and some of these water sources can be polluted through the dumping of waste products from homes, industries and run-off from farm areas. Today, we use water far more than it can be recharged. Abramovitz (2003) estimates that the amount of fresh water withdrawn for human uses has raise nearly 40 fold in the past 300 years, with over half of increase coming since 1950. Proper household water and sanitation practices can increase resilience to water-borne disease risks. These measures include sanitary sewage disposal, safe water piping materials and storage, and education on hygienic behaviours. Energy-efficient water infrastructure and water conservation measures can also decrease the burden of water-bornediseases (WHO 2007).

**0.2 The situation of potable water in Africa**

To Pandey (2009) urbanisation contributes significantly toward environmental and water pollution and water shortages. This situation poses unique problems related to the provision of water, sanitation and a healthy environment. This explosive growth of urban populations has resulted in African cities having overcrowded, informal settlements, characterised by inadequate housing and poor infrastructure such as water supplies, sanitation and waste management services. According to the United Nations Environment Programme (UNEP), e-waste dumped in Ghana and other parts of West Africa is in part due to the illegal imports of used electronic goods particularly from the wealthy Americas and Europe. Electronic companies often smuggle their unusable electronics into Africa **(**Elizabeth 2010). It is necessary that the protection of the environment begin with the reinforcement of laws to prevent big and rich companies who are unscrupulously damaging the land and the health of the poor.

According to Singler (2013), in Africa south of the Sahara, agricultural level is low because access to water is limited based on time (during droughts and dry seasons) and space (in arid areas). But water scarcity in the region is not necessarily caused by a physical lack of

water. In fact, much of the region is generally considered to suffer from what is called “economic water scarcity,” which means that investments in water resources and relevant human capacity are not substantial enough to meet water demands in an area where the population does not have the financial means to make use of an adequate water source on its own. About one-third of the world's population lives in countries that are experiencing moderate to high water stress, resulting in part from increasing demands fuelled by population growth and human activity. By 2025, as much as two-thirds of the world population would be under water stress conditions (UN, 1996). As human population continues to expand with an increasing number of people using finite resources, future availability of adequate supplies of fresh water for human and agricultural needs may become critical in many regions (Postel, 1996).

There is a need for a greater attention to be given to sanitation. Population growth and urbanisation in developing countries had been rapid. An expansion of piped water services and higher household water use will lead to an accelerating demand for water. Within sanitation, more emphasis is needed on household connections and low cost technologies. Lack of proper sanitation causes diseases. Most of the diseases resulting from sanitation have a direct relation to poverty. The lack of clean water and poor sanitation enhances the spread of diseases. It is estimated that inadequate sanitation is responsible for 4.0 % of deaths and 5.7 % of disease burden worldwide. According to WHO, 40% of the world is still living without basic sanitation and it is the devastating fact that out of those 2.4 billion people, an estimated 300 million are in Africa alone. This suggests that there are no measures in place for people to safely dispose of their waste, including human excreta.

The poorly enforced measures of waste disposal mean that human fecal matter easily contaminates the clean water sources and soil. Municipal sewage (a mix of water and excrement) usually goes to a safe disposal point, but this is often not the case, leading to water-borne diseases that affect mostly the poor. One example of these water-borne illnesses is Cholera, which remains rife in Africa to this day. Cholera is an extreme diarrheal infection that leads to dehydration, and ultimately to death if left untreated and if the disease runs its course, it can kill within hours.

Another sanitation problem facing Africa is specifically in Uganda, in which the educational system is facing a sanitation crisis whereby in some schools there is only one toilet per 700 pupils, and there are no separate toilets for girls and boys (UNICEF 2019).

Many girls go on to drop out of school as a direct result of this. The loop then becomes endless: poor sanitation leading to illiteracy leading to poverty leading to poor sanitation.

**0.3 The situation of potable water in Cameroon (with a special focus in Yaoundé VI)**

Cameroon is endowed with numerous water resources which can sum the resources of about four other countries (Katte et al., 2003; Lambi, 2006). An assessment of these resources, including the unreliability, quality, quantity, use and sustainability, has not been systematically carried out. Hence, there is a notion of assured abundance of fresh water resources in Cameroon to meet the rising needs of the country but water still remains a scarce resource because of inadequate management practices (Mafany, 1999). According to the Department of Statistics of National Account and UNICEF (2005) approximately 45% of Cameroonians (about 7 million inhabitants) do not have access to adequate drinking water. Fonteh (2003) as cited in Masoke (2013) considers these statistics striking for a nation endowed with abundant fresh water resources, estimated at about 18.536$m^3$ per year. A staggering situation is observed in the rural areas, as 6 out of 10 persons do not have access to safe water. Most of the villages and small towns have access only to groundwater supplies like wells and bore holes (Kette et al., 2003).

WHO and UNICEF's (2005) report indicates that towns in Cameroon are not yet on track to meet the Sustainable Development Goals (SDGs) for water and sanitation. However, there is notable progress. Since 1999, 70% of the people have had access to safe drinking water (WHO 2006). The coverage rate in urban centres like Buea, Bamenda, Bafoussam, Douala and Yaoundé is questionable due to poor management, increasing water scarcity and intensity of water-borne diseases like cholera and typhoid, plaguing most of the urban populations in Cameroon. Fube (2009) indicates that many countries face difficult choices amidst growing urbanisation, industrialisation, rising demand for water or other type of uses notably irrigated agriculture, with attendant environmental concerns. The town of Dschang, situated on the western highlands of Cameroon, to her is not an exception to this phenomenon as it suffers from frequent water shortage. Because of population growth and the inability of the Cameroon Water Utilities Corporation (CAMWATER) to satisfy the water needs of the population, most people resort to other informal sources of water supply and the severity of this water shortage is on human health as divulged by soaring recurrence of water-borne diseases in Dschang.

Cameroon is crisscrossed by many rivers that run from the country mountainous north to the south. It is believed to have one of the world's largest reserves of fresh water, but for many years now, millions in the Cameroon capital have gone without water. Specific places like Carrefour du Palais, Etoug-Ebe, Damas, TKC, Mendong, Nkolbisson, Essos, Mvog-Ada, Ekounou Palais, Tropicana, Obobogo, Nsam and Nsimeyong have become the unintended face of a severe water scarcity that has been affecting the Cameroon capital city for many years now. The populations have devised means to cope with these crisis by using wells and bottled water for drinking and domestic use (Mulema 2012).

Stories of water shortages are reported across the city and the mineral water business is booming in every part of Yaoundé city and in the streets. Small traders hawk water in bottles and plastic bags. The main bottled-water companies have introduced larger containers to meet growing demand for quantity as well as quality. A few years ago, Cameroon had only two major bottled water companies today, they are uncountable. Daily life and finances of the population have been affected. The inhabitants do not have enough water to clean and many things remain dirty because they have to take out extra money from their pocket to buy water while paying bills, a practice which is very expensive today. Yaoundé presently needs more than 300,000 cubic tons of water daily, but can only get about half of that (Nforwag 2015). The Ministry of water and energy, planned to increase supply to 200,000 metric tons by December 2013, but water scarcity has rather become worse. At the moment, the only hope is a plan to increase water supply to 500,000 metric tons in 2030 by tapping into the Sanaga, one of Cameroon's largest rivers that flows north of the city. When the dry season approaches, city dwellers brace themselves for worse conditions and there has so far been nothing.

Due to rapid rural-to-urban migration, economic stagnation and depression, high unemployment, poverty, informal economy, forced or manipulated ghettoisation, poor planning, politics, natural disasters, and social conflicts, Yaoundé city has given birth to slums and ghettos. This had led to the rise in environmental health and social problems. Cameroonians live in slum neighborhoods because they cannot afford the high cost to rent a room. The populations have no alternative but to turn to slums and swampy areas to construct their little shanties houses, with no building permit from the city council. Slum dwellers always record high levels of poor health problems due to poor infrastructure and dirty environment. Poor solid waste management is also common in slum areas like

Bonamoussadi, Mendong, Damas and “Centre”. This led to the prevalence of diseases and death rates.

### 0.4 Justification

Two reasons justify the choice of my research concern

#### 0.4.1 Personal reasons

For many years now, many people have been shown over the television, newspapers, and magazines struggling to get water. The consequences of these crisis have led to a lot of health hazards and, consequently, death mostly to people who do not have the finances to seek for health care services. In the past, I used to think that water scarcity and shortages happened only in over-populated countries until when I settled in Yaoundé. I then noticed that the issue of water crisis and sanitation is affecting everybody.

In a discussion with medical personnel in town, I discovered that people have serious health problems as a result of scarcity and consumption of polluted water. Furthermore reports from Central Intelligence Agency (2018) in the United States prove that a water-borne disease like Diarrhea is one of the deadliest diseases in Cameroon caused by poor environmental sanitation, poverty and inadequate supply of water. When I look at the rapid rate of urbanisation of Yaoundé VI council area, I was scared of what would happen in the next 10years if something was not done immediately to solve this problem. Most health care providers believed that the state of an individual depends on his/her surrounding factors such as potable water, good sanitation and financial stability. As a result of water scarcity and poor sanitation, there is a high tendency of poor health situation among the population. This alone gave me the reason to undertake this study to show some of the coping strategies put in place by the inhabitants of Yaoundé VI to fight the water crisis. Lastly as an anthropologist, it is my interest to contribute in the development of this field by researching on issue like water.

#### 0.4.2 Scientific reasons

Yaoundé is estimated to have 3.5 million people, according to population data in 2018. This high population rate has had a negative impact on the people in various domains putting the lives of the inhabitants at risk. Yaoundé which is the capital city of Cameroon is expected to have potable water because all the ministries are located in Yaoundé and they act as the main source of information to other regions. We want to study the values people hold on water and the adaptation of households towards water scarcity. In this light, the focus is on the measures through which the problem can be squarely tackled as well as the type of

policies to be used and potentials for their effective implementation. Today, Yaoundé is the opposite of what people expect to see in terms of water and hygiene. In doing this research, we will help to identify the various difficulties the inhabitants suffer as far as access to potable water is concerned and the strategies put in place to overcome this crisis.

**0.5 Resarch Problem**

Water is a necessity to many uses and there is this general assertion that cleanliness is next to good health, yet accessing a clean environment and water has continued to pose severe health challenges to many people in the world. From reports, news, and common knowledge from the inhabitants themselves, Yaoundé VI is one of the areas facing this crisis. In this regard, people have been trying their best to see how they can cope and adapt to their environment. For this reason, the Cameroonian government has put into place ministries like the Ministry of water and Energy, Ministry of Housing and Urban Development, Ministry of Public Health, Ministry of Environment and other stakeholders or Non-Govermental Organization such as World Health Organisation to provide potable water and good sanitation its citizens.

Despite the efforts of these ministries and organizations to take care ofaccess to potable water and environmental problems in the city of Yaoundé VI, the rate of water pollution and scarcity is still increasing. Researchers have not had enough or sufficient studies to show or prove the cause of water crisis. Equally, there have not been enough technical studies to prove the causes of water crisis in Yaoundé VI. The implications of water crisis on health care in this area have not yet been proven and we do not know the dynamics of the crisis. Furthermore, the nature of the crisis and adaptation strategies has not been subject to empirical investigations. So our research was to find out find out why the problem of potable water is persisting and how it is being taken care of by the inhabitants.

**0.6 statement of the research problem**

This study, entitled “coping strategies for access to potable water in Yaoundé” is on medical anthropology. This branch has an active role in examining the relationship between humans and their environment across space and time. It is one of the most developed specialisations of anthropology that examines the ways in which humans beings organise themselves to adapt to their environment.

Water is a necessity to many users and there is this general assertion that cleanliness is next to good health, yet accessing a clean environment and water has continued to pose

severe health challenges to many people in the world. Because of, modernization, water has become more critical where we are in need of water because of its multiple uses by the inhabitants. Yaoundé in general and Yaoundé VI in particular has grown statistics from 3, 868,954 to approximately 4,000,000, (Census 2015) the demand ofwater has increased due to the creation of new quarters in Yaoundé VI area: repeated reports, news, and common knowledge from people themselves. Yaoundé VI is one of the area facing this crisis; with the common knowledge they have, people have been trying their best to see how they can cope and adapt to their environment. For this reason, the Cameroon government has put into place ministries like the Ministry of water and Energy, Ministry of Housing and Urban Development, Ministry of public health, Ministry of environment and other stakeholders or Non-Govermental Organization such as World Health Organization to provide potable water and good sanitation its citizens.

Despite the efforts of these ministries and organizations to take care of water and environmental problems in the city of Yaoundé, the rate of water pollution and scarcity is still increasing. Anthropologists have not had enough or sufficient study to show or prove the cause of watr crisis, equally there has not been enough technical study to prove the causes of water crisis in the environment or area. The implication of water crisis on health care have not yet been proven and we do not no the dynamics of the crisis. Further more, the nature of the crisis, and what they do to adapt to the environment is not known.

In order to better understand this issue of coping strategies for access to water, theories like cultural ecology which sees Ecology as the study of the interaction between living things and their environment is used. Human ecology is the study of the relationships and interactions among humans, their biology, cultures, and their physical environments. Human ecology includes ecological anthropology and environmental anthropology. Human ecologists study many aspects of culture and environment, including how and why cultures do what they do to solve their subsistence problems, how groups of people understand their environment, and how they share their knowledge of the environment. Socio-cultural and local interpretation and description of interprertative theory include surface-level observations of behaviour while thick description adds context to interpretation. Explaining the context requires grapping individuals' motivations for their behaviours and how these behaviours are understood by other observers of the community as well. This will be important for this research because they will help to explain the relationship between man and his environment with its different strategies to adapt in the environment.

## 0.7. Research questions

### Main question

How do inhabitants of Yaoundé VI subdivision cope with water shortage and scarcity?

### Specific questions

- What are the typologies of water sources in Yaoundé VI?
- How is water crisis manifested on the inhabitants of Yaoundé VI area?
- What are the cultural practices that cause water pollution and water scarcity
- What are the possible sociocultural adaptations strategies put in place by the population to better cope with such water problems?
- What are the functions of water actors in Yaoundé VI council area?

## 0.7.2 Research hypotheses

### Main research hypotheses

The population uses different strategies like drilling of boreholes, local springs, treating of water before consumption, local water usage by going to streams to wash dresses, flush toilets, collect rain water and young people who collect water from distance places to sell and the emergence of several categories of water sold in plastic papers and bottles.

### Specific hypotheses

- The said population has diversified means over the years by using nearby streams, tap water, wells, springs and lakes as sources of water in Yaoundé
- Yaoundé city is experiencing water shortages and poor management in terms of water quality and quantity.The population faces problems like scarcity of water, water pollution, water-borne diseases and environmental pollution.
- Cultural practices like waste poor waste management, agricultural activities, urbanisation are able to cause water pollution and insufficient water
- The inhabitants have resulted in using filter, boiling of water, salt, detergents, and use of bottled and plastic water.
- The stakeholders are providing bore holes, finances, sensitisation on water-borne disease are some of the roles played by the water actors in Yaoundé VI council area.

### 0.7.3 Objectives

**Main objective**

The main objective of this research is to identify the different sociocultural coping strategies put in place by the population to overcome water scarcity and shortage.

**Specific objectives**

- To identify the different water sources used by the population to cope with water crisis
- To identify the various problems that have resulted from insufficient water, polluted water that is affecting the indigenes.
- To identify some of the cultural practices that are causing water pollution and water scarcity
- To unveil different strategies used by the Yaoundé VI inhabitants to solve their water crisis
- To see what the different actors or stake holders are doing to better manage water pollution and water scarcity.

### 0.8 Research methodology

Methodology is a systematic, theoretical analysis of the methods applied to a field of study. It does not set out to provide solution but it sets out methods or best practices that can be applied to a specific subject (Marshall 1998). Any of the selected methods correspond to the topic of a given research that will be able to bring out the best results after doing the fieldwork.

Qualitative and quantitative research method was used because there where they have the best techniques in collecting quality and quantity data. Qualitative research method is defined as a research method that focuses on obtaining data through open-ended and conversational communication originated in the social and behavioural sciences (Marshall 1998). The different types or techniques of qualitative ethnographic research methods that was used are in-depth interview, focus groups, content analysis, and case study research. Qualitative research design was used because it determines relationships between collected data and observations. Quantitative research methods focus on gathering numerical data and generalising it across groups or people to explain a particular phenomenon. This research

method emphasises measurement, statistics, mathematics or numerical analysis of data collection (Bryman2012).The main quantitative method that we used in collecting quantitative data was the use of questionnaire.

### 0.8.1 Research design

The research design used was the ethnographic research design done on people and their behaviours and social interactions within their town or community (Vermeulen 2008). This is because in collecting this data the researchers need to stay on the field with the informant while collecting the data. It involves studying people in context, mainly making observations, rather than focusing on hard data and numbers. At this level, the researcher lived with the Yaoundé VI inhabitants for over a year, researching on the people and their culture through a process of sustained observation and participation.

### 0.8.2 Study population

The targeted population was the inhabitants of Yaoundé VI. Attention was given to every inhabitant because water and sanitation affects everybody (men, women and children). Keen attention was given to some ministries like the Ministry of Water, Nature and Environmental Protection to see their various coping strategies put in place to overcome the issue of water and sanitation crisis in these targeted area.

### 0.8.3 Purposive sampling

Purposive sampling method is also known as the judgmental sampling, it is are form of non-probability sampling in which the researcher rely on his/her own judgment when choosing members of the same population or community to participate in an interview and focus group discussion (Creswell 2012). This sampling method requires that the researcher should have a prior knowledge about the purpose of our study so that we properly choose and approach eligible participants for interviews.

We had a complete list of every quarter found in Yaoundé VI sub-dividion which constituted both main and sub quarters. During this research, we selected participant we felt that they can give us information based on our research topic. So the age limit for participation was 18 and above reason being that they can give us reasonable enough to know what the community is going through as far as potable water is concerned.

### 0.8.4 Data management

After collecrting the data, we did quality check of our data. This was done on daily basis to make sure that nothing was left out. In the event of any omission, we went back to the field. When interviewing, the information was recorded with the consent of the informant and after each day, the information was transferred to the computer to create more space for more information to be recorded after doing transcription of data from the recorder.

The data also were arranged in themes, key words (cultural meanings), summaries for description, themes and narrative quotes. Informants direct quotes were put in italics, as their contribution. The names, time, date and place were written or recorded. An appropriate atmosphere was established such that participants feel at ease to express themselves. Tables and diagrams were used to present the information gotten from the field. All the books consulted and names of the informants interviewed during this work are found at the annex part of the work.

### 0.8.5 Data collection procedures

In collecting data we used secondary and primary sources.

**Secondary data**

We got data from both internal and external sources. In doing this research, documents were available which provided us with information on the study site, population and socio-economic activities. We used external sources to review what other authors had said in relation to our topic from magazines, articles, cyber and published books from schools library both public and private. These documents included general and specific documents related to the concerns of this thesis. Some documents were borrowed, photocopied or downloaded from the internet and printed out.

The advantage of these secondary data was that it is available and gave us required relevant information. Also, it is less expensive than the primary data. However, not all the data were specific to our needs and, at the same time, incomplete. Thus, it was insufficient to enable us to reach a conclusion and lastly the authenticity of the research results might be skeptical.

**Primary data**

Primary research data constituted of fieldwork which took one year and we constantly went back to the field in case of any doubt. This took place in Yaoundé VI sub division and Interview was conducted with the population and in some selected ministries. Qualitative and quantitative research methods were used and this allowed for an understanding the depth of coping strategies put in place by these people to overcome water and sanitation crisis.

### 0.8.6 Techniques of data collection

#### Participant observation

Participant observation was conducted in the Yaoundé VI sub-division where I happened to spend some months in the area. These technics lasted for about 1year that was from the October 2019-October 2020 in the field, where we walk round the council area observing and participating in some of the activities fetching water and filtering water. We were able to get most of the information without interviewing people through this method. The fieldwork did not only last for a year given that I had to go back to the field when analysing the data to confirm some information before actually writing down some points or data.

#### Interview

Conducting in-depth interviews is one of the most common qualitative research methods. Interview was done both individually and in groups. The advantage of this method was that it provided us with great opportunity to gather precise data about what people believed and practised as far as water crisis is concerned. To get more information, we asked such follow-up questions that helped us to collect more information. These interviews were performed face-to-face, or by phone and they usually lasted between 20-30minutes. This was carried out in the whole of Yaoundé VI sub-division which lasted from October 2019 to October 2020. Interviews were done using interview guides, with subthemes that best describe the work of the researcher. Face-to-face interviews gave us a better opportunity to read the body language of the respondents and match it with their responses. We interviewed 58 females and 45 males with a sum total of 103 informants.

#### Focus group discussion (FGD)

A focus group is also one of the commonly used qualitative research methods for data collection. A focus group usually includes a limited number of respondents (8) from within our targeted population and the main aim of the focus group is to find answers to the why, what and how of questions. FGD was carried out at Mendong and “Centre” in Febuary 2020 with the use of focus group guide, camera, pen, paper and a field assistant. This method is very useful when it comes to community projects like water, roads and construction of infrastructure. Two (2) focus group discussions were carried out. The groups were mixed with both men and women because water affects all and there is no way we can do without water.

**Questionnaire**

Questionnaire is one of the commonly used techniques in research method for data collection. A questionnaire is a research instrumentg that consists of a set of questions for the purpose of gathering information from the respondents through survey and statistical study. We used a mix of close-ended and open-ended questions, depending on the expected response form the respondent. The questionnaire was administered to informants a total of 30 respondents.

**Case study method**

The case study method has evolved over the past few years to become a valuable qualitative research technique. It is used for explaining an organisation or an entity. This type of research method is used within a number of areas such as education, social sciences and other related disciplines. Although this method seems difficult, it is one of the simplest ways of conducting research as it involves a deep dive and thorough understanding of the data collection methods and inferring the data.

**Photography**

Pictures were taken on the field for visual illustration. This was done with the use of a camera showing population fetching water, the type of structures or coping methods put in place to overcome water crisis.

**Data collection tools**

**Tape recorder:** was used to recording our information using telephone,

**Laptop:** helped in storing information from the field,

**Pen and pencil**: were used in writing down information and lastly a note book was used in documenting information.

### 0.9. Ethical consideration

Before carrying out this research, an authorisation was obtained from Head of the Department of Anthropology, Senior Divisional officer, Mayor and hospitals in Yaoundé VI council area. An Informed Consent Form was presented to each informant for them to know what exactly they are to do. We informed the informants on the process involved and that they had the will to take part or not during the process. They were notified that their names were not to be written in other to protect their identity and confidentiality. Lastly, the informants were made to know that the information is for academic purpose.

### 0.10. Interest of study

The interests of this work were to find out the various coping strategies adapted to water shortages it was done in two parts that is, the theoretical interest and the practical interest.

### 0.11. Theoretical interest

This study, provides great importance to the sciences in general and medical anthropology in particular because its produces knowledge on strategies used to overcome water and sanitation problems in Yaoundé VI. The study also contributes to knowledge in rapidly growing towns of low-income countries like Africa in general and Cameroon in particular. The information and knowledge on the variety of water sources available in urban areas will lay a solid foundation for the utilisation of effective water management strategies. Furthermore, this study will help in the identification of the cost effective approaches of meeting the water needs of the ever growing population of the study area. In order for science to keep growing, researchers need to continue to do research in various domains to give their own contribution to what is happening in the society.

### 0.12. Practical interest

This work contributes to the people and area concerned to understand the problem and strategies put in place by the Yaoundé VI inhabitants to adapt to water and sanitation crisis. It work can be used by the Ministry of Water and Energy in Cameroon and beyond to see those quarters which are in need of potable water and how it can be ameliorated. In all, the

work is going to serve as a source of information or data bank for other international organisations like WHO, WASH, and other non-governmental organizations to see how they can improve on providing potable water to the inhabitants of Yaoundé and Yaoundé VI in particular.

Firstly, it is hoped that the study will be of vital help in the Ministry of Water and Energy (MINEE) in developing a municipal master plan for water resources through which the different water sources and uses can be identified. It will also help in the development of new sources of water and conservation measures for the existing ones. Finally, the expressed trends in population growth and water use will inform policy makers on water production and use in the study area.

The Yaoundé VI sub-division or council is expected to benefit from the on-going process of decentralisation and allocation of resources and competences to local councils. Therefore, this study should be of great importance to the council since it will help it to understand the importance of water to the economy of Yaoundé whose population is not only increasing by the day but also the economic activities which also demand and use water. This study will also help the council to understand the need for protecting water points to prevent the population from being contaminated with diseases such as cholera and typhoid. This can be achieved if the council implements fines on people polluting streams through defecation or dumping of waste through seminars and sensitisation.

The local population is expected to benefit much, since their lives and livelihood are strongly link to water. They will gain explanations from the researcher on the disappearance of some springs and streams, reducing yields of water supply and the causes of water supply contamination and its effects on their health. This will go a long way to reduce the adverse effect of water shortage on health, income and education. The researcher will also raise people's awareness on the growing water needs of the population, the emergence of new water users as well as the relationship between changing life style, new technology and water use.

**0.13. Scope of study**

Geographically, this work was carried out in Yaoundé VI Sub-Divison.The data collection process lasted for 1 year from October 2019-October 2020. This work was based on the coping strategies put in place by the Yaoundé VI inhabitants to fight or cope against water pollution and water scarcity.

### 0.14. Limitations

We faced the problem of weather condition, the constant postponement of appointment by the informants as well as some informants not willing to cooperate. There was little literature review written on the coping strategies of water in Yaoundé VI. Yaoundé VI being heterogenous made it difficult to get all the cultural perception different cultures have on potable water. However, the bad wether condition was not all the time so we made use of the good weather had, we had to keep to the appointment of the informants. Lastly, many writers and students have written on water management, water pollution, and adaptation strategies to water scarcity in other areas and we were able to read some of those documents.

### 0.15. Organisation of the work

This constitutes a general introduction, seven chapters and a general conclusion. The General Introduction focuses on the context of study, justification of the chosen topic, problem, statement of the problem, research question, research hypothesis, research objectives, methodology, data analysis and interpretation, ethical consideration, interest of study, scope of study and difficulties encountered on the field. Chapter One describes the geo-political location of the study site, physical, social and economic study of the area. Chapter Two presents literature review that is authors who have written similar books related to our topic and theoretical frame work. Chapter Three gives the enthnography water resources in the YaoundéVI municipality.Chapter four talks of the description of water crisis in Yaoundé VI. Chapter Five describes the various cultural practices that are causing water pollution and water scarcity in Yaoundé VI and Chapter Six shows the various coping strategies put in place by the population to adapt to water shortage and pollution. Chapter Seven unveils the role of water actors in Yaoundé VI. The General Conclusion summarises the findings, presents the way forward and suggestions for further research.

# CHAPTER I
# ETHNOGRAPHY STUDY OF YAOUNDE VI

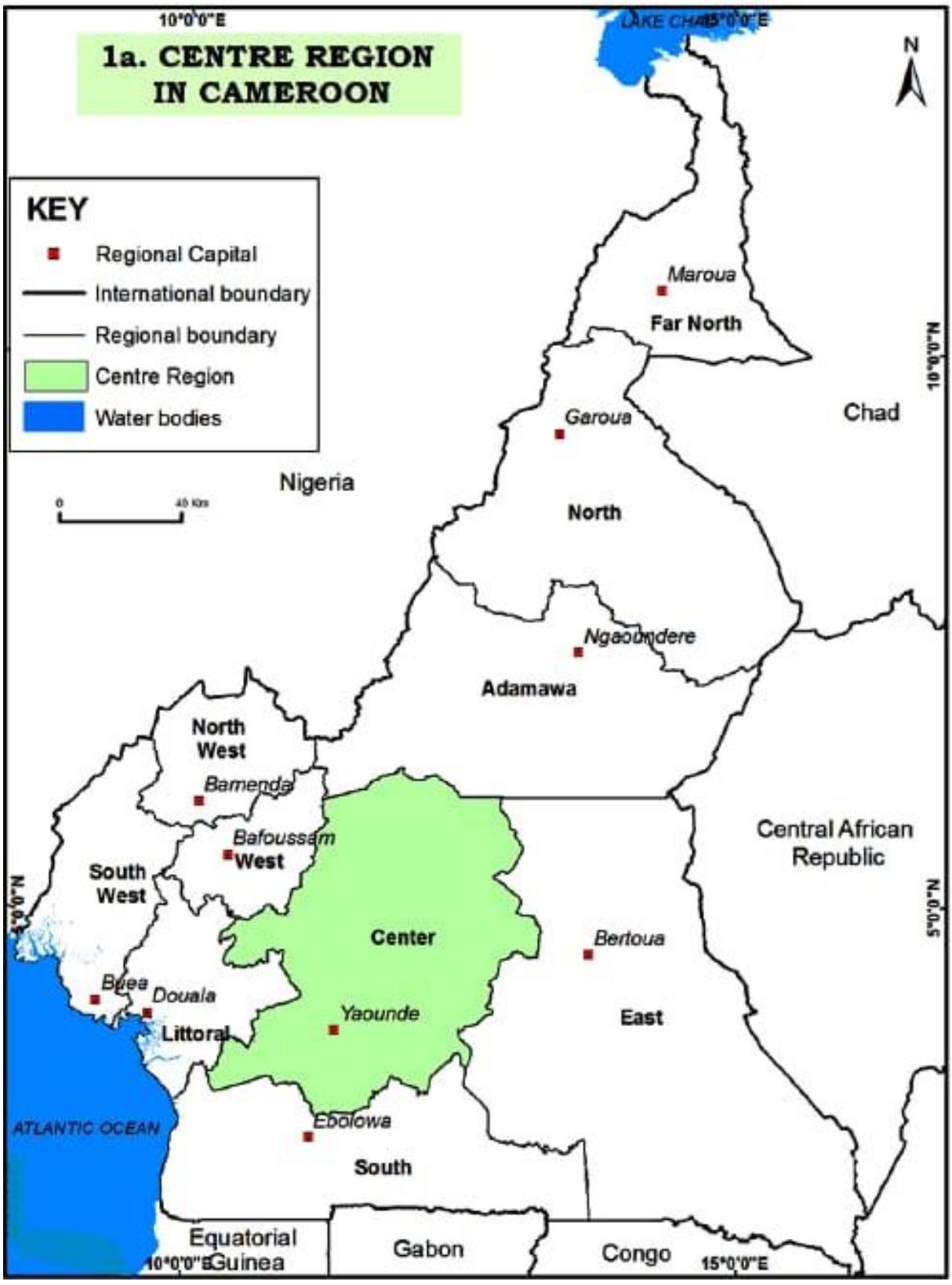
This chapter gives a vivid description of Yaoundé VI Sub Division in Cameroon, in its various characteristics like: geographical aspects and reliefs, quarters, ethnic composition and relief. Developmental aspects include; urbanisation, basic necessities like housing, schools, and water that is CAMWATER and natural sources, electricity, food, roads and administrative services of the council area. Concerning the culture of the main ethnic groups of people in Yaoundé VI, we have the people from the centre who are the Beti people from the forest zone. Thus, we shall present a summary of Yaoundé VI in its physical, cultural, economic and political dimensions.

## 1. Study site

### 1.1 Administrative location of Yaoundé VI

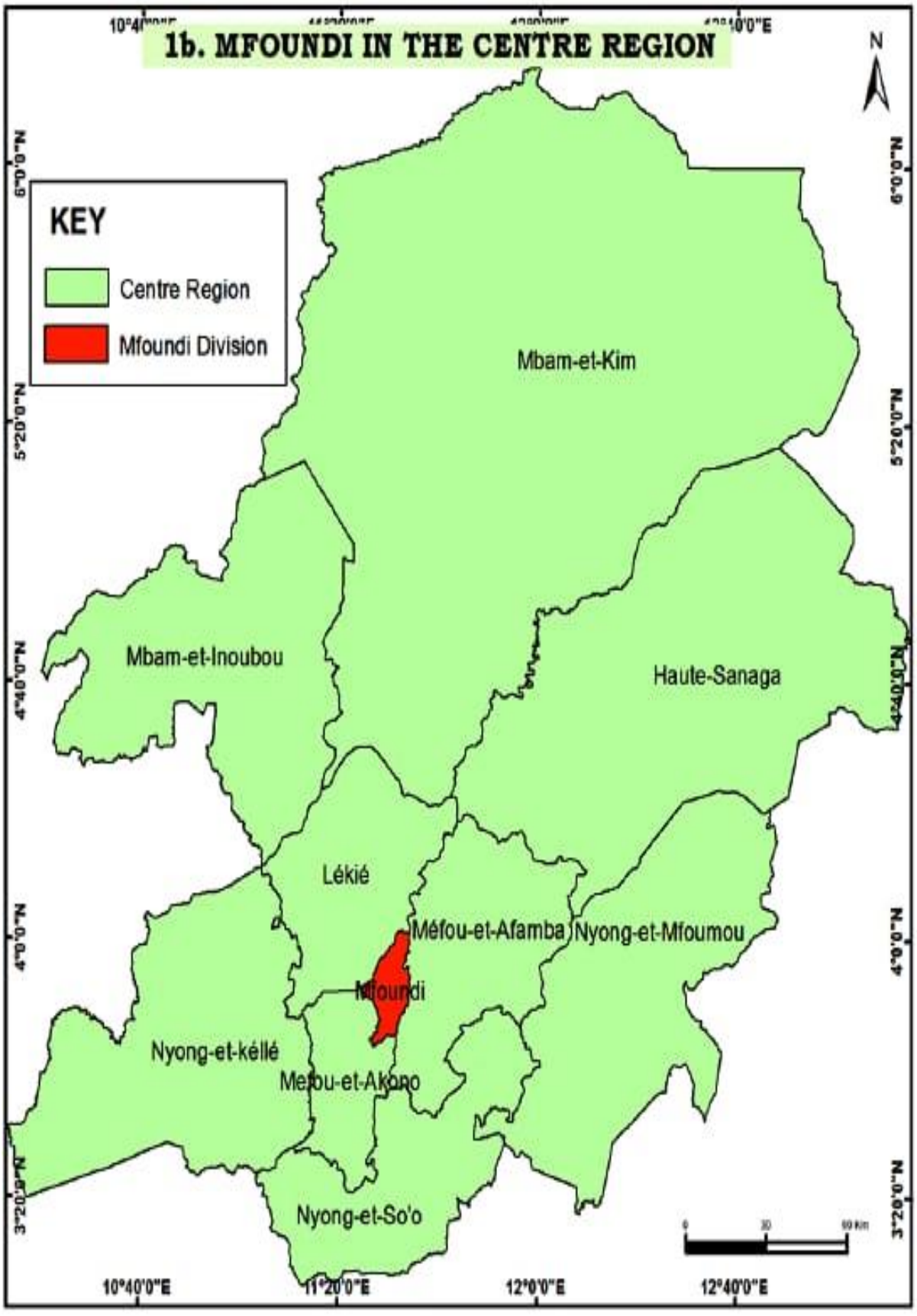
These different administrative sites are predominantly determined by the landscape which, in itself, transforms in the course of the urbanisation processes of Yaoundé (Eno 2001:11). Yaoundé is the political capital of Cameroon since the colonial period in 1921 and is found in the Centre Region of Cameroon.Yaoundé is a cross road linking the west Adamawa region, to the east by East Region, to the south by the South Region and to the west by the Littoral Region and West Region. The major ethnic groups here include the Bassa, Ewondo and Vute. Yaoundé is described as having a surface land area of 180km (70 square meter) with a population of 2.432million in 2015 population census. It is the second largest city in Cameroon after Douala which is the biggest town in Cameroon (Eno 2001:11).

**Fig 1: Map of Cameroon showing the Centre Region**



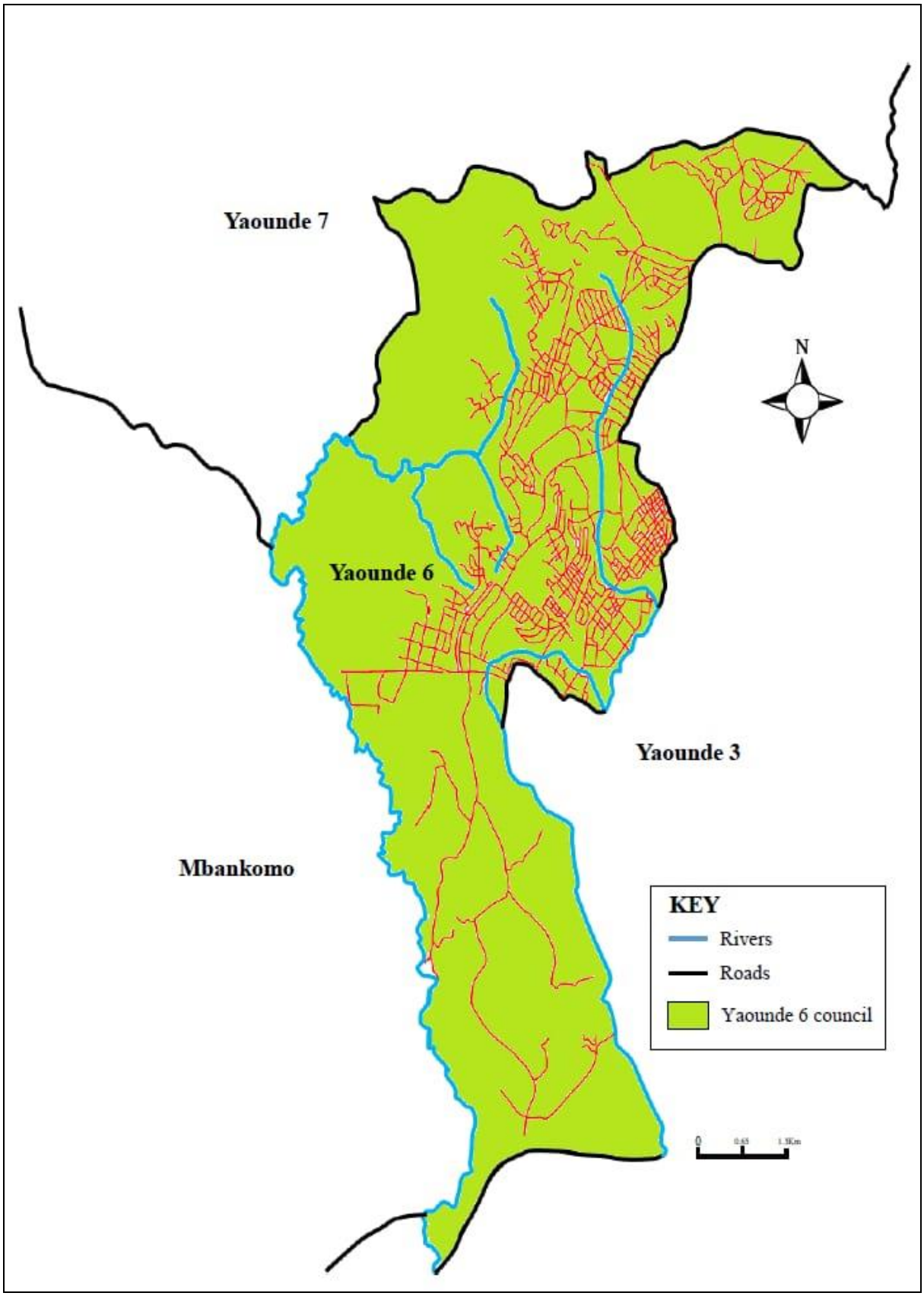

*Source: Adapted from National Institute of Cartography, Yaoundé*

**Fig 2: Map of Centre Region**




*Source: Yaoundé Urban Council*

**Fig 3: Map of Yaoundé VI**




*Source: Yaoundé VI Council*

Yaoundé is located in the heart of the equatorial forest between latitudes 3.47 and 3.56 north and longitude 1110$^{o}$ and 11 45$^{o}$ east. It is, however, marked by a rather accidental relief which for the most part is comprised of hills. Hence, it is called the City of Seven Hills "la ville au sept collines". Yaoundé is described as having seven undulating hill sites. This makes water to run down stream or valleys with little streams causing floods like in cases of "Centre" and Biyem-Assi and other council area in town with quarters like Bonamoussadi and Mokolo-Elobi. Most lakes in the Centre are man-made and located in the Yaoundé areas. The majority of these lakes were created during the colonial period. The most pronounced one is known as Lac municipal. There is another one located in Bonamoussadi, behind the University Teaching Hospital.

According to Franqueville (1970:371), Von Puttkamer described Yaoundé as a station situated on a hill between the forest and the savanna, an ideal and favorable situation. Yaoundé developed in a zone of different sociological and economic passage which was well exploited before the German colonial era. Today, Yaoundé remains a vital node of communication between the maritime frontage largely open to western influence and the east, very rich in natural resources. The city is located 240km from Douala, 290 km from Bafoussam (the main conglomeration of the Bamileke country), 380 km from Bamenda, the main Anglophone of the North West Region of the country) and 380km from Bertoua and 173km from Ebolowa, headquarters of the South Region.

Yaoundé is a host to most of the public institutions in Cameroon. Another nick name for Yaoundé is "Ongola", which means "enclosure" or fence, making allusion to the wall of the old German colonial station. The national and international status of Yaoundé is one of the basic elements which concur with the governance of the city. An analysis of the political, administrative and cultural functions of the city leads to the conclusion that the urban council has a saying in the government of the city. The State and the urban council have put in place some structures that continue to play an important role in the governing of Yaoundé VI. These structures include the Ministry of Housing and Urban Planning, Ministry of Public Works, Ministry of Finances, Ministry of Water and Energy, Credit Foncier du Cameroon, among others which govern the population as it is supposed to be done by the ministries.

Before independence, the urbanisation rate was very slow but accelerated in a geometric manner immediately after independence. The evolution of the urban population of Cameroon is too rapid as shown by the administrative and demographic census of 2016. The political status acts as a pull factor to Cameroonians of all cultural and linguistic backgrounds

as well as to foreigners. Some of the factors that pull this number of people are the presence of industrial centres, especially agriculture which incudes cash crops which is another important economic factor. Out of the capital and the plantation zones, most inhabitants are subsistence farmers.

The constitution of 18 January 1996 modified the administration of the urban council which remains under the command of the government delegate but created six district councils. As of today, Yaoundé has seven municipal councils namely: Yaoundé I, Yaoundé II, Yaoundé III, Yaoundé IV, Yaoundé V, Yaoundé VI and Yaoundé VII.

### 1.1.1 Climate

From our research, we discovered that climate is one of the most important factors that contribute to water scarcity in Yaoundé VI council area. Climate through its components of temperature and rainfall plays an important role in the spread of diseases. It falls completely within type A or Guinea type climate. This gives the region high humidity and precipitation, with rainfall averaging 1,000- 2,000 mm each year. Precipitation is highest in the south most portions and diminishes towards the north. Temperatures are fairly steady, average of $24^0$c for the entire region except for the northern portions of Mbam division where they fall to $23^0$c (Gwangogbe 1999).

Yaoundé VI features a tropical wet and dry climate, with constant temperatures throughout the year. However, primarily due to the altitude, temperatures are not quite as hot as one would expect for a city located near the equator. Yaoundé VI features a lengthy wet season, covering a ten-month span between March and November. However, there is a noticeable decrease in precipitation within the wet season, seen during the months of July and August, almost giving the city the appearance of having two separate rainy seasons. It is primarily due to the relative fall in precipitation during these two months that Yaoundé VI features a tropical wet and dry climate, as opposed to a tropical monsoon climate (Gwangogbe 1999). In 2021, the climate in Yaoundé witnessed a very high temperature causing the water table to reduce and, consequently, reducing water supply from the natural sources.

Extreme heat and cold cause potential fatal illnesses, heat stress or hypothermia as well as increasing death rates from heart and respiratory diseases. Other weather extremes such as heavy rains and floods also have severe impacts on health from water-borne diseases. Climate change affects diseases transmitted through water, especially the global killers which are

diarrhea, malaria and malnutrition. These alone caused more than 3.3% death globally in 2002, with 29% of these deaths occurring in the region of Africa (WHO 2006). Extremes of this climate change can damage property and infrastructure and impose on human health and the economy heavy costs. Climate change is happening so fast that many plants and animals are struggling to cope. Some plant and animal species are at risk of extinction if global average temperatures continue to rise unchecked. Many terrestrial freshwater and marine species have already moved to new locations (Neba 1983).

Humans are increasingly influencing the climate and the earth's temperature by burning fossil fuels, cutting down rainforests and practising environmentally unfriendly agriculture. This adds enormous amount of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming. These are just some of the factors that contribute to water scarcity in the environment. According to European commission**,** the causes of climate change are as a result of the factors listed above.

### 1.1.2 Global warming

The current global average temperature is $0.85^{0}$c higher than it was in the late $19^{th}$ century. Each of the past three decades has been warmer than any preceding decade since records began in 1850. The world's leading climate scientist think human activities are almost certainly the main cause of the warming observed since the middle of the $20^{th}$ century. An increase of $2^{o}$c compared to the temperature in pre-industrial times is seen by scientists as the threshold beyond which there is a much higher risk that dangerous and possibly catastrophic changes in the global environment will occur. For this reason, the international community has recognised the need to keep warming below $2^{o}$c.

During the dry season, the temperatures are so high that the blazing effect of the sun scorches the plants and dry them up. The temperature or climate has been so harsh that the water table has reduced causing water shortage in Yaoundé VI council area. The larva of mosquitoes which could have been carried away by the flowing river now remains stagnant and the larvas mature into full grown mosquitoes that are able to transmit malaria. During this period, there are a lot of dust particles. It affects their respiratory system, causing respiratory tract infections such as cough, and tuberculosis, etc, and areas whose roads are not tarred like "Centre", Mendong, Simbock, Mvog-Beti are most affected. Infected individuals around some quarters who do not have health facilities have to go far away to seek medical attention.

### 1.1.3 Vegetation

Vegetation occurs naturally while some are being planted by humans in most round about like Rond Point express, Carrefour Simbock in Yaoundé VI council area and many others, planted for decoration of the city. They all help in beautifying the area and some people use it for relaxation. The vegetation of this area is dominated by short trees and shrubs and with the increase in population, most of the trees have been cut down without control and used for fuel, construction of houses, furniture and many other wood arts. The area is very poor in natural fauna so there are rare species of trees, snakes and other animals that can be found in a natural forest.

Common trees found in Yaoundé VI council area are eucalyptus trees which are used for decoration by some stakeholders like Ministry of Nature and Environmental Protection and some individuals. They are a great source of antioxidants, particularly flavonoids, which protect the body from oxidative stress and free radical damage. The dried leaves of these trees are used to make medicine. People use eucalyptus as medication in cases like asthma, bronchitis, toe nail fungus and many others, even though there is no scientific evidence to support these uses. Planting of eucalyptus trees in rural areas has provided relief to the people by meeting their needs for fuelwood and small timber, otherwise obtained from natural forest resulting in depletion of natural forest. This means that less labour is required for collection of fuelwood, an activity often carried out by women and men.

Furthermore, the Yaoundé VI city has mango and pear trees which are planted all over the council area. The most consumed product from a mango tree is its fruits which are sweet and have therapeutic properties. They help in preventing anemia because it is rich in iron. Consuming them in adequate quantities helps in increasing iron levels. Also, the vitamins c present in mango increases the absorption of iron. It improves digestion, especially when there is disorder in the digestive system. Being rich in fiber, and polyphenols, consuming mango aids in decreasing constipation and inflammation of the bowels (future science journal 2016 April 18).

That of a pear is used for mild digestion problems, diarrhoea, cholera, constipation and also used for hardened liver problem. There is also palm nut tree that produces kennel used for oil extraction and other sorts of flowers like clematis, lantana, begonia, African lily and many others. All of this vegetation is good in the environment especially Yaoundé VI, because they help in trapping carbon dioxide to be able to release oxygen that is consumed by

humans. But it has its own effects in that if the trees are not kept clean in these environments they tend to be a nuisance to the environment, especially in the rainy season. Most of the trees, if not kept clean are used as breeding space for vectors like mosquitoes, rats, dogs and others who can help in disease transmission both from water and out of water.

The vegetation growth of Yaoundé VI depends on the water supply. Since there little stream found in Yaoundé VI the vegetation in the area produces poorly because water is needed for a green Yaoundé VI.

### 1.1.4 Land (Soil type)

Yaoundé VI soil type is primarily composed of Precambrian deposits of metamorphic rocks, such as gnesis, mica, migmatites and schist. Red feralitic soil dominates most of the region, including the forest zone and much of the savanna area. Though ten meters deep, these soils are leached by silica and percolating water, making it only marginally productive for agriculture. However, it is use in building houses. Red soils have high iron content and are fit for crops like groundnuts and castor seeds. Black soil is rich in calcium, potassium and magnesium but poor in nitrogen content. Crops like cotton, tobacco, chilly, oil seeds, jower, ragi and maize, beans, cocoyams plantains and many others grow well in it. With scarcity of water in this area, the crops that need water, can not do well consequently leading to hunger to the inhabitants of the Yaoundé VI area.

### 1.1.5 Relief

The entire Yaoundé VI area is situated on the southern Cameroon plateau. The land varies from 500-1000 meters above the sea level except for the valleys and tributaries, which dip as low as 200 meters. The land rises gently in escarpments from the south western coastal plain before joining the Adamawa plateau via depression and granite massifs. The terrain is characterised by rolling, forested hills, the highest of which have bare rocky tops. Most of the quarters like Mvog-Beti, Centre and part of Mendong are located in a hilly area making access to potable water difficult. Most of these areas do not have pipe borne water and they depend on the natural sources like springs which, at some point, dry off during the dry season. So, access to potable water becomes difficult to the inhabitants.

### 1.1.6 Settlement

With an estimated population of more than 3million, Yaoundé VI is one of the most densely populated council areas in the Centre region of Yaoundé (Geonames 2020 and www.wikipedia.org/wiki/Regions of Cameroon). The area has been inbabited mostly by the

Beti people for over a century, but it has experienced a great amount of immigration due to the placement of Cameroon seat of government there in the colonial periods. The construction of a large and well maintained road network has contributed to the area's boom. Another factor that contributed to the booming of the area is the presence of good schools, health facilities and touristic sites. The traditional houses are rectangular in structure made of mud bricks and thin posts with alluminium zinc for roofing.

Yaoundé VI has a variety of settlement patterns in its council area in all the 24 quarters (that is main and sub quarters). Quarters like "Rondpoint Express", Jouvence, Simbock, Acacia, Biyamassi, "Centre", TKC, Melen, Mvog-beti, Nkolbikok and Elig-effa, all have clustered settlement. This type is when buildings are closely parked together, some facing each other which is nick named "face me I face you compounds and rooms". The advantages of these kinds of houses are that the inhabitants learn how to socialise with one another, new cultures, different languages and dressing styles. This proximity makes communication quicker and easier than in linear and dispersed settlements. Because people are closer, it is also easier to perform joint tasks such as the buying and selling of goods and services. However, clustered settlements enhance promiscuity.

Dispersed settlement is the scattered pattern of households in a particular area. This form of settlement is common in the world's rural regions. The settlement pattern contrasts those found in nucleated villages. In the Yaoundé VI council area, quarters like Ako-Ndoe, Ahala and Mvondo have dispersed settlement because they are just newly created quarters in the council area. A dispersed settlement has its merits and demerits. Due to the isolation of individual households in a dispersed settlement, the inhabitants are at great risk to breaches in security.

The minimal social interaction between the households in a dispersed settlement is another result of the household isolation seen in a dispersed settlement. Access to public amenities such as schools, hospitals, and government offices is another challenge faced by people residing in dispersed settlements. In the event of natural disasters or accidents, emergency response is hindered by the expanse of the farms between households in a dispersed settlement. Poor sanitation and drainage systems are not a problem in dispersed settlements. The large size of the land in dispersed settlements makes it ideal for the employment of machinery for economic activities for improved productivity (Williamson 2004).

Today, materials used in constructing are very expensive and is making life difficult for some people who are low-income earners. To get those wood made houses is very rare because most landlords are making their possible efforts to transform their houses to what suits to the society of today which knows modern houses. With this, it has made some of the ethnic groups to forget their culture and tradition all in the name of acculturation as they tend to abandon their own way of life to copy that of the western cultures. Some of these materials are not durable so they cannot last for a longer period of time. This makes life very costly for the inhabutants because they have to constantly replace either the roof or any other thing in other to keep the house in a good shape. In Yaoundé VI, there are informal and formal housing.

Informal housing includes any form of shelter that is constructed illegally, with out controlled by the government. The inhabitants usually have insufficient social amenities like potable water, electricity, roads, sanitation and waste disposal or collection. Most of these occupants live in slump settlements which the UN defines more narrowly as contagious settlement where inhabitants are described as having inadequate housing and basic services often not address by the public authorities. Yaoundé VI now is experiencing informal housing, driven by mass migration to the town in search of employment or fleeing from war or environmental disaster. Rural-urban migration gives birth to poverty-stricken a squatter settlement that tends to become permanent, establishing themselves as unmovable communities with adverse planning implications.

The economic interests of governments lead to development of such policies that increase economic opportunities of individuals in metropolitan areas. It's provides an incentive for migration to the rural population in search of better sources of livelihood. Also, due to higher government investments in urban areas for development, it acts as a pull factor for the rural population to migrate in order to have a better quality of life (Agarwal 2016).

In Yaoundé VI council area, we have quarters that have informal housing structures like sub quarters in Etoug-Ebe, Centre, Biyem Assi and Melen. As earlier mentioned above, the occupants lack social amenities like water, roads and waste collection. Most of these areas have bad odour that pollutes the air causing breathing difficult. Their dirt piled up for many months without collection by the company responsible. Most at times, they use the available running streams to dispose their waste products. Water too is another important basic need that is not always available in these areas and so we find many people suffering from water-borne diseases because they cannot afford a reasonable income to live in good houses.

Formal housing are those that have a particular standard of building, respect the rules and regulations of the state especially from the Town Planning Ministry. Adequate home ventilation is particularly important where wood, coal and dung are used for cooking or heating, since these fuels give off smoke. There must be adequate drainage system that will channel water such as rain water or used water, out of the house in order to avoid flooding and other water hazards and disaster. Sanitation is the hygienic means of promoting health through prevention of human contact with the hazards of wastes. Security is the degree of protection against danger, damage, loss, and crime.

Today, in the city of Yaoundé VI, just about 65% of the inhabitants practice a formal way of building houses. In Yaoundé VI council area, quarters like Jouvence, Mendong, and Simbock have good buildings that follow good rules of the state. By so doing they have good access to roads, good connection of electricity, places where trash cans can put for easy access by the company in charge of waste collection. At Mendong, there are buildings that are owned by the government meant for low income earners. But the situation today is different, the houses are occupied by the people who are well to do. All of this increase is due to the increase in population which is also associated with high prices on basic commodities like food and water.

**Table 1: Types of settlement in Yaoundé VI council area**

| **Nucleated settlement** | **Dispersed settlement** |
|---|---|
| Biyem Assi | Ako-Ndoe |
| Etoug-ebe | Elomde |
| Melen | Mvondo |
| Elig-Effa | Simbock |
| Simbock | |
| Rondpoint express | |
| Acacia | |
| Jouvence | |
| Carrefour Mboma | |
| Centre | |
| Nkolbikok | |

*Source fieldwork: Matilda Musah (September 2019)*

The table above shows the different types of settlement present in Yaoundé VI area. There are some areas which have been restricted from buidings like valleys and along the stream. But the populations have not respected these restrictions and have constructed all over the area causing water to dry off in those areas leading to water shortage. Yaoundé VI have

marshy area that if the regulatuons where respected by the population, the water table of these areas will not go down. But because the law is not respected by the people, construction is done even in marshy areas causing water to dry off in those areas and as a result causing access to potable water difficult in the area.

### 1.1.7 Population demography

Despite economic growth in some regions, poverty is on the rise, and is most prevalent in rural areas, which are highly affected by unemployment, declining incomes, poor school and health care infrastructure, and a lack of clean water and sanitation. Under-investment in social safety nets and ineffective public financial management also contributes to Cameroon's high rate of poverty. Yaoundé is the capital of Cameroon and, with a population of more than 2.8 million, the second-largest city in the country after the port city, Douala. It lies in the Centre Region of the nation at an elevation of about 750 metres (2,500 ft) above sea level. The increase number of population in Yaoundé particularly in Yaoundé VI is as a result of basic amenities like hospitals, education, recreation centres, cinema halls, sport and many others.

Some of these amenities as listed above are not found in other regions and sub-division that the inhabitants want to enjoy them. Yaoundé in general has a total population of about 3,822,000 in 2019 which will definitely increase by the end of 2020. Yaoundé VI council area which has about 24 quarters has a population of 268,428 population census in 2005 and today, it can be estimated to be 868,475 populations. The increase in population is clearly seen with the number of quarters that are newly created in Yaoundé VI area. In addition, the current crisis that is in the North West and South West Regions has pushed many of the population to settle new areas where they can have a lot of space for their families.

**Table 2: Population demograghhy of Yaoundé**

| Year | Population |
|---|---|
| 2021 | 4,000,000 |
| 2020 | 3.992.000 |
| 2019 | 3.8222.000 |
| 2018 | 3.656.000 |
| 2017 | 3.459.000 |

*Source: National institute of statistics (web, June 2020)*

The increase in population in Yaoundé VI area is one of the factors that is causing water pollution and water shortage.

**Table 3: Population demography of seven sub divisions of Mfoundi 2015 census**

| **Year** | **Population** |
|---|---|
| Yaoundé I | 282.586 |
| Yaoundé II | 238.972 |
| Yaoundé III | 252.501 |
| Yaoundé IV | 477.350 |
| Yaoundé V | 265.087 |
| Yaoundé VI | 268.428 |
| Yaoundé VII | 97.997 |

*Source: BUCREP 2015 (web, June 2020)*

From the table above, one can see the estimated population of the seven divisions that make up Yaoundé (Centre). Yaoundé IV is the division with highest population, followed by Yaoundé I, third by Yaoundé VI, fouth by Yaoundé V, six by Yaoundé II and the seven by Yaoundé VII. From the census of 2015, the estimated number was 1.882.921 population. From the period of 2021 till now one can say that the population has greatly increased. This gives one of the reasons why the inhabitants here still suffer from water shortages and water pollution. The increase in population in Yaoundé, especially in Yaoundé VI, has made access to potable water difficult because of water shortage. Even though some people develop strategies like using well and spring water, it is still insufficient to the population.

### 1.1.8 Drainage pattern

When one looks at the Yaoundé VI council area, it is clearly seen that the drainage system in this area is very poor. The area has very few streams, with poor canalisation by the inhabitants. Furthermore, when one looks at the way houses are built in this area, it seems as if the council has no town planning document. In the quarters, one can see how the houses are constructed haphazardly, leaving out no space or channels of waste water to run through. This has had a lot of negative effects on the inhabitants, thereby making access to potable water become difficult.

### 1.1.9. Education

Education is a process of teaching, trainng and learning especially in schools and at homes to improved knowledge and developed skills. It helps to mould children as they grow

up in the society, especially at the basic level. In Yaoundé VI, there are various schools both public and private sectors at all level from pre-nursary to university level. To some parents or care givers to pupils and students, water and sanitation is one of the basic necessities that they have to check before sending their child or children to a particular school. If water is not present in any school, it makes life difficult to the student and pupils because we live on water. To this effect, most of the schools in Yaoundé VI council area have water in the compound which permits the school to have sanitation and permitting the students to study well in the environment.

### 1.1.10 Health care Services

In the Yaoundé VI council area, there are hospitals like the Biyem Assi district hospital, Etoug-Ebe hospital and "hopital de soeur" at Mvog-Betsi. All of the hospitals function as expected by meeting the needs of the patients that they receive on daily basis. There are pharmacies at various points like "Pharmacie de la Grace" Mendong and many others. There are also a lot of road side vendors of drugs and even in the markets.

Hospitals are the primary ultimate healthcare facilities and their services vary greatly, depending on their location and size, as they typically have a wide range of units to save lives that can give emergencies dealing with non-intensive care and intensive care. The non-intensive unit deals with surgeries, rehabilitation, childbirths. Intensive care units deal with the emergencies like most serious injuries and life-threatening diseases. These hospitals have the following departments; Blood bank, Ambulatory surgical centres, Emergency unit, Maternity section, Pediatric section, Orthopedic and rehabilitation centres, Diabetes education centres**,** Dialysis centres, Radiology centre and more.

It is not possible to see hospitals surviving without water that is why most clinics and hospitals in Yaoundé VI either have pipe borne water or well that they use to provide water to the patients, workers and for cleaning of equipment in the hospitals and clinics.

## 1.2 Socio- Political Organisation

### 1.2.1 German administration

Three years after the German annexation of the Cameroons in 1884, the first white men moved in, under orders of Governor Julius Baron Von Soden, to explore the territories of the Beti. A later governor, Jesko Von Puttkamer, began extensive plantation farming in the south of Cameroon, particularly of cocoa, which he introduced in 1905. Native peoples were used through forced labour. In response to this and to their loss of lucrative trade to the

Germans, the Ewondo revolted in 1895 but were suppressed the next year. Other rebellions occurred under the Bane and Mbidambani. A second Ewondo resistance occurred in 1907 when the Germans tried to prop up their collaborator, Charles Atangana, as the over-chief of Ewondo.

Germany made various improvements to the territory, including the building of roads from Cameroon's coast to the inland areas, beginning in 1900. The first long-distance automobile journey took place in 1913, from Kribi to Yaoundé, a distance of 280 km, in eleven hours. The Germans also brought the railroad to the area, beginning a line from Douala to Yaoundé in 1909. Work was stopped at the outbreak of World War I, however. Germany moved the capital of the colony from Buea to Yaoundé at this time. Some of the Centre's largest towns and cities were originally German outposts, including Yaoundé (founded in 1889) and Mbalmayo.

A Catholic mission and school were established in Yaoundé in 1901 by the German Pallotin Fathers. This was followed by similar setups in other settlements until 1907. The Presbyterians were quick to follow, establishing a presence in 1909.

### 1.2.2 French administration

The French gained control of the Centre Province in 1916 after World War I. They divided Cameroon into several zones, and the current Centre Province's area fell into the Yaoundé, Edéa-Eséka, and Ebolowa-Akoafim zones. Much of France's administration of the territory was simply a continuation of policies set up by the Germans. The French Company for the Development of Tobacco set up in Batchenga near Yaoundé in 1947, and the sugar plantation at Mbandjock was planted in 1964. In fact, the town of Mbandjock did not exist then but grew up around the French sugar cane farm.

The French also maintained the German policy of propping up puppet chiefs when existing traditional rulers were uncooperative or where such native rulers were absent. They also opened a school in Yaoundé on 27 December 1933 to educate and indoctrinate the sons of chiefs. France made many more improvements to the territory, as well. They built large, opulent government buildings there, including a governor's mansion. The railroad between Douala and Yaoundé was finished in 1927, and this was modernized in 1933. The main road from Douala and on to Bertoua was widened and improved in 1939 (Mokake 2006).

The Ewondo and their other Beti-Pahuin relatives` migrations also coincided with the apex of European trade off the Cameroonian coast. The newly claimed jungle and near-

coastal territories of the Beti-Pahuin allowed them to ensconce themselves into a lucrative role as middlemen; in exchange for European goods. They provided items such as kola nuts, ivory and slaves. After the establishment of a British naval presence in 1827 to hinder the West African slave trade, Beti-Pahuin merchants widened their operations to include such products as palm kernels and rubber.

Beginning in 1887, German colonisers penetrated Beti-Pahuin territory to search for individuals to enslave on their coastal plantations. They also stopped the coastward migration of the people. Meanwhile, the French stopped further Fang penetration into their colony at Gabon, though the Fang of Equatorial Guinea continued unimpeded toward the sea and began using copper and iron money introduced by the Spanish (Schnee 1926).

In time, the Germans expanded their Cameroonian plantations inland, and the Beti-Pahuin formed the easiest and most accessible source of enslaved labour to work, to build the accompanying road network, and to serve as sexual prisoners for the German overseers. The Germans also outlawed or tried to suppress native customs that they deemed "barbaric" or unsavoury, such as the sacrifice of a chief's wives after his death and the initiation rite (Schnee 1926). Among these alleged barbaric practices the Germans were to outlaw, slavery and sexual exploitation at the hands of the Germans was not one of them and it was not long before the Beti-Pahuin showed resistance.

The Bulu first revolted, in 1891. Their main complaint was that the coming of the Germans had stripped them of their profitable position as traders. The rebellion was squelched in 1895. Later that year, Ewondo chiefs of the Mvog Betsi clan were deemed "disruptive" and whipped before their village. In response, the villagers killed the men who did the whipping, and the Ewondos rose up over the insult. This rebellion lasted less than a year before the Germans suppressed it. Elements of the Bane and Mbidambani also led rebellions. In response to these aggressive actions, the Germans instigated a policy of removing uncooperative chiefs from power and propping up puppet rulers and paramount chiefs in their places. The most well-known example of this is the 1911 appointment of the German-sympathiser and interpreter Charles Atangana, a member of the Mvog Atemengue sub-lineage, as paramount chief of the Ewondo and Bane.

The Bulu feared that their trade relations and autonomy would be threatened by Atangana's appointment. Martin-Paul Samba led an uprising in 1912, but it was quelled. French colonial rule of Cameroon began in 1916 and largely followed in the German mold.

Plantations multiplied and expanded as the French concentrated chiefly on cocoa. Meanwhile, the Beti-Pahuin continued to supply a significant source of free labour. The French also maintained a system of indoctrinating and installing handpicked tribal rulers. However, as France granted increasing levels of self-rule to its African holdings, the Beti-Pahuin were quick to seize upon it. An early example was the Bulu tribal union, a group of representatives from all clans who met to establish common tribal policies.

Yaoundé also became the location of an international airport. In the realm of education, an Advanced Primary School was placed in Yaoundé in 1939, and Ayos became the site of a nursing school in 1925. The French expansion into the region also allowed better access for missionary groups. The Seventh-day Adventists set up centres in Nanga Eboko and Yaoundé. This religion continues to claim large numbers of followers in the province. A major Catholic seminary was opened in Yaoundé in 1927.

By making Yaoundé the centre of government, France also made it the centre of the colony's politics. After France made all its West African colonies self-governing in 1956, many of Cameroon's earliest political parties were located there. The biggest of these were the Union Camerounaise, with large constituencies in the Centre and North (led by Amadou Ahidjo), and the Democrats Camerounais (DC), with support from the Yaoundé region headed by André-Marie Mbida. Most of these parties offered a pro-independence platform. The capital was also the natural site of early political protests. When the colony's most vocal political party, “Union des Populations du Cameroun” (UPC), raised prices at Yaoundé market stalls, for example, the government outlawed the group. This led to multiple clashes between pro- and anti-UPC factions in Yaoundé, which continued even after independence in 1960.

Yaoundé VI council was created by decree No 93/321 of 25 November 1993. It was only in 1996 that it opened doors to the public. Its birth was a result of the split of Yaoundé III council.Yaoundé VI is one of the seven subdivisions of the Mfoundi division whose boundaries almost align with those of the city of Yaoundé. It has a population of 2, 6I8, 428 in 2005, representing 14.26 % of the population of the Mfoundi and 350.000 populations in 2019. It was its third most thickly populated sub-division. The sub-divisions have various quarters that make up the subdivision, with various quarter heads to help circulate information from the council to the population and vice versa. In all of these quarters, there are some beautiful restaurants, hotels, bakery, gardens for relaxation and many other activities that pull the population into the city (Yakan 2019).

Yaoundé VI council was created because government wanted to bring administrative works closer to the people. The council is responsible in providing services such as: administrative works, maintain hygiene and sanitation by providing water and excuting good waste management in the area. The council is also responsible in providing roads and giving out opportunities for people to do manual jobs especially during the holiday's period.

Yaoundé VI council area is situated in the Centre Region and imposes itself as a commercial and industrial centre. The concentrations of many activities in one area like commerce, transportation agencies, with engineering companies and transformation industries, have played a major role in the urbanisation of Yaoundé VI council area. The growth of this area took place over a length of time. To a certain extent, economic development accompanied demographic growth of the town. Nevertheless, Yaoundé VI council area is unique in its own way due to the fact that its native tribes which are the Beti, Ewondo are the minority, dominated by the halogens, especially the Bamilike and Anglophones.

### 1.2.3 Post-independence period

Under Cameroon's first president, Amadou Ahidjo, Cameroon was split into seven provinces. The present-day Centre and South Region were at this time combined into one Centre-South Region. It would remain this way until Cameroon's second president, Paul Biya, split the Centre-South into the present Centre and South Provinces on 22 August 1983. Under Ahidjo, the railway was pushed northeast, reaching Bélabo in the East Province in 1974. In an effort to better unify the north and south portions of the country, Ahidjo also ordered a road built north from Yaoundé to Ngaoundéré (National Road 1).

Ahidjo also paved major roads, including the stretches between Douala and Yaoundé and Bafoussam and Yaoundé, beginning in 1966. Education also experienced improvement. The University of Yaoundé was founded in 1962 for a student body of 7,500. After large student protests in 1973 and 1980 against overcrowding of the facilities, that institution was decentralised, and other universities were opened in other regions of the country.

### 1.2.4 Urbanisation of Yaoundé VI

Yaoundé VI council area did not develop in a single day, but rather it has been and is still a gradual process that leads to its present state as one sees it today. The rapid urbanisation of this area was, and is due to the presence of activities like education, religion, recreation centres, touristic sites and social amenities which act as a pull factor to the

population. As part of the political and administrative capital of Cameroon, Yaoundé VI has witnessed a very high population growth two thirds of which can be attributed to migration, safety, and protection, especially those affected by the current crisis in Cameroon.

#### 1.2.4.1 Inhabitants of Yaoundé VI council area

It is estimated that about 75% of household heads in Yaoundé VI council are from elsewhere (Matilda 2020). These statistics show that the indigenes of this area merely constitutes of 25% of the total population. Yaoundé VI had the influx of other people, like the North, Far North, Bamileke, Bassa, Beti, and the Anglophones. It should be noted that these people remain distant to each other, despite apparent co-existence, maintaining quite different sociocultural aspects and antionic migration. They are able to survive in this area because they have water in their area which is an important factor that drives people in settle in a particular environment.

#### 1.2.4.2 Aborigines of Yaoundé VI

Yaoundé VI being a heterogenous town, there are different people with different cultures. In as much as our study is based in Yaoundé VI, some tribes will be taken into consideration as the indigenes of Yaoundé VI. In our study, the Beti (Ewondo, Eton and Bulu) will be used as the autochtons of the study area.

##### 1.2.4.2.1 Ewondo People:

Ewondo people are part of the larger Beti-Pahuin ethnic group of Bantu origin, residing predominantly in Yaoundé. Cameroon`s capital city, Yaoundé was named after them, Ewondo people who belongs to Beti. The remainder of the territory lies in the Northern portions of the Ocean Division in the South Region. Historically, Ewondo, like all Beti-Pahuin groups, originated from the forests, south of the Sanaga River, not far from their current territory. At some point, they crossed the Sanaga and moved north until they reached the upper Kadéï River.

They came under attack there from the Vute or Mbum people, so they fled further north to the eastern Adamawa Plateau. The groups would not remain there long, however. Their migration coincided with the jihad and Fulbe (Fula) conquests of Usman Dan Fodio and his lieutenant, Modibo Adama, in the early 19$^{th}$ Century. Under pressure from Fulbe raiders, the Vute moved once more into Beti-Pahuin lands, and the Beti-Pahuin were forced to relocate once again. They moved south and west in a series of waves. The first group

included the Bulu and Fang, who split somewhere near what, is known today, is the town of Ebolowa (Binet, 1965).

The Ewondo are known for their Bikutsi dancing musical genre from Cameroon. The word 'bikutsi' literally means 'beat the earth' or 'let's beat the earth' (bi- indicates a plural, -kut- means 'to beat' and -si means 'earth'). The name indicates a dance that is accompanied by stamping the feet on the ground. In its modern form, bikutsi is very popular, and rivals makossa as the country's most renowned style. Popular bikutsi first appeared in the 1940s with the recording of Anne-Marie Nzie. Some twenty years later, the style was electrified with the addition of keyboards and guitars. The Ewondo are also known for their traditional Nkul drum. As a result, they are popularly known as "the People of Drum of God." It is said that in the past, the beat of an nkul, a wooden slit drum, reverberates at dawn around and through the trees and houses of the Ewondo people (Binet, 1965).

#### 1.2.4.2.2 Eton people

The Eton people migrated south and west from the Sanaga River basin into equatorial forest regions. The Betis people are Bantu people who once lived in northern parts of Central Africa, with a complex, undocumented and debated prehistory. They likely moved into equatorial Africa in the seventh or eighth century, then further southwest in central Cameroon. Between the seventeenth and nineteenth centuries, likely after waves of wars and slave raids from the Fulani people, they were also a targeted source for slaves and ivory by the Hausa people.

Their initial migration in the 17$^{th}$ century was from highlands and forested regions east of the Sanaga River towards south and west. They continued to face jihads and violence from the north by the Fulani people (also called Fulbe or Fula people), abandoned their settlements and migrated further into southern parts of central Cameroon till the 19th century when European traders and colonial forces intervened as they sought trade, routes and markets. The first European power to create a colony that partly included the lands of the Beti people was the German Kamerun colony in 1884. After the First World War, the German colony was taken over, divided by the French and the British colonial powers.

#### 1.2.4.2.3 Bulu

The third grouping is called the Bulu and makes up about a third of all Beti-Pahuin in Cameroon. The Bulu include the Bulu proper of Sangmélima, Kribi, and Ebolowa, the Fong

and Zaman of the Dja River valley, the Yengono, Yembama and Yelinda of the Nyong River valley, and the Yesum, Yebekanga, Yebekolo, and Mvele.

**1.2.4.2.3 Economy and diet**

Most Ewondo people maintain an agrarian lifestyle. Cassava and maize form the staple crops with plantains, yams, and groundnuts also playing a vital role (in fact, "Ewondo" and "Yaoundé" mean "groundnut"). Varieties of forest products, such as greens, insects, mushrooms, and various palm products, supplement the diet. Livestock is limited to small animals that may be left to forage unattended, such as goats, pigs, and chickens. Fishing is central to the lives of many Beti-Pahuin, particularly in Equatorial Guinea and São Tomé and Príncipe. Toward Yaoundé in Cameroon and other large towns, bushmeat forms a substantial form of income for many villagers, who sell their kills to passing vehicles for retail in the urban centres.

The Ewondo farther north often find work as unskilled labour, as their environment is much more urbanised. As late as the colonial period, many Beti-Pahuin were highly skilled workers in wood, ivory, and soapstone. They were particularly noted for their lively masks. Today, however, very little of this traditional craft is still pursued, though missionary groups have encouraged some carvers to continue to practice with an eye toward the tourist market.

These are typically saved for special occasions such as funerals or New Year's celebration. Instead, the main source of animal protein during the year, comes from bushmeat, that is, wild game such as pangolin, porcupine, and monkey brought in by jungle hunters. Likewise, fishing is central to the lives of many Beti-Pahuin, particularly in Equatorial Guinea and São Tomé and Príncipe.

**1. 2.5 Language**

The Beti people, like the other Beti-Pahuin people speak a dialect of the Fang language, also known as Pahuin or Pangwe. Sometimes called the Beti language, it is a Southern Bantu language belonging to the Niger-Congo family of languages. The Beti language is sub-classified as Bulu language, Eton language, Ewondo language and Fang language because though different, they are mutually intelligible to respective speakers. While the languages are similar, there are linguistic differences suggesting a complex interaction between these peoples (Owona 2004).

Ewondo people (or Kolo-Beti) speak Ewondo or Kolo language which is Bantu language that belongs to the larger Niger-Congo language family. Ewondo is also a trade

language. Dialects include Badjia (Bakjo), Bafeuk, Bamvele (Mvele, Yezum, Yesoum), Bane, Beti, Enoah, Evouzok, Fong, Mbida-Bani, Mvete, Mvog-Niengue, Omvang, Yabekolo (Yebekolo), Yabeka, and Yabekanga. Ewondo speakers live primarily in Cameroon's Centre Region and the northern part of the Ocean Division in the South Region. Apart from Kolo, Ewondo people speak Ewondo, which is a Beti-based pidgin of Cameroon, spoken in the area of the capital Yaoundé (Owona 2004). This language also makes use of a lot of proverbs such as: “Ba kar ki loué nvou be bele nding.” (Proverbe ewondo) “On n’appelle pas le chien avec le fouet.” (Proverbe ewondo) “One does not call a dog with a whip.” (Ewondo proverb) Meaning: A mean person cannot claim to want to gather and reconcile people.

### 1.2.6 Other ethnic groups

Looking at the geographical ethnic groups, amongst are other settlers from the grass field like the Anglophones, Bamileke, south people, and those from the east region. Their implantation appears to be in many forms as they are found mostly in all the quarters in Yaoundé VI council area. Foreigners constitute a typically cosmopolitan heterogenous group. It represents about 75% of the people in the Yaoundé VI council area. We have the Bamileke concentrated at one end of the area known as “Cite des Palmiers” a quarter in Mendong. We have the Anglophones at Biyem Assi, “Centre”, Etoug-egbe, Melen and other quarters are mixed together. The knowledge of interurban migration has a geographical importance since it constitutes a great aspect of the formation of the new Yaoundé VI urban area. At the beginning, the newcomers come in search of their family brothers and sisters and they find themselves settling in the area as long as they can fend for their families. It is as a result of this migration that the set area is experiencing water shortage because there are few water point with more population.

### 1.2.7 Infrastructure

Infrastructure is the foundation upon which the structure of the economy is built. It refers to functional modes including highways (transport roads), electricity and water supplies.

#### 1.2.7.1 Road network in Yaoundé VI area

A road is a long piece of hard ground which is built between two places so that people can drive or ride easily from one place to the other. Where there are no roads, movement is difficult for people and even vehicles rendering activities to be slow in the communities. In Yaoundé VI today, we have major routes which are tarred by the state, no individual is allowed to tar any road. There is graded road which is done still by the state at least at this

level individuals can only grade the roads leading to their homes and not the street and lastly paved or foot paths thatare just created or formed by the people. We can have such roads in newly created quarters where the roads are still to be graded. Most of the newly created roads now destroy some of pipe borne water in the quarters causing pollution and water shortage in the area.

#### 1.2.7.2 Hydrology in Yaoundé VI area

There exist three main sources of water namely: surface water, air water and biomass water. Surface water consists of running water. Generally Yaoundé is drained by several water sources among which are the Mfoundi, (Mball I and II), Ewoue (Emombo), Ake (Emombo) and Tongolo (Etoudi and Mballa II).

Yaoundé VI area has streams, wells, underground water and tap water that are used by the people for domestic activities. Underground water constitutes an important source for wells and drilling water. They come from free water underground layers of the soil. Rain water which is a vital utility for households also falls in this category. Biomass water is found in living matter, especially fruits. Apart from consumption, it is not used by the population for other domestic needs. Despite the presence of these water sources, in Yaoundé in general and Yaoundé VI council in particular, people still experience water shortage and water pollution. This study in the subsequent chapters will be looking at how inhabitants of Yaoundé VI council get access to potable water due to frequent use of water for domestic usage.

#### 1.2.7.3 Electricity in Yaoundé VI area

Electricity is all around us, powering equipments like our cell phones, computers, lights, soldering irons, and air conditioners. The Yaoundé VI area is highly electrified, even though there are some homes where we can find them not using electricity. When there is power failure, houses that are using boreholes as water sources have problem because the engine inside the well needs electricity to be able to pump out water. Consequently there is water shortage in those homes.

#### 1.2.7.4 Telecommunication

The telecommunication network in this area is not bad. Radio and television signals are available all over. It is rare to find people these days without telephone and it is easy to trace to located people from different place or location. The various network available here for communications are the MTN, ORANGE, NEXTLE AND CAMTEL network which is assessible to everybody. The communication rate/airtime is not too expensive for people to

afford. But at times these networks have their own problems that render communication challenging, especially in cases where there is an emergency case to handle. Some of these issues usually last for days and, at times, a week. When a quarter needs an urgent response from CAMWATER with issues of water supply in the homes it becomes difficult to communicated with the personnel when there is no network, and it can cause damage especially in hospitals.

### 1.3. Economic activities in Yaoundé VI council area

Economic activity is the activity of making, providing, purchasing, or selling goods or services. Any action that involves producing, distributing, or consuming products or services is an economic activity. Economic activities exist at all levels within a society. Additionally, any activities involving money or the exchange of products or services are economic activities. For instance, running a small business is a great example of economic activity. Employees working in a factory and receiving wages, for example, are performing economic activities. Their employers are also economically active because they pay the workers. Some of the economic activities here include; agriculture, livestock production, business, transportation, secretariat works, saloon, engineering works, wood wok and commercial sex.

#### 1.3.1 Agriculture

Agriculture often involves the cultivation of the soil to grow plants and the raising of animals for human needs. The words “crops” and “livestock” are also used. However, both words are special or technical terms. “Crops" should clearly mean plants (with exceptions, as in mushroom) which are useful to man while “livestock” applies to both domesticated animals and poultry. Agriculture is practised for the purpose of producing food and other human needs such as clothing, shelter, medicines, weapons, tools, ornaments, and indefinitely many more including livestock feed.

In the Yaoundé VI council area, urban agriculture is what is being practised due to insufficient land for extensive agriculture. The people have just small land to cultivate their small gardens by their homes or houses. This type of agriculture is meant for consumption by the families or individuals concerned because they cultivate in smaller quantities.

In Yaoundé VI, the people cultivate crops like beans, corn, cassava, plantains, cocoyams and vegetables (okro, huckleberry, green, tomatoes, onion, ginger, garlics, green spices and cabbage). Some people use natural manure like vegetable waste from homes and some people go for an artificial fertiliser like ammonia on their crop.

**Fig 2: Crops cultivated in Yaoundé VI council area**

*Source fieldwork: Matilda Musah (September 2019, Mendong)*

The picture above clearly shows what is cultivated in this council area which is corn, cocoyams, beans, sweet potatoes, cassava, plantains and bitter leaf. These are crops that the people consume mostly in their homes.

The pros of pesticide and fertiliser use are offset by the problems related to their toxicity. For example, pesticides used to protect crops from harmful pests often kill beneficial insects. Runoff of chemicals used in pesticides and fertilisers can drain into streams and lakes, and eventually our water supplies. Excess nitrogen from fertiliser runoff can cause excessive algae growth in rivers and lakes. Pesticides can also adversely affect the health of people who use them, as well as people who live near large agricultural areas, not to mention those who consume food treated with chemical pesticides. As many as 20,000 Americans suffer from pesticide poisoning each year, and the World Health Organization (2005) estimates 1 to 5 million people worldwide are affected by pesticide poisoning annually. As a result, despite certain agricultural advances, more crops today are destroyed by pests than in the 1940s.

Yaoundé VI council area practices urban agriculture and this agriculture depends on the water supply. This suggests that if there is little or insufficient water supple, agriculture cannot be carried out effectively. In most areas of Yaoundé VI, very little urban agriculture is carried out due to water insufficiency.

### 1.3.2 Livestock production in Yaoundé VI

Livestock is commonly defined as domesticated animals raised in an agricultural setting to produce labour and commodities such as meat, eggs, milk, fur, leather, and wool. The term is sometimes used to refer solely to those that are bred for consumption, while other times it refers only to farmed ruminants, such as cattle and goats. The Yaoundé VI people classify pork, veal, beef, and lamb as livestock and all livestock as red meat. Poultry and fish are not included in the category. The breeding, maintenance, and slaughter of livestock, known as animal husbandry, is a component of modern agriculture that is practised in Yaoundé VI. Animal husbandry practice varies across cultures and time and continues to play a major economic and cultural role in numerous communities (Clutton- Brook 1999).

Livestock activities in Yaoundé VI area are very limited. This is because land which is one of the most important factors individuals need to be able to keep livestock is in limited supply. Secondly when doing livestock ativity, individual are soppose to have enough water to make sure that the animals do not run out of water. Due to limited water supply, the inhabitants do less activites on livestock.

### 1.3.3 Business activities

Business refers to the organised efforts and activities of individuals to produce and sell goods and services for profit. Businesses range in scale from a sole proprietorship to an international corporation. Business includes large, medium and small scale business as long as it brings in income to the individuals, councils and the country as a whole. Some of the activities here include market areas, bars, door-to door business and salon (hair dressing and barbing) and tailoring.

When one talk of economic activities, it is known that there must be an exchange for something like goods and money for the individual that needs it. But with the case of Mauss (1923), he says:

> *The obligations on us to give gifts are more importantly to reciprocate that which is given in either equal or greater value that which is receives. Potlatch the system through which gift are exchange, encompassing the acts of giving and receiving the most importantly in the text, the way they are reciprocate.*

To Mauss, exchange that is done should not equally be in the same or equal quantity but the most important thing is that there is that aspect of giving that was practised in the archaic societies. But with the case of the Yaoundé VI council today, exchange is being done and the

money given should be equal to the goods that are to be given in return for money. The business ventures in Yaoundé VI includes: shops, supermarkets, bus stations, banks, credit unions, just to name a few.There are cases where sellers cheat on the buyers just to have more profit. They do not care about what they are selling, for example we have those that sell fruits, especially things like pears, pawpaw, pineapple, plantains and tomatoes. The people go as far as using chemicals to spray on these food and fruits items just to fasten the ripening of the fruits, a practice which is not healthy for the body. We have cases where some individuals warm water and poor them on pear just to foster the ripen process of the pear. In this case the people do not care of what they give out but what they want is have their money which at times is not the best way because one cannot keep customers by treating them poorly.

Furthermore, other activities that help in raising income or capital to the people of Yaoundé VI are: transport buisnesses, mechanic work shops, carpentary works, hawking, restaurants, tailoring, hair dreesing, water sellers, credit union, banks and money transfer agency. If there were potable water in the area, the people would also get involved in selling water.

### 1.3.4 Markets in Yaoundé VI area

A market is a place where two parties can gather to facilitate the exchange of goods and services. The parties involved are usually buyers and sellers. The market may be physical like a retail outlet, where people meet face-to-face, or virtual like an online market, where there is no direct physical contact between buyers and sellers. In the Yaoundé VI council area, we have various market areas where exchange of goods and services takes place and it all involves both the large, medium and small size businesses. Some of these places include: Acacia market, Mendong market, “Centre” market, Mvog-Betsi and other small ones like Melen, Simbock which usually hold only on Saturdays. These markets are divided into various sections: those that sell dresses in their own part, those selling food on their section, those with vegetables have their own, those with fruits have theirs, section for cosmetics, section for shoes, section for electronics and sections for grinding mills.

Some of these markets do not have water points, putting the people selling in the market at risk. Some of the people spend their money in buying water, thereby reducing their income level.

**Fig 3: Various items sold in the market**

*Source fieldwork: Matilda Musah (September, 2019, Mvog-beti)*

The figures above confirm how some goods are being placed on the ground for marketing. If these fruits are not properly washed by the consumers, it is possible that they cause infections like dysentery, diarrhea etc to their consumers. This explains why water is needed in the market area for some consumers who cannot wait to reach their houses and wash their fruits before consuming them.

### 1.3.5 Hawking

In hawking, the sellers go to prospects, indicating a system of direct contact with individuals. Rather than relying on marketing to bring in new customers, hawkers walk from one place to another, doorway to doorway in the literal sense, engaging prospects in conversation about the features and benefits of their product or service. Hawking canvassing techniques are also used to market, advertise or campaign.

In the Yaoundé VI area, this type of activity is carried out by men, women and youths who move from one place to another with their goods to meet the customers rather than them waiting for the customers to come to them. These people that go around do not usually have enough capital for their business. Some of them carry on their heads, some use trucks and others hand pulled carts as long as they can push them around. There are people that do shoe mending with their working equipment around and those that do tailoring also carry their

sewing machine all round. Most of the people who are engaged in this business carry things like articles, fruits, dresses, groundnuts, eggs and many others.

Hawking is one of economic activity that seems difficult. The people who hawk along the street lose a lot of water from theirn body through sweating. This water needs to be replaced in the body if not they can eventually fall ill. When one looks at some of these hawkers, they do not have enough capital so the little they sell becomes difficult for them to use and buy water.

### 1.3.6 Bars

A bar is a business where drinks (such as beer, wine, or liquor) are served or sold and also they serve food. Bars are also found in public, quarters, homes and nightclubs. In most countries, bars are regulated and licenced by the regional or local governments, which establish laws regarding the opening hours and serving policies. The bars also pay taxes regarding the music they play. In most bars in Yaoundé VI council area, they don’t have clean toilets and water. Some of the bars do not even toilets at all and the council is supposed to do sanitary inspection, to make sure that all those public bars have toilets. It may seem minute but it is an important factor or means through which diseases are been transmitted from one person to another because of the poor hygienic situation of those places. So bars need to have good water system to avoid diseases tramission from most of their toilet and to keep their hygienic condition safe. As a result, some bars may not have customers if they cannot provide good hygienic conditions for their costomers, thereby reducing their income activities.

### 1.3.7 Restaurants

It is a place where cooked food is sold to the public, and where people sit to eat. Some restaurants are a chain, meaning that there are restaurants which have the same name and serve the same food. These restaurants serve fast food, that is, inexpensive food, prepared and served quickly. In some, one does not have to even get out of the car to eat. You can pay and get your order from a window. There is road site food restaurants that is people who sell in an open air at times without seats, customers are bound to stand and eats. These people equally do not have restrooms where one can go whenever he or she is pressed. This has caused many people to practise open defecation everywhere.

Restaurants must also adhere to health and safety regulations. Food inspectors have to visit restaurants periodically, or in response to consumer complaints, to ensure compliance.

Safe equipment and operational standards are important to employee and customer safety. Standards for food storage and preparation, and for general cleanliness, all relate to customer health and sanitation. Restaurants owners in YaoundéVI area, especially the roadside restaurants do not have good water supply. At times, one does not know the source of water they have in their containers and it make it difficult for people to consume such and it scares some people from eating in such places because they are scared of what can happen during and after eating.

### 1.3.8 Hair dressing

Hair dressing or sometimes beauty shops, is an establishment dealing with cosmetic treatments for men and women. Other variations of this type of business include hair saloons. Hair dressing and many small businesses do offer both sets of treatments; beauty saloons provide extended services related to skin health, facial aesthetics, foot care, nail manicures, aromatherapy, even meditation, oxygen therapy, mud baths and many other services.

Pressure alleviation together with the hectic lives of everyone now operating kids, two jobs, and school and handling family responsibilities, it is necessary to relieve pressure as much as you possibly can. Whether you are having your hair styled, a manicure or pedicure, one will benefits from the massages that will release people from stress. Most of these places also serve to employ people who can do the job well and at the end of each day or month one has something to boost of. Another thing is they do not dispose off their waste properly which serves as breading sites for mosquitoes, rats and many others.

For a hair dressing saloon in Yaoundé VI area to function well, they need water, to be able to wash the hair of their customers. It becomes difficult to people to visit one saloon knowing fully well that the owner will not do his or her job well. So most people will prefer going where they can be well taken care. As a result it reduces the income of some families.

### 1.3.9 Washing points

Washing points are areas or places where cars, bikes, carpets are being taken to be washed. It is one of the most flourishing businesses in the Yaoundé VI council area. It needs no working experience but as long as you can withstand the scotching sun, and long standing hours. These people use a greater quantity of water in their business. Water seems to be the only factor that hinders their work because of shortages; most of them tend to sink wells, forage and some use solar energy to pump water from the available streams.

**Fig 4: Washing point at Yaoundé VI**

*Source fieldwork: Matilda Musah (April, 2020, Etoug-Ebe)*

The above figure shows one of the businesses in the Yaoundé VI council area which is able to employ a good number of people.

This helps in providing food and shelter to people involved especially those in Yaoundé VI area, since it is able to generate income to them by providing employment. Some of the people do not have enough space for the business so it becomes difficult for many cars to come in at the same time. On the other hand, some of the workers too do not know how to communicate with their clients there by sending most of them away.

### 1.3.10 Commercial sex

Commercial sex is the exchange of money or goods for sexual services. Sex workers are women and men who receive money or goods in exchange for sexual services, and who consciously define those activities as income generating even if they do not consider sex work as their occupation. Prostitution is not going away anytime soon because there will always be men looking for sex and women ready and waiting to rent out their bodies for the right price and it is practise in every culture and society (Charles Leblanc 2019).

Commercial sex is practice in Yaoundé VI areas like Melen, Centre, TKC and other quarters. Informants reported that sex work is an easy and good source of income compared to other jobs. They said that sex work is suitable for a low-educated person because working

in a bar does not require formal training or skills and is quickly learned. Some strategies for increasing their income to accept whatever thing their customers want. Many clients need oral sex before vaginal or anal sex or both and you can use that to ask for more pay.

For this kind of job, the women involved need to be clean at any given point intime. This is because it is difficult having sex with one man and the next without bathing. If they do so definitely most of their costumers will run away from them. For them to have costumers they need to be extremely clean to be able to generate their income and for them to adapt in cases where there is limited or scarcity of water, they need to always stored water in their houses or motel that can be use for bathing after every each round of sex.

### 1.3.11 Transport

Transportation is the movement of humans, animals and goods from one location to another. In other words, the action of transport is defined as a particular movement of an organism or thing from a point A (a place in space) to another B. Modes of transport include air, land (rail and road), water, cable, pipeline and space. Transport enables trade between people, which is essential for the development of civilisations. For example when we look at the Yaoundé VI area, since 2019, there has been a lot of work done concerning the roads in this area. Motor transport is not as reliable because during the rainy season, roads become unfit and unsafe for use in the Yaoundé VI area. There are more chances of accidents and breakdowns in case of motor transport because of the nature of the road. The rates charged for transportation are also unstable and unequal. People complain about mass transportation systems also because they can be crowded, uncomfortable, dirty, and unreliable.

It is this same transport business that the inhabitants do to be able to provide potable water for their homes like buying mineral water especially in those areas like centre where they have limited water supply. Bike and taxi drivers working in this sector should be able to carry water from far and near and store in their houses in case of shortages and scarcity

### 1.3.12 Commercial phone services

With the advanced technologies in our society, commercial phone services have been a very good business in our community. In the Yaoundé VI sub-division, there are men, women and youths who are doing this activity. They are able to sell air time, sim cards and do what is known now as money transfer. A call in a minute costs 25 FRS and this has facilitated the means of communication. On the other hand, it has caused the reduction of phone prizes, and those working in money transfer agencies now do not have enough client

and have tend to lay off some of their workers since they are unable to pay them. People now keep money in their phones instead of using the banks which is meant purposely for that.

People who are engaged only in commercial phone services do not have enough profit so they engage in selling small articles like sweets, biscuits, cigarettes, kolanuts, bubble gum and many others. The disadvantage here is that the transactions are sometimes slow because of the network to transfer air time or make a phone call. Making profit from this business definitely will help them in providing potable water in their homes.

### 1.3.13 Tourism

Tourism which is a leisure activities include, drinking, sports, visitation of touristic sites like hotles for swimming parks, gardens, snack bars for drinking and dancing. There are a lot of snack bars like Vatican bar where people visit for relaxation. We also have hotels like prestige hotel at carrefour Biyem Assi, Nikita hotel and many others that have good environment for relaxation. Mvog-Betsi zoo is a place of interest where tourists visit, typically for its inherent or an exhibited natural, historical significance, offering leisure and amusement with its natural beauty. Because of the tourist to this sites, it contributes to government revenues; direct contributions are generated by taxes on incomes from tourism employment and tourism businesses, by direct levies on tourists, such as departure taxes, provide employment, support conservation of habitats, species and historic sites, stimulate infrastructure investment and contribute to local economies of the council area.

Although jobs are created by tourists like hotel service, restaurant serving, and so forth. These low-wage, low-skill workers have little prospect for advancement or promotion. Most of the youths who are school dropped outs engage into drinking, prostitution and there is an increase in stealing and juvenile delinquency in the community. Most of these places uses as touristic sites have water supply if not people will not go there relaxation and leisure times. Money generated from this activity can be used to get potable water in most of the people working in these places.

### 1.3.14 Economic situation

The economic situation of the Yaoundé VI council area is low because of unemployment which is a term referring to individuals who are employable and seeking jobs but are unable to get one. However, it does not encompass individuals who have stopped looking for a job in the past four weeks due to various reasons such as leaving work to pursue

higher education, retirement, disability, and personal issues. Even people who are not actively seeking a job anywhere but actually want to find one are not considered unemployed.

The impact of unemployment can be felt by the workers, the national economy and individuals involved. Unemployment causes workers to suffer financial difficulties that may lead to emotional destruction. When it happens, consumer spending, which is one of an economy's key drivers of growth, goes down, leading to a recession or even a depression when left unaddressed. This has let many in to stealing, scamming and many are moving out of the country in search of greener pasture there by reducing the working population of the country and Yaoundé VI council area in particular. Water which is also one of the important factor that people need to survive, when one is unemployed, it becomes difficult for to survive. The little one has will be thinking of buying food, renting a house or going to school. To crown it all, once one do not have good sanitation, the little money we have is spent in the hospital for treatment from one disease to another.

**1.4 Belief system**

Yaoundé in general and Yaoundé VI in particular has been highly Christianised since the 1930's. In this area, the most dominated denominations are the Muslims, Catholic, Baptist, and Full Gospel and Presbyterian churches. Other believing churches who are sprawing are located in everycorner of the council area which are uncountable. There are also people who do not go to church because of their personal conviction, fetish beliefs, and many others.

A church is commonly defined as a building used for public worship of God. However, many people refer to a church as an organisation. Examples are the Catholic Church, Presbyterian Church, Baptist Church, Full gospel, amongst many others. In public buildings, there are supposed to have basic necessities like toilet and water should be available for people to use. When these things are lacking from these areas, the environment becomes so mess-up because Christians or the users will not be able to keep the environment clean and hygiene will not be practised among them. During our fieldwork, we went through some churches around the Yaoundé VI neighbourhood and found out the various water supplies that are being used by these churches and there are some of the churches that do not have water points.

The Catholic church (St Peter and Paul Parish Simbock, Elig-effa parish), are places available for Christians to serve God in their own way. These churches have all the basic

needs that people need to use while worshiping God in the environment. The church had enough space that permits children to play when they want. They have toilets for urination and defecation and lastly, water is used for drinking, washing or cleaning of the church by the Christians. There are also some Catholic churches that do not have these necessities. During our fieldwork, we meet a christain from St Peter and Paul parish, who told us the type of water they used in their church premises. This is what he said:

> *The type of water we use here is the tap water which is available all the time. But when it cuts it does not take a longer period. But during the dry season, it can cease and last for 2 to 3 days and during this period we can resort to well from neighbors to use. In our church, potable water is used for baptism, and we use it as an art of blessing the christains when ever they are inchurch.* (Christable, 18 December, 2019, Simbock).

According to informant Christable, they use tap water because that is the one that available for them. When one looks at the social status of this church, one can see that they have all it takes to have all the water system in their environment. The catholic people use potable water for baptism and blessing of their christains. Also the catholic christains, use water at the entrance of their door, somuch so that everyone entring the church should be able to use the water and do the sign of the cross before taking his/her seat in the church.

Information was also gotten from a christain who told us about their church not having all the basic necessities as it is normally supposed to be. This is what she said:

> *Our church has been going on operationally for 2years now and what we have is just the toilet which is a pit one and there is no potable water yet. Since there is no pipe borne water system this area, what we will do in the long run is to construct a well so that it will be cheap since it is manually done. We have some of our Christians who can do that because we will not have the funds to dig a well. But as time goes one never knows God can still make a way for his children as he says in His words. I'm saying so because; it is difficult to have untrained people to dig up a well. So as time goes on, we can decide to pay up trained people to dig up a good well for the Christians. When we want to clean the church, we go to the neighbors and ask for water to use* (Elvis, 16 December, 2020, "Centre").

According to Elvis, it is really hard to know that water is life but they have infrastructure that does not have it. Imagine in a church service that has to last for a whole day or night, people will be thirsty but no water to drink what more of the kids who will always disturb to drink to water. This will cause the christian to always come along with water bottles to avoid cases where they to run into the neighbor house begging for water.

For baptist churches, we have the Etoug-Ebe Baptist church, Berean Baptist church at Ako-Ndoe, Maranathan at Mendong, Rhema at Ako-Ndoe II just to name a few. When we went round these churches, we found out the following information from the informant we met on the field. This is what he said:

> *Here in our premises, we use tap water and well (drilled well). We had to construct the drilled well because we usually have issues with water and given the fact that human system needs water we had to do that to avoid cases of where we have to run to neighbour's house begging for water to be used for cleaning and drinking. We consider the water potable that is why we are using it. We use water for baptism and our baptism is always done by emersion so using potable water is very necessary to use potable* (Ernest, February 2020, Etoug-Ebe).

To Ernest, they saw the need of drilling the well because of the potable water shortage to avoid certain circumstances that can lead to quarrels or what so ever. Potable water is aslo use for baptism because they believe as the sign that, your sins has been completely washed away by the potable water. So if the water is contaminated, it cannot be used by the christains. So the church have decided to construct drilled well in the church premises to enable them have potable water that is used for such activites.

This is what another informant gave us concerning water in the church area:

> *In Maranathan Baptist church, we use well water. We use well water here because there is no pipe borne water in our area to us we think is potable enough to be use by the christains. This has also saved us from going into people houses begging for water, also trekking to stream to carry water is a problem. I remember when this area was under construction we had to spend much just to have water for construction all because water availability is scarce in this area. So now that there is well it helps us carry out basic activities freely without disturbing anybody* (Manuel, January 24 2020).

To Manuel, well water has really helped them in doing their basic works around the church environment and it has prevented the long distance trekking just to get water. To him, going to people's houses to beg for water was very inconvenient given the fact that not everyone will welcome or give you water as you needed it.

We also got some of the Baptist churches like the Berean, Rhema amongst many others who do not have water in their vicinity. Most of the complaints were that the area itself does not have pipe born water. Again some cannot afford to construct a good well for their Christians, some due to the topography of the area that makes it difficult for them to have access to pipe born water.

Some Presbyterian churches that we came across were Presbyterian Church Etoug-Ebe, Presbyterian Church Mendong, Presbyterian Church Simbock, and Presbyterian Church Ako-Ndoe II. In most of these churches, that of Ako-Ndoe was the only that did not have water neither the well or tap water. We meet a prebyterian christain in Ako-ndoe and this is what he said concerning water:

> *Our place is newly constructed so we are still trying to see how water can be gotten into this area. But for now there is a spring water around even though it takes some 10-15minutes to get there, but that is where we get our potable drinking water and sometimes we use for cleaning. But when you look at the church it is still under construction so we don't use water that much. At times we ask help from the neighbouring houses around especially those who fellowship with us. Potable water is use for baptism in our church and we believe that it takes away your sins making you righteous or clean before God* (Leonard, January 18 2020, Ako-ndoe).

From Leonard's words, one will tell that the area is still under construction. But yet they have the spring soures which is consider potable for them to use and that is why they use it for baptism and other purpose. So for now they do not use much quantity of water since their floor can easily be swept without being mopped. The Presbyterian Church Etoug-Ebe is using tap water in their premises and they know that is potable for enough for them to use..

Another informant gave us information concerning water in their church premises. This is what she said:

During the fieldwork, we also meet an informant who gave us information concerning water used at the Superette Mosque. This was what he said:

> *The mosque has been existing for a long time. We constructed it after which did not took us time to get potable water connected. During the construction, we were using the stream behind for construction after which the pipe borne water was connected after the construction* (Jibril, June 12, 2020 Superiette).

From Jibril's words, they had a source of water that they were using at first which was the stream. As Muslims one will conclude that they cannot do without water because they need it for ablutions before they do their prayer. So one can imagine that using the stream behind the mosque, is not safe given the fact that it is not clean. So tap water is always good for that process since they have to brush or wash their mouths as well.

From the analysis above from the different belief system in the Yaoundé VI council area, its ties to what Geertz in 1973 is talking about cultural interpretations. The church is a group of believers, and they have their own culture as a group. So using potable water for

different purposes and different ways gives us the different cultural interpretations of water in church cultures.

From the pie chart above, the highest percentage of water that is used in various churches. The blue quarter represent well water with 60% percentage, green quarter represent tap water with 25% and lastly the red quarter with 15% represent stream water.

In this chapter, we have talked about the geographical location, of Yaoundé in general and Yaoundé VI council in particular, the settlement pattern and the history of the Yaoundé people. Still in this chapter we looked at the socio political and religious organisation of the people. We also made mention of their infrastructure which permits them to carry out their daily activities. The next chapter concerns the literature review, theoretical framework and definition of key concepts.

# CHAPTER II
# LITERATURE REVIEW, THEORITICAL FRAMEWORK AND DEFINITION OF CONCEPTS

This chapter reveals the works of preceding authors to see what they have written in relation to the concerns of this study. In this chapter, we will not be looking at water from the technical point of view but from the utilitarian (usefulness to the environment), its economic dimension and cultural attachment (beliefs, norms and values). Attention will be paid on water in general, distribution of water on earth, water sources, importance of the water sources, causes of water pollution and water scarcity. We will also looked into the effects of water pollution, scarcity and coping strategies, water and gender equality. Equally chapter looks at some key terms by defining them and also brings out the theoretical framework used in this study.

## 2. Literature Review

Water literally surrounds us on earth, in the air as we breathe, as an invisible vapour and in tiny liquid droplets. Water as a liquid fills streams, bayous, rivers, wetlands, groundwater aquifers and vast oceans. It is stored in the soil beneath our feet (Pennington and Cech, 2010). Water is an essential part of the ecosystem, a natural resource, a social and economic good, whose quantity and quality determine the nature of its utilisation. In Southern Africa, it is a limiting resource for development and a change in water supply can have major implications in most sectors of the economy, especially in the agricultural sector. Factors that contribute to vulnerability in water systems in Southern Africa include seasonal and inter-annual variations in rainfall, which are amplified by high run-off production and evaporation rates (Schulze and Perks, 2000).

From the beginning of human settlement on earth, water has been used for drinking, sanitation and irrigation purposes. In pre-historic times, humans usually settled in areas of reliable water supply. During times of drought, clans of humans were often forced to relocate to survive. Prior to human intervention, the world's water supply remained in a natural state (Sipes, 2010). Floods and droughts were common in many regions of the pre-historic world. Natural global warming and cooling varied the earth's climate, causing life in the various ecosystems to evolve, adapt, or disappear. As human population increased, the need for food supplies steadily grew (Pennington, 2010). Between 1940 and 2000,

withdrawal of fresh water has increased more than four fold, despite improvement in water efficiency. Yet in developing countries, the provision of water services still lags far behind water needs. Even though many people in the world still lack basic water services, water scarcity has increased in many parts of the world.

With the supply of fresh water limited by the dynamics of hydrological cycles, water availability declines as population grows. Increased contamination by population has further reduced supply of fresh water and increased the cost of treatment of available supplies (Lange and Hassan, 2006). Human use of water is believed to have remained relatively unchanged for millions of years. However, in the past 100 years, global water use has increased at a rate more than twice the earth's population growth, and has caused chronic water supply problems. By 2025, it is estimated that 800 million people will live in regions of severe water scarcity. Today, most countries in the Near East and North Africa, as well as Mexico, Pakistan, South Africa, and many parts of China and India are suffering from serious water shortages (Sipes, 2010).

Humans can survive eight to ten days without food, but only two days without water. Water must be safe to drink since poor-quality drinking water can lead to infectious diseases. Unsafe drinking water is a daily problem faced by nearly two billion people around the world. Water is a basic natural resource, indispensable for life. Although not priced, the value of rain is undisputed. Income and food for millions of people are directly dependent on the availability of fresh water (WHO 2019).

## 2.1 Distribution of water on Earth

Water is found everywhere on earth, and is the only substance that can naturally occur as a liquid, solid or gas. The earth contains approximately 1.39 billion cubic kilometers (331 million cubic miles) of water, with 961.5% stored in the oceans. Approximately 1.7% is stored in glaciers, permanent snow, seas, ice and polar ice caps, while 1.7% 12 exists as ground water, and in rivers, lakes wetlands, and the soil. The remaining 0.1% is contained in the earth's atmosphere (Cech, 2010).

### 2.1.1 Oceans

Salt water covers over 70% of the earth's surface, but is unequally distributed (Sipes, 2010). The oceans are saline, and are composed of about 3.5% dissolved salts by weight. Human tolerance for salt is less than 2%, which makes seawater undrinkable. Most agricultural crops are not salt tolerant and most industrial processes cannot use salt

water. This has important implications for humans and ecosystems since nearly 97% of earth's water is salty, difficult, expensive or impossible to utilise for drinking water, agriculture and industrial uses (Pennington and Cech, 2010).

### 2.1.2 Fresh water

Fresh water is naturally rare, which may, at first glance, seem surprising. Fresh water comprises some 3% of the total, and a large proportion of this is unavailable for use because, it is frozen in ice caps and glaciers or locked away as soil moisture. Approximately 0.36% is in underground aquifers, and about the same amount makes up lakes and rivers (Feldman, 2012). Globally, fresh water is not evenly distributed across the continents, and varies from season to season and year to year. Approximately two-thirds of the population, around four billion people, live in locations that receive only one-fourth of the world's annual precipitation. In addition, much of this precipitation is seasonal, for example, mountain snow or monsoon rains (Sipes, 2010). Therefore, water scarcity has developed as one of the most critical global risks.

### 2.1.3 Groundwater

Groundwater is water stored under the earth's surface. Groundwater represents about 30% of the total fresh water supply, with the remaining 70% in polar ice caps, sea ice, permanent snow, glaciers, lakes, rivers, wetlands and in the atmosphere. The total volume of groundwater on earth is small, but is 35 times greater that the volume of water in all the fresh water lakes and flowing rivers of the world. The quality of world's groundwater ranges from extremely salty particularly in some coastal areas, to relatively mineral-free groundwater in Iceland.This makes groundwater unsuitable for some uses, especially drinking water About 33% of the earth's groundwater is found in the Asian continents, 23% in Africa, 18% in North America, 13 per cent in North America, 6% in Europe, 5% in Australia and the remaining 2% in other locations of the world (Pennington and Cech, 2010).

Groundwater is typically a poorly-understood source of water as compared to easily seen lakes and rivers. Groundwater can be collected or concentrated in a variety of ways. Water beneath the surface is called an aquifer and it is often known of as a distinct pool of water. An aquifer is simply water found in soil, porous rock, or sand. It can be found in very small spaces and the properties of the soil or rocks that characterise the aquifer determine a great deal about the extraction possibilities (Shaw, 2005). Groundwater depletion is increasing on all continents and many countries rely increasingly on

international water sources, creating a potential for conflict over water in the future. In addition, the scientific community expects climate change to have a major impact on the hydrological cycle, in ways that cannot be predicted at this time (Lange and Hassan, 2006).

Economically, groundwater is much cheaper than surface water, as it is available at the point of demand at relatively little cost and it does not require the construction of reservoirs or long pipelines. It is usually of good quality, usually free from suspended solids and, except in limited areas where it has been affected by population, free from bacteria and other pathogens. Therefore, it does not require extensive treatment before use. Groundwater contributes substantially to the base flow of many lowland rivers, so any steps taken to protect the quality of groundwater will also indirectly protect surface water (Gray, 2008). Over the years, it has been discovered that groundwater and surface water are fundamentally interconnected and are integral components of the hydrological cycle and they have to be thought of as one cohesive system.

In Yaoundé, particularly in the Yaoundé VI council area, there is underground water in quarters like Melen, Mvog-beti, “Centre” and Mendong. It is also found in Yaoundé III council area like Damas where people use it for domestic purposes.

Water quality criteria of various groundwaters have been studied from different sources. Examples are Tube well, dug well and Bore well etc. A few of them have been listed. It has been reported by oral ssources from informant and news that well water in the study area Yaoundé VI was not suitable for drinking due to high contamination of total and fecal coliforms and moderate contamination by nitrate and manganese from fertilisers. It has been reported that the level of electrical conductivity, total solids, color, chloride, chemical oxygen demand, sodium, copper and lead in the groundwater of wells located adjacent to the disposal site were higher than the other areas. Nitrate pollution of groundwater in other quarters of Yaoundé VI area (Beryl 2020).

### 2.1.4 Rivers, streams, lakes and wetlands

Surface water is a general term describing any water body that is found flowing or standing on the surface, such as streams, rivers, ponds, lakes and reservoirs. Surface water originates from a combination of sources like surface runoffs: rainfall that has fallen onto the surrounding land and that flows directly over the surface into the water body. There is direct precipitation: rainfall that falls directly into the water body. Interflow, excess

soil moisture that is constantly draining into the water body. Furthermore, water table discharge, where there is an aquifer below the water body and the water table is high enough, the water will discharge directly from the aquifer into the water body (Gray, 2008).

According to Sipes (2010), water resources involve surface water, water below ground, and water that falls from the sky. Most cities meet their needs for water by withdrawing it from the nearest river, lake, reservoir, or aquifer. The quality and quantity of surface water depends on a combination of climatic and geological factors. The recent pattern of rainfall, for example, is less important in enclosed water bodies such as lakes and reservoirs where water is collected over a long period and stored, whereas in rivers and streams where the water is in dynamic state of constant movement, the volume of water is dependent on the preceding weather conditions.

In rivers the discharge rate is generally greater in winter than in summer due to a greater amount and long duration of rainfall. Short fluctuations in discharge rate, however, are more dependent on the geology of the catchment. Some catchments yield much higher percentages of the rainfall as streams flow than others. Even a small reduction in the average rainfall in a catchment area for example, 20%, have the annual discharge from a river. This is why when conditions are only marginally drier than normal a drought situation can readily develop (Gray, 2008). In addition to their hydrological functions of moving and storing water, they perform many functions from wildlife habitat, flood water attenuation (holding flood water), drinking water resources, to recreation (Pennington and Cech, 2010). Water resources can also become scarce or reduced due to a lack of precipitation and soil moisture, which will lead to the term called “drought” and its management.

According to Nforngwa (2014), Cameroon is crisscrossed by many rivers that run from the country mountainous north to the south. It is believed to have one of the world’s largest reserves of fresh water. Howver, millions in the Cameroon capital can go without potable water for more than three months. In spite of Cameroon’s abundant fresh-water resources, water scarcity is a major problem not only in Yaoundé but across the country. According to estimates by the government and international organisations like the World Bank, only about 30 to 40% of the population has access to potable water.

As the days go by, hundreds of people from across the city come with their buckets and jerry cans as the line stretch into the distance until long after dark, even into midnight and that has been the daily routine for some time. “Carrefour du Palais”, the main junctions

outside the presidency, has often become the unintended face of a severe water scarcity that has been affecting the Cameroon capital. There are few places in Yaoundé such as Yaoundé III, Yaoundé II where water still runs with little uninterrupted.

**2.2 Ground water quality**

Water quality expresses the suitability of water for various uses and processes and it comprises the physical, chemical and biological qualities. This quality can be described in terms of concentration and state of some or all of the organic and inorganic materials present in water, together with certain physical characteristics of the water. Groundwater in its natural state is generally of good quality because rocks and their derivatives such as soils act as filters. However, the natural waters are not pure and contain some amounts of dissolved gases, solids, and suspended materials (Fetter, 1994).The quality of groundwater depends on the composition of the recharged water, the interactions between the water and the soil, dissolved gases, geological conditions, the and reactions that take place within the aquifer.

Therefore, considerable variations may be found. Hence, it is necessary to monitor all aspects related to the provision quality water. For some various purposes and a special attention needs to be made on physical,chemical, bacteriological and radiological parameters influencing water quality and for proper monitoring of parameters. It is needed to set up appropriate mechanisms from top to bottom level in country.

The characteristics of ground water, including temperarure, colour, odour, taste and electrical conductance, determine the physical quality. Most of the ground waters are colourless, odourless and without specific taste. The chemical composition is derived mainly from the dissolution of minerals in the soil and rocks with which it is or has been in contact. The chemical characteristic depends on interaction with solid phases, residence time of groundwater, seepage of polluted runoff water, mixing of groundwater with pockets of saline water and anthropogenic impacts (Umar *et al*, 2006). The type and extent of chemical contamination of the groundwater is largely dependent on the geochemistry of the soil through which the water flows prior to reaching the aquifers (Zuane, 1990). As water flows through the ground the dissolution of minerals continues and the concentration of dissolved constituents tends to increase with the length of the flow path. At great depths, where the rate of flow is extremely slow, groundwater is saline, with concentrations ranging up to ten times the salinity of the sea.

Groundwater can become unpotable if it becomes polluted and is no longer safe to drink. In areas where the material above the aquifer is permeable, pollutants can seep into groundwater. Groundwater is more mineralised in alluvial aquifers than in the weathered basement aquifers (Kundell, 2008). The importance of drinking water quality has been enhanced in the last few years by the increased awareness and attendant publicity afforded to the pollution of water courses.

Globally, the UN declared an International drinking water supply and sanitation decade between 1981 and 1991. The physical and chemical quality of water is important as the potability of the water and its fitness for domestic purposes largely depend on its chemical quality (Tiwari and Ali, 1988). In view of the wide variations in the chemical quality of water available in different parts of the world or country, rigid limits cannot be laid down with regard to chemical constituents. Certain chemical substances, which may be present in natural waters, are toxic to human beings.

It is expected that a great majority of water quality problems are related to bacteriological contamination. A significant number of very serious problems may occur as a result of chemical contamination of water sources from agricultural practices and malpractices (Mawulikwame, 2011). Chemical and physical constituents should not be permitted in drinking water in excess of the permissible concentration. Some other parameters that render the water unpalatable and unfit for domestic use should have limits such as a maximum permissible limit. The suitability of water for drinking purposes with regard to its chemical and physical quality therefore has to be determined on the basis of general characteristics of the water available in the locality, and its freedom from toxic substances.

**2.3 Importance of water**

Lamikanra (1999) says water is the symbol of life, an essential unique universal solvent needed by living organisms. Without water, life is not possible on this planet. Water acts as a media for chemical and biological metabolic reactions, internal and external medium for several organisms. It is the most common, vital and the most precious resource on earth that provides basic needs of human being without water, development is not possible. Good drinking quality water is of basic importance to human physiology and existence of life depends much on its availability (FAO, 1997 19-20).

Water as a source of life for human, plants and other forms of life. It can not be replaced by any other solvent. The search of life begins with the search of water. Drinking water is not a single compound but it is a very dilute solution in which numbers of chemicals are dissolved and essential for maintaining equilibrium in biochemical reactions taking place in all living organisms in order to maintain the physiology. It constitutes two-third of the human body weight and it is the integrated system of biological metabolic reactions in an aqueous solution that is essential for the maintenance of life and cells of organism functions.

### 2.4 Causes of polluted water and water shortages

Some of the major factors which are responsible for causing water pollution or degradation can be enumerated as growing population, rapid industrialisation, and urbanisation, use of science and technology and modern agricultural practices.

#### 2.4.1 Urbanisation

Urbanisation is a change of land use, construction and change in the improvement of infrastructure in rural and urban areas. Ultimately, it leads to horizontal or vertical growth of urban areas. A country is considered to be urbanised when over 50% of its populations live in the urban areas. The criteria used include population size, space, density and economic organisation. Urbanisation is not a new phenomenon. However, since the process of urbanisation is ongoing, it is dynamic and has affected land use, change and water quality. Rapid urbanisation, industrialisation and rural land conversion are factors that easily affect water quality. Contamination of water by urban centres mainly occurs via outflow of domestic sewage systems, which is not only constant and highly polluting, but is also related to the spread of human water-borne diseases. At this point, the investigation of the river and stream water quality is very important for public health policies.

The hardship of rural life is encouraging migration to towns and cities, with the result that approximately half the world’s population is now living in urban areas. This has, however, not necessarily resulted in either an escape from poverty or better progress towards the SDGs. In 2005, for example, slightly more than one third of the urban population in developing regions lived in slum conditions, with the associated problems of inadequate water and sanitation facilities, and lack of social infrastructure, including for health and education (UN 2008). A person living in an urban area of the developing world like Cameroon is more than twice as likely to have a piped drinking water supply on premises as a

person living in a rural area. Disparities are evident in other Regions like Bamenda, Baffoussam, with the second lowest coverage of improved drinking water in urban areas. Only 73% of rural populations in the regions mentioned above use an improved water source, compared to 27% of urban dwellers.

Pandey (2009), Urbanisation is also another major factor which contributes significantly towards environmental pollution. Subsequently big cities also developed just near the water courses particularly besides the big rivers. Water is considered as life and we owe a great deal to water for the sustenance of our lives. Thus with the development of the big cities all other forms essentials that makes living comfortable also developed. These, developments in the field of communication and transportation are worthy which can subsequently attracted the establishment of industrial and commercial basis in and around the cities. As these sectors heavily depend on water and all advanced system, it is natural that the population or individuals involve should know their first choice of area for settlement. Since many towns and cities lack a proper sewerage system, the condition worsened further adding to the misery of the people.

### 2.4.2 Demographic Exploitation

The demographic growth of Cameroon was very slow until 1960, when it abruptly accelerated (Kuete *et al* 1991). The population, estimated at 4.8 million in 1958, was evaluated in 1991 to be 12,239,000 inhabitants (given an increase of 155%). The cities of Douala, Yaoundé and other towns like Bafoussam in the West Region have all witnessed astronomical increases in population in recent years. With this increase in population, the impact on the natural environment, coming mainly from its misuse and depletion in a bid to sustain a modern economy and lifestyle, is apparent. Starting in the early 1990's, Yaoundé, the political and administrative capital of Cameroon, has experienced a growing influx of rural migrants. Today, the city 4.8 million population growth rate is 6% (Kuete *et al* 1991), and with its population standing at 4 million inhabitants. Housing and infrastructure construction programmes are unable to keep pace with the growing demand of its residents. Consequently, the poor state of water and sanitation provision in the city has become alarming.

Evacuation of waste water is absent in most national development plans. Cameroonian towns and cities do not have waste water treatment plants or where they exist, they have broken down, for example in Yaoundé (Mpakam *et al* 2006). Most risky areas (hill

slopes and swamps) unfit for human habitation in the cities of Yaoundé and Douala are occupied by the poor. More than 60% of such urbanised areas are vulnerable to flooding. Thus, it is the poor in urban and rural areas who bear the brunt of lack of access to safe drinking water. This disparity in urban and rural poverty goes to explain partially the disparity in access to safe drinking water between rural and urban areas. It is not surprising then that the Far North region which according to fouth Cameroon household survey (ECAM4 2015) survey results was the poorest in the country is one of the least covered with access to water supply and sanitation infrastructure.

According to Misachi (2018), seven billion people on the planet earth, their consumption of water, meat and vegetables is rising, and increasing competition for water from industries and urbanisation and, of course, more water will be needed in the future for food production because of the increase in population. It was found out that more than 1.2 million, live in areas of physical water scarcity where there is insufficient water to meet all demands. 1.6 billion Live in areas experiencing water scarcity where limited investment in water or insufficient human capacity makes it impossible for authorities to satisfy the demand for water. One third of the world's population does not have access to clean drinking water. The report found out that it will be possible to produced food in future, but that continuation of today's food production and environmental trends would lead to crisis in many parts of the world.

According to the World Health Organisation (WHO, 2006), over 600 million urbanites live in low quality shelters or other areas plagued by overcrowding and inadequate provision of sanitation services, including potable water and safe waste disposal. The number of people without access to these services is still increasing, despite general improvements in urban sanitation programs. In the last twenty years, sanitation coverage has made great strides, but it continues to be less accessible to the urban poor. According to United Nations Development Programme (UNDP) and World Bank, Water and Sanitation Program, in 1990, 453 million urbanites "had no sanitation services," and despite efforts to ameliorate this crisis, in 1994, this number had increased to 589 million people. The challenge of sanitation intervention is to keep up with the growing population. Currently, the rate at which sanitation programs are being introduced to communities is far lower than the rate of overall population growth, resulting in more underserved people despite these attempts to increase coverage.

Furthermore, population growth results in overcrowding, exacerbating sanitation issues and in many instances, the urban poor live illegally in areas “deemed unfit for habitation,” making the residents “officially invisible”. Without permission to live on banned areas, they have no access to government support for sanitation or health care programs. These conditions do not only affect the people who live in them, but also influence the rest of the city as well. Public health officials regard slums and encampments as threats to the health and safety of people who live or work nearby. In this way, the plight of the “invisible” spills into the visible sector, producing recognised health outcome human beings need only about 5 litres of water each day for cooking and drinking (WHO and UNICEF, 2005).

However, good health and cleanliness require a total daily supply of about 30 litres per person (11 cubic meters per year). At the household level, demand for water is determined by demographic factors such as household population, occupation and age structure. Population growth leads directly to increase in overall water demands.

According to estimates released by UN Habitat (2003), more than one-third of the developing world’s urban population of over 863 million people live in slums. As city infrastructure starts to crumble under pressure, availability of adequate sanitation facilities becomes the first problem faced by the people. Due to an acute shortage of adequate toilets, nearly 100 million people globally are being left with no other option but to practice open defecation. The remaining 600 million people rely on toilets that do not fulfil minimum requirements of hygiene, safety or privacy including dirty and crowded communal toilets. In fact, it is estimated that almost one-fifth of all urbanites that is nearly 700 million people live without a decent toilet.

To put that into perspective, the queue of people waiting for toilets globally would stretch around the world 29 times. These severely compromised sanitary conditions are not only damaging the environment but also posing a real-time health risk to the people in the form of communicable diseases, such as cholera and more. A recent report by Water Aid the state of world’s toilets 2016 put India at the number one position for having the largest number of urbanites living without sanitation. Close on the heels of India is China. The instance of huge populations migrating constantly to urban areas that are most ill equipped to handle the rush is exceedingly resulting in an ever-increasing gap between economic development and urban planning for both countries.

In UNICEF's 2008 report, only 31% of the population had access and used improved sanitation facilities. A little more than half of the 16 million residents of New Delhi, the capital city of India, have access to this service. Every day, 950 million gallons of sewage flows from New Delhi into the Yamuna River without any significant forms of treatment. This river bubbles with methane and was found to have a fecal coliform count 10,000 times the safe limit for bathing. Surface water contamination, due to lack of sewage treatment and industrial discharge, makes groundwater increasingly exploited in many regions of India. This is aggravated by heavily subsidized energy costs for agricultured practices that make up roughly 80% of India's water resource demand.

To illustrate the sheer challenge of improving water quality in India, 80% of the health issues come from water-bornediseases (UNICEF 2008). Part of this challenge includes addressing the pollution of the Ganges (Ganga) river, with 400 million populations. The river receives about over 1.3 billion litres of domestic waste, along with 260 million litres of industrial waste, run off from six million tons of fertilizers and 9,000 tons of pesticides used in agriculture, thousands of animal cases and several hundred human corpses released into the river every day for spiritual rebirth (UNICEF 2008). Two-thirds of this waste is released into the river untreated. India's growing population is putting a strain on the country's water resources. The country is classified as water stressed with a water availability of 1,000-1,700 $m^3$/person/year. This is in part due to large inefficiencies in the water infrastructure in which up to 40% of water leaks out.

UNICEF (2008) report, Kenya, a country of 36.6 million, struggles with a staggering population growth rate of 2.6% per year. This high population growth rate pushes Kenya's natural resources to the brink of total depletion. Much of the country suffers from a severely arid climate, with a few areas enjoying rain and access to water resources. Deforestation and soil degradation have polluted surface water, and the government does not have the capacity to develop water treatment or distribution systems, leaving the vast majority of the country without access to water. This has exacerbated gender politics, as 74% of women must spend an average of 8 hours per day securing water for their families.

The growing population and stagnant economy have exacerbated urban, suburban, and rural poverty. It also has aggravated the country's lack of access to clean drinking water which leaves most of the non-elite population suffering from disease. This leads to the crippling of Kenya's human capital (UNICEF 2008).

Mesfin (2016) affirms that fresh water scarcity is increasingly perceived as a global systemic risk. Previous global water scarcity assessments, measuring water scarcity annually, have underestimated water scarcity by failing to capture the seasonal fluctuations in water consumption and availability. We assess blue water scarcity globally at a high spatial resolution on a monthly basis. We find that two-thirds of the global population (4.0 billion people) lives under conditions of severe water scarcity at least 1 month of the year. Nearly half of those people live in India and China. Half a billion people in the world face severe water scarcity all year round. Putting caps to water consumption by river basin, increasing water-use efficiencies, and better sharing of the limited freshwater resources will be the key in reducing the threat posed by water scarcity on biodiversity and human welfare. Other countries in which a very large fraction of the population experiences severe water scarcity year-round are Libya and Somalia (80 to 90% of the population) and Pakistan, Morocco, Niger, and Jordan (50 to 55% of the population) (Mesfin 2016) .

James (2006) is of the view that runoff water from intense rains is much greater from the impervious surfaces of urban areas compared with turfgrass lawns. This runoff carries organic pollutants such as oils, greases, fuels, paint thinners, organic preservatives, and solvents. Turfgrasses are effective in decreasing runoff water and thereby can trap or filter out significant quantities of associated organic pollutants. Runoff waters also can contain potentially toxic metals such as lead, cadmium, copper, and zinc and these metals can be trapped in the turfgrass. The large, diverse microbial population in the turfgrass/soil ecosystem is one of the most active biological systems for the decomposition of organic pollutants washed from hard-surface areas. This turfgrass ecosystem microbial activity serves a valuable function in the decomposition of trapped organic pollutants from urban areas.

According to Msangi (2008), challenges arise from a variety of facts including the fact that rainfall in the Southern Africa Development Community (SADC) is highly variable, with the resulting impact on reliability and disaster associated with droughts. The available water resources are unevenly distributed across the region and water availability and demand are not matched. Yet another challenge emanates from the fact that there is widespread poverty in the region, with many people not having access to adequate water for basic human need especially domestic and household purposes as well as water for productive use. The low level of access to safe drinking water and adequate sanitation adversely impacts the livelihoods, health and productivity of the poorest and most vulnerable members of society.

Amongst the key problems that make it difficult to provide people with water in the region is the uncoordinated planning of human settlements. A substantial number of the inhabitants live in the rural areas in the semi-arid south and southwest of the region, dominated by ephemeral rivers, which rely on groundwater. Relocating the people is often met with resistance and stigma. There is also a general attachment to ancestral land as well as unwillingness to abandon places with graves and significant cultural sites amongst SADC communities. A good case in point involves the Topnaar community perched along the Kuiseb River in the middle of the Namib Desert who faced acute water scarcity, yet they resist relocation (Msangi 2008). Inequality is also found within certain sectors such as urban areas where upmarket areas are better catered for than informal settlements.

The global scenario is that the water infrastructure is generally inadequate and often not effectively operated and maintained. So it is unable to meet the growing demands for development and services. More challenges arise from inadequate and inconsistent water resources information management among the individual states so that there are associated problems for cooperation and planning in shared water courses. Similarly, there is wide range of legal, policy and regulatory frameworks within the member states making it difficult to establish linkages during enforcement at both national and regional levels, posing challenges for consistent implementation of regional initiatives.

Weak linkages between different sectors, weak information flow and inadequate institutional capacity arising from low levels of awareness, education and training hamper comprehensive and integrated development. Limited or lack of appreciation of the finite nature, economic value of water by some sections of the population is a problem to solving water crisis. Furthermore, limited awareness and/or lack of effective stakeholder participation are other factors that affect water scarcity. Involvement particularly women, the youth, the disabled and the poor in decision making at a local, national and regionallevels remain a great challenge to addressing water scarcity issues in the region.

### 2.4.2 Industrialisation

In words of Tripathi (2009), rapid industrialisation is another cause of worry as far as water pollution is concerned. Immediately after the independence of India, major steps were taken in the country in its stride for development in order to give its economy a big push. Industrialisation was then considered the most important factor that could put the country on

the path of progress. But to our utter surprise, industrialisation along with development brought with it a danger to the human civilization- the problem of environmental pollution.

Modern agricultural practices and application of new technological processes in the field of agriculture severely affect the environment. Inorganic fertilizers are being widely used now-a-days. Fertilisers like phosphates and nitrates cause wide spread damage when applied carelessly to crops. The fertilisers can be transmitted to ground water by leaching and to surface waters by natural drainage and storm run-off. In addition to fertilisers, various kinds of pesticides and insecticide are also applied. Almost, all the pesticides used are toxic to humans and animals. In Yaoundé VI which is an urban area, most of the farmers used fertilisers on their crop which is a source of water pollution in the area.

### 2.4.3 Poverty

Ako *et al* (2010) portray poverty as another major issue in Cameroon. Although the poorest areas are in the Far north, all regions suffer in varying degrees. The first national household survey in 1996 estimated that 51% of the population was living in poverty. The figure had fallen to 40% by the time the second survey was conducted in 2001. However, the declined mainly benefited urban dwellers. Just over 22% of people in urban areas are poor, compared with nearly 50% in rural areas (IFAD 2008). Preliminary results of the third national household survey (ECAM III) of 2007 show that poverty rate in Cameroon is 39.9% with 7.1 million people living below the poverty line of 738FCFA (ECAM 2007). The analysis also highlights the importance of education and infrastructure services in explaining poverty.

It shows that one out of two poor persons lives in a household where the main income provider does not have a primary education, and that access to basic social services (education, health, water, road) is more difficult for the poor than for the non-poor. Urban economic poverty affects 22 % of the population, a substantial increase from just over 10 % in 1983. This poverty line is based on a minimum nutritional standard of 2,400 calories per day provided by maize, groundnuts and fish as reference goods (Amin and Jean-Luc 1999). A 1995 World Bank study showed a marked increase in the incidence of poverty in Yaoundé and Douala, the two largest cities, from 1 per cent of households in 1983 to 20 and 30 %, respectively, in 1993. A closer examination of the case for Yaoundé indicated that the consumption in 1993 was 10 % lower than in 1964 (1983 prices). On the whole, urban

poverty affects close to 2 million people, concentrated mostly in the cities of Yaoundé and Douala.

Income poverty is reported to be even more severe in these areas, taking into account the other dimensions of the living environment of the population in correlation with income levels. In fact, close to half of the households in Yaoundé and Douala are not directly connected to electricity and three quarters do not have individual access to safe water. The high population density of precarious neighborhoods and smallness of dwellings have many effects on the level of basic infrastructure affecting the health of the population. The lack of a collective water and sewage treatment system in these neighborhoods has led to the spread of many diseases such as malaria, intestinal diseases and more recently the appearance of a few cases of cholera.

Generally, there has been a 13% drop in poverty according to the two household surveys conducted in 1996 and 2001 (Dah 2008). A diagnostic report on 23 towns suggests that poverty can be seen mainly in the following: poor mastery by council authorities of the urban development fabric, the lack of urbanisation master plans in most towns has engendered the disorderly settlement of the population including hill slopes and/or swampy areas. More than 80% of urban lands are neither registered nor occupied in an orderly manner. Very poor access to basic urban services: less than 40% of households are connected to a safe water supply system, and more than 85% of the urban population use individual water treatment methods with all the pollution risks involved.

According to Misachi (2018), the most affected are people of the developing countries living in extreme conditions of poverty, normally peripheral- urban dwellers or rural in habitants. Poor hygiene behaviours and inadequate sanitation in public places, including hospitals, health centres and schools, do not have good access to sufficient quantities of safe water because of lack of priority given to the sector of water supply and sanitation services. Every year, more than 3.4 million people die as a result of water-related diseases, making it the leading cause of morbidity and mortality around the world.

Most of the victims are children, the vast majority of whom die of illnesses caused by organisms that thrive in water sources contaminated by raw sewage. A report published recently in the medical journal, the Lancet, (2005) concluded that poor water sanitation and lack of safe drinking water take a greater human toll than war, terrorism and weapons of mass destruction combined. According to an assessment commissioned by the United Nations,

4,000 children die each day as a result of diseases caused by ingestion of filthy water. The report says four out of every 10 people in the world, particularly those in Africa and Asia, do not have clean water to drink.

**2.5 Water pollution**

River water pollution is broadly categorized into two sources that is point and non-point sources (Chapman, 1996; Hammer and MacKichan, 1981; Pierce *et al*., 1998). Point sources discharge pollution from specific sources such as drain pipes, ditches, or sewer outfalls. Examples of point sources are factories, power plants, sewage treatment plants, underground coal mines and oil wells. Non-point sources or diffuse sources on the other hand have no specific location where they discharge into a principal body of water. Examples of non-point sources of pollution include run off from farm fields and feed lots, golf courses, lawns and gardens, construction sites, logging areas, roads, streets and parking lots (Hammer and MacKichan, 1981). Chapman (1996) asserts that an important difference between a point source and a diffuse source is that a point source may be collected, treated or controlled. Non-point sources of pollution pose a major challenge to environmental management due to the diverse sources of pollution and multiple and often complicated pathways of pollutant transport.

According to Pereria (2009), aridity is a natural permanent imbalance in the water availability consisting in low average annual precipitation, with high spatial and temporal variability, resulting in overall low moisture and low carrying capacity of the ecosystems. Drought is a natural but temporary imbalance of water availability, consisting of a persistent lower-than-average precipitation, of uncertain frequency, duration and severity, of unpredictable or difficult to predict occurrence, resulting in diminished water resources availability, and reduced carrying capacity of the ecosystems.

Desertification is a man-induced permanent imbalance in the availability of water, which, combined with damaged soil, inappropriate land use and mining of ground water, can result in increased flash flooding, loss of riparian ecosystems and a deterioration of the carrying capacity of the land system. Water shortage is also a man-induced, sometimes temporary water imbalance including groundwater and surface waters over-exploitation. Resulting from attempts to use more than the natural supply, degraded water quality, is often associated with disturbed land used which altered capacity of the ecosystems.

## 2.6 Climate change

Anticipated impacts of climate change on fresh water sources and their management are reported to be as follows (IPCC 2007).By mid-century, annual average river runoff and water availability are projected to increase by 10–40% at high latitudes and in some wet tropical areas, and decrease by 10–30% over some dry regions at mid-latitudes and in the dry tropics, some of which are presently water stressed areas. In some places and in particular seasons, changes differ from these annual figures. Drought-affected or water stressed areas will likely increase in extent. Physical characteristics and processes leading to water scarcity by climate change are; heavy precipitation events which are very likely to increase in frequency and intensity, and thus to augment flood risks. In the course of the century, water supplies stored in glaciers and snow cover are projected to decline, reducing water availability in regions supplied by melt-water from major mountain ranges, where more than one-sixth of the world population currently lives.

Impacts of climate change are of diverse nature and biodiversity due to changes in environmental conditions affecting the ecosystems. The present boundaries of natural ecosystems may change due to modifications in climate regimes. Actual crop patterns may have to be modified due to changes in environmental conditions influencing the crop cycles, development and production. Rains fed crops are therefore more vulnerable than irrigated ones due to changes in precipitation, infiltration, evapotranspiration and soil moisture regimes. Food security is therefore threatened in more vulnerable regions and countries of the world. Changes in rainfall regimes will induce changes in stream flow regimes and lower base flow is expected. Moreover, the water quality regimes will also change and contamination impacts may be larger, affecting public health. The latter may also be impacted due to increase of frequency and severity of heat waves and wildfires.

On the whole, the water availability is expected to decrease, thus enhancing competition among users and making it more difficult to satisfy the increased urban water demand for residents and tourism. Mitigation and adaptation measures are required and are already being partly implemented to reduce both the process drivers and the impacts and vulnerability to climate change. However, due to the wide nature of these measures, large efforts are required from politicians and decision makers to create a sustainable process of mitigation and adaptation. Advice and guidance is also needed from researchers in a large variety of disciplines to develop technological, economic, managerial, cultural, educational

and social measures appropriate to each country and environment to efficiently reduce vulnerability to, and expected impacts of climate change.

It is important to recognise climate change as a process driving exacerbated water scarcity and threatening development in developing countries. Unfortunately, many other processes and driving forces are contributing to degradation of Earth's environment and people's welfare, including devastating wars.

To Hoektra and Chapagain (2007), erratic water supply has various causes, most of which are capable of being remedied or alleviated. Water use has been growing at more than twice the rate of population increase in the last century, and, an increasing number of regions are chronically short of water (European Commission, 2007b). In future, most of world's population will be experiencing water stress; situation will be and is catalysed by rapidly growing urban areas which place heavy pressure on neighboring water resources.

Irrigated agriculture which needs applying controlled amounts of water to plants at needed intervals, represents the bulk of the demand for water in most countries, is also usually the first sector affected by erratic supply and this results in a decreased capacity to maintain food production while meeting water needs for domestic, industrial and environmental purposes (IPCC, 2001). In order to sustain their needs, most countries need to focus on the efficient use of all water sources (groundwater, surface water and rainfall) and on water allocation strategies that maximise the economic and social returns to limited water resources, and, at the same time, enhance the water productivity of all sectors (IPCC, 2001).

The leading cause of water crisis is mismanagement by government officials. In the World Water Vision Report which asserts that the water crisis faced today in many countries, it is not about having too little water to satisfy human needs, but, is a crisis of managing water so badly that billions of people and the environment suffer badly (Karanja, 2008). An expanding population (high population growth rate) has over-stretched the available fresh water resources leading to water scarcity which translates to low water supply. In reference to urban water solutions, 30 years ago there was a third of water available to people but in another 30 years it will be down to a third of current levels. The population is rising and the catchment area for water is declining.

Kenya has now just 1.7% of forest, far below the 10% recommended for any country (Birongo and Lee, 2005). Environmental degradation and climate change has further weighed on the water shortage problem as they contaminate water resources and reduce the natural storage of water (Kandji, 2006). Due to prolonged dry spells, the rate of evaporation is high and this has led to drying of water tables, reducing the level and amounts of water available for use. Environmental degradation due to deforestation, sand harvesting, erosion due to human related activities has led to drying of catchment areas leading to low amounts of water available (IPCC, 2001).

Environmental factors leading to erratic water supply are caused by demand side factors like over extraction and pollution as they are interdependent. These lead to increased depletion and deteriorations in water quantity and quality. This has greatly led to reduced amounts of water available for consumption (Diwakar and Nagaraj, 2002). Major environmental factors causing inadequate drinking water supply include non-availability of constant water sources and high dependency on groundwater. Groundwater has been experiencing wide fluctuations and cyclically declining in many countries due to geographical and geological conditions, rainfall fluctuations and low recharge rate (GoI, 2002).

Depletion of ground water (a supply factor), as over extraction (a demand factor) also contributes significantly to this depletion. The rapid and accelerated withdrawal of ground water to meet competing demands from agriculture, industry and other sectors has led to decline in the water table (GoK, 2004). Lack of frequent precipitation during the rainy seasons has caused water shortages during the following dry season, even though during the dry season rainfall is normal or above normal. This has largely resulted to over dependence on ground water translating to over extraction of underground water (Rajamarthanda, 1998).

Water supply capacity of surface sources like rivers, lakes, reservoirs and tanks decrease owing to forest degradation, siltation, uncertainty and fluctuations in rainfall (GoK 2004). The general neglect in conserving rainwater has resulted in waste of rainfall by way of run-off and evaporation. Increasing demand and over exploitation are the other demand based causal factors leading to inadequate drinking water availability. Groundwater extraction is growing rapidly as it is used for drinking, irrigation and industrial needs. These factors reduce groundwater availability in aquifers, particularly during the dry season, creating wide fluctuations in drinking water supply (White, 1998). Pollution which is deteriorations in water quality is another factor

that contributes to unreliable water supply in most countries. Since pollution is a major cause of poor water quality, it causes both temporary and long-term water shortages (Kimani *et al.,* 2007).

Deterioration in drinking water quality either at source or in the distribution system has been caused by factors such as natural, man made (or demand driven) and institutional (like lack of monitoring system) (Mogaka *et al.,* 2006). Natural factors such as geological and geographical characteristics lead to inorganic contamination with excess fluoride, iron and nitrates while man made factors like over extraction of groundwater, discharging pollutants to surface and ground water bodies, inadequate and improperly designed drainage and sewage systems too add their share of pollution (Rajamarthanda, 1998). In addition, the common practice of using open places for defecation, washing clothes and animals, bathing around water bodies, also pollute water sources. Industrial effluents discharged to open place and water bodies is another major cause for decline in water quality (Karanja *et al*., 1990).

Lakes and streams have a limited natural ability to rid themselves of impurities, but it is a very slow process and some impurities can never be removed. Prior to our industrial expansion, population growth and the increased use of chemicals, lakes and streams could handle small amounts of wastes without harmful effects on water supplies. However, the self-cleaning process cannot cope with the amounts and types of wastes being discharged into lakes and streams. Our wastewater must be cleaned at treatment plants before being returned to a lake or stream. Wastewater treatment plants are expensive to build, and large amounts of energy are needed to treat and move the wastewater- resulting in higher costs and higher taxes (Dion, 1998).

Short term pollution causes water shortages by floods. Water for restricted use must be trucked into affected communities. Long-term pollution causes water shortages in coastal South Carolina when ground water is pumped out faster than it is replenished and salt water replaces the freshwater in the wells (Brooks and Sethi, 1997). A combination of drought and pollution causes water shortage. Water shortages can also occur when the sudden demand of new industry, or a large increase in population, is too much for an existing water and sewer system. Finding additional water, and increasing freshwater and sewer capacity, solves the problem (Barkatullah, 1999).

Erratic water supply is also brought about by lack of operation and maintenance of water supply schemes (GoK, 2000). Other management related causes, attributable to variations in water supply, are leakages in the distribution network and power fluctuations, which make water supply schemes sub-optimal (GoK, 2002). Leakages and unaccounted water, caused disparity in distribution reducing the actual quantity of water supplied. According to GoK (2000) in urban areas, water loss through leakage is a major factor reducing the quantity. The leakage occurs mainly due to corroded pipes in distribution network, damages caused during road widening repair works and also use of poor quality pipes in majority of household connections.

**2.7 Water scarcity**

Water scarcity is defined in a number of ways. For example, Falkenmark (2004) developed a water stress measure that related population to blue water availability. This was represented empirically in terms of people per flow unit. One flow unit constituted 1 million cubic metres of water. As populations neared 600 people per flow unit, Falkenmark argued that societies would experience water problems associated with pollution and dry spells. Between 600-1000 people per flow unit, societies suffered water stress. As societies approached 2000 people per flow unit, they would experience absolute water scarcity. Pallett (1997) expresses it differently. It may be said that where available water dipped below 1700 cubic metres per capita (i.e. below the World Health Organisation minimum of 50 litres/person/day), societies would experience water stress.

Below 1000 cubic metres per capital they would experience chronic water scarcity; and below 500 cubic metres per capita, they would be living beyond the water barrier (Falkenmark and Rockstrom, 2004). In the southern African case, such statistics indicate that by 2020, Botswana, Malawi, Namibia, South Africa and Zimbabwe will all suffer absolute water scarcity with Botswana, Malawi and Namibia all living beyond the water barrier (Pallett, 1997). According to available statistics, South Africa is approaching 1000 people per flow unit, or less than 1000 cubic metres of water per capital. The South African National Water Resources Strategy (NWRS) states that South Africa's water resources are, in global terms, scarce and extremely limited in extent (DWAF, 2004, p17). This understanding of scarcity can be criticised from a number of perspectives. For example, Pallett (1997) argues that Falkenmark's measure is very crude, neither distinguishing between total run-off and available run-off, nor accounting for groundwater or water stored in lakes and dams.

Swatuk (2002), citing Rockstrom (2001), argues that since most food crops are rain-fed, measuring the 20 ratio between population and blue water overstates human dependence on surface water for survival. Moreover, Swatuk (2002) argues that given that 70 per cent of all water used in the region goes to irrigators whose contribution to national/regional GNP is very small, it suggests that 'scarcity' results in part is a result of political decisions. Authors such as Allan (2003) introduced the concept of virtual water that is the amount of water that may be found in traded goods and services to, among other things, suggest that even where there is absolute water scarcity, the consequences are not necessarily inevitable. Indeed, in the case of Israel, Allan (2003) argues that the country has been living beyond its water barrier for many years, compensating for its lack of water by importing it in the form of food and other goods.

Winpenny (1995), in a discussion document prepared for the Food and Agricultural Organisation (FAO), argues that "in popular usage, water scarcity is a state of affair where there is not enough water to gratify normal requirements". He contends that this common sense definition is of little use to policy makers and planners.To him there are degrees of scarcity absolute, life threatening, seasonal, temporary, cyclical etc. He further argued that scarcity may have its roots in water shortage, but it may also be a social construct, a product of affluence, expectations and customary behaviour. To him water scarcity situations can have different origins and it can be dealt with by countries that would face such situations.

Winpenny feels that scarcity is not necessarily inevitable or immutable. Recent efforts to move southern African states toward demand management practices also suggest that scarcity is in part socially constructed. Reflecting historical patterns of infrastructure development, institutional management practices, and popular perceptions about the "god given" nature of water (Swatuk, 2002; Gumbo et al, 2004).Thus, managing demand can create more water without tampering with the hydrological cycle. However, as demonstrated by 21 Swatuk (2005), changing historical practice is largely a political issue.

In the South African case, results have been haphazard at best (Gumbo et al, 2004). A different way of defining scarcity is the historical preoccupation with the role of water in industrial development. For example the 1997 UN Study Comprehensive Assessment of the World's Freshwater Resources introduced the idea of technical water stress, that is the percentage of total blue water withdrawal relative to available resources. Where more than

40% of a state water sources had been developed, they were said to be entering a condition of high water stress. Where less than 10% of the resource was developed, there was said to be low water stress. According to this measure, South Africa is said to be suffering from high water stress.

Falkenmark and Rockstrom (2004) have attempted to arrive at a more nuanced understanding of water scarcity that combines various forms of water (blue, green), development patterns, and biomes (arid, semi-arid, sub-humid, and humid). When these various factors are taken into account, the sorts of stress societies face may be quite different arid regions suffer green water scarcity. In other regions where blue water is scarce, the cause may be due to technical stress (over-exploitation) or social stress (increasing population). A States capacity to deal with these problems is reflected in 'coping capability problems', for example lack of financial or human resources or an unwillingness to reallocate water toward more sustainable and equitable patterns of use (Falkenmark and Rockstrom, 2004, p95).

Batisse (2000) investigates the challenges facing the world and reflects upon the specific problem of water for food production to meet the needs of all people. He argues that domestic supply can be met with the available water. However, this might not be the case in meeting the demand in other sectors. In the case of agriculture, he says that by using modern scientific solutions, like biotechnology, sufficient food can be produced to meet the needs of the global populace without major problems. He does, however, raise concerns about the emerging limitations of rain-fed agricultural expansion (green water), thus bringing about greater future dependence on irrigated crop production.

Highlighting the competing demands of water, Batisse (2000) cautions that the projected expansion of irrigated agriculture will consume 2250km$^3$ of water by 2025. This volume of water will require an abstraction of 3200km$^3$ if irrigation losses are taken into account. Coupled with the increase of demand for domestic and industrial use, this volume of consumption is unsustainable. This would avert the impending crisis of an estimated 2,7 billion people who will access less than 1000m$^3$ per person per year.

From Batisse's perspective, 'sustainable irrigation' would mean finding appropriate institutional, technological and social solutions to meet the expectation of more crop per drop. Like, Batisse, Gleick (2000) also looks at an impending global water resources crisis. To him, indiscriminate economic development choices are having a severe impact on

the ability of this generation to ensure a situation where future generations could meet their basic needs. He does, however, recognise that a greater number of water management institutions are revisiting their approaches and are investigating ways to use water more effectively, making better water demand management choices and redistributing water between different users in a bid to fill the potential gap between future demand and supply. He acknowledges that the connection between water and food production is getting more attention in the light of less water being available. This issue is also being investigated by amongst others, Swain (1998), Yang *et al* (2002) and Pereira *et al* (2002).

Ohlsson (2000), reflecting on the history of water resources management, postulates that first order scarcity (water shortages) is followed by second-order scarcity (the ability of society to overcome the water shortages). He argues that, as society changes, the solution for ensuring adequate water has to change. This ability of society to find new solutions to water scarcity is called adaptive capacity. Ohlsson sees the evolution of the approaches ensuring water security as oscillating between a perceived natural resource scarcity of water, and the social resource scarcity of adaptive capacity. Taking the notion of water scarcity out of the natural resource context and locating it in a social context, he concludes that the concept of adaptive capacity shifts water shortages from absolute scarcity to relative scarcity, from a natural construct to a social construct.

Mehta (2001) explores the social construction of water scarcity in the context of the exploitation of the perceptions of scarcity by the powers that be in fuelling development investments in large-scale water infrastructure. She uses the case of the Sardar Sarovar Project in Kutch, a partially dry district in western India. Her study concluded that the fixation of a discourse about decreasing rainfall and increasing droughts creates an acceptance of the notion that water is scarce. This is true even where the social dialogue and popular beliefs of water scarcity is refuted by scientific indicators. Typifying this discursive scarcity as manufactured scarcity, Mehta (2001) contends that peoples' perceptions of water scarcity become a powerful tool in shaping the discourse about development which is not reflected at grassroots.

This discord between perception and reality requires that water scarcity be analysed as a biophysical and as an anthropogenic problem. To her, water scarcity as a bio-physical phenomenon means there are real water scarcity or water shortages as a result of little or very little precipitation. Water scarcity as an anthropogenic phenomenon

means that there is sufficient precipitation but people do not have access to water because of human action, hence the concept of manufactured scarcity.

The simultaneous existence of both states of water scarcity fuels a generalised perception of water scarcity. This perception in turn influences the pursuance of development in the communities where it prevails. Mehta (2001) contends thus that this paralysis provides the space for proponents of some preferred solution to enforce that solution as opposed to the development of solutions suited to local contexts. Hoekstra (1998), in his discussion on the nature of water scarcity, raises different debating points on the issue. To him, the term water scarcity implies a situation where users are in competition over water resources. Firstly, it is manifested in terms of the biophysical situation of supplying sufficient water of the right quality at the right time to meet the demand.

Secondly, it concerns threats to the resource such as people's drive for economic development coupled with an increasing birth rate. This, he contends, can be managed by controlling water consumption, setting tariffs and educating the users about the resources situation. Thirdly, he discusses the widely accepted concept of "water as an economic good" and says that if one should follow this edict the cost of water is an appropriate indicator of water scarcity (Hoekstra, 1998). Water scarcity can thus be perceived to present problems from both a supply and demand level.

## 2.8 Effects of polluted water and shortage of water

Tripathi (2009) illustrates a number of effects of pesticides that adversely affect human beings all these years. Some of these effects are cancer. Many studies have examined the effects of pesticide exposure on the risk of cancer. Associations have been found with leukemia, llymophoma, brain, kidney, breast, prostate, pancreas, liver, lungs and skin cancers. This increased risk occurs with both residential and occupational exposures. Increased rates of cancer have been found among farm workers who apply these chemicals. A mother's occupational exposure to pesticides during pregnancy is associated with an increase in her child's risk of leukemia, wilms tumor and brain cancer. The effects of polluted and shortage of water on: neurology, reproduction system and diseases.

### 2.8.1 Neurological effects

Strong evidence links pesticide exposure to worsened neurological outcomes. The risk of developing Parkinson disease is 70% greater in those exposed to even low levels of pesticides. People with Parkinson's disease were 61% more likely to report direct pesticide

application than were healthy relatives. Both insecticides and herbicides significantly increase the risk of parkinson's disease. There are also concerns that long term exposures may increase the risk of dementia.

### 2.6.2 Reproductive effects

Strong evidence links pesticide exposure to birth defects, foetal death and altered foetal growth. In the United States, increase in birth defects is associated with conceiving in the same period of the year when agrochemicals are in elevated concentrations in surface water. Agent orange, a 50:50 mixture of 2,4,5-T and 2,4-D, has been associated with increased birth defects in Vietnam.

### 2.6.3 Diseases

Pesticides study shows that it has an adverse effect on diseases too. A number of pesticides including dibromochlorophane and 2,4-D has been associated with impaired fertility in males. Thermal pollution results out of excessive heat generated from thermal plants which use water in the process of cooling their generators. This water due to contact with excessive heat and high temperature gets polluted because of the decrease in the solubility of dissolved oxygen. The excessive heat has adverse effect in bio-chemical reactions which are detrimental for human health and aquatic organisms.

According to Try and Price (1995), viruses are of topical interest in relation to exposure risks from waste water used and discharged. Public Health Laboratory figures show that Hepatitis A, responsible for infectious jaundice, has increased since 1987. Shellfish consumption can increase risk but no link has yet been made with recreational water exposure. There is no evidence supporting risk to the public from exposure to recreational waters or sewage from HIV, the causative agent of AIDS. Bathing waters can suffer from potential microbiological hazards other than from sewage discharge. Notably, environmental contamination can result from gulls which have a prevalence of enteric bacterial pathogens such as Salmonella and Campylobacter in their faeces. The position is similar where inland waters are used for recreation.

The concentration of faecal organisms is the principal factor in the risk of disease. Recreational exposure, including canoeing, swimming, sailing, and fishing differs only slightly from marine waters in the degree and intimacy of exposure. Rivers act as repositories for large bodies of treated wastewater, surface water, and agricultural run-off Sewage effluents, although subject to stringent discharge consents still have significant inputs of

faecally derived microbes. Abstraction of river water for drinking purposes places constraints on the location of the water purification works and the type of treatment required. The often quoted risks of leptospirosis, or WeilÕs disease, must be kept in context. Sewage workers may have an increased risk from indirect exposure to rats and this has led to confusion with the risk of exposure to sewage. In fact the disease is usually contracted by exposure to the urine of infected rats or of urine-contaminated stagnant water. Infection occurs through cuts and abrasions or via the mucous membranes.

Chapman (1996) notes that diarrhoeal diseases, mostly associated with a lack of safe potable water, insufficient water, inadequate sanitation, poor hygiene and combinations thereof, account for an estimated two million deaths per year, and of these a vast majority are in children under five years old, almost all in poor countries. The mortality figures represent only a tip of the illness iceberg: tens of millions of children suffer repeated bouts of diarrhoea during their early years. The spread of oral rehydration therapy, in which UNICEF and the World Health Organisation have been closely involved for the past 30 years, is important in tackling one of diarrhoea's most lethal symptoms: dehydration and electrolyte imbalance caused by the loss of gut fluids. But some diarrhoeal infections such as bacterial dysentery cannot be managed with oral rehydration therapy only. Such infections also require antibiotics.

In the end, there is only one way to reduce the toll of childhood diarrhoeal disease and death, by preventing as many infections as possible in the first place. In June 2009, the World Health Organisation (WHO) recommended that a rotavirus vaccine be introduced in national immunization programmes. Rotavirus, also transmitted via the faecal–oral route, is thought to be the leading single cause of severe diarrhoea in infants and young children, and the vaccine was found to significantly reduce severe diarrhoea episodes in studies in Latin America, South Africa and Malawi. In a statement on the recommendation to give rotavirus vaccine to all children, the World Health Organisation also said, 'because there are other causes of diarrhoea, it is also important to improve water quality, hygiene and sanitation'.

The pollution of rivers also has socio-economic implications. An inadequate supply of water and sanitation facilities could reduce the likelihood of safe disposal of human waste thereby increasing risks or exposure to disease and death. An adequate water supply promotes good health and improves the prospects of new livelihood activities which are otherwise denied and are a key step out of poverty (UNESCO, 2006). Where water and sanitation investments are not made, the likelihood of contracting diseases such as diarrhea, dysentery,

cholera, typhoid and schistosomiasis is high. When the 'bread winner' or household head becomes victim to these diseases, it has implications for the livelihood of the household, particularly that of the poor.

Working days as well as productivity are lost and household incomes are greatly reduced where alternative sources of income are limited or non-existent. Household incomes might not be able to support the buying of water from expensive alternatives, thus the household is caught up in the cycle of poverty due to the lack of good quality water for drinking, irrigation and sanitation (WHO 2001). Majority of those who suffer this trend are women. According to the WHO, almost 70% of the 1.3 billion people living in extreme poverty are women and often trapped in a cycle of ill health (WHO, 2001).

The World Bank (2008:6) also maintains that labour is often the only asset that poor households have and that sickness and death can have intergenerational effects. Any improvements in environmental health can have long-term impacts on households' ability to move out of poverty. An improved water supply could therefore trigger a reduction in working hours and increase rest for women and children who, hitherto, had to walk long distances or join long queues to fetch water of questionable quality.

For poor rural women, the time saved could be used for household child care, the collection of more water for hygiene or the engagement in productive activities as trading to supplement household incomes. According to Tsunoda (2011), water pollution not only can influence human health directly but also can threaten aquatic life, particularly fish. For instance, in the early 1960s, millions of fish in the lower Mississippi river died from the effects of chlorinated organic pesticides. In the early 1970s, contamination of fish with Dichloro-diphenyl trichloroethane (DDT) and PCBs (polychlorinated biphenyls) caused an abrupt halt to commercial salmon fishing in the upper Great Lakes. Although much progress has been made since, and the public is encouraged by the reports on the decreased levels of chlorinated hydrocarbons and other toxicants in fish crops, problems of water pollution in the Great Lakes appear to have persisted for some time. In addition, children could gain more time to attend school (Smet and Van Wijk, 2002).

Data from countries that have a surveillance system for water-bornediseases have provided numerous examples of the importance of a secure and well-operated distribution system in supplying safe drinking water. In the United States of America (USA), from 1920 to 1990, 11–18% of reported outbreaks of water-bornediseases were attributable to

contamination of the distribution system. From 1991 to 1996, contamination of water in the distribution system was responsible for 22% of the reported outbreaks, caused by corrosion, cross-connections, backflow, improperly protected storage or repairs to water and plumbing (Craun and Calderon, 1999; Craun, 1986).

In the United Kingdom, from 1911 to 1995, problems related to the distribution system accounted for 15 (36%) of 42 reported water-bornedisease outbreaks in public water supplies (Hunter, 1997). Similarly, in Scandinavia, between 1975 and 1991, cross connections or backflow were responsible for 20% of the reported water-bornedisease outbreaks in community supplies and 37% of the outbreaks in private systems (Stenström, 1994).Deteriorating water treatment facilities and distribution systems can pose a significant public health threat, as illustrated by a study in Uzbekistan (Semenza *et al*., 1998). More than 30% of the households with piped water lacked detectable levels of chlorine residuals in their drinking-water, despite two-stage chlorination of the water source were at increased risk of diarrhea. 42% of these municipal users reported that water pressure had been intermittent within the previous two days.

There was a dramatic reduction in diarrhea rates when home chlorination was implemented, indicating that a large proportion of diarrhea disease was waterborne. The authors concluded that the epidemiological data supported the hypothesis that diarrhea disease could be attributed to cross-contamination between the municipal water supply and sewer, due to leaky pipes and lack of water pressure. An epidemic of cholera that began in Peru in January 1991 marked the first such epidemic in South America since the 19th century. Subsequently, over 533 000 cases and 4700 deaths have been reported from 19 countries in that continent.

Trujillo, the second largest city in Peru, the water supply was unchlorinated and water contamination was common (Swerdlow *et al*., 1992a; Besser *et al*., 1995). A water-quality study showed progressive contamination during distribution and storage in the home. Illegal cross-connections, low and intermittent water pressure and the lack of chlorination all contributed to the widespread contamination. These authors found a wide variability in chlorine concentrations in the municipal water that was distributed to dwellings.

Trujillo’s water and sanitation problems, which are found on all continents, reinforce the need for measures to prevent the spread of epidemic water-bornediseases at the treatment plant, in the distribution system and at the household level. It is not only developing countries

that are at risk, as illustrated by a large Escherichia Coli O157:H7 outbreak in a small rural township in Missouri, in the USA, that had an unchlorinated water supply (Swerdlow *et al*., 1992b). There were 243 case patients, of whom 86 had bloody stools, 32 were hospitalised, 4 died and 2 had haemolytic uremic syndrome. In a case control study, no food was associated with illness, but persons had drunk more municipal water than had the controls (Swerdlow *et al.*, 1992b).

The study showed that, during the peak of the outbreak, bloody diarrhoea was 18.2 times more likely to occur in persons living inside the city and using municipal water than in persons living outside the city and using private well water. Shortly before the peak of the outbreak, 45 water meters were replaced and two water mains ruptured. The number of new cases declined rapidly after residents were ordered to boil water and the water supply was chlorinated. This was one of the largest outbreaks of E. coli O157:H7 infection and the first that was shown to be transmitted by Microbiology of piped distribution systems 5 water. System wide chlorination, as well as hyper chlorination during repairs, might have prevented the outbreak.

According to Jay and Keeley (2005), it is important to point out that the failure to provide basic clean water and sanitation services takes a serious toll on human health and results in economic loss in many countries of the world. Reports have shown that water, shortages, polluted water, and unsanitary living conditions claim millions of lives annually (7,20,34). The World Health Organisation reports that 80% of diseases are overtly or covertly water-borneand/ or consequent to freshwater shortages. Moreover, in much of the world, polluted water, improper waste disposal, and poor water management cause serious public health problems. For example, diarrhoeal diseases leave millions of children underweight, mentally as well as physically handicapped, and vulnerable to other diseases.

According to Cunha (2014), urine retention has the following consequences. Urinary tract infections (UTI), urine is normally sterile and the normal flow of urine usually prevents bacteria from infecting the urinary tract, developing urinary retention means an abnormal urine flow gives bacteria at the opening of the urethra a chance to infect the urinary tract. Bladder damage, if ones bladder is stretched too far or for extended periods, the muscles may become permanently damaged and lose their ability to properly contract. Kidney damage, sometime urinary retention can cause urine to flow back into the kidneys. This is called reflux and can damage or scar the kidneys. Urinary incontinence (after prostate, tumour, or cancer surgery) Transurethral surgery to treat an enlarged prostate can result in urinary incontinence

in some men. It's often temporary with most men gaining bladder control in a few weeks or months after surgery. The removal of tumours or cancerous tissue in the bladder, prostate, or urethra may also result in urinary incontinence.

**2.9 Water, sanitation and water-borne diseases**

A large number of people in developing countries mostly live in extreme conditions of poverty. The main factors responsible for this situation include lack of priority given to these sectors due to inadequate financial resources, inadequate water supply, sanitation services, poor hygiene behaviours and inadequate sanitation. These situations are mostly seen in public a place which includes hospitals, health centres and schools. Most of the diarrhoeal and other water-borne diseases are caused by contaminated water. Polluted and contaminated water can cause water-borne diseases like diarrhoea, cholera, typhoid fever and dysentery. Ozkan *et al* (2007), had reported that absence of adequate and safe water supply, coupled with sanitation systems, was responsible for various kinds of sicknesses such as diarrhoea along side with other water-bornediseases in rural areas of Turkey.

In a meta-analysis by Fewtrell *et al*. (2005), improvement in water supply, water quality, and sanitation reduced the risk of diarrhoea-related morbidity by 25%, 31%, and 32 %, respectively . Bhavnani *et al* (2014) concluded that unimproved water source (rivers, ponds, lakes and unprotected springs) and unimproved sanitation were the major risk factors of diarrhoea in Ecuador. Water and sanitation management practices can actually decrease diarrhoea incidences by one-third to one-fourth.

**2.8 Impacts of water supply on socio-economic development**

The main challenges of the water sector globally remains the low development and use of the water sources potential due to deficiency of water infrastructure. Also, the deficient agricultural water management, missing water services, institutional platforms, inadequate access to markets, lack of financing and capacity of institutions and the weak government commitment (Birongo and Lee, 2008). These issues are detrimental to a sector that is otherwise in a unique position to reduce exposure to food crisis and to deliver poor growth among urban and rural households.

The economic case for the development of water resources as an instrument for economic growth can easily be made. Agriculture, industry, and hydropower depend on water and can drive a country's economy upward in a significant way. Yet, if people and

businesses have much to gain from developing and better managing this precious resource, the extent of the losses and the missed opportunities from neglect will be devastating (UNEP, 2004). Africa loses 213% of their agricultural products, annual Gross Domestic Product (GDP) to regular power outages, and between 5 and 25% to droughts and floods in affected countries (Alcamo, 2007).

In Kenya, for example, estimated losses from flooding in 1997-98 and drought in 1998-2000, amounted respectively to 10% and 16% of GDP. This means that if Kenya could separate its economy from rainfall variability, it can increase its GDP growth by approximately 2.4%. While the continent (Africa) has only 9 per cent of the world's internally renewable water and 15 per cent of the global population, the problems related to food security and energy are more linked to the under-development of water resources (Bouwer, 2002). Water supply is a current concern for the population in Kenya. Positive results between increasing water pollution and decreasing freshwater supply may rapidly raise the importance of water quality in the area.

The loss of productivity due to water-bornediseases and water fetching is devastating. The poor, in particular women and girls, spend a significant amount of time fetching water in both rural and urban areas. For example, the 2007 Citizen Report Card survey showed that users of water kiosks in cities fetch water 4-6 times per day. In Kisumu, this meant that a poor household spent 112 minutes per day to fetch water at normal times, and as much as 200 minutes per day during times of scarcity (Ballance and Tremolet, 2005). In most countries, Kenya included lack of access to safe water, especially in rural areas or some urban areas and among poor communities.

This obliges women to spend hours every day collecting water for their families' daily needs, causing drain on their energy, productive potential and health. Largely because of their role in collecting water, washing clothes, cleaning and cooking, and in rural areas, performing day-to-day agricultural tasks, women are constantly exposed to the risks of contracting water-related diseases that affect their reproductive health.

Exposure to contaminated water sources is associated with pregnancy failures and with infant and childhood development difficulties, illness and mortality. Most literature suggests that women are primarily responsible for the collection of water (Water Aid, 2004a). As stated by Water Aid (2006b), many benefits of water, sanitation and hygiene projects particularly impact upon women. Poor people, particularly women, are often unable

to engage in paid work when they do not have safe water nearby (Joshi and Fawcett, 2001). This is because they often spend hours each day trekking to the nearest water source, waiting their turn in long queues for water, or is too ill with water-related diseases to have the strength to work. This has a negative impact on paid employment for the females or males that are employed since they are not able to constantly attend to employed work.

The World Health Organisation (WHO) estimates 5.6 billion working days would be gained annually if there was universal access to safe water and sanitation. In contrast, people living near safe water supplies can look after the water needs of their family in a matter of minutes, leaving the rest of the day free to earn much-needed cash (World Bank, 1996). According to Joshi and Fawcett (2011), women, being the main collectors of water, often have their lives changed the most dramatically. Thus, the scarcity of water leading to erratic water availability implies that females spend more time in water collection activities. If the water supply issue is addressed in many countries, it would be available closer to their homes. Women will have additional time for other activities and decision making.

Women are further subjected to go to isolated places to fetch water, dark areas to be able to use the rest romes or bushes. Hence, they are at risk for sexual harassment (Water Aid, 2006b). Poor communities without access to water supplies (pipe borne water, boreholes and shallow wells), particularly in urban areas, often have no option but to spend money they can hardly afford buying water from water vendors who possibly get their water from unaccountable sources (UNEP, 2004).

Conflicts linked to the quantity of water are also a global problem. Conflicts due to water are grouped into: conflict that may arise between sectors or users, like municipality verses industries, connected verses unconnected people, urban verses peri-urban, present and future generations). Conflicts linked to the quality reduce the availability of potable water and causes water-borne diseases. Poor people are the most affected as they do not have any means to treat water. It is too expensive and domestic users result to complaints to the municipality. This also increases physical barriers preventing access to water and their unfair settlements generate conflicts (Janakarajan, 2002).

The access to water impacts the psyche of a community in several ways. In communities where access is limited and people (water collectors) must walk long

distances to fetch water, there is increased tension from the safe arrival of the female family member that fetches the water. This is because some water points are in deserted areas that are unsecure. There is also reduced self-respect since most of the attire they put on as they fetch water gets dirty (Water Aid, 2001). Despite the many negative impacts, there is also the positive aspect in it. Employment opportunities for personnel employed at the water distribution points and the population earn a living out of that. Water kiosk owners, they distribute water to consumers on payment, thus make a living out of that (Malesu *et al*., 2007).

**2.9 Coping strategies to potable water**

Beth (2006), posits that, in the early 1900s, after discovering a large number of typhoid and other disease outbreaks from contaminated water, states and local governments began establishing programs to protect water supplies. The first were water pollution control programs, which focused on keeping surface water supplies safe by identifying and limiting sources of contamination. Early water pollution control programs concentrated on keeping raw sewage out of surface waters used for drinking. Early drinking water programs were aimed at providing safe and adequate drinking water to a community.

At first, these programs were not separate from the water pollution control programs because they also focused on identifying and maintaining safe sources of drinking water. For example, efforts were made to site intakes used to collect drinking water upstream from sewage discharges. By the mid-1900s, State public health departments were well established regulatory agencies. The primary contaminants of concern were microbes and States used the following multiple barrier approach to prevent microbial contamination of drinking water.

Pejack (1996) says that heating water to a sufficiently high temperature for a certain period destroys harmful micro-organisms, this process is often termed pasteurisation after the scientist Louis (1822-1895) who predicted the required temperatures and corresponding periods for the destruction of microbes. The time required to pasteurise water decreases exponentially with an increase in temperature (Feachem *et al*., 1983). It is a common misconception that water pasteurisation requires boiling water (sometimes it is even stated that the water must boil for 20 min).Unnecessary boiling wastes a significant amount of fuel, which is already an expensive and scarce item in much of the world (Feachem *et al*., 1983).

The idea that water must be boiled to be pasteurised may have arisen because it is easy to tell when water boils, and one can then be certain that the water has been heated

above 65$^{o}$c for the germs to be destroyed. Note that the type of pasteurisation discussed is concerned with the destruction of microbes only. Toxic chemicals, metal salts, and other contaminants are not removed by pasteurisation. Insoluble material such as silt can be decreased by pre filtering or settling the water. Pasteurisation as discussed in this chapter is a thermal process, relying on the destruction of microbes by temperature (achieved with solar energy). A related but different water treatment concept is solar disinfection (SODIS), where microbes are destroyed by the direct action of certain wavelengths of the solar spectrum, independent of temperature. It is the ultraviolet range of the spectrum (200-400 nm) that is most effective in destroying microbes, consequently, transparent containers that have good transmittance in this wavelength band should be used.

Udouyk (2010), notes that the World Health Organisation Standards for water per capita is 135 l/ capita/day. Out of that, drinking is 03 l, cooking is 04 l, bathing is 20 l, washing clothes is 25l, washing utensils is 20 l, toilet flushing is 40 l, gardening is 23 l. Quite a large portion of the water (63l) is used for last two purposes and the quality of water for that can be type B (inferior to type A that is, for drinking and cooking) (Márquez-Bravo 2007). Waste water from bathrooms, kitchen and rain water can be collected in settling tank where primary treatment of water will be done and then it is taken to second tank in which powder (catalyst) is mixed into it and pumped to solar flat plate reactor.

After solar detoxification, the water is stored in the storage tank and recycled for toilet flushing and gardening. So the waste water from kitchen, bathrooms can be recycled for toilet flushing and gardening after passing from solar experimental set-up (Inamdar and Singh 2008). To the best of our knowledge the application of solar purification at household level in sites at latitude more than 45° has not yet been investigated. In conventional treatment methods, lot of energy is wasted and also they generate harmful byproducts. Instead of these methods solar purification method is used because; it carries eco-friendly operation, it does not create any harmful byproducts and it is energy efficient method as it uses solar energy.

### 2.9.1 Water desalination

Technologies for this purpose are classified under two broad categories (European Union (EU), 2008): distillation processes (Khawaji *et al*., 2008) and membrane processes (Kim, 2011). Thermal desalination was the main method used before the early 1960s when membrane processes came on stream. Thermal distillation technologies use heat to convert water to steam, which is then condensed to produce distilled water. Membrane desalination

technologies use a thin film of porous material called semi-permeable membranes, which allows water molecules to pass through it but simultaneously minimise or prevent the passage of other ions like salt. Membrane technologies are either pressure driven, as in reverse osmosis and nano filtration, or electric potential-driven, as in electrodialysis reversal. The major thermal and membrane technologies used globally (EU, 2008). Thermal technologies require a higher energy input than those utilising membranes.

**2.10 Pollution prevention (Source controls)**

To Marsalek and Jimenez-Cisneros (2008), the first step towards sustainable waste water management is minimization of wastewater generation, generally by reducing water consumption and practicing industrial process water recycling. Minimising wastewater production by reducing water use is important with respect to both the volume of wastewater generated and the energy needed to transport and treat water. There are also concerns about using the highest quality water for all purposes, some which do not require that quality. Both issues are dealt with in the soft path for water approach to urban water management. This concept emphasises matching the quality of water supplied to the quality required and conserving the highest quality potable water (Brandes and Brooks 2006).

Preventing or limiting wastewater contamination is important particularly in municipalities allowing industrial discharges into municipal sewers. Such discharges must be pre-treated at source and their quality is controlled by sewer by-laws. For example, Toronto's Sewers by-law (City of Toronto 2010), aims to protect water quality by setting strict limits on heavy metals and toxic organic compounds in wastewater discharged to the sanitary and stormwater sewers, and identifying the ways of reducing and/or eliminating pollutants at source. Recognizing that most of such contaminants are hydrophobic, the bylaw helps improve the quality of biosolids (City of Toronto 2010). In Yaoundé VI, there are water treatment plant found in Rond-point Express and Mokolo (Messa). This treatment plant helps to separate out solid particles from waste water before releasing the water into the environment. These treatment plant facilities are designed to speedup the natural process of purifying water. With thousands of people in Yaoundé VI and even more waste water, the natural process is overloaded. Without waste water treatment, the amount of waste water would cause devastation, as it still doing today in Yaoundé in general and Yaoundé VI in particular.

According to King and Balogh (2006), water management is one of the dominant factors controlling turfgrass management decisions and turfgrass quality. Controlling the quantity and timing of irrigation is a major factor in conserving the quality and quantity of water resources. Integrated water-use plans for turfgrass must consider water stress, water use, and water conservation. Water use affects both water quality and quantity when water resources are limited or drought conditions occur. Cultivation and aeration of turfgrass soils will maintain high rates of infiltration and soil drainage. High rates of infiltration and percolation decrease losses in surface flow. Movement of soluble pollutants into subsurface drainage systems, however, may reemerge in drainage effluent.

Cleverson and Fernado (2007) put it that waste water treatment processes usually applied are very efficient in the removal of suspended solids and organic matter, but generally insufficient for the removal of pathogenic micro-organisms. In spite of the great importance of this item in developing countries, it has not yet received due consideration. Protozoan cysts and helminth eggs are removed by different mechanisms (e.g. sedimentation) and are not well represented by coliforms.

According to Ako *et al* (2010), the World Bank has also been involved in major road network and sanitation projects. The area forecast discussion (AFD) is involved in rural water supply projects and has also contributed funds for the rehabilitation of deteriorated sanitation and road networks. The Inter-American bank (IDB) funds rural water supply projects. Belgium's Technical Cooperation Department also finances rural water supply projects, particularly in the far north of Cameroon, and projects to rehabilitate and extend water and rainwater drainage systems in Maroua. In addition to rural water supply, Kreditanstalt Fur Wiederaufbau (KFW) has financed the development of water and sanitation services in Cameroon. It remains the responsibility of Cameroon to complement these forms of assistance with effective management of the water and sanitation systems to improve access to safe drinking water and sanitation to its population.

Distribution of drinking water in Cameroon is the responsibility of Cameroon Water Utility (CAMWATER) which replaced the National Water Company of Cameroon (SNEC) after its privatisation. Despite its efforts to provide water to the population, the supply remains lower than demand. The coverage of big urban centres needs major improvement and the unfavorable geo-ecological situation of some cities and the lack of appropriate policies on the other hand has hindered the search for long-term solutions. CAMWATER is more and more unable to respond to the population's needs (Kouam *et al*. 2006).

The percentage coverage in drinking water supply in urban areas is 40% and 30% causing the local population to resort to wells, springs and streams of doubtful water quality for their potable water (Mpakam *et al*. 2006). According to the UNDP Human Development Report 2009, the percentage of people not using an improved water source in Cameroon is 30%, which gives Cameroon a rank of 116 out of 182 countries with data (UNDP 2009). Most developing countries' efforts to achieve the MDGs have benefited from the improved economic growth and relatively low inflation that characterised much of the period since 2000.

**2.10 Stakeholders adaptations to water supply**

Numerous approaches broadly characterised as water governance exist to reconcile multiple demands for water in the context of physical and human drivers of shortage, erratic supply and vulnerability. Systems to allocate water, assign rights, establish priority uses, and balance human and ecosystem needs differ with historical, political, and institutional context. Flexibility in decision making, particularly to incorporate new information, methods and changing priorities in water use and management enhances adaptation. The main adaptations to erratic water supply that stakeholders should consider is conserving the already available water. This can be done indoors and also outdoors. In indoors, the bathroom is where you can save most water.

This involves toilets (water closet toilets that require flushing) and cemented floored latrines that require daily washing, bathing and showering, basins and sinks. Toilets use a lot of water to get the waste away (Mable and Sheard, 1999). Bathing and showering are second to toilets as large consumers of water. It takes approximately 25 gallons of water for an average tub bath. Most older-model showerheads use an average 8-10 gallons per minute, meaning a five-minute shower uses 40-50 gallons of water (White, 1999). One can conserve water by bathing in a partially-filled tub or by taking shorter showers or ones using less water in a basin. Replacing 16 shower head, consider one of the new Automatic Super Water Saver Showerheads which uses only 2 gallons per minute. Close the bathtub drain before running water instead of waiting for the hot water to arrive (Marble and Sheard, 1999). Hand dish washing: use water sparingly to wash dishes. Close tap when washing dishes to avoid water wastage and may rinse in a basin preferably.

Most stakeholders have also put into consideration and practice basic household cleaning tips (Bouwer, 2002). These include: use of bucket or basin during cleaning, instead

of using running water, scrubbing floors on wash days to enhance water re-use, using sponge mops instead of rag mops since they require less water for mopping and they clean quickly (Bouwer, 2002). Adaptations to erratic water supply also involves outdoor conservation measures. According to Herrero et al., (2010), main conservation measures include: re-using of water used to cool off and in wading pools to water flower beds, kitchen gardens, shrubs and lawns: keeping watering schedule flexible.

Interruption of automatic sprinkler systems, after raining if necessary; checking outside taps daily to see that they are turned off when not in use to avoid water wastage; checking shut-off valves for leaks often to unnoticeable leakage and making sure all faucets are turned off completely each time they are used; replacing washers on dripping faucets and showers to reduce the amount of water to be used; replacing damaged or leaking sprinkler heads on underground sprinkling system to avoid water loss. Stakeholders with swimming pools have adapted to erratic water supply by, filling the pools with the right level of water to control spillovers that may occur, covering the pool when not in use to prevent evaporation, minimise replenishment, and keep it cleaner. They do not drain the pool unless repairs are needed to prevent water wastage (Marble and Sheard, 1999). Shortage of water is a big problem in many cities (Janakarajan, 2002).

Water is sometimes turned on only a couple of times a day for about a half an hour each time. People with money have special storage tanks to collect water during those times, which in turn allows them to have water round the clock. People without storage tanks collect water in cans, jugs and buckets and often have to take bucket baths when the water is not turned on. Erratic water adaptation strategies also involve the use of storage containers to store water to ensure availability when needed for use. Most people globally have resorted to storing water because of its scarce nature (Kimani *et al*., 2007).

**2.11 Water and gender**

Closing the gender gap in access to productive agricultural resources is crucial for achieving FAO's goal of a world free from hunger (FAO and UN, 2021). It is estimated that women comprise about 43 % of the agricultural labour force globally and half or more of the agricultural labour force in many African and Asian countries. The labour burden of rural women exceeds that of men and includes a higher proportion of unpaid household responsibilities, such as food preparation and the collection of fuel and water (http://www.fao.org/land-water/world-water-day-2021/watergovernance/water-gender/en/).

Although the contributions of women to agriculture and food production are significant, women often lack formal rights to the land they farm and the water resources they need to irrigate their fields. In many regions, women suffer discrimination in land rights, including with respect to communal lands, which are controlled largely by men. Women also lack status in their communities to influence natural resource governance decisions and practices.

Agricultural water management has been effective in increasing yields and food production worldwide. Water professionals have developed and promoted agricultural water management techniques such as rainwater harvesting and flood control. In many places, however, planners, engineers, extension staff and decision-makers still fail to perceive women as farmers. Consequently, policies, programmes and projects frequently overlook the knowledge, tasks, needs and requirements of women and other vulnerable groups (e.g. ethnic groups) in agricultural water management.

According to UNESCO report (2019) on World Water Assessment Program (WWAP), the majority of society's women and girls are responsible for fetching and carrying water, and for using it for the health and wellbeing of their families, these women and girls rarely have the decision-making power it takes to control and preserve water resources. This is true at the community, national, transboundary and international levels

**2.12 Water and culture**

UNESCO (2021), the often-intangible nature of some sociocultural values attributed to water regularly defies any attempt at quantification but, nevertheless, can be regarded amongst the highest values. Culture directly influences how the values of water are perceived, derived and used. Therefore, the perception of the values attributed to water and its related benefits can be highly subjective.For any values, it is extremely important to understand the cultural background under which they arise and how culture influences how they are used. The values of water to human well-being extend well beyond its role in supporting life-sustaining functions, and include mental health, spiritual well-being, emotional balance and happiness. For example, water in landscapes has aesthetic values that contribute to mental health.

Unsurprisingly, life satisfaction and happiness depend to a great extent on water: water can appeal to people for spiritual reasons, or through scenic beauty, because of its

importance for wildlife or recreation, among others. Water plays an important role also across faith-based traditions worldwide, symbolizing elements as diverse as life, purity, renewal and reconciliation, but also chaos and destruction. In some, water is seen as a gift for humans to care for, whilst others embrace a view that accentuates water's importance for the environment and wildlife. The connection between water and place, often categorized as 'relational values', can be strong in many indigenous cultures. The fate of humans and water is inextricably linked. In the words of the Whanganui River Tribe's proverb, 'Ko au te awa, ko te awa ko au' - I am the river, the river is me.Water is also contributing factor to the conflict, as the source of contention but a spirit of dialogue helps to transform water-related conflicts into cooperation. Water, therefore, can at times act as a conflict indicator, and/or as connector to support conflict resolution and peacebuilding.

Water may not hold memory, but the communities managing the water do. Water managers and planners can and should benefit from a rich past of water knowledge in innovating for water related climate action. Also, working with values, traditions, sense of place and spiritual connections to water, can help support adaptation by talking to human hearts and minds. By speaking a language relating to values, cultural and spiritual heritage, we can perhaps connect to decision-making and change makers around the world. For example, when countries in Europe for many years struggled to collaborate over river pollution and the need for waste water treatment, a notion such as "bringing back the salmon" instead triggered understanding, a deeper connection to what was at stake, and triggered action and change. This field of adaptation with the help of our cultural heritage is welcoming members to help support building a language and various tools to support change making.

MELIA (2007) water is considered fundamental for life, as living creations can't survive for long without it. Egyptians, as religious people, drive lots of their culture features from their beliefs. The Bible referred that God instructed Profit Moses to strike a rock, and out of this flinty hardness flowed sufficient water to meet the needs of all people and their livestock, the Bible writers later saw this rock as a symbol of Christ. Quran has deepened the basic belief of water importance through the text, that all living organisms are originated from water. Throughout man's history, the basic requirement for water has led developing communities to be centralized along waterways due to the power and life sustaining qualities that water provides. Modern societies are often influenced by man's dependence on water for the sustenance of life. Runoff from hills, mountains, and plains, flowing across watersheds, and channeling water into nearby ponds, lakes, and rivers provides the moisture required to

produce crops and support both animal and plant life on which man feeds. Rivers provide the means to transport grains, minerals, materials, products from one region to another. This article reviews the footprint of water importance in different phases of Egyptian culture though out the history.

Water a source of inspiration is one of the crucial life-sustaining elements, it is not surprising that water has been a source of inspiration to the major world religions. One common thread running through all of these is a reverence for water. Paradoxically enough, despite the deep respect for water and its prominent place in cultural and religious beliefs, in everyday life water is often taken for granted, polluted, spilled and fought over. So water wisdom does not always result in wise water governance. Take for instance Hinduism, According to Indian myths, the Ganges flowed from the heavens and purified the people of India who touched her. Traditionally, the rivers of India have always been considered pure. Modern industrial contaminants and human waste, however, have seriously polluted the rivers. Nonetheless, Ganges water still plays an important role in India's ritual life. One such ritual is the morning cleansing with river water, being a basic obligation for Hindu people. The famous city of Varanasi, situated along the banks of the Ganges, is an important place of worship for Hindu people as well as a cremation ground. Western visitors, witnessing the daily activities in the Ganges, are usually appalled when they see people using the water to bathe or brush their teeth while at the same time noticing the remains of dead corpses floating past. Religious traditions obviously prevail over what would generally be considered healthy practice.

**2.13. Anthropology of water**

According to Uimonen. P (2021), due to their different perspectives on not only how water assumes social importance and is attributed cultural meaning but also the way it flows (hydrological cycles, sea tides, etc.) and changes chemical composition (from fresh water to seawater and back again) and material appearances (transparency, temperatures, etc.), their analytical focal points differ, which is reflected in the issue's organisation and the articles' order. Starting with a review of how humans throughout history have imagined water as a symbol of life and power, we move first to East Africa and then Scandinavia to explore the unseen in water as a spiritual force or material waste, and lastly to South America where we read about the multiple ways freshwater fashions indigenous people's worldview and struggle to cope with both existential and socio-political challenges. Alternate worldviews assist societies in developing less anthropocentric ways of thinking about and engaging with the

non-human world Strang's point is that sacred water serpent beings provide a way of conceptualising the hydrological movements of water and its annual cycles so that societies can work with these and the material environment to maintain social and economic stability

To Strang V (2019) Anxieties about meeting basic human rights of access to sufficient clean water tend to obscure other aspects of people's immediate engagement with it, but these are also powerful influences on how people respond to a range of water issues. Water's essentiality to life means that it has a central place in multiple religious belief systems. In many place-based societies, where what are often described as 'nature religions' pertain, its elemental powers are frequently manifested in deities responsible for rain, fertility, and the creation of life. For example, in Africa, Mami Wata, a water goddess valorised in many parts of the continent's west coast, provides all of these things (Drewal 2008). In Aboriginal Australia, water is the source of cosmogenesis in the creative era known as Dreamtime, in which the world was formed, while the Rainbow Serpent, which is a manifestation of the powers of water, continues to generate life from within the land (Merlan 1998, Strang 2009). In the monotheisms of larger societies, water features as a vital manifestation of a humanised deity's divine beneficence or, in the form of floods or drought, as an expression of god's wrath. Thus for many people, access to sufficient and timely water carries an important moral and religious dimension.

Whatever the form of the providing deities, many religious schema also conflate ideas about water and the human spirit, generating visions of 'living water', vital to physical and spiritual well-being (Krause & Strang 2013). Such beliefs are central to a host of rituals in which water cleanses, heals, and blesses, and metaphorically carries the spirit between material and non-material domains. The notion of living water is also a response to people's phenomenological engagement with it as an animated and animating element that is always in motion: shimmering, flowing, appearing, and disappearing. Physical and immediate interactions with water bathing, drinking, swimming, and observing provide a range of compelling sensory experiences, which lend emotive weight to people's thinking about water and what it means (Krause 2016, Strang 2005). Thus, an understanding that water flows through, enlivens, and connects people and places supports important ideas about common substance and identity. These are neatly expressed, for example, in the use of water for rituals of baptism that welcome individuals into particular groups or congregations, or which conjoin them in marriage (Mallery 2011). The inevitable dark side of this understanding is that a vision of identity as literally 'substantial' also allows for many anxieties about social

and/or physical pollution, and invasions of ‘otherness’ that might compromise individual or collective health and well-being (Strang 2004).

Concepts of holiness, health, and wealth are both etymologically and conceptually related. They express capacities for maintaining (spiritual, bodily, or fiscal) wholeness and flourishing. As well as being seen as fundamental to physical health, the relationship between health and water has seen a transition from assumptions about water’s intrinsic healing qualities (as assumed, for example, in the thousands of holy and healing wells in many parts of the world) to more material notions about the healing properties of water’s mineral content, which led to a major fashion in Europe for spas and baths (Anderson & Tabb 2002). Water’s centrality to processes of production leads to cross-cultural acknowledgement of its essential role in enabling human agency and generating wealth. What constitutes wealth is culturally diverse, but in many societies the relationship between water and wealth is often demonstrated in the ways that the ownership of water, displayed in landscaped gardens, fountains, and pools, provides a key signifier of wealth and social status.

As the above implies, the control of water is intrinsically related to economic and political power, and historical and ethnographic research has demonstrated that how water is controlled and distributed provides a precise mirror of social, political, and environmental relations. A classic study of Balinese water temples, for instance, describes the carefully balanced social and hydrological relations mediated by local priests acting as both religious leaders and water managers (Lansing 1991). On a larger scale, it has famously been argued that major infrastructures such as irrigation schemes, requiring the centralisation and coordination of labour, were foundational to the creation of nation states (Hocart 1970).

However, Wittfogel’s more fundamental point, that power and the control of water are inextricably related, remains influential, and contemporary ethnographers have continued to explore how the control of water mediates relations between states and citizens, with access to water often demonstrating persistent social inequalities. For example, the manipulation of weirs, sluices, and water flows in a South Indian irrigation scheme has been shown to reinforce the advantages of village elites (Mosse 2003). In multiple development contexts, gender inequality influences women’s access to and control over water (Coles & Wallace 2005). The provision of water in Mumbai turns out to be linked to social identity and recognition of ‘hydraulic citizenship’, and leads to the exclusion of marginal groups lacking such recognition. Shifts in ideology are similarly reflected in water. A strong focus on

instrumentalism a determination to act directively on the material environment in industrialised societies has been exported, via literal and economic colonialism, to many parts of the world under the guise of development (Lewis & Mosse 2006).

Water has its own material powers, of course, in the force provided by water flows. Many societies have harnessed these powers, via channels, water wheels, and mills, to do work to support their processes of production, and to direct irrigation to their crops. But water is not always amenable: it also has its own agentive effects in making and unmaking environments and impacting upon human lives. In a world dominated by dualistic ideas of nature as the 'other' to culture, water is commonly seen to represent the capacities of the non-human world to reject the authority of human instrumentality. Water's material forces highlight that such efforts often involve an intrinsic tension a wrestling for control (Edgeworth 2011). This brings to the fore the reality that every cultural landscape is also a cultural waterscape. Control over water flows is achieved via the imposition of dams, canals, drainage, reservoirs, pipes, and other directive infrastructure that materialises societal ideas, values, and practices in relation to water. As with other forms of infrastructure, such concretization inscribes long-term patterns of human-environmental engagement upon the land and waterscape (Bichsel 2016, Harvey & Knox 2012, Larkin 2013).

Over time, human communities have engaged with water with varying degrees of determination to control its movements and direct its flows into serving their interests. Early societies, and those that have retained pre-industrial economic modes of hunting and gathering, horticulture, and small-scale agriculture, have tended to be conservative in their practices, working with the inherent processes of local ecosystems, and imposing relatively low-key forms of manipulation of the landscape for their purposes. In many larger societies, however, trajectories of human-environmental engagement have been very different, as population growth and technological developments have encouraged more assertive efforts to control water flows. Social and religious changes, in particular movements from nature religions to monotheistic beliefs, have led to notions of 'dominion' and the desire to impose patriarchal authority on 'nature', often feminised as alternate to male 'culture' (Plumwood 1993, 2002). The objectification of nature has also been encouraged by a more scientific lens upon the world, through which ideas about what water is have become 'disenchanted', leading to its reconceptualization as $H_2O$ (Illich 1996, Linton 2010).

Greater dominion over water has been realised through new forms of science and technology enabling extensive engineering of the landscape and increasing capacities to direct water flows into supporting the needs and desires of rapidly enlarging human populations. Water usage has risen, in part because of more profligate domestic habits, but also in its use to support societies' growing dependence on irrigated agriculture, as well as industry itself, which due to the embodied water in goods and production processes often results in the movement of water globally from arid environments to densely populated and wealthier temperate regions (Hoekstra & Chapagain 2007, Meissner 2012).

The commoditization of water, and its reductive reframing as a resource or economic asset, has further encouraged utilitarian ideas about the material world as the basis for the provision of 'environmental services' or 'ecosystem services' to humankind. Patterns of water use in many societies have reflected the dominance of these ideas. In the last century there has been a race to build large dams, canals, and other infrastructures designed to direct water into enlarging urban areas; into hydro-electric generation; and into irrigated agriculture (Khagram 2004). Today over 70% of the earth's freshwater is directed into irrigation, and the World Bank has stated that a further 15% will be needed in the next decade to provide sufficient food and energy for the expanding human population. They are predicting major shortfalls, which raises the prospect of a range of problems, including rising numbers of environmental refugees.

## 2.14 Theoretical framework

### 2.14.1 Cultural ecology

Steward (1955) in his book, The Theory of Cultural Change, defines Cultural Ecology as a holistic device for understanding the effect of environment upon culture. Steward's book also looks at the concept of multilinear evolution, which identifies different society's progress at different paces, with the pace of development depending on the natural resources that surround a society. The author also goes on to critique fellow anthropologists in his book. He feels that the majority of his contemporary anthropologists overlook the impact of environment on a society.

Theory of Culture Change also contains Steward's three fundamental procedures of cultural ecology, which are as follows:

> *The first fundamental procedure states that the more complex a society is, the larger the presence of socially-derived needs rather than necessities. The*

> *behaviour patterns involved in the exploitation of a particular area by means of a particular technology must be analyzed .This looks at the interaction between people based on the environment. The abundance or scarcity of resources determines whether people will make a collective effort or work independently. Ascertain the extent to which the behaviour patterns entailed in exploiting the environment affect other aspects of culture. The final procedure as stated by Steward applies the other various aspects of a culture to its relationship with the environment. Without looking at all the various anthropological aspects of a culture, then it is impossible to fully grasp the effect of environment on a culture (Julian 1955, 17-19).*

From the Julian words above, she says when a society is complex, the larger social needs than necessities. This indicates that there are two types of socities that is simple and complex society. Herbert Spencer (1971) defines simple society as one which forms a simple working whole unsujected to any other and of which the parts cooperate for certain public ends. They have low division of labour, their occupational differentiation is being limited primarily to birth, sex and age. These societies have no specialized economic organisation. According to Herbert Spencer, complex society grows through economic and other acts of spontanoeus cooperation by gregarious and social individuals who are themselves displaying what is called social self consciousness. Division of labour emerges, that exhibits a relatively stable functions and structures. In simple societies, they are more interested in their needs like food, water and shelter. These are the most important things those in the simple societies need. While those in the simples society are interested in organisations, how the economy is structured according to specialisation and a division of labour.

In our context of study, access to potable water in simple societies becomes easy because they are controlled by individuals or notables in those societies givien the fact that the population is small and is easy to manage. But in complex society, it becomes difficult because the government or the state will be looking at the functions of the various structures put implace to over look issues that concerns water and sanitation. In most cases their produces takes a lot of time. In simple societies, there are a lot of community activities just to make sure that the inhabitants are in good condition. Like for example in some communities like villages in the North West Region, they practice a lot of community spirit. There are days they keep aside to clean up their water points, repair won out pipes just to name a few. They also have confidence in the people or the head they have. But in complex society lik Yaoundé VI area, there are no community activities, even the various water points that the inhabitants use are not constructed. In large communities, there is little or no trust to the stakeholders or the government that the people have making their activities more complicated.

Furthermore, we can also see from Julian words some of these environmental activities affect people culture. In most of our communities streams are used for bathing (men, women and chilfren), laundry and some cultural traditional rites. But in towns or cities, the culture of bathing at the streams becomes a taboo in the area. Some of the traditional rites now have been loss because they cannot be practice in complex society. To that eefect, it is the environment that determinds our culture and not our culture determing our envieonment.

Definition of cultural ecology by Anderson:

> *Ecology is the study of interaction between living things and their environment. Ecology is the study of the relationships and interactions among humans, their biology, cultures, and their physical environments. Human ecologists study many aspects of culture and environment; including how and why cultures do what they do to solve their subsistence problems, how groups of people understand their environment, and how they share their knowledge of the environment* (Anderson 1992).

Anderson, define ecology as the study of interaction between living things and environment (biology, cultures and physical environment). In our context of study, the living things include plants and animals in its biological nature and the environment contains the culture and the physical environment. It is our interaction in the environment that determinds our biological fitness. If the environment is able to produce polluted water and toxic food, these substances are not fit for the human system thereby rendering putting health of the inhabitants at risk. Also, for the environment to produce polluted water and toxis food also depends on the human activitiea like agriculture, poor waste disposal and finaces. If these factors are well managed, the environment will become a better place for settlement to all living things. Adapting to the environment like in our context, the inhabitants need strategies to adapt in the environment like in the case of water shortage, natural springs and well water seems to be the best option to use.

Yaoundé VI, constitutes multicultures, that is different cultures found in this area from different regions. In this case, culture change is bound to happen because their original place is not the same as in Yaoundé VI. The inhabitants in this area are bound to have similar cultures because of the environment that they find themselves in. The inhabitants learn the culture of using alternative measures to cope with the environment to adapt with water scarcity and it is this interaction in the environment that determinds our culture.

### 2.14.2 Cultural interpretation theory

Geertz (1973: 3-27) views people as being entangled in webs of meaning that are of their own making culture for Geertz is embodied in the person who acts out of and in a certain context, and culture is revealed in this person's actions and his interpretation of their meaning. Characteristics of culture according to Geertz;

> *The total way of life of people, the social legacy the individual acquires from his group, a way of thinking, feeling, and believing, and an abstraction from behaviour. The theory on the part of the anthropologist about the way, in which a group of people in fact behave, is a storehouse of pooled learning. a set of standardized orientations to recurrent problems, learned behaviour, a mechanism for the normative regulation of behaviour, a set of techniques for adjusting both to the external environment and to other men. To him, if an individual possess these characteristic then you are a member of that community or society. The description of interprertative theory include: surface-level observations of behaviour while thick description added context. To explain this context, it required graping individuals' motivations for their behaviours and how these behaviours is understood by other observers of the community as well*.

From the above assertion by Geertz, we can point out two key words that will be used in our work. We have the behaviour, collectively and individually.

Behaviour in our work coping strategies for access to potable water, one will wish to know the interpretation given to potable water. The way people care and protect their water sources depends on their behaviour. Given that Yaoundé VI is a heterogenous town, it will definitely provide us with the perception people have toward water, believe, functions of the potable, and how they care for their potable water. In our context, one can conclude that water is not a valuable need, because if it was valued, the inhabitants would have taken care of the various water points. But from their behaviour it shows that water has no important to them. For instance the Ewondo people who cherish large rivers for their traditional rites will see the small streams around as nothing since it can not be used for their cultural activities. In our context, most of the population have leraned new behaviour in pother to adapt to the new environment given that Yaoundé VI is not their original place or home. No community spirit is one of the characteristics found in Yaoundé VI area so as an inhabitant of this area, one need to learn how to mind his or her own business to become a member of the community in this council area.

Thick description is an anthropological method of explaining with much detail as possible the reason behind human actions. Many human actions can mean many different things, and Geertz insisted that the anthropologist needs to be aware of this. Thick description

results from a scientific observation of any particular human behaviour that describes not just the behaviour, but its context as well, so that the behaviour can be better understood by an outsider. In relation to our work, thick description will mainly be talking about reasons why people use well water, spring, tap, and mineral water. The circumstances that permits the inhabitants to use mineral water like incases when you are sick or only for children. Thick description also permits one to know how this water is being use and where it is being used. These are the various points that motivate an individual that motivates his or her behaviour to act in the manner that best suits them. Furthermore, the thick description also permits the know-how of the population on how to get potable water to themselves, the importance of water in their culture, importance of potable water to them as humans, the effects of not using potable water and some of the effect of using potable. One can equally try to see if the population has the knowledge on how water preservation can be done and how they can treat their water before usage, in case where they have water that is not potable.

From the above two theories, that is, cultural ecology and cultural interpretation, one can actually see how the theories are related to our work from what we have been able to illustrate.

### 2.15. Definition of key concepts

#### 2.15.1. Water

The definition of water has been given by diffierent sources some of which we shall describe below:

It is a liquid without colour, smell or taste that falls as rain, in lakes, rivers and seas, and is used for drinking, washing (*Oxford Advanced Learners Dictionary*, 8$^{th}$ edition).

A more scientific definition of water is given by Steven and Zumdahl (2019), According to them, water is a substance composed of the chemical elements hydrogen and oxygen and existing in gaseous, liquid, and solid states. It is one of the most plentiful and essential of compounds. A tasteless and odourless liquid at room temperature, it has the important ability to dissolve many other substances. Indeed, the versatility of water as a solvent is essential to living organisms. Life is believed to have originated in the aqueous solutions of the world's oceans, and living organisms depend on aqueous solutions, such as blood and digestive juices, for biological processes. In small quantities water appears colourless, but water actually has an intrinsic blue colour caused by slight absorption of light at red wavelengths.

To William and Shiel (2018), they gave a medical definition of water as; liquid containing or resembling water is a pharmaceutical or cosmetic preparation made with water, a watery solution of a gaseous or readily volatile substance see ammonia water, a watery fluid (as tears or urine) formed or circulating in a living body and amniotic fluid often used in plural also as bag of waters formed in a woman during pregnancy period.

Water is a component found in the environment that is being used by man and other animals in the environment and in its economic diamension. In this environment, water is being given its cultural significance and its meaning by the people.Water found in the environment is also used by the people to adapt in their environment for cultivation; domestic usage, and attachment of some cultural values to like beliefs, norms and their values. This is confirming what the theories above cultural ecology and cultural interpretation are describing

**2.15.2. Potable water**

Potable water is relative meaning; each and every individual has its own way of defining potable water. Potable, have many definitions as will be seen from different authors below:

Safe to drink (Oxford Advance Learners Dictionary, 8$^{th}$ edition 1948).

According to Marriam Webster dictionary (1828), potable is a liquid that is suitable for drinking especially: an alcoholic beverage.

The definition of potable is something that is safe to drink. Unspoiled milk is an example of something that would be described as potable.

Potable also means good for drinking without fear of poisoning or disease.

According to WHO (2004), potable water does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages.

**2.15.3 Cope**

To deal successfully with difficult (*Oxford Advance Learners Dictionary*, 8$^{th}$ edition).

According to Merriam Webster (1828), cope is; to deal with and attempt to overcome problems and difficulties often used with. It is also to deal with and try to find solutions for problems.

Merriam dictionary, Macmillan dictionary (2009) defines cope as to deal successfully with a difficult situation or job.

To Folkman and Lazarus (1985, p.152), coping refers to cognitive and behavioural efforts to manage, master, reduce or tolerate a trouble some person, environment and relationship. In our context of study, we shall be looking how human tolerated water pollution and water scarcity.

### 2.15.4. Strategy

Strategy is defined below as follows;

*Oxford Advanced Learners Dictionary, 8th edition,* (1948) defines strategy as a plan that is intended to achieve a particular purpose; it is also the process of planning or putting a plan into operation in a skilful way.

According to *Business Dictionary* (2019), strategy is a method or plan chosen to bring about a desired future, such as achievement of a goal or solution to a problem. The art and science of planning and marshalling resources for their most efficient and effective used. The term is derived from the Greek word for generalship or leading an army.

Another definition from Henry (1998), states that it is a directed course of action to achieve an intended set of goals, similar to the strategic planning concept. In the context of this study, strategy will be viewed as the various mechanisms and methods put in place by inhabitant's of the Yaoundé VI municipal area to cope with the water crisis they face.

### 2.15.5 Access/Accessibility

Access is defined as follows, according to the *Oxford Advanced Learners Dictionary, 8th edition,* as a way of entering a place. According to *Merriam Webster Dictionary*, (1828), access is permission, liberty, or ability to enter, approach or pass to and from a place or to approach or communicate with a person or thing, freedom to obtain or make use of something. In this study, we will be looking at the various accessible means the inhabitants of Yaoundé VI have in getting potable water.

### 2.15.6 Adaptation

Adaptation is a characteristic that improves an organism's chances of survival. It can bebiological and ecological, referring to the process of adjusting in behaviour or structure to become more suited to an environment, what is termed as natural selection by Charles Darwin (1871). When one looks at the term adaptation and relating it to coping strategies,

this refers to the various cultural methods or means used by the population of Yaoundé VI to cope in times of water crisis, as stated above by cultural ecology theory. At this point, the people use their knowledge to survive in the environment such as boiling water for drinking, using natural springs in times of shortages etc.

### 2.15.7 Ecology

It is the study of the environment, and helps us to understand how organisms live with each other in unique physical environment (Stadler 1998). In biology dictionary 2017, it defines ecology as that branch of biology that studies how organisms interact with their environment andother organisms.every organism experience complex relationship with other organisms and this has lead to natural selection which causes population of the same specie to evolve. This equally boils down to the theory of cultural ecology which tries to explain how people need to understand their environment, in order to be able to cope in it. Their cultural strategies to survive in harsh conditions like coping in the area of limited water supply will be seen in the Yaoundé VI council area.

### 2.15.8. Culture

Culture is generally defined as the ways of life of a given community. According to Eward Tylor (1871), it is a complex whole which includes knowledge, belief, art, laws, morals, customs, and any other capabilities and habits acquired by man as a member of a society. When one looks at the definition above, the two theories stated above are all involved. The first theory which talks about cultural ecology is making us to understand that one need to have all the characteristics listed above to be able to survive in an environment. This means if an individual is unable to acquire this, he/she cannot be called a member of the society. The second theory which talks about cultural interpretation is simply talking about thick description of water culturally, meaning that there are different cultural groups and its different cultural use of water in the environment like with the case of Yaoundé VI which is an urban setting. According to Mbonji (2010), La culture n'est pas une science de vivre, mais un art de vivre, une formulation et une solution au quotidien du problème de vivre, formulation et solution faites de réalités insérées dans un être-le-monde d'où elles tirent sens, cohérence et non vérité unique. From Mbongi definition, he sees culture to be that solution to every problem to what the human being face in the community.

### 2.15.9 Cultural ecology

It is the study of human adaptations to social and physical environment from wikipedia. Human adaptation refers to both biological and cultural processes that enable a population to survive and reproduce within a given changing environment. Cultural ecology which is the theory coined out by Julian (1902-1972) she said cultural ecology is the analysis between culture and environment. In order words, how does physical environment (weather, vegetation and animal life) affects culture. She also proposed that cultures interact with their environmental setting by adapting features of technology, economic organisation, and even kinship or religion to allow people to best pursue their livelihoods. She tries to bring out the cultural strategies that can be used by the people to cope in their environment.

### 2.15.10 Scarcity

Scarcity refers to the limited availability of a resource in comparison to the limitless wants (Edmund 1990). It may be with respect to any natural resources or with respect to any scarce commodity. Durham 1979 says scarcity refers to the absence of sufficient resources to support human needs. In our work, it is as a result of water scarcity and pollution that causes people to look for cultural adaptation strategies to be able to cope in the environment as stated in the cultural ecology theory.

### 2.15.11 Pollution

Pollution is the introduction of a substance that causes adverse changes in the environment and living entities (Laura 2017). When our water sources are polluted, the environment becomes unfit to the organisms because human cannot use polluted water for consumption. Pollution is mostly caused by human activities like farming, poor waste disposal etc. By so doing, they try to adapt to the environment by looking for strategies that can or will help them survive in that given environment as coined out by the cultural ecology theory.

### 2.15.12 Environment

It is a sum total of all the living and non-living elements and their effects that influences human life that is living and non-living things occur naturally. It is this environment that we live and give different interpretations and meanings to all our behaviour and activities, this brings us to the cultural interpretative theory where we give meanings or detailed cultural interpretation of works. It is also in this environment where one is able to

change the environment to suit or to be able to adapt given any situation, which is related to the first theory cultural ecology.

### 2.15.13 Urban

It is a town or a city (Oxford *Advanced Learners Dictionary*, 8th edition). Urban is a town or city like Yaoundé VI area. Being urban, it has characteristics of urban areas like water pollution, poor hygiene and sanitation, crowthing, heterogenous, segmentation of personality, social distance, some of the characteristics of urban society already tells us that there are different classes of people existing that is the high class those who are well to do; for this individuals to cope or adapt to water pollution and scarcity, they tend to buy mineral water because they can afford the means. For those who are of the lower class, they have their own strategy of adapting to the environment during water crisis which is by resorting to streams and well water. These are all cultural strategies put in place by the inhabitants to be able to survive in the environment due to the challenges they are facing concerning water. Also being heterogenous, it involves different cultural background and they all have their own meaning given to the importance of water and how they manage to cope in the environment during water crisis

From the above literature review, one can notice the gap in that, all the literature is based on socio-economic point of view living out the aspect of culture which encompasses everything as far as environment and human beings. Secondly there is little or no knowledge on water and culture in Yaoundé VI area. The above work did not equally show how cultures actually give meanings to water. So for us to fill in this gap we will be looking at the relationship between water and culture in the YaoundéVI. In the following chapters where our data will be analysed and interpreted, one can actually see the relationship between water and culture, how water is important to man culture and how various cultural meanings people give to water. The data was gotten through interviews and group discussion in the Yaoundé VI council area.

In this chapter, we have brought out what authors like Mehta in (2001), Tripathi (2009), Chapman (1996), Gok (2000),Swatuk (2002), Falkenmark and Rockstorm (2004) and some organisations like WHO, UNICEF who have written on the subject matter. This was done in different themes like causes of water scarcity, pollution and water purification. Again, we have discussed the theories that were used to analyse data that was collected from the field which were the cultural ecology theory and interpretative theory. Lastly, we defined

some of the key terms of our work which were water, coping, potable and strategies. The next chapter, we shall be seeing the different water sources used by the inhabitants of Yaoundé VI council inhabitants.

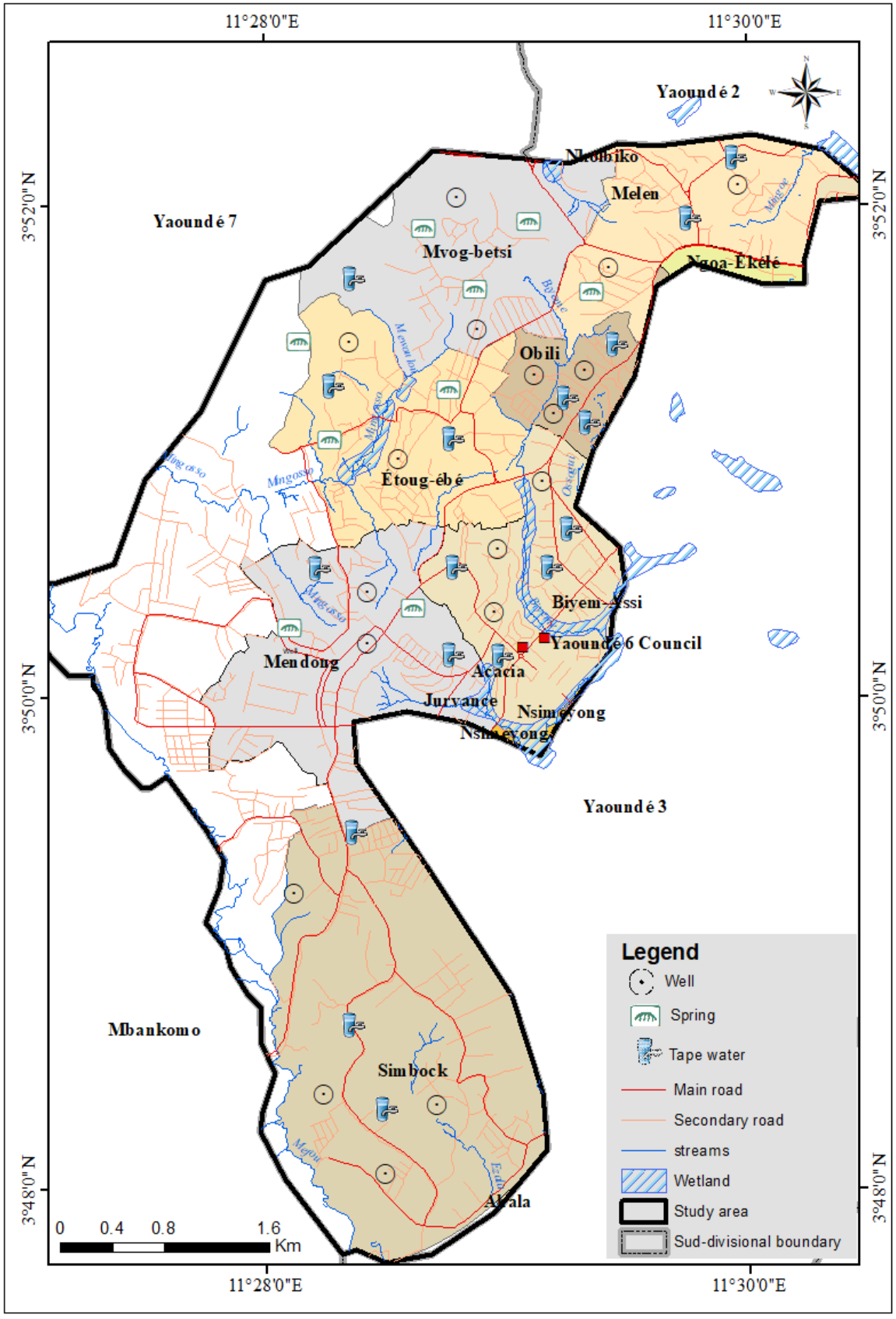
# CHAPTER III
# ETHNOGRAPHY OF WATER SOURCES IN YAOUNDÉ VI

This chapter shows the different water sources and their uses. Some of these water sources include: streams, rain water, well, tap water, springs and mineral water. We also brought out the cultural use of these water sources by the inhabitants of Yaoundé VI. The importance of the various water sources will equally be seen in this chapter, as well as the manner in which water is recycled.

## 3. Water sources in Yaoundé VI

Community water systems obtain water from two sources: surface water (streams, rivers, lakes, reservoirs or oceans) and ground water (drilled wells and springs). People use surface and ground water every day for a variety of purposes, including drinking, cooking, and basic hygiene, in addition to recreational, agricultural, and industrial activities. According to the United States Environmental Protection Agency (EPA, 2007), the majority of public water systems (91%) are supplied by ground water. However, the population (68%) are supplied year-round by community water system that is the surface water. This is because large, well-populated metropolitan areas tend to rely on surface water supplies, whereas small, rural areas tend to rely on ground water (Molden, 2007).

**Fig 5: The Different Water Sources in Yaoundé VI**




*Source fieldwork: Matilda Musah (June 2020)*

The map above clearly shows the various quarters that depend on springs, well water and tap water. The population of Mvog-Betsi, Centre and part of Mendong depends mostly on ground water that is the spring source and well water, rain, tap water and mineral water. While those in Biyem-Assi, Simbock, Melen and Nkolbikok use well, tap and mineral water. We will be seeing the various water sources used by the population of the Yaoundé VI council area.

**3.1 Surface water**

Surface water includes streams, rivers, lakes reservoirs or oceans. These are natural flowing watercourses, usually freshwater, flowing towards an ocean, sea, lake or another river. In some cases, a river flows into the ground and becomes dry at the end of its course without reaching another body of water and can also be defined as a stream because it flows through a channel on the surface of the ground. In Yaoundé VI, there are a number of streams flowing in the area. A river begins on high ground or in hills or mountains and flows down from the high ground to the lower ground, because of gravity. A river begins as a small stream, and gets bigger the farther it flows. It is from a river that damps are constructed and processed to potable water. In Yaoundé VI area, we have streams in quarters like Mendong, Mvog-beti, Centre Simbok just to name a few.

From these sources, the water is channelled into pipes where it is being supplied to the communities concerned as tap water. In Yaoundé, there are many rivers (river at Mfou and Mbalmayo) that have been constructed and supplied to the community for use which makes life easy for everybody.

A stream is a body of surface water flowing on the surface of the earth following a directed pattern. According to Misachi (2018), it is a water body with surface water flowing within the bed and banks of the channel. It exists by itself and joins with other streams to form a large river. The flow of a stream is controlled by three inputs - surface water, subsurface water and groundwater. The surface and subsurface water are highly variable between periods of rainfall. Groundwater, on the other hand, has a relatively constant input and is controlled more by long-term patterns of precipitation. The stream encompasses surface, subsurface and groundwater fluxes that respond to geological, geomorphological, hydrological and biotic controls.

An informant told us some sources of water that he knows in his words and this is what he said: *"I know of surface water like rivers, lakes and streams, all of these are being used by the population for various reasons. Water is very important and it needs to be*

*available for inhabitants for survival*" (Kelvin, 10th October 2019, Simbock,). In Kelvin's opinion, there exists surface water in the community which is very important for the population for their various uses. Different people use water for different purposes. So, they are all important at all levels. M point of view confirms what Gray and Feldman (2012) said concerning surface water. To him, most cities meet their needs for water by withdrawing it from streams, rivers and lakes are all naturally found in the environment. Water is one of the things found in the environment that humans need it for survival.

**Fig 6: Stream at Etoug-Ebe**

*Source fieldwork: Matilda Musah (November 2019)*

The figure above shows a stream which originated from a spring source, a broken pipe that flows into the stream and houses around this area use the stream as their waste disposal inside. Such streams are often used for waste disposal. Waste disposal increases water pollution in the quarter, as well as the environment, producing odour from the undecomposed materials.

Streams typically derive most of their water from precipitation in the form of rain. Most of this water re-enters the atmosphere by evaporation from soil and water bodies, or by the evapotranspiration of plants. Some of the water proceeds to sink into the earth by infiltration and becomes groundwater, much of which eventually enters streams. Some precipitated water is temporarily locked up in snow fields and glaciers, to be released later by evaporation or melting Cech (2010), and Feldman (2012). The rest of the water flows off the land as runoff, the proportion that flows varies according to many factors, such as wind, humidity, vegetation, rock types, and relief. This runoff starts as a thin film called sheet wash,

combined with a network of tiny rills, together constituting sheet runoff. When this water is concentrated in a channel, a stream has its birth and some creeks may start from ponds or lakes (Langbein 1995).

### 3.1.1 Types of streams in Yaoundé VI

Streams can be broadly categorised as perennial or intermittent streams depending on the characteristics of their flow. Perennial streams are streams that flow throughout the year and are common in the humid areas where the ground and surface water systems are connected. The groundwater supplies water to the streams even during dry seasons, ensuring that the streams flow all year round. In Yaoundé VI, there are streams that flow throughout the season. We can have this type in quarters like Etoug-Ebe, Mendong and others.

Intermittent streams are streams that only flow when significant rainfall occurs. The intermittent streams are also referred to as seasonal streams. The streams are often dry during the dry season and are common in deserts. Other streams may only flow only during and immediately after precipitation. Such streams are referred to as ephemeral streams. Some people have argued that ephemeral streams are simply surface runoff (Misachi 2018). There are also intermittent streams in Yaoundé VI area and one can find them at Centre, and Mvog-Betsi, just to name a few.

Inermittent treams provide many upstream and downstream benefits. They protect against floods, filter pollutants, recycle potentially-harmful nutrients, and provide food and habitat for many aquatic organisms. These streams also play a critical role in maintaining the quality and supply of drinking water, ensure a continual flow of water to surface waters, and help recharge underground aquifers.This was what an informant told us concerning intermittent stream.

*"There is a small stream behind my home but it flows only during the rainy season and dries off during the dry season. Like now it has started flowing out. So my family and I use it in doing house chores like cleaning***"** (Carine, 12 June 2020, Mendong). Carine point is validating what Misachi is saying above concerning intermittent streams. This climate change has now condition the environment on how to meet the need of the inhabitants. But all the same, the people use the water for their daily activities as long as it flows out.

Streams play a critical role in the quality and supply of our drinking water by ensuring a continuous flow of clean water to surface waters and helping recharge underground

aquifers. The population gets some or all of their drinking water from public drinking water systems that rely in part on these streams.

Headwaters, seasonal streams and rain-dependent streams absorb significant amounts of rainwater, runoff and snowmelt before flooding. These streams have significant storage ability and play a critical role in protecting downstream communities by moderating flooding during heavy flow and by maintaining flow during dry weather.

Streams are also vital for recharging the groundwater supply. Water enters the groundwater through the stream bed. Even during dry periods, groundwater replenishes flow in the stream to feed downstream waterways. In arid regions, water from rain-dependent and seasonal streams supports springs, wetlands and plants far from the recharge areas. A major source of water in rivers is from groundwater released into streams that only flow part of the year. The intermittent stream reduces water pollution since they do not flow throughout the year.

Streams can reduce the pollution that flows to downstream rivers, lakes, bays, and coastal waters. They are able to retain sediments and excess nutrients, such as nitrogen and phosphorus, and prevent these pollutants from traveling further downstream where they could cause algal blooms or dead zones.

Streams that only flow for part of the year are unique and diverse habitats that can support thousands of species, including plants, fish, amphibians, birds and mammals. These streams are important as spawning and nursery habitats, seasonal feeding areas, refuge from predators and competitors, shelter from extreme weather and travel corridors. Many stream species, including fish, snails, crayfish, insects and salamanders, are now in danger of extinction as a result of human actionsor activities.

Streams that flow for only part of the year provide crucial habitat, food and water for plants and wildlife. In the arid regions, vegetation and wildlife near these streams which often have water flowing just below the surface even when the surface looks dry is significantly higher than in the surrounding uplands.

Protecting streams is important for the economy, particularly for their key role in fishing, hunting, agriculture, and recreation. Healthy streams and headwaters support many industries that are dependent on water.

Everyone is affected by water quality and quantity like the streams and rivers. They are used for public water supply (drinking, laundry, doing the dishes, showering), recreation

(swimming, boating, and fishing), and habitat for animals, farming and manufacturing industries. From the above economic importance of surface water, fishing and agriculture are practised in Yaoundé VI but the rate at which fishing is practised in Yaoundé VI is very low such that the population cannot depend on that as an income generating activity and for survival. Agriculture that is practised in this area can be called urban agriculture because it is done in town and in a very small quantity, mostly for family consumption and not for economic purpose. Even though some people do sell the fish, that alone cannot support them financially.

In order to cope with the standard of living, they engage in activities like trading, hand work, others do house help job, transport business, industrial cleaning, and some work in private organisations while others are civil servants. Furthermore, there are also recreational centres, hotels with swimming pools which offer jobs for the inhabitants of Yaoundé VI. All these activities help the population in generating income for their families and upkeep.

### 3.2. Tap water in Yaoundé VI

Tap water (running water, city water, town water, municipal water, sink water, etc.) is water supplied to a tap (valve). Its uses include drinking, washing, cooking, and the flushing of toilets. Indoor tap water is distributed through "indoor plumbing", which has existed since antiquity but was available to very few people until the second half of the 19th century when it began to spread in popularity in what are now developed countries. Tap water became common in many regions during the 20th century, and is now lacking mainly among people in poverty, especially in developing countries. Tap water is often culturally assumed to be drinking water, especially in developed countries. Usually it is potable, although water quality problems are not rare (AWWA Research Foundation 1999).

**Fig 7: Showing tap water**

*Source fieldwork: Matilda Musah (June 2020 Biyem-Assi)*

The picture above shows tap water that is connected into a house which eases the work of the family from going far away in search of water. The tap in this house saves time for other activities in the house. This tap has been technologically connected into the house, unlike streams, rivers and lakes that are very open in the environment.

The Importance of using tap water is explained by Van der Leun (2009) as healthier for human, The World Health Organisation states that tap water is used around the world and doctors frequently publish reports stating that this water is safer than or as safe as bottled water for drinking. In some places like Madrid, Zurich, Munich, Stockholm and Oslo, the local tap water which they consider it potable tastes great to most of the people and we can have this too in Buea and other towns in Cameroon where they have potable water to a certain extend. In other countries and local municipalities, it may taste poor or really bad. This can only be contrast with water out of Yaoundé, like Buea because the whole of Mfoundi division has problem potable water and it is confirmed by the colour and particles always found in the water.

The tap gives the population unlimited fresh water whenever they need it for drinking, cooking, coffee, tea or watering of plants. In the Yaoundé VI area, convinecy to a certain extend with tap water is experience by few quarters in the area like part of Acacia, Biyem-Assi, Jouvence, Rond-point express, part of Melen, Elig-Effa, part Etoug-Ebe. Other quarters

like Centre, Mvog-Betsi, Mendong and Simbock, part of Mendong not the whole quarters have tap water, it does not flow frequently. The cost of mineral water is usually less than 500 FRS or less per bottled water. The cost of filtered, water in a tangi bottle is 25FRS, tap water in a 25liter container is 50FRS. The number of containers one carries also increases the amount of money he or she has to pay.

AWWA Research Foundation says tap water have good quality potable water that is good for consumption but it is contrary to what we have in Yaoundé VI as confirmed from the news and informant from the council area. In conclusion, tap water should be boiled or filtered before drinking if one can and depending on its availability and the means for filtration and boiling.

### 3.3. Ground water in Yaoundé VI

Groundwater is the water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through geologic formations of soil, sand and rocks called aquifers. Groundwater is contained in what is called ‘aquifers’. An aquifer is a geological formation or part of it, consisting of permeable material capable to store/yield significant quantities of water. Aquifers consist of materials like: unconsolidated sands and gravels, permeable sedimentary rocks such as sandstones or lime stones, fractured volcanic and crystalline rocks, etc (Kundell 2008).

Groundwater is (naturally) recharged by rain water from water that leaks through the bottom of some lakes and rivers. Groundwater also can be recharged when water supply systems leak and when crops are irrigated with more water than required. There are also techniques to manage aquifer recharge and increase the amount of water infiltrating into the ground. Groundwater can be found almost everywhere. The water table may lie deep or shallow depending on several factors such as the physical characteristics of the region or area, the meteorological conditions and the recharge and exploitation rates. Heavy rains may increase recharge and cause the water table to rise. But in the other hand, an extended period of dry weather may cause the water table to fall. Examples of ground water we have the springs and well or drilled water which are all found in Yaoundé VI area as it will be discussed below.

#### 3.3.1 Spring water

Spring water is a popular form of bottled water which comes from underground water far below the earth’s natural water table. It is collected at the opening of a spring and it can

also be collected directly underground from a borehole like well. The spring is culturally generalised as purified (potable) because it travels through natural filters like limestone, sandstone and clay before reaching the earth's surface.

The figure below shows the water coming out from a rock which is known as underground water or springs. The environment is surrounded with crops planted around the area which are obviously doing well. Photo B shows people carrying water from the spring which is connected with the help of a container that is carved to connect the water to flow through. Photo C shows how the ground water is connected with the help of a pipe, helping the people to carry their water easily.

Figure D below shows how people are carrying water from an underground source, a part of the water connected with a Tangui bottle that has been cut and the other not connected. But the people have no problem carrying the water as it is.

When groundwater reaches an aquifer, it does not stand still. It normally keeps flowing but much slower than before reaching the aquifer. How fast groundwater flows depends on the characteristics of the aquifer. The direction it moves is normally from high to lower levels ruled by gravity, unless there is any anthropogenic impact such as pumping wells. The groundwater will move until it discharges into another aquifer or another water body like a lake, a river, an ocean or until it is extracted by a well.

To be able to store and yield groundwater, an aquifer needs to have certain physical characteristics. It needs to have empty space (pores or fractures) where groundwater can be stored and the spaces need to be connected to allow it to flow through. Technically, when there are spaces and they are interconnected, the geological formation is permeable. When there are no spaces or they are not interconnected, the geological formation is impermeable. The more groundwater is stored and yielded by an aquifer, the more permeable and porous it is.

**Fig 8: Some Spring Water Sources in Yaoundé VI**


*Source fieldwork: Matilda Musah (May 2020, "Centre", Mvog-Betsi and, Mendong)*

### 3.3.2 Well water

A well is an excavation or structure created in the ground by digging, drilling to access liquid resources, usually water. The oldest and most common kind of well is water well, to access groundwater in underground aquifers. Well water is drawn up by a pump, or the use of containers, such as buckets, that are raised mechanically or by hand. Water can also be injected back into the aquifer through the well. According to Raymond (1995), drilling equipment includes explosive loader trucks, diamond drills, rotary drills, percussion drills, and drill boom jumbos are used in drilling wells. Placing a lining in the well shaft helps create stability, and linings of wood or wickerwork which date back at least as far as the Iron Age.

**Fig 9: Well water sources**


*Source fieldwork: Matilda Musah (November 2019, Mewoulu ("Centre")*

Picture above is a local well with a lid to protect stray animals and other dirty particles from getting into it.

These wells have traditionally been sunk by digging, as is the case in rural areas of the developing world. These wells are inexpensive and low-tech as they use mostly manual labour, and the structure can be lined with bricks or stones as the excavation proceeds. Below are types of wells (Raymond 1995).

### 3.3.2. Types of wells in Yaoundé VI

There are basically three types of wells which include driven well, driiled well and dug well.

Driven wells: Driven wells may be very simply created in unconsolidated material with a well hole structure, which consists of a hardened drive point and a screen (perforated pipe). The point is simply hammered into the ground, usually with a tripod and driver, with pipe sections added as needed. A driver is a weighted pipe that slides over the pipe being driven and is repeatedly dropped on it. When groundwater is encountered, the well is washed of sediment and a pump installed.

Drilled wells: Drilled wells are typically created using either top-head rotary style, table rotary, or cable tool drilling machines, all of which use drilling stems that are turned to create a cutting action in the formation, hence the term drilling. Drilled wells can be excavated by simple hand drilling methods (augering, sludging, jetting, driving, hand

percussion) or machine drilling (rotary, percussion, down the hole hammer). Deep rock rotary drilling method is most common. Rotary can be used in 90% of formation types.

**Fig10: Drilled well**

*Source fieldwork: Matilda Musah (April, 2020, Mendong and Centre)*

The figure above is a drilled well that were provided by the Yaoundé VI council to the community. The picture above validate what the council of Yaoundé VI has been doing and is still doing as water provision is concern in the community.

Drilled wells can get water from a much deeper level than dug wells can often down to several hundred metres. Drilled wells with electric pumps are used throughout the world, typically in rural or sparsely populated areas, though many urban areas are supplied partly by municipal wells. Most shallow well drilling machines are mounted on large trucks, trailers, or tracked vehicle carriages. Water wells typically range from 3 to 18 metres (10–I5 ft) deep, but in some areas can go deeper than 900 metres.

Dug wells are inexpensive and low tech (compared to drilling) as they use mostly manual labour to access groundwater in rural locations in developing countries. They may be built with a high degree of community participation, or by local entrepreneurs who specialize in hand-dug wells. They have been successfully excavated to 60 metres (200 ft). They have low operational and maintenance costs, in part because water can be extracted by hand bailing, without a pump. The water is often coming from an aquifer or groundwater, and can be easily deepened, which may be necessary if the ground water level drops, by telescoping

the lining further down into the aquifer. The yield of existing hand dug wells may be improved by deepening or introducing vertical tunnels or perforated pipes.

**Fig 11: Dug wells**


*Source fieldwork: Matilda Musah (April 2020, Centre and Mvog-betsi)*

The figures above A and B validates the presence or usage of dug well in Yaoundé VI area. But then when one looks at the pictures, it is seen that they are not really in good state that can be use by the inhabitants or the owners. Normally a dug well is suppose to be well protected to prevent stray animals or even children from running into it.

### 3.3.3. Characteristics of underground water (spring and well water)

Underground water is basically water in its natural state, and so can be affected by a huge variety of issues, depending on the location, depth, eology, soil etc; some common issues are. They are hard, they have high iron content, they have bad odour, they have taste and colour. They have high solid content and presence of bacteria, lead, cyst, nitrates and other health affecting, aterials etc. This characteristics above substantiate on what Fetter (1994) said concerning groundwater. In his words, he confirmed that groundwater is not pure because it contains some small amount of dissolve gases, solids and suspended materials in it.

Underground water is basically water in its natural state, and so can be affected by a huge variety of issues, depending on the location, depth, ecology and soil. They are hard; they have high iron content; they have bad odour and they have taste and colour. They have high solid content and presence of bacteria, lead, cyst, nitrates and other health affecting

materials. It Groundwater represents about 30% of world's fresh water. From the other 70%, nearly 69% is captured in the ice caps and mountain snow/glaciers and merely 1% is found in rivers and lakes. Groundwater counts in average for one third of the fresh water consumed by humans, but at some parts of the world, this percentage can reach up to 100%. In the illustration an overview is given of the earth's water distribution.

### 3.3.5 Importance of ground water in Yaoundé VI (spring and well water)

According to Shiklomanov (1993), Ground water is a very important natural resource and has a significant role in the economy. It is the main source of water for irrigation and the food industry. In general, groundwater is a reliable source of water for agriculture and can be used in a flexible manner. When it is dry and there is larger demand, more groundwater can be extracted and when rain fall meets the necessities, less groundwater will need to be extracted. Globally, irrigation accounts for more than 70% of total water withdraw (both surface and groundwater). Groundwater is estimated to be used for total irrigation water use.

To the environment, groundwater plays a very important role in keeping the water level and flow into rivers, lakes and wetlands. During the dry periods or months when there is little direct recharge from rainfall, it provides the environment with groundwater flow through the bottom of these water bodies. This becomes essential for the wild life and plants living in this environment. Groundwater also plays a very relevant role in sustaining navigation through inland waters in the dry seasons. By discharging groundwater into the rivers, it helps in keeping the water levels higher.

Groundwater is found in Yaoundé VI almost everywhere and its quality is usually very good (potable). The fact that groundwater is stored in the layers beneath the surface, and, sometimes at very high depths, helps to protect it from contamination and preserves its quality. Additionally, groundwater in Yaoundé VI is a natural resource which can often be found close to the final consumers and therefore does not require large investments in terms of infrastructure and treatment, as it often is necessary when harvesting surface water. The population of Yaoundé VI needs some finance to build water tanks around the sources. The most important thing about using groundwater is to avoid overexploitation and to avoid pollution of this crucial resource.

For some, especially those in rural areas, access to a municipal water supply is unavailable and therefore well water is the only option when it comes to getting water. Not to worry, well water has many advantages. A main advantage of well water is that it is the

cheapest way to deliver water to homes or structure. All things considered, well water is much more affordable than municipal water and provides long-term savings.

Once a well has been dug, it can provide a practically endless supply of water. With adequate water filtration, well water is perfectly healthy to drink and use. Once a hole is dug it can be used endlessly for needs. In normal conditions, ground water that is dug into a well is safe for consumption, and pure, which is what makes well water a great option for some people. Well is easy to dig and can be maintain with local knowledge and skills. During the fieldwork, we meet an informant who digs wells as his job in the area and this is what he said:

> *I do dig well manually with the use of hole, bucket to carry ground, use robe and a spade. I usually do it for 10days when I engage in the activity and am not always alone because I need someone who will help me carry the ground whenever I dig it. Before doing that, I usually look at the area where I know it will be possible to have water easily in the compound or area that the house is to be constructed or is already constructed. This will permits me not to waste my time digging an area where there will not be water or will meet rocks as I do the work. After the digging, I pour gravel and sand at the floor of the well this will help sifter any solid particles from the water making the water to be clean. Also I used salt and eau de gavel to disinfect the water. At the bottom, we put rings of cements that have been built to protect the walls from falling into the water. Some people who have money will do that in the entire well. But for some who will just want to manage will just put the rings at the bottom of the well. Others will do it at the top and the bottom and those who don't have money will not put it at all. I usually do this mostly in the dry season because the ground is hard and difficult to collapse when digging. I do have some people whom I trained them for the job. I usually do it for 200.000 FRS and at times for 250.000 FRS. With this, am able to provide the needs of my family* (Leslie, October 12 2019, Mendong).

To the informant Leslie, he fines pleasure in what he does so long as it gives him what he need to keep his family together. Also, he is careful of the various periods he engages to do the well digging.  M is just giving the authenticity of groung water relating to what Shiklomanov (1993) said above. Ground water is naturally found in the environment and the population is making good use of the water.

We met another informant who gave use the importance of well water. In her view, *"Well water is important to me and my family because it is what we use in doing our domestic works. Since in this area we do not have tap water, we had to dig our well for water provision and it is cheap to afford"* (Mabel, October 12 2019, Mendong).

According to Mabel, well water is important to them because it is the only source of water they have. So they depend on it for every activity that needs to be done in their home. Well water is found free in the environment and it can only be potable for the people to use it when they keep a good relationship with the environment. This point is confirmed by what Mbonji said culture is a solution to every problem in the environment. Water found in the environment is culturally used by the population tomeet their needs. This is also confirmed by what Gray (2008) said, Economically, groundwater is much cheaper than surface water, as it is available at the point of demand at relatively little cost and it does not require the construction of reservoirs or long pipelines. It is usually of good quality, usually free from suspended solids and, except in limited areas where it has been affected by population, free from bacteria and other pathogens. Therefore, it does not require extensive treatment before use.

This is what another informant told us about well and spring water : "*We do not use well for drinking because we know it is not of good quality given the fact that there has been a lot of contruction closed to well which domestic liquid waste can seep through easily*" ( Odette, 13 of June 2020, Jurvance). According to Odette, well water is not good for drinking but she uses the water for other domestic used. This was confirmed from what we observed from the field and Pennington (2010) also said, the quality of world's groundwater ranges from extremely salty particularly in some coastal areas, to relatively mineral-free groundwater in Iceland. This makes groundwater unsuitable for some uses, especially drinking water about 33% of the Earth's groundwater is found in the Asian continents, 23 % in Africa, 18% in North America, 13% in North America, 6% in Europe, 5% in Australia and the remaining 2% in other locations of the world. This is also validated by what Umar (2006) is saying that the chemical composition is derived mainly from the dissolution of minerals in the soil and rocks with which it is or has been in contact. The chemical characteristic depends on interaction with solid phases, residence time of groundwater, seepage of polluted runoff water, mixing of groundwater with pockets of saline water and anthropogenic impacts.

### 3.4. Rain water and its importance in Yaoundé VI

Rain water harvesting is the collection and storage of rain, rather than allowing it to run off. It is collected from a roof-like surface and redirected to a tank or buckets depending on whoever is doing the collection. Collecting your own rainwater is an excellent way to conserve this precious resource. A basic rainwater collection system catches rainwater from

the roof or other surface and channels it into a container for storage. Rainwater itself is generally clean, but it can pick up micro-organisms, pollutants and debris when it hits the roof. This is why systems for rainwater use inside the home often include filtration or other treatments for safety.

In the Yaoundé VI area, rain is another source of water that the population depends on it. During this time, the people have various containers of different sizes and shapes to collect and store their water. The figure below clearly shows how rain water is collected in the Yaoundé VI area.

**Fig 12: Rain water**

*Source fieldwork: Matilda Musah (October 2019, Mendong)*

The above figure shows how rain water harvesting is done in some homes. These people use bowls and containers to store the water for usage**.**

Outdoor rainwater collection systems do not need as much treatment because the water is typically used outside. One of the easiest rain collectors to make is a repurposed old garbage can, whereas one can install a rainwater cistern if there is a need for a larger system. Despite the fact that rainwater remains one of the world's primary sources of drinking water, for many people living in modernised areas the idea of rainwater harvesting has become divorced from everyday life (Hatch 2018).

There are a variety of methods of rainwater harvesting and a virtually limitless amount of uses for harvested rainwater. A rainwater harvesting system can take many forms:

in its simplest form it is nothing more than a bucket left out to collect rainwater. More complex system can include extensive filtration, catchment tanks, and other professional solutions. On a broader scale, something like a fish pond or small reservoir can be considered a rain harvesting system. According to Hatch (2018), potential benefits include: drinking and cooking, bathing and laundry, flushing toilets, watering lawns, compositing, out door ponds, reduced environmental impact and savings on water bill.

This is what an informant told us concerning rain water: "*I use rain water in my house especially during the raining season. I use it for domestic purposes like cleaning and washing; it is a free gift of nature sois not expensive to me am sure potable enough that is why am suing it"* (Stelle, 17of August 2020, Mendong). According to Stella point of view, she uses rain water in her home for domestic uses, it is less expensive so that alone gives a good reason for her to use. This point is validated by Hatch (2018), giving out the potential benefits of rain water that includes: drinking and cooking, bathing and laundry, flushing toilets, watering lawns, compositing, out door ponds, reduced environmental impact and savings on water bill. This was also confirmed from what we observed from the field during our study.

### 3.4.1. Characteristics of rain water

Rain water is pure as long as it is not produced by acid rain water. It does not take a large amount of money to accumulate. It can be stored and is free of charge and, lastly, it is drinkable.Rainwater can actually be a very high-quality water for human consumption. It is relatively pure and does not contain any chlorine or other chemicals, which are often used to sanitise tap water. The problem starts when rainwater is collected from roofs or other dirty surfaces. Rainwater can be made safe to drink by installing a filtration system, boiling or distilling the water. Some systems can also directly collect clean rainwater to use for drinking. Washing clothes accounts for about 22% of indoor water use in the United States. Showers take 17%, and baths 2%. Effectively used harvested water can reduce municipal water use by over 40% (Hatch 2018). Rainwater can be used treated or untreated, deepending on the purpose.

Using rainwater can reduce water bills, provide an alternative supply during water restrictions and help maintain a green, healthy garden. This in turn can help reduced the need

for new dams or desalination plants, protect remaining environmental flows in rivers and reduce infrastructure operating costs. According to Hatch:

> *Rainwater is a clean source of water; the quality of rainwater is often better than ground water or water from rivers and basins. Rainwater is salt-free which means that it can easily be used for irrigation purposes without damaging plants and roots. However, atmospheric pollution due to high industrial and agricultural activities or traffic and contamination of the catchment surfaces are major issues as they contaminate the rainwater and make it unsuitable for drinking. Consequently, in many cities around the world, rainwater should not be used for drinking without prior treatment. Additionally, especially in tropical and subtropical areas, storage tanks can provide a habitat for harmful vector diseases, bacteria, microorganisms and algae* (Hatch 2018).

Rain water, from the excerpt above, is a clean source and with a good quality as compare to other sources like sea and rivers. To Hatch, areas which are highly industrialised should treat their rain water before drinking because of the atmospheric pollution. In some rural areas, some tanks acts as habitat for bacteria, so the rain water needs to be treated before drinking. Yaoundé VI area, there are tanks that people do not wash them so it acts as habitat to some bacteria.

### 3.5. Mineral water

Mineral water is water from a mineral spring that contains various minerals such as salt and sulphur compounds. In many places, the term mineral water is used to mean any bottles water that carbonate water or soda water as opposed to tap water. In our community today, people define mineral water as any water that is bottled and found in the market. This has made individuals to involve in water business in as much they have water bottled and selling, people will buy because they know it is mineral water.

Mineral water is known for its original purity, originated from protected underground water source, they have contains enough minerals and most of them are bottled and sell in the markets. During our fieldwork, we met an informant who gave us his point on mineral water

*"I don't like mineral water because it has a slippery texture in the mouth. I prefer natural sources like spring, rain, tap water and well water"* (Cliton, 19 January 2020 Mendong). In Cliton's point of view, he does drink mineral water because it has a slippery texture in his mouth so he cannot spend his money on buying mineral water. Culturally or naturally, Cliton is used to natural spring or tap water not the one that has undergone several processes before bottles and sell in the market. He is use to what the environment has

offering naturally and his taste buds in his mouth are used to it. That is why he can easily detect mineral water and tap water or spring water. To Cliton mineral or bottled water is not potable enough to him for drinking.

The importance of mineral water includes the fact that it is a source of magnesium which plays the role of regulating blood pressure, blood glucose and nerve function. It also helps to lower blood pressure, regulates blood circulation, strengthens bones, promotes digestive health and reduces the risk of negative health effects like drinking natural water or plain water.

**3.6 General characteristics of water**

The general characteristics of water include physical and chemical properties. From Gullan's (1962) points of view, water has both the physical and chemical characteristics. Physical characteristics of water include properties like turbidity, colour, taste and odour. This is illustrated below;

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality. The turbidity is measured by a turbidity rod or by a turbidity metre with optical observations and is expressed as the amount of suspended matter in mg/l or parts per million. When one looks at the water in the Yaoundé VI area, the water in this place contains these fine particles that cannot be seen with the naked eyes.

The presence of colour in water is not objectionable from the health point of view, but it can spoil the colour of the clothes being washed. The standard unit of colour is that which is produced by one milligram of platinum cobalt dissolved in one litre of distilled water. For public supplies, the colour number on cobalt scale should not exceed 20 and should be preferably less than 10.Colour is determined by an instrument is known as tintometer. The tap and well water in Yaoundé VI has a brown-colour which is easily seen.

The extent of taste or odour present in a particular sample of water is measured by a term called odour intensity, which is related with the threshold odour. Water to be tested is therefore gradually diluted with odour free water, and the mixture at which the detection of odour by human observation is just lost, is determined. The number of times the sample is diluted represents the threshold odour number. For public supplies, the water should be generally free from odour, taste and colour.

A chemical characteristic is the behaviour of a substance that may undergoes a chemical change or reaction. Chemical properties of water includes total solid and suspended solids, ph value of water, ph Measurment, hardness of water, chlorine content, free ammonia and nitrates.

Solids (suspended solids + dissolved solids) can be obtained by evaporating a sample of water and weighing the dry residue left and weighing the residue left on the filter paper. The suspended solid can be found by filtering the water sample. Total permissible amount of solids in water is generally limited to 500 ppm.

If the ph of water is more than 7, it will be alkaline and if it is less than 7, it will be acidic. The alkalinity is caused by the presence of bicarbonate of calcium and magnesium or by the carbonates of hydroxides of sodium, potassium, calcium and magnesium. Some and not all of the compounds that cause alkalinity also cause hardness.

The pH value of water can be measured quickly and automatically with the help of a Potentiometer.

Hard waters are undesirable because they may lead to greater soap consumption, scaling of boilers, causing corrosion and incrustation of pipes, making food tasteless Temporary hardness, if bicarbonates and carbonates of calcium and magnesium are present in water, the water is rendered hard temporarily as this hardness can be removed to some extent by simple boiling or to full extent by adding lime to it. Such hardness is known as temporary hardness or carbonate hardness. Permanent hardness**,** if sulphates, chlorides and nitrates of calcium or magnesium are present in water, they cannot be removed at all by simple boiling. Therefore, such water requires special treatment for softening. Such hardness is known as permanent hardness or non-carbonate hardness.

The chloride content of treated water to be supplied to the public should not exceed a value of about 250 ppm (parts per million). The chloride content of water can be measured by titrating water with standard silver nitrate solution using potassium chromate as indicator.

Nitrites are highly dangerous and therefore the permissible amount of nitrites in water should be nil. Nitrates in water are not harmful. However, the presence of too much of nitrates in water may adversely affect the health of infants, causing a disease called methemoglobinemia, commonly called, blue baby diseases. The nitrate concentration in domestic water supplies is limited to 45 mg/l.

### 3.7 Importance of potable water to the inhabitants of Yaoundé VI

Water as an important component of human system has many advantages to living organisms. Petraccia (2005) brought out some importance of water to living organisms. Bad water is bad for humans, but safe water is key to life and good for the inhabitants. Water has so many health benefits that the Centre for Disease Control and Prevention (CDC) recommends drinking eight (8) ounce glasses of water every day. Water and health are linked. According to the CDC, the top causes of disease outbreaks related to drinking water are *Giardia* intestinalis, hepatitis A, norovirus, and *Shigella*. Bad as that sounds, it is far from being a complete list. Yet, water is essential. The human body is, after all, 70% water, and although a human being can survive a month or more without food, but a week without water can be dangerous to human system. The general importance of water to living organism is listed below.

#### 3.7.1 It lubricates the joints

Cartilage, found in joints and the disks of the spine, contains around 80 % water. Long-term dehydration can reduce the joints' shock-absorbing ability, leading to joint pain. We had an interview with X and this was what she said: *"I know that for my body to be able to function well especially in movement it need liquids in it to be flexible and that ease movement*" (Shaline, 13 May 2020, Rondpoint Express). To Shaline, our body needs water for lubrication and makes it easy for movement especially at the joints level that needs a lot of movement. Naturally, human body needs water to be able to lubricate and make movement both materials in the body and locomotion easier: water we are talking about is naturally found in the environment so culturally our environment provides us with need to adapt to our environment.

#### 3.7.2 It forms saliva and mucus

Saliva helps us digest our food and keeps the mouth, nose, and eyes moist. This prevents friction and damage. Drinking water also keeps the mouth clean. It delivers oxygen throughout the body, Blood is more than 90% water, and blood carries oxygen to different parts of the body. It boosts skin health and beauty, with dehydration, the skin can become more vulnerable to skin disorders and premature wrinkling. This is what an informant gave us concerning importance of water as mucus in the body.

*"To me, water in my nostrils help to remove any dirty particles, and it also washes away dirt from my eyes for good vision"* (Collins, 12 May 2020, Acaccia).From Collins's

view, water is useful in both eyes and nostrils for cleaning which is important in the body. Under normal circumstances, it is water that flows out of our nostril so culturally it cleans our nostrils making it free from bacteria and germs; this water is being gotten from our environment culturally by our activities like cooking and drinking,

### 3.7.3 It cushions the brain, spinal cord, and other sensitive tissues

Dehydration can affect brain structure and function. It is also involved in the production of hormones and neurotransmitters. Prolonged dehydration can lead to problems with thinking and reasoning. Water regulates body temperature. Water that is stored in the middle layers of the skin comes to the skin's surface as sweat when the body heats up. As it evaporates, it cools the body in sport also when there is too little water in the body, heat storage increases and the individual is less able to tolerate heat strain. Having a lot of water in the body may reduce physical strain if heat stress occurs during exercise. However, more research is needed into these effects.

This is what an informant told us "*Water helps to cool down temperature both on equipment and the human body. I use water especially when places are hot like to bath and drink"* (Patience, 14 May 2020, Melen). According to Patience point of view, water help to cool temperature when places are hot. From out theoretical framework, cultural ecology, it talk on how human adapt in an environment, when F environment is hot, culturally he knows that if he use water it wil cool down his temperature that is why one will see he, using water to cool his temperature. This was also validated by our observation during our study on how people use water in their homes and workshops.

### 3.7.4 The digestive system and health

The bowel needs water to work properly. Dehydration can lead to digestive problems, constipation, and an overly acidic stomach. This increases the risk of heartburn and stomach ulcers and it also flushes body waste. Water is needed in the processes of sweating and removal of urine and faeces and it helps maintain blood pressure. A lack of water can cause blood to become thicker, increasing blood pressure. The airways need it, when dehydrated. Airways are restricted by the body in an effort to minimise water loss. This can make asthma and allergies worse. It makes minerals and nutrients accessible. These dissolve in water, which makes it possible for them to reach different parts of the body. It also prevents kidney damage. The kidneys regulate fluid in the body, insufficient water can lead to kidney stones and other problems.

This is what an informant gave us as importantce of water in the body.*"To me water helps digest the food substance in the body, it also help in moving or transporting materials and food substance from one place to another. I also know that if there is no water in the body, I will suffer issues of constipation and many others.meaning water is medicine to me"* (Clovis, 28 of September 2020, Jurvance). From Clovis points of view, he knows that without water in the body the movement of substances will be very difficulty in the body. He also knows that the absence of water in the body can cause a lot of illness in the body.The above discussion is validated by what FAO (1997) said in chapter two, good drinking quality water is of basic importance to human psychology and existence of life depends very much on its availability. The human system normally need water to be able to function well, that is the normal or cultural functions of water in human system meaning in the absence of water in the body, the body will not be able to adapt and function as it is supposed to be. This point is also confirmed by what Socpa (2015) in which he says water is use as medicine. This can only be used by those who considered water medicinal because it is relative to everyone.This can also be interpreted that when one meets a human being who is suffering from the above disease it can be concluded that the individuals lack some amount of water in his or system

### 3.7.5 Good for appliances

High quality water is good for home appliances. Softened water can save one money by keeping appliances at top efficiency, and making them last longer. The amount of dish and laundry detergent people use can be cut by half, or even more, if you use softened water. Individuals can also lower wash temperatures from hot to cold without a drop in performance. We interviewed an informant, and this is what he said:

> *I know that water is used in industries and our homes to cool down utensils or equipment like iron whenever they are over used and it is hot. In order to cool the equipment, we either throw water on it or we allow it for some time to cool by itself and others like iron, needs water inside, grining meals machine like the once in the village always used* (Edmond,19 January 2020, Acacia).

To Edmond, this equipment gets over heat when constantly in used so in other to cool them, water is needed to cool the appliances. Most of the grinning meals in places with no electricity always have some big drums around the machine with water helping in cooling the equipment. Culturally in most of our villages and industries, water is used to cool off machines when they are over used, which are the nature of the equipment as they were created to always use water as a cooling agent. So most of the equipment cannot do without

it, this takes us to our theory cultural ecology meaning for the machines to be adapted to it usage, it must use water as a cooling agent or it loses it function. This point is backed by United States Geological Survey (USGS, 2000) saying that, water is used in inductries for fabrication, processing, washing, diluting, cooling, or transportation of products. It is also used by producing chemical products, food, and paper products.

In a 2009 study commissioned by the Water Quality Research Foundation (WQRF) and conducted by the Battelle Memorial Institute found that adding a water softener helps water heaters and major appliances operate as efficiently as possible, while preventing clogs in showerheads, faucets, and drains. For example, researchers ran dishwashers and washing machines for 30 days and 240 wash cycles. They ran softened water through half of the units, while using a hard water source for the others. At the end of the month, the washers using softened water were nearly free of scale build-up, but the washers using hard water required scale removal to work well.

Studies conducted by the independent test firm Scientific Services S/D, Inc., of New York, revealed the following benefits of softened water; Washing machines, softened water can reduce detergent use by 50% and save energy by making it possible to wash in cold (60ºF) rather than hot (100ºF) water. Cold water washes with softened water achieved the same or better results when it came to removing stains and whitening fabrics. In dishwashers, softened water can achieve the same cleaning results as hard water while using less than half as much detergent.

### 3.8 Water availability in public milieu in urban areas (Yaoundé VI council area)

The Yaoundé VI council area is vast in nature and therefore access to potable water depends on the area (environment), topography and social status. When we talk of public milieu, it includes the, schools, hospitals, offices and markets.

#### 3.8.1 Educational milieu

Education as people will always say is the key to success so for it to be manifested, it has to have all the basic facilities that the pupils and students will need to be able to learn in a comfortable environment, some of these basic necessities include water and toilet. Some of the schools we visited where Philantroph nursery and primary school, Government School (GS) Biyem Assi, Govvernment Bilingual High School (GBHS) Etoug-Ebe, GHS Biyem Assi, Success Evening School, Centre and GBHS Mendong. At GBHS Etoug-Ebe, the area

has a tap water. In the following paragraphs, we will see what informants told us concerning potable water in educational milieu:

> *This infrastructure is using tap water which we know is good for the students (potable). Just that most at times we spent a lot of money repairing the head taps as long as it gets bad. Since the students are too rough or carefree about the things they used. This water helps a lots to do cleaning especially the class rooms, toilets, drinking and washing of hands* (Ernest, May 14 2020, Etoug-Ebe).

To Ernest, the tap water is good but expenditure that comes with it is another burden. Students seem to be a careless set of people, and the majority of them very are destructive. They will just want to spoil anything not minding the effect that will come after that. From the above information, one can tell that most of the schools spent more money in repairing the spoiled taps which could have been used for another thing in the school campus. Culturally for students or pupils to adapt and perform well in their studies, the environment needs to be conducive for them. So, if water is not available in the school premises, adaption becomes difficult for the students. This is because they need water to do cleaning and drinking, for a good hygiene and sanitation making the area suitable for learning.

Another informant gave us information on which water source that is used at ASEC and Success Evening School. This was what he said:

> *Our school uses a well, which is used for, drinking and washing. We use this because it is the one that is available since there is no tap water in our area. And even if there is tap water, it does not flow most at times and that will probably hinder those basic activities of the students in the campus. Most at times the people around who have those taps complain of water seizure at all the time* (Edward, 26th September, 2020, "Centre").

From Edward's words, one can conclude that even though they are using well water, if they have the opportunity to get cam water, they will not take because the water always have issues of not flowing at all times. So they prefer the well water which is going to be available at all times. According to the cultural ecology theory, the people need to adapt to their environment to be able to function, given that there is no tap water in the school premises, the students need to adapt to the one that is available and make it suitable for them to be able to cope in the environment.

We met, another informant who gave us information of the state of water in their school Philantroph nursery and primary school. This was what she said:

> *Even though we don't have water, we use any available source around us and we have been using open well from our neighbours and a natural spring we consider it potable. Even though we got insult and embarrassment from those giving us water we don't have any choice, because at times to get to the spring, it is always far away from the school. So the school decided to employ someone who takes care of that making sure that he provides water in all the class rooms and the offices* (Claris, 10th Oct, 2019, Ako-Ndoe).

According to Claris, they use all the available water points from the neighbours around them. Even though they have been receiving insults from the people they do not have a choice than to continue begging. Furthermore, they do not have any plans of even digging out a well because the school area is very small to do that, so they are ready to receive more of those provocative words. This has also helped individuals who have been recruited to provide water in all the class rooms. It has serve as a job to someone this leads us to the cultural interpretative theory meaning that the absence of tap, well and any source of water serves as employment to some individuals to provide water in schools.

Below is a pie chart that is illustrating the percentage of water sources that some schools used.

### 3.8.2 Potable water availability in markets

A market is a regular gathering of people for the purchase and sales of provisions like, livestock, and other commodities. Market holds almost every day except days that have been kept for cleaning. Some areas will prefer doing the cleaning early in the morning and opening later in the day like those at Mendong and Acacia and shops along the street. In Yaoundé VI council area, there are a number of marketing areas, those that are constructed and those that are still in the open air. Constructed market areas in this council include Market at Mendong, Acacia, Rond point express and Mvog-Betsi. The ones in an open environment include "Centre", Melen old market and new one at Tradex Simbock, even though they sell mostly on Saturdays.

Most of these markets do not have tap or well water. An interview was done with an informant concerning water in market area and this was what he said:

> *We don't have water in this market so getting water to drink becomes difficult. Well even thou there are people doing water business around, but we know these things were supposed to be provided by the government for us the sellers. But no we are the once paying for what was supposed to be given to us at a lower price. So we pay higher cost most at times, just to get drinkable water* (Gerald, November 17, 2019, Mendong).

To Gerald, water was supposed to be provided by the government to those selling in the market. But because they got their own way of doing things, we are now paying expensive for what was supposed to be done free or at a lower cost. One can also say that instead of keeping the money, it is being spent on water and there are people whose capital is not enough and after selling they have to buy water just to keep the body cool. Relating this to our cultural ecological theory, one can say that the accessibility for water in the market is difficult, because the business people tend to spend more to buy bottled or sachet water that is available to be able to cope in the market as they sell their goods.

We got another informant who said:

> *In this market, there is no tap water, so one depends only on the people selling water in the market. And if they were not around, it would have been difficult. It is really funny that Cameroon government builds up market without providing water. And to add that they construct water closet without water. I do not know what they expect us the users to be doing or they want us to carry water from our homes for drinking and at the same time the one to flush the toilets after using. ohhh I do not know it is really not good for us* (Glory, May 18, 2020, Acacia).

According to Glory, the government should have provided water to the market sellers and buyers but they have not done so. If the people selling water were not around, that would have been hell on the people. Again, one cannot buy water to use in the toilet. It is very expensive doing that, so it is preferably that these markets that do not have water should have but pit toilet instead of water closet because there is no water to use. The absence of water in some market is culturally interpreted that the government itself does not want to satisfy their citizens. This is because if they knew the importance of water in the community, they will not construct market without providing water.

Another informant who sells at Mvog-Betsi:

> *We do not have us water here, so most at times I carry water from my house to my shop, even though it is heavy to carry. But I don't have a choice. I carry because I cannot depend solely on buying water. When I sell my goods and there is small gain, I spend it in buying water. Business, as it is, has its own good and bad days. The days i do not sell, but i need to drink water it becomes expensive doing that. So I do not have a choice than to carry my water from home to my shop* (Emile, August, 15 2020, Mvog-Betsi).

From Emile's point of view, he has no choice than to carry water from his house because he is not ready to buy water every day. He finds it very expensive buying water because, instead

of saving the little that he has gotten from the business, he uses it to buy drinking water. Spending more on water is not because he has money, but because the body needs water for proper functioning. The market environment at Mvog Betsi lacks water for its users. The business people need to survive in this place to be able to do their business. So M has no option than to carry water from his home to his business place to be able to cope.

Another informant we meet at Simbock said:

> *This area we are using is not constructed, so for me coming here, it is at my own risk, but I don't have anything to do. I need to faint for my family so I have no choice than to do the business. So when coming here to sell, am aware there is no water so I came along with my water and knowing that I will delay here because we sell mostly in the morning, by noon I am done, so I retired home. So with that I do not spend much on water* (Sylvie, 15 March 2020, Simbock).

According to Sylvie, when she is coming to the market, knowing that there is no water, coupled with the fact that she is not going to stay in the market, she carries along her drinking water and by midday, she retires home where she gets her water to drink. The scarcity of water in the market areas has made people resort to what is available in their homes., According to F, bringing water from her home simple making us to understand that she does not trust other sources of water in the market if not she will not border to bring water from her home this is just relating to the cultural interpretation of scarcity of water in market areas.

Below is a pie chart showing the percentages of water used by business people in the market of Yaoundé VI area.

### 3.8.3 Availability of water in hospitals

Hospitals are very delicate areas that will be very bad for them not to have water in their premises. This is because, in the entire department and the different activities, water is needed to wash their hands, equipment that is being used as well as keeping the environment clean. The Yaoundé VI council area has hospitals like "hopital des soeurs" at Mvog-Betsi, Etoug-Ebe hospital at Biyem-Assi and Biyem-Assi hospital.

At "hopital des Soeurs", we met an informant who said:

> *In "Hopital des soeurs", we used drilled water that is about 350-400meters deep. This is because we knew we were constructing a hospital and it is going to consumed alot of water because we need the water to be able to carry out our work effectively. This hospital has been for more than 25 years and all along we have been using drilled water. Also we prefer this because we know it is from its natural sources that have no contamination from the environment. We were*

> *also forced to do this because there was no CAMWATER in the area when we were doing the construction and even up till now that there is CAMWATER in the vicinity, we still prefer this because there is a lot of water cutoff in the area. Imagine that a doctor is doing an operation and need water and out of a sudden the water ceased, you can imagine what can happen at that point. While using this, we have a stand-by generator that is always ready to be use when there are no lights. We know this well water uses light to be able to pump water so we have generator should in case there is no light.* (Blessing, October 18th 2019, Mvog-Betsi).

From Blessing's point of view, the well water has been the most efficient and sufficient water that the hospital will prefer using. This is because it is a sure source of water. The hospital will never experience water shortage, since the water has been drilled deep down into the earth. When there is no light, they used generator that will be able to pump water for any activity to continue. Also they still prefer their drilled water even though there is CAMWATER in their area, because they do not want cases where the hospital will experience water shortage and seizure. Again, they believe that the water has no contamination and can never be contaminated because it is really deep into the earth. Another thing that discourages the stakeholder seriously is the fact that, before one gets water from the company in charge, it takes a very long time. It takes long procedures and it is costly too. So, they just prefer using their drilled water.

When we look at Blessings point of view in relation to our cultural ecology theory above, it is clearly that the hospital has two water sources that is tap water and forage; meaning water is available but yet they prefer using the forage water so there is no scarcity of water in the hospital, the people or the patients prefer to use forage water. This is because they believe that well water is good, as compared to the forage. They also believe that it is difficult for it cut off as compared to CAMWATER that seizes most at times and takes days for it to flow. So, the usage of forage helps them to adapt and cope well in the environment.

Furthermore, we met another informant from Etoug-Ebe hospital and this is what she said:

> *Here at Etoug-Ebe hospital, we have two water sources which are the CAMWATER and a drilled well. Before the construction of the hospital, we had CAMWATER already, so there was no problem for us accessing water that could be used. These made even our construction process easier so we did not have issues in getting water. But as time went on, the problem we started facing was the issue of water seizure which occurred frequently. This made our activities very slow, rendering the patients' health at risk, because it is very difficult to work in the hospital without water. This is because all the equipment needs constant washing before using them on any patient and we could not bear the risk of begging water and rendering peoples life at risk. That was when the idea of*

> *drilling a borehole came to our mind. So the borehole was drilled to assist the CAMWATER that we have in the premises though it was very expensive, we had no choice but to do it rather than putting life at rick. This has really helped us because there are days CAMWATER can go for more than 2-3days and we survive from the drilled water. Since we use drilled water more than the CAMWATER because it is thought that the drilled water is more pure than the CAMWATER* (King, October, 12 2019, Etoug-Ebe).

From King's words, one can understand that, water source the hospital is using, is of a great importance to them. The CAMWATER which was the first in the premises was good but due to the issues of water cutoff which usually last for days. Water seizure became an issue because the hospital is supposed to have a constant flow of water due to the complicated nature of the equipment that is being used by the doctors and nurses. So, drilled water was constructed to assist the tap water should there be any water seizure. To them, the drilled water is purer than the water from CAMWATER. So, they prefer using the drilled water most. In relation to our theory one can see that the environment has offer all the water sources that both the personnel and patients are using giving them a good access to water,. So, there is no scarcity, as compared to other places. The presence of a forage and tap water enables them to cope and adapt to their working environment.

Information was also gotten from an informant working at Biyem-assi hospital and this is what he said:

> *In this Biyem-assi hospital, tap water is being used here. We use tap water here because is the only water point that we have here, and it help us in doing our activities when it comes to cleaning and washing of equipment and even our uniforms. For us here, we don't really have a problem in using CAMWATER even though at times we experience water cutoff but usually does not last for more than 2 days* (Julliet, December 18 2019, Rond point express).

According to Julliet, the CAMWATER that is being used is good and they have not been experiencing some kind of challenges that can provoke them to think of another water source. For Julliet, it is clearly that the environment or the hospital premises offers just a source of water to be use by the personnel and patients in the hospital. To her, she believes that the water has no issues or problem so it is good to be used by anybody. When one looks at this from the cultural interpretation point of view, it can be seen that tap water is the best source of water, as compared to others. That is why the hospital does not care to have any water source by rely on the tap water.

The above explanations show that, most of the hospitals use two water sources which are tap water and well water (forage). These two water sources are readily available and they rarely have problems with forage. Below is a pie chart showing the percentages of water sources use in the some hospitals.

### 3.8.4 Availability of water for domestic use

Generally, water is important in life so every human needs water to survive, whether poor or rich. Water in households is important to a family to be able to carry out work like cleaning, washing, cooking and not forgetting drinking which is necessary for human health. In the Yaoundé VI council area, we explored the various sources that the inhabitants have been using to be able to do cope with their daily activities. During the fieldwork, we saw water sources like the streams, springs, tap water, wells, mineral water and rain water. Below we will be showing some of the water sources given to us by the informants from the field.

We met an informant at Mendong and this was what she said: *"To me, I use the stream especially in the dry season when there is insufficient water. During this period, i resort to the stream, carry water to do house chores, and it is still the area use for dispose of waste materials"* (Divine, November 2019, Mendong). According to Divine, a stream serves a big purpose in her family because one can actually imagine when there is no water and the human being depends on that to survive. Still she uses stream water to dispose of her waste product she is being very tolerant to the water from the stream. This is due to the fact that, the companies responsible for waste disposal hardly pass around their quarter for collection. It is also noted that, streams dried up during the dry season. So with this, the present velocity is unable to transfer the dirt, causing the environment to be polluted. The environment is very harsh in that water sources is insufficient making her not to adapt to the environment normally, even though she has to resort to stream water which she uses for many other activities. This is relating to our cultural ecology by Steward (1955) in that even though the environment seems not to be the best but she tries to adapt the way she could in other to survive for continuity.

Another informant explained to us how she uses stream that is found in her area. This is what she said:

> *Ohhh stream is very important to me because I use it for the cultivation of crops like vegetables. It is from this garden that I used to feed my family and some*

> *sold to increase the income of my home. Even though the stream velocity reduces at times when the dry season is at its high peak, harvest reduces. But during the raining season, I have no problem with water and the harvest increases and I do plant variety of crops* (Voilet, 18th November 2019 Jouvence).

According to Voilet, the stream is for free, so she spent no money in using water for her agriculture. It is from this activity that her family survives meaning, if this farm work is taken away from her, then the family will suffer because they will not have anywhere to go except returning back to the village. At this point, the stream Voilet is talking about is an intermittent stream because it dries off at a particular period like the dry season. The ecology has provided a good medium for this lady to be able to adapt to her environment by using stream water to do farming. This is just one of the cultural activities farming that is able to solve the problem of hunger in our community and different homes from hunger.

Another informant told us the type of water she uses in her home and this is what she said:

> *I used well water because that is the only water source I have here, I use it for cleaning dishes, cooking and doing laundry. To me I don't have any choice because there is no way I can leave from here pay a bike or taxi to another neighbourhood just to have tap water. I can't do that because I don't have the money. So I have to bear it, whether the water is clean or not am bound to use it* (Janet, 7th February, 2020 at "Centre").

In Janet's opinion, well water is not the only source she uses. So, she does not care about the quality of the water, and she is bound to use it because she has no option than to use it. This is because she cannot afford to go for another source which is definitely very far away from her. This well in question, is not her own in person, so whether the owner treats it or not is not her problem. But as long as she gets what she can use for herself and the family she is satisfied. The environment has presented F with no option other than to use what is available. It is the scarcity of other water sources that has caused her to resort to well water, even though it is not potable. So, for her to adapt and cope to her environment, she has no other option than to use the available one.

> We got information from another informant who said:

> *I used open well water and forage. Open well is used for cleaning, washing and cooking, while the forage well is use for drinking, even though it is not for free, it is being sold. With the forage, a container costs 50 FRS so my family, we are six of us and we cannot live on that only. I discover that if I do that then is*

> *going to be difficult, because almost half of the income will be spent on water. So I decided that most of the household activities, we will be using the open well to do that so that less amount will be spent on drinkable water* (solange, February 28, 2020 at "Centre").

To Solange, an open well is best for her house hold activities because is it not for sell and it is easy to have. But for the drinkable water, she buys it and that costs a lot that the whole family cannot depend on the forage well water to do household activities. This is because, the family income is low and it should not be spent more on water at the expense of other activities. From F's statement above, one can culturally interpret that, to her, open well water is not actually good for drinking for it is polluted with germs and bacteria. That is why she uses it for different domestic activities and forage water for drinking. This is also to point out that she prefers forage water for drinking other than any other source.

Furthermore, another informant gave us his own point of view concerning water sources in his home and this is what he said:

> *In my house I use tap water and open well. Tap water or CAMWATER is used for cleaning, cooking, laundry and flushing, while well water is used for my small garden and watering of the compound. I do not use well water for household chores because I know it is not clean and definitely not good for my health and that of the children. Another reason too is that since there is constant supply of CAMWATER in the house, there is no reason for me using well water even though at times we experience water cutoff but it does not last for more than 2 days* (Cathrine, June 12, 2020 at Jouvence).

From Catherine's report, we can conclude that he has no issues with water. He uses well in his small garden in his compound that is able to provide him with some good vegetables which is necessary for the body. CAMWATER in his place is used for other household chores and drinking which he prefers and he knows is clean for consumption. Culturally F knows that tap water is good so there is no need for her resorting to other sources when she has tap water. Even though she experiences water seizure at times, she will prefer to wait till it comes back, meaning that she has more confidence in tap water. This is just confirming what cultural ecology talks about our environment helping us to adapt in all ways of life.

Information from whom we met during our fieldwork says:

> *In my home, i use only tap water because i know it is a good source of water and is good for me. We use it to do all activities in the house, so we do not have a well or anything is just the tap water that is available. Even though*

> *there are some times I experienced water seizure, but it does not last for many days* (Sandra, April 20, 2020 at Superette).

To Sandra, tap water is the only water source that she is using for her different activities in her house. To her, there is no problem with the water, even though she experiences some water seizure but it does not last for days. When one look at the cultural interpretation theory above, it can be concluded that F believes so much in tap water this is because back in their village or homes they knew tap water as the best water one can ever have, so the environment too provides what they think or know best suits them to adapt and survive in their community.

In an interview with another informant, this is what he said:

> *I use tap water and mineral water, the tap water is use for household chores while the mineral water is use for drinking. I use tap water for the chores, because I believe that the tap water is not good for consumption because there were times that it caused me problems. Because of that, I resorted to mineral water. Even though the mineral water is expensive too but I have no choice than to do that. I prefer spending money to have good health rather than going to the hospital most of the times because of the bad water that am consuming* (Felicia, 11 December 2020 at Simbock).

From Felicia's report, one can conclude that tap water is not the best as people will say. According to him, he has been having some ill health caused by the consumption of polluted water. So he prefers spending money in buying mineral water than going to the hospital again and again. This point above clearly relates this to the cultural interpretation theory where the individual believe so much in mineral water because he knows that the tap water is not served for him. This has led to culture change because back in the days there were no mineral water and people depend solely on tap water but the environment these days has change people mentality on tap water to resort to mineral water because they know is actually the best for human health.

Furthermore, another informant gave told us how she uses mineral water and this is what she said:

> *I use mineral water only on my new-born children each time I put to birth. I know the other sources of water are not good for the new-born even though it is always prescribe at the hospital for us to use that after six months. I resorted to forage water that we are using because the money is not always available that one can use till then child is a year* (Tina, 16 July 2020 at Mendong).

According to Tina, only new-born in her house consume mineral water, because it is prescribe from the hospital. Also, it is very expensive to be buying the water for everyone in the house. Again she does use it till when the child is a year old. She has her limited time which is 6 months after which, she stops giving the child mineral water because of the issue of finance. Culturally the environment have water sources that this lady feels is not good for her baby, for she resort to mineral water where she things is the best, to her the babies system need only the mineral water to be able to survive but the other sources are contaminated.

Another informant told us what she the various water sources she uses in her home and this is what she said;

> *We use open well water and spring water in our home. Open well is used for cleaning, cooking and laundry while the spring is used for drinking. This is because well is very close to my house which makes it easy for my children to carry and the spring source is far off from my home so my children go there once to carry drinkable water. Even though it is not safe for them to go and carry water because is far but it is better because the open well water we have is usually very very dirty and cannot be used for drinking* (Victor, 15 April 2020 at "Centre").

From Victor report, the open well is mostly for household activities but it cannot be used for drinking, because of its dirty nature. So there is a spring available, though far off the house, but lucky enough, she has her children that fetch the water. Even though it is risky for them at times, but they have to go through that because there is no other option for them. Cultural ecology points out to the fact that spring water is naturally found in the environment and it is safe for people to consume that is why M prefers drinking spring water.

Information gotten from informant which she says;

> *In my home, we use just spring water which is the only source available for my family. So we use it in all of the household activities and lucky enough it has no effect on us since we have been using it. Even though during the dry season the velocity of the water flow slows down and there are many people to fetch the water we have no option than to wait and carry as usual* (Carol, 19 May 2020 at Mvog-Betsi).

To Carol, spring water is the only water source she has available for her family. She believes is good because it is from the ground that has no contamination. Moreover, it is not difficult to access by her children even though at times they experience insufficiency because of the change of season. But it is the only available source she uses with her family. The scarcity of other water sources has caused Carol to resort to spring. This is because she needs it to be

able to adapt and cope in the environment. The ecology therefore has provided natural sources of water that people depend on it.

From the data above, most of the households uses well, spring and forage. While small amount of people use tap water and mineral water.

**3.9 Other activities that consume potable water**

There are some activities that consume water more than the household chores and public milieu that we have seen above. Other activities include washing point, restaurants and hair dressing.

A washing point is an area where different categories of cars and bikes are being washed on daily bases. In doing these businesses, there are different sources of water that these people use to wash cars. During our fieldwork, we met an informant who owns a washing point and this is what he said;

> *Here is my washing point that I have, it has been operating for more than 6 years now and it has been able to put food on my table and taking care of my family. In as much as I have this place, I cannot work all alone so I had to employ some people who are capable of doing the job so that I don't keep my customers waiting. I do use CAMWATER for my business and this water has no problem as long as am using it to do washing and other laundry works like washing of carpet. With the fact that I have many customers the rate at which I consume water here is high more than those who do not have customer. Most at times I can receive about 10-15 cars a day. Even though there are times that we experience water cutoff but it does not last for long* (Edwin, August 14 2020 at Jouvence).

From Edwin report, one can conclude that CAMWATER is the only source that he uses to do his business and it is really giving him what he needs to survive with his family. This work has helped some jobless boys around who have been employed by J. At this washing point, they use much water, it therefore means their bills are moderate if not such business will not continue. An estimate of 198.122 $m^3$ of water is used by car washing points daily in the Yaoundé VI sub-division. Out of this amount, 153.1 22 $m^3$ are obtained from the Cardholder Data Environment (CDE) network. On average, the 39-50 washing points, which obtain their water from the CDE, network use up to an average of 3464 l or 3.464 $m^3$per day. The calculations were done from estimates gotten from car wash operators who declared their water consumption in litres by virtue of reservoirs used per day or the amount of money paid as water bills to the CDE (Humphery 2016). The cultural ecology theory by steward confirmed that natural environment has provided water for people to use like the streams. M

is able to do washing point business because the natural well (forage) that is following it not it would be difficult for him to use tap water for him to pay the bills, so the earth has made it possible for him to cope with his business.

We met another informant who owns a washing point this at Mendong and this is what he said:

> *This is my washing point; it has been operated for more than 7ears today. As you can see I do use well water from the ground even though it is a difficult task for me to do but I had to engage into it since there is no profitable job for me to do and there was nobody to help me out. So I had to think wise in order to start this business though it has not been easy but at least it is giving me what I need. The water here is been pump from the well, it is difficult to calculate the amount of water I use per day and since I have my own SONEL meter, I only pay the bill that is given to me by the ENEO. The bills are moderate so am able to pay and continue with this work* (John, 18$^{th}$August 2020 at Mendong).

According to John, forage water is the only available source of water that he is using to do his business. Though it is the only one, he prefers it since he has no quarrel with anybody when it comes to payment of electricity and because the bills are always moderate making it easy for him. The natural environment is able to help people adapt in their area.

Information was also gotten from an informant at Mendong and this is what he said:

> *This washing point here, I can't say there is an owner here since we are using but the stream to wash the cars. This place has been operated for 3years now and I did not started it alone since it is a stream I could not have done the manual work alone to clean the area and make it comfortable for the customers. We were three of us having nothing to do, so we organized ourselves came and clean the area, dig deep the stream so that the water can stand at a quantity. We succeeded in doing that and today, we have no bills to pay to any one since the water we is natural stream (*Fred, 13$^{th}$ September 2020, Mendong).

According to Fred's report, the water they use is from a natural source, so they have nothing to do as far as bills are concerned. This has also given them the opportunity to be able to survive given that they don't have a white collar job. The stream being within the cultural ecology has help many to adapt and cope in their businesses like this; this is the use of a stream to other people serves as employers to those who can do car washing.

Pressing is another type of activity that consumes water in town, those involved uses a lot of water to wash dresses and shoes. We met an informant and this is what he said:

> *The champion pressing, is the name of my pressing, we do use tap water for this work. This is because it is the only available source of water that we have here. This business is good because it is not seasonal as compared to some activities around. The bills that I pay are moderate that is why am able to maintain the shop even though there are times that experience water seizure and no light. It is not a major issue because it does not last long* (Walters, 12 July 2020 Mendong).

According to Walters, tap water is the only source of water that is being used in his pressing shop. He is able to do this because his bills are not expensive so it is very relax and making him to be able to met up with the family upkeep. The scarcity of other water sources has made M to use just tap water for his business and is readily available whenever he needs to use it. He believes more on the tap water such that when there is seizure he does not use any source but rather waits on the tap water.

Information was gotten from another informant at Mvog-Betsi and this was what he said:

> *Here in my pressing shop, I use forage water even though am not the one that bore the hold but my landlord. i have a good number of customers and that make me to use much water, but I don't have any difficulty with the bills that my landlord gives me if not I would left this place* (Jason, 16 July 2020 at Mvog-Betsi).

To Jason, it shows that forage water is the source that he uses to do his work and he has no problem with his landlord. This is because bills are just normal which permits him to do his work successfully. Cultural environment has been of help to many who have been able to use it well and adapt to the environment.

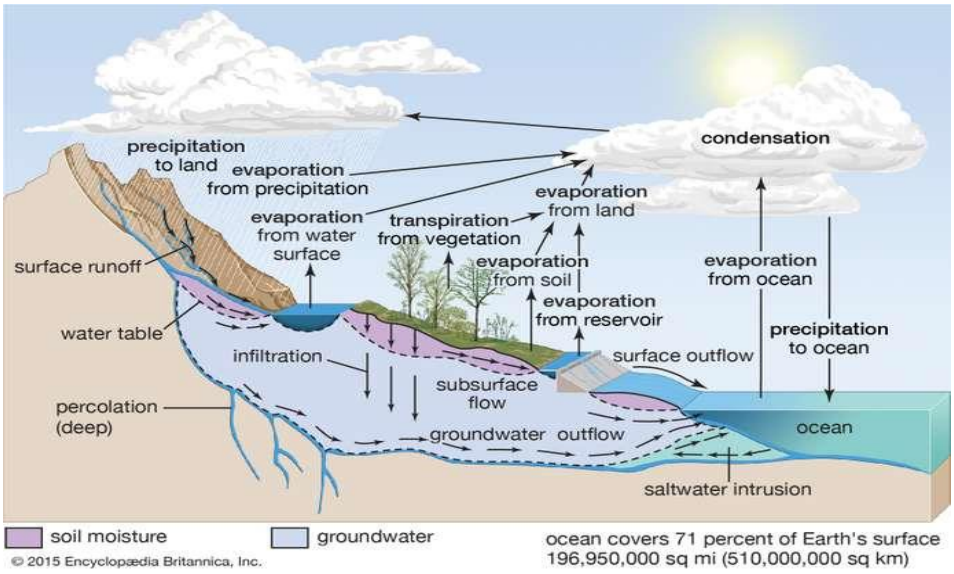
The above analysis from the various informants on water used in public areas like the schools, markets, hospitals is validating what FAO (1997), Lamikanra (1999) said about the importance of water in the environment. Also how water is an essential unique universal solvent neede by living organism. They went ahead proving that without water, life is not possible on this planet. It is also a vital and the most precious resources on earth that provides basic need of human being and without water, development is not possible in our community.

### 3.13 Water cycle

Water cycle, also called hydrologic cycle, is the cycle that involves the continuous circulation of water in the Earth. Of the many processes involved in the water cycle, the most

important are evaporation, transpiration, condensation, precipitation, and runoff. Although the total amount of water within the cycle remains essentially constant, its distribution among the various processes is continually changing.

**Fig 13: Hydrologic cycle**



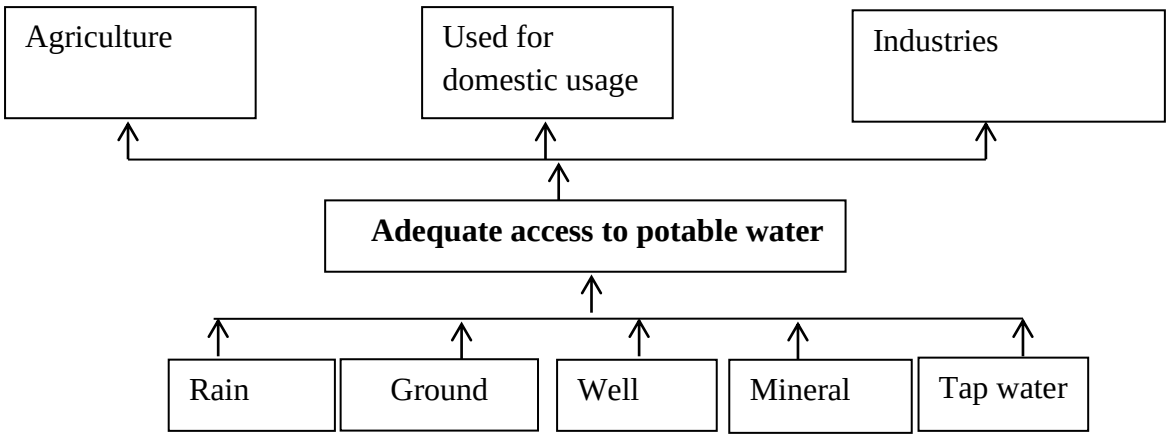

Source: Lyle 1988

From the table above, when water evaporates into the air from various sources like plant, man and homes, the following occurs:

- Water precipitates and falls back as rain (rain water is being used by inhabitants for house hold activities).
- Water precipitates and falls back as rain and there is runoff (that flow as natural stream, some flow to form a river and others into the sea). It is from the river and seas that, is it constructed and transform into tap water and mineral water after a process of purification).
- Rain water infiltrates into the soil forming what is known as ground water (where there is natural spring which flows out and drilled water when dug).

Below is a tree diagram illustrating water sources and its main uses to the inhabitant:

**Fig 14: Tree diagram showing the various water sources and their importance**




*Source fieldwork: Matilda Musah (2020)*

The tree diagram above shows the various sources of water used by the population. The three sections shows the roots which are the water source, the stem which show access to potable water and the fruits which is the where water is being used.

This chapter focused on water resources which are naturally found in the environment, used by the individuals of Yaoundé VI for survival. This goes ahead to confirm what cultural ecology is all about- the relationships and interactions among humans, their biology, their cultures, and their physical environment. It is this availability of water sources that makes inhabitants to survive in Yaoundé VI since humans cannot do without water. This is supplemented by human activities, giving a positive relationship between the environment and human beings. Water is also being gotten from rain as it falls naturally during its season and it is of a great help to the people. This water supply which is free of charge is mostly used by the population for different purposes like farming. Most people do farming during the rainy season because they have abundant water which is able to water their crops and this is a positive impact of water sources. Others used it for domestic purposes (laundry and cooking). The inhabitants of Yaoundé VI have a wide variety of water resources. Whether rich or poor, they can access water at all levels. When one looks at the majority of them, they use mostly the natural water sources that are gotten directly from the soil. Those who have access to CAMWATER also rely on it. Those who do not have access to CAMWATER turn to the natural sources which are good because many of them will not have had the money to spend on buying mineral water. This water in the environment is replenished naturally by precipitation. In the next chapter, we will look at the manifestation of water crisis in Yaoundé VI council area.

# CHAPTER IV
# DESCRIPTION OF WATER CRISIS IN YAOUNDÉ VI

There is water crisis today in both developed and developing countries but that of the developing countries is alarming like in the case of Africa in general, Cameroon as a whole and Yaoundé VI in particular. But the crisis is not only about having insufficient water to satisfy the people but also the managing water system that is poor causing people and the environment suffer. To that effect we will be looking at the manifestation of water crisis that is the effect of water pollution and water scarcity in Yaoundé VI. We will be looking at how water manifest in the health of the population, environment, and gender issues just to name a few.

Access to safe drinking water is measured by the proportion of population with access to an adequate amount of potable water located within a convenient distance from the users' dwelling. In urban areas, a distance of not more than 200 meters to fetch 20 litres of potable water per person per day from a home to a public water source may be considered reasonable access (WHO 2006). The table below illustrate the different diseases, microbial agents, symptoms and it effect. According to the EPA's (1993) study, the different water-borne diseases are outline in the table below.

**Table 5: Names of different water-borne diseases and their symptoms**

| **Diseases** | **Microbial Agents** | **Diseases Symptoms** | **Chronic Effect** |
|---|---|---|---|
| Toxoplasmosis | Toxoplasma gondii | "Flu" with swollen lymph glands or muscle aches, damage to the brain, eyes, or other organs | anaemia, enlarged liver or spleen, seizures, limp muscle tone, feeding difficulties, hearing loss, mental retardation |
| Typhoid fever | Bacterium (Salmonella typhi) | Fever, headache, constipation, appetite loss, nausea, diarrhoea, vomiting, appearance of an abdominal rash | Nosebleed, Chills, Delirium, Confusion Agitation Fluctuating mood attention deficit Hallucinations |

| | | | |
|---|---|---|---|
| Viral Gastroenteritis | Viruses (Norwalk, rotavirus and other types) | Fever, headache, gastrointestinal discomfort, vomiting, diarrhoea | Dehydration |
| Legionnaire's Disease (a type of pneumonia) | Legionella pneumophila and other Legionella species | Pontiac fever is an acute-onset, flu-like, non-pneumonic illness | Delirium Pulmonary complications Gastrointestinal tract complications Central nervous system complications Kidney insufficiency Pneumonia |
| Hemolytic uremic syndrome | E. coli O157:H7 | Bloody diarrhoea and stomach pain, | Pallor, Petechiae, purpura and oozing, renal failure, ataxia, coma or seizures, infarction, intussusseption, perforation or hepatomegaly |
| Schistosomiasis (immersion) | Schistosoma | Rash or itchy skin. Fever, chills, cough, and muscle aches | according to species, i.e., S. japonica, S. mansoni, and S. mekongi primarily affect liver and intestines; while S. haematobium primarily affects the urinary tract |
| Salmonellosis (oral transmission) | Bacterium (Salmonellaspecies ) | Gastroenteritis, fever and rapid blood-poisoning. | Dehydrated, the infection spreads from the intestines |
| Campylobacteriosis | Bacterium (Campylobacter jejuni) | Fever, abdominal pain, diarrhoea | Chronic sequelae, such as reactive arthritis and Guillain-Barré syndrome (GBS |
| Cholera | Bacterium (Vibrio cholerae) | Watery diarrhoea, vomiting, occasional | significant decrease in the pertussis-toxin-catalysed |

| | | | |
|---|---|---|---|
| | | muscle cramps | ADP-ribosylation, prolactin secretion increased |
| Cryptosporidiosis | Protozoan (Cryptosporidium parvum | Diarrhoea, abdominal discomfort | The small intestine is most commonly affected, Cryptosporidium infections could possibly affect other areas of the digestive tract or the respiratory tract. |
| Giardiasis | Protozoan (Giardia lamblia) | Diarrhoea, abdominal discomfort | leak flux, malabsorptive and secretory components |
| Amebiasis | Protozoan (Entamoeba histolytica) | Abdominal discomfort, fatigue, diarrhoea, flatulence, weight loss | Colitis, Appendicitis, Peritonitis, Liver abscess, Lung abscess |
| Hepatitis | Virus (hepatitis A) | Fever, chills, abdominal discomfort, jaundice, dark urine | Numbness in extremities. Mental confusion / 'brain fog Dizziness and peripheral vision problems.Cognitive dysfunction Shortness of Breath Visual Changes, Female Problems (irregular menses, severe PMS) |
| Shigellosis | Bacterium (Shigella species) | (Shigella Fever, diarrhoea, bloody stool | seizures, confusion or coma, kidney failure, arthritis, rashes |

*Source: EPA 1993*

The table above shows the different disease agents, symptoms and their effects. This will help those who like to read books especially the medical personnel for one to know exactly what he or she is suffering from when you are experiencing particular symptoms listed above. Also

when one is aware of these diseases and it causes, it keeps them aware of what to do and how to keep themselves or family safe from these diseases.

### 4.1 Effects of inadequate potable water supply in Yaoundé VI

A large number of people in developing countries mostly live in extreme conditions of poverty and the main factors responsible for these situations include lack of priority given to these sectors. This is due to inadequate financial resources, inadequate water supply and sanitation services, poor hygienic behaviours, and inadequate sanitation in public places, including hospitals, health centres and schools. Polluted and contaminated water can cause water-bornediseases like diarrhoea, cholera, typhoid fever and dysentery. Ozkan et al. (2007) had reported that absence of adequate and safe water supplies with sanitation systems were responsible for various kinds of sicknesses such as diarrhoea together with other water-borne diseases in rural areas and urban areas like the case of cholera outbreak in the south west region of Cameroon and Yaoundé. The effects of inadequate water supply can be grouped into many areas, that is, household, Health, Education, and economy.

#### 4.1.1 Effects of inadequate supply of potable water faced by households in Yaoundé VI

A household consists of one or more people who live in the same dwelling and share meals, the same idea, joy and happiness according to a lay man definition. It may also consist of a single family or another group of people. According to Malinowiski (1913), it is a bounded set of people (a mother, a father, and children) who recognise each other as a family or sharing the same genetic connection. A dwelling is considered to contain multiple households if meals or living spaces are not shared. In a given community, there exist different households, different tribes, religion, character, literacy level and social status. These entire characteristics contribute to the way they react to different problems in the homes and community. The inhabitants of Yaoundé VI in particular and Yaoundé in general, news have been complaining of the continuous water cut in the quarters, poor water quality which is also limited in supply. Ozkan et al (2007), had reported that, the absence of adequate and safe water supply, coupled with sanitation systems, were was responsible for various kinds of sicknesses such as diarrhoea along side with other water-borne diseases in urban areas.

Bhavnani et al (2014) concluded that unimproved water source (rivers, ponds, lakes and unprotected springs) and unimproved sanitation were the major risk factors of diarrhoea in Ecuador. Water and sanitation management practices can actually decrease diarrhoea incidences by one-third to one-fourth. In this case, we are going to describe the various ways by which different homes and individuals react to the inadequate supply of water and this will see from what the informants report from our fieldwork. Nforwag (2015) also said that Yaoundé needs more than 300,000 cubic tons of water daily but can only get half of it. Meaning that the water in Yaoundé in general and Yaoundé VI in particular are unevenly distributed, causing many to look for alternative sources of water to be use in their houses. Despite the efforts to provide water to the population of Yaoundé and Yaoundé VI in particular, the supply remains lower than the demand. The coverage of big towns like Yaoundé needs major improvement and the unfavourable-ecological situation of some of these cities, lack of appropriate polices has hindered the search for long-term solution. Like the CAMWATER who are unable to respond to the population need (Kouam *et al* 2006).

During our fieldwork, we met some informants who gave us the problems they faced because of polluted and insufficient water. This is what one of them said:

> *We usually have water shortage, especially during the dry season, because the water dries off. When it rains too much we are bound to have water shortage because the water becomes dirty that we cannot carry. With this it is very difficult to do house chores like cleaning and cooking* (Edward, 26 September, 2020, "Centre").

According to Edward, their water source dries up during the dry season. Due to that, the water supply becomes very limited and household activities like cleaning and laundry become difficult. Living in an unclean environment is not good for us as humans. Also during the rainy season, there is too much rain that the water becomes muddy and unsafe to drink or even to do cleaning. It is possible for a house to have a bad odour because of the unkept nature of the house. It can also acts as a breeding place for mosquitoes, houseflies. This point does not confirmed to what out theory of cultural ecology is saying. According to the theory, the environment we lived in help us to adapt to the various water sources like spring and streams. They are naturally found in the environment and are the best water source. But when it rains which is also a natural phenomenom, the soil is soft and it dissolves easily by rainwater making the source unsuitable for consumption. Run-off from rain water pollutes the

water naturally. This is also confirmed by our observation in the field while we were collecting data.

This is what another informant said:

> *I experience water shortage during the rainy season, because when it rains, it floods and covers the pipe that connecting the spring water, making it difficult for me and other people to carry. That is the only water source where we carry drinking water. At times, the floods can last for two or three days causing water shortage and pollution* (Esther, 18 January 2020, TKC).

To Esther, they consume spring water. The spring water is connected using a small pipe, it has been inserted to canalised the water for people to carry. But now that there is too much rain, floods always occur in the area, covering the pipe and making it difficult for her and others to carry water. To this effect, water consumption in the house reduces. Living with children, it is risky for her, because the children can resort to other means of water consumption without her knowledge which may not be a good source for them to drink. Spring sources always known as the best source of water traditionally, becomes an obstacle to the population when overflooding occurs at the spring source. This therefore means that the area does not have a good drainage pattern because most spring sources are always in hilly areas.

**Fig 15: Overflooding of rain water over a spring source**

*Source fielwork: Matilda Musah (2020, Abega at Mendong)*

The figure above shows an area that is over flooded with rain water. This place is a spring source use by the people of this area. From what we have above, the pipe that connects the spring water cannot be seen because the rain water has covered it. This helps in contaminating the water, it is easy for the runoff to go into the pipes that connect the ground water and mix with the spring water. This causes water shortage because the people cannot carry until when the runoff water is dried of making way for people to carry water.

This is what another informant gave us as her own point of view.

> *Since am the only one using my forage water, I do not suffer from water shortage. But when there is no light that is when I have problems with water. At times when light goes off and comes with high voltage, it damages the machine, rendering me to suffer for a while before thinking of what to do* (Larisa, 1 September 2020, Mendong).

In Larisa's point of view, she uses her drilled well alone so she has no problem with water. Because of water crisis in our environment today, F has changed her cultural method of coping with water by using a forage which is a modern way or style of adapting to the environment. The modern style which is now becoming a cultural way of coping or adapting to water crisis has its own disadvantage: Since the drilled well needs electricity to function, there are times when there is power failure and she has to resort to other sources or if not she has to wait for the electricity to return for the water to be pumped. Furthermore, there are times that high voltage spoils the machine pumping the water. This rendered her to do expenditure that she was not expecting at that time and before then she must have spent or have difficult times in getting water to use in her house.

Another informant we met told us that,*" I use well water but the owners do not treat them as it is required, but I don't have any choice because I don't have the means to get access to another potable sources"* (Leonel, 16 September 2020, Superitte). To Leonel, he has no option, even though the water source he is using is not being treated by the owner as required. Since it is not his well, he has no choice but to carry the well water the way it is. To look at it one can conclude that his stomach has adapted to that source of water, if not, he would look for another alternative that will be good for him. More so, without the water, he cannot cope with activities like cooking, cleaning and bathing.

Furthermore, this is what another informant gave us as her point of view

> *During the dry season, at times we do not cook because of water shortage, equally, we do not usually bath when there is no water. If we want to carry water, we get up early as 5am or late in the evening around 8pm. This at times disturbs the owner even though we buy the water. 20litres of water cost 50 FRS. At times we need to buy water that. This is when one can know the value of water* (Clotilda, 17 of December 2020, Biyem-assi).

From this point of view, one can really see how a given household goes without food because of lack of water and not only food but they do not have their bath because of water. One can imagine if she is with the children in the house it becomes so difficult to cope with such situations. The data above confirmed that long dry season period creat a wide fluctuation in drinking water supply (White 1998). This point is also confirmed by Socpa (2008), water being one of the factors that inhibits food production and consumption. Furthermore, if they want to carry water, they will have to go to the sources very early in the morning at 5 am that is she has to cut up her sleeping time in order to fetch water. Early mornings can be dangerous because she can be harassed by unidentified men that could harm her. One can also imagine if she is married then she will have to abandon her husband to get water for the family. Eating or cooking eating which is a cultural activity in all the homes becomes difficult due to the absence of water and the culture of cooking every day begins to change.

**Fig 16: People waiting to carry forage water**

*Source fieldwork: Matilda Musah (February 2020, Mvog-Betsi)*

The picture above shows the people waiting to fetch water from forage well. The number of people present in this place indicates that there is insufficient water especially during the dry

season. One can see people with 20litres and ten litres of water. This will eventually give income to the owner. Information from the informant says;

> *My family carries or uses the spring water. We have been in this quarter for over 17years and our water source has been the spring water. At first, we usually had no problem of water, but now that the population has increased the issue of fetching water has become complicated. Now, during this dry season, it is the worst because I have to get up at 4am in the morning, just to come and fetch water, but upon arriving at the sources, I still meet people that were there before me. Like today, I came here at 4am, but look at the time am still here, it is already 10am. By the time I get home, I will be tired of doing house work and if am to do them, I cannot finish because the water I have now will not be enough for me to do all the house chaos. So it is really difficult getting water during the dry season. To me, the people here will have looked for a way to make sure this water source is protected, but when one proposed nobody takes it into consideration. Look at the water now that is flowing as wastage and nobody is using it. If the people would have decided to build even a tank that will be able to store the water and open at particular time for everyone to carry it will have been a nice thing but nobody takes that into account* (Carole, 19 of May 2020, Mvog-Betsi).

From the above point from Carole, one can see how people really suffer from water crisis in this part of the town. She had to go to the water sources at 4am in the morning, not minding how risky it is, not only time wastage but the quantity of the water she carries is still not enough for her to do the various activities in the house. She really sees reasons for the people to construct a water tank for water storage but as it is in the society today, nobody cares about others. So, it is all about themselves and not others. Also, it is very easy for her to catch a cold and even fever because of the cold she has to stay out early in the morning just to fetch water. Naturally, because of climate change, urbanisation, agriculture and no community spirit, the people are suffering and have to adapt to what the environment is offering to them. This point is validated from what we observed and noticed from the field during the study.

Another informant we met on the field told us this:

> *Water bill is very expensive and most of our or my land lords use the opportunity to extort money from us the tenants. When the water bills come he do not show us the original bill, they just write theirs as it suits them and give us to pay since I will not be the one to take to the office for payment. These make me very angry and disappointed with the type of people I am living with in the quarter* (Jones, 4 December 2020, Etoug-Ebe).

According to Jones's point of view, one can say that most of the landlord use this means to get money from their tenants. Usually, when the bills come for them to pay, the original bill

is not always shown to the tenant but the landlord gives each of the tenant his/her own part of the bill to pay. Anywhere, since the tenant is not the one to go and pay the bill, they have no option than to pay the money. But under normal circumstances, the bill is supposed to be shared equally to everybody and even shown to the tenants. That will, at least, give the tenant the confidence to trust the people he or she is living with.

This is what another informant said concerning water bills:

> *We to pay 4000 FRS, which is really expensive for water bill but for some time now we have not been paying because we have not had water for about two years now. So we were just paying metre rent but stopped at a certain level because we cannot be paying for what we do not consume* (Erida, 29 April 2020,TKC ).

To Erida, the water bill she pays is too expensive given the fact that they are few in the house. Another problem is here is frequent water cut with expensive bills to pay. But for some time now, they have not had water, but the CAMWATER people always bring them bills to pay for metre rent. Instead of them to look for another source of water, they are paying metre rent, which will have been used to buy water that is available for them. This also reduces household income, making the cost of living high. Paying expensive water bills have become a routine to her and she is use to paying the bills which is now a normal thing for her to do. This point contradicts what Gray (2008) is saying about water even though it is specifically ground water. But it is generally known that water is natural found in the ground so if the inhabitants are paying water bills it should be moderate considering that the equipment and chemicals for water purification needs to be taken careof.

We met this informant who told us how he spends much in purchasing water. This is what he said:

> *I spend about 10000 FRS to get mineral water per month and the job I do is not well paid, but I have to sacrifices much just to get water. The well water we have in this compound is not good for drinking. So I have no choice than to spend more on water rather than going to the hospital for any water-borne diseases. Most of the people who fall sick in my house are my children.* (Kelvin, October 5 2019, Simbock).

From Kelvin's point of view, he spent more for mineral water because he is not ready to pay much money in the hospital. One can imagine if he has a family, it will be hell, given the fact that his job is not a white colar job so he does not earn much and half of it is spent to just for water. To this effect, his income reduces as a result of poor quality of water in the

community. The money used in getting mineral water will have helped him to get other commodities that will help him adapt well in the environment.

From the above analysis concerning income and water from the informants, it validates what Falkenmark (2004) said that lack of financial or human resources or an unwillingness to reallocate water towards more sustainable and equitable patterns of use. WHO is confirms that majority of those who suffer from these diseases are women and children. According to their report in (2001) 70% of the 1.3 million people living in extreme poverty are women often trapped in a cycle of ill health. From their analysis, one can say that women and children suffer most because they might have a fragile system as compare to men who are always stronger than the women and children.

This is what an informant gave us concerning the distances the people have to go in order to get water*"My children use about 20mins to and fro for the spring, 10mims to carry forage water is just in the next compound"* (Gerald, 12 November 2019, Mendong). According to Gerald, the road to where they have a spring in the quarter is far away from them. His children have to trek for a long distance before getting water and at the end, they are very tired and any other thing is not possible for them to do. One can say that, most of the time, it takes a longer time whenever there are many people at the source, the people will have to wait and other households activities will be delay because of the population at the water site.

### 4.1.2 Effects of water crisis on health and sanitation on the inhabitants of Yaoundé VI

Water makes up 60% of the human body and is needed to help maintain a healthy weight, flush toxins from the body, and produce bodily fluids like saliva. Water also contributes to regular bowel function, optimal muscle performance, and clear, youthful-looking skin (Water science school 2019). In many areas in Yaoundé VI, people are forced to drink low quality water from flowing streams, wells, tap and rain which it may be contaminated. There are many water-borne diseases that people die off. Less water also means sewage does not flow, and mosquitoes and other insects breed on steel (stagnant) dirty water and the result is deadly malaria and other infections. Insufficient water or bad quality water causes huge sanitation issues in that, when there is insufficient water, the people cannot bathe as required. Clinics, local restaurants, public places of convenience and many other places are forced to use very little water for cleaning. This compromises the health of the

staff and people who uses the facilities. Like what we have in area today in Yaoundé VI, the water is insufficient and has low quality and helps promote a bad health condition

However, failing to drink enough water can cause dehydration and adverse symptoms, including fatigue, headache, weakened immunity, and dry skin. Is it possible one's health problem is being caused by not having enough water in the body. Below are some signs that indicate that one may need to start drinking more water to benefit from improved health (http://water.usgs:gov/edu/propertyyou.html, 12 of March 2020).

#### 4.1.2.1 Health systems

Concerning the health system, we have bad breath, fatigue or tiredness, frequent illness, constipation, poor skin health, sugar craving and decrease in urination.

Bad breath is the air that is sent out of the mouth with an odour, water is essential for saliva production and helps rinse away bacteria so one can maintain healthy mouth odour. Lack of water inhibits saliva production and causes bacteria to build up in the mouth, teeth, and gums, contributing to bad breath. If one does not practice good oral hygiene, he or she continues suffering from chronic bad breath and it is possible that the individual is not drinking enough water (http://water.usgs:gov/edu/propertyyou.html, 12 March 2020). We met an informant during our fieldwork, and this is what he said concerning water and bad breath:

> *To me, water is needed constantly in the body to prevent bad odour from the month. When one closes his or her month for a long time, it produces fowl smell that the individual cannot sit in the mist of people freely. For one to avoid this, the mouth needs to consume water frequently* (Laura, 7 of August 2020, Melen).

According to Laura, if an individual does not frequently drink water, his or her mouth will have an odour. Quite often, this odour can scare people away from the individual because people will not be able to feel free when talking with any one with mouth odour. In normal circumstances, when one seat alone without communicating and with his or her mouth close, it produces an odour. As human beings we are supposed to be drinking water at any given time to avoid mouth odour.

Fatigue: drinking insufficient water can cause an overall fluid loss in the body. This fluid loss can lead to a decrease in blood volume that puts excess pressure on the heart to deliver oxygen and nutrients to the organs, including the muscles. Lack of water can cause

someone to experience periods of fatigue and low energy as body tries to function without enough water. If one is constantly feeling sluggish and tired despite getting a quality night's sleep, one may need to boost the water intake (http://water.usgs:gov/edu/propertyyou.html, 14 March 2020). This is what an informant said concerning water and fatigue or tiredness:

> *Generally our body needs water, so when the water is not available it causes the body to be weak. Most of the time, when I go to the hospital, the first thing the nurses give me if there is a need for admission is water. It boasts of my health even though the drips have medicine in it. So it is through the water that gets me strong. Again, when I over work myself in the farm, I sweat a lot and get tired but once I take water, replenish the water loss and gives me some strength. When am tired I usually bath with cool water and it boast up my system* (Yanick, 14 of March 2020, Melen).

According to Yanick, water is medicine to him. Like he said above, most of the time his medication is given through drips which are liquid in nature. Again when he does hard labour, water also plays a role, as giving him energy as he consumes it or bathes with water especially the cool water. From the cultural ecology point of view, one can actually confirm that water which is found in our environment is medicinal because of its part it plays in the human system. This point is confimed by Seaver (2022) update of her work; she listed out the various consequences of not having water in the body. Individual might feel low energy as water helps keep your mind alert and the body balanced. If we are not drinking enough during the day, that afternoon slump will hit even harder, and one might feel too tired to continue on with work or make it to your evening workout. It might increase your risk of stroke being dehydrated can raise risk of strokes and prolong recovery time, if we had one. So, to keep our heart in tip-top-shape, pay attention to how much we are drinking. One may be moody, it might lead to overeating sometimes we confuse thirst with hunger.

Furthermore, it could slow down our metabolism water is needed for every single function in the body, so when we are dehydrated, our metabolism naturally slows down and with it, so do our energy levels. We equally may experience headaches since our brain needs water, when it's lacking it can lead to headaches and fatigue. So, before taking medication, have some water first and rest. Not drinking enough water can increase the effects of aging. with insufficient water, collagen can crack, leading to fine lines and wrinkles.One may have weaker workouts, when we are sweating, there is a loss in electrolytes and water, so it's important to drink before, during and after working out to replenish lost stores.It may lead to increase in weight, a little weight gain is nothing to lose sleep over. That said, if it continues

over time or is in the belly region in particular, it can put one at a greater risk for various chronic diseases, including diabetes, heart disease and more.

Frequent illness: water helps flush toxins, waste, and bacteria from the body to fight disease and infection as well as strengthening the immune system, so one become sick less frequently. If the body seems always getting sick, one may need to start drinking more water to keep the body free of toxins and functioning at an optimal level. Again, lack of water causes fatigue; it can render the body physically inactive, another risk is that it weakened immunity. We met an informant who gave us her own conception about water and illness. This is what she said:

> *I hardly fall sick but when I get slight or light headache, i know that I have not consume water for that day. This is because immediately I take two glass of water, the headache goes away or subsides. So I believe so much in water. I know that, water keeps the body free from some bacteria that would have accumulated and causes harm to the system* (Larisa, 1 September 2020, Acacia).

According to Larisa, water keeps her healthy, especially when she have headache. One can also say that, the head could be cause by stress and work and with a glass of water and rest it stops the headache. Also to her, water help in removing some of the germs or bacteria that would have accumulate and cause some damage to the body. From the cultural interpretation of lack of water in the body to her, headache is caused by little or no availability of water in her body and water which is medicine according to her is from the natural environment. The point above also confirms what chapman (1996) who said lack of water is associated with diseases, inadequate sanitation and poor hygiene. It is also validated by what Seaven said above concering the effects of lack of water in the body.

Constipation: water promotes good digestion and regular bowel movements by keeping the stool soft and moving it easily through the digestive tract. Insufficient water can cause the body to pull water from stool to compensate for fluid loss, leading to harder and firmer stool that is more difficult to pass out. The bowel movements are irregular and infrequent, one can try drinking more water to loosen the stools and relieve constipation and bloating. This is what an informant gave us in the field:

*"Most often when I drink water, it helped digest the food in the body and prevent constipation in my system. But when I do not drink water frequently like am supposed to do, I feel constipated"* (Belta, 12 of November 2020, Biyem-assi). To Belta point of view,

naturally her body responds well when she takes a lot of water, but when she does not take water as required by her body, she becomes constipated. This makes her unconfortable in doing her daily activities.

Poor skin health, water hydrates and plumps skin cells to make the skin look brighter, vibrant, and more youthful. However, lack of water can cause skin to lose its plumpness and elasticity, leading to dryness, flakiness, fine lines, wrinkles, and sagging skin. Water even helps reduce acne and other skin problems by flushing harmful toxins from the body. If beauty products and skin treatments are failing to improve the appearance of your skin, drink more water to achieve a more youthful appearance and to reduce or improve skin problems. Water deficiency symptoms include weakness, low blood pressure, dark urine, dizziness, confusion and reduced cognitive function. One may also see visible changes like sunken eyes, reduced tear production and decreased skin elasticity when dehydration is mild or moderate (http://water.usgs:gov/edu/propertyyou.html, 14 March 2020).

Decreased urination: when the body is dehydrated, the kidneys retain as much fluid as possible to maintain their function. This can lead to decreased urination one of the most common signs of low water intake. Lack of water can cause the urine to become yellowish in colour, strong odour, and cloudier in appearance. Individual may also face a higher risk of urinary tract infection when the body lacks enough water to flush out toxins and bacteria. An individual will know when he/she is drinking enough water when he/she start urinating more frequentlyand the urine is clearer, lighter in colour, and far less odorous (http://water.usgs:gov/edu/propertyyou.html, 14 March 2020). An informant in the field gave us some information relating water and urination. This is what he said:

> *I know that if i do not drink water I will not urinate frequently. I also know that when i drink plenty of water, it boast up the body system by moving the substance and fluid in the body from one organ to another. So if i do not consume water, it will be difficult to urinate and with that, it can cause harm to me if waste products are not send out from the body* (John, 16 August 2020, Centre)

To John, frequent urination is a means of sending out waste product from the body. It boosts up the immune system, keeping it healthy. It also helps to move substances from one area to another. Again, she believes that if the waste product is not removed, it can harm the body. In normal circumstances, the human body is made up of water; it is this water that human are able to move. Substances move round the body and keep the body moist, this water naturally

found in the environment which is consumed by humans to be able to adapt to the environment especially in times of extreme hot conditions.

Hunger: it takes a lot of water to grow food and care for animals. Experts say that globally we use 70% of our water sources for agriculture and irrigation and only 10% on domestic purposes (WFP 2012). Less water means farming and other crops that need water to grow have lower yield. It means farm animals will die and others will not do well without water. The result is constant hunger, thirst and low quality of life. If there is no water that can be used in order to help water the crops, then one is going to have people that are going hunger strike. Animals will also die, which will result in a lack of meat consequently insufficient protein in the body.

Water scarcity causes starvation to both people and animals that are found in the community. Food (and water) is fuel for the body and our muscles need this fuel to function. Without food for a couple of days, the body will convert all fats stored in the body to energy for use. If this condition is prolonged, the body begins to reduce its activities naturally, and the result is the slow response, low activity and slow reaction that can be seen on or in people who are starving. The body has run out of energy and cannot work.

Every now and then, we see adverts, news and other stories on television (TV), newspapers and internet with extremely skinny children, together with their skinny mothers. Those are very difficult images to ignore, but they are real. In many places in the world, there are families who cannot even bring themselves to think, talk, walk or even sleep because there is simply no energy in their bodies to do so. Extra energy is needed during pregnancy and while breastfeeding mothers so insufficient water and food can lead to body weakness which is not good for pregnant women too.

According to FAO (2012), it is very easy to think that people who are hungry in some countries are just lazy and hunger is the only result they deserve. That is not the case. It is just difficult for individuals to help themselves, especially if they are caught up in the usual conflicts, extreme climates, political or economic difficulties involved. A state, lasting for at least one year, of the inability to acquire enough food, defined as a level of food intake insufficient to met dietary energy requirements. Aside from an obvious lack of drinking water, hunger is one of the biggest effects of water scarcity. The case of crisis we have today in the North West, South West and Northern Regions of Cameroon, those in the bushes have it difficult in getting potable water and food, this cause body weakness and malnutrition.

In the field, we met an informant this is what she said that*"there are times my family and I will go for days without cooking because there is no water for us to use for cooking*" (Blessing, 18 October 2019, Mvog-betsi). Blessing confirms what the WFP explains above concerning food shortages. When there is no water, it is impossible for a family to survive because there is no water. So, one can conclude that, the absence of water can cause a lot disaster to human health that is starvation and malnutrition. Water which is naturally found in the environment causes problems to the human system because of it scarcity in the area. It is this environment that the humans do other activities that if it does not suits the environment, it causes harm to other factors that are able to promote healthy living. It is because of some cultural activities like farming where high quantity of water is needed to be use in the farm while humans do not have what to use.

Water shortages directly contribute to lower crop yields and the death of livestock, which can quickly lead to food shortages. Starvation can result in the flare up of conflict, and incite migration efforts, which can be both dangerous and hard to properly manage. The United Nations says food production should be increased by 60% by 2050 in order to stave off political turmoil, civil war, terrorism, and other problems. Children who are hungry or thirsty often do not go to school, which means education suffers as well. Malnutrition is a universal issue that no country in the world can afford to overlook. A third of reproductive-age women are anaemic, while 39% of the world's adults are overweight or obese and each year around 20 million babies are born underweight. Beyond health, slow progress on malnutrition is also impacting the social and economic development of countries (UNICEF 2018).

This is what another informant we met told us:

> *I know that too much retention of urine and feaces in the body cause infections which is able to damage body organs causing disfunctioning of the human system. Most at times I retend urine and feaces in my body because there is no water for me to use and go to the toilets so I have to condition myself and wait till when I have water*( Laura, 7 of August 2020, Melen).

From Laura point, one can see that water has a lot to do when it come to sendingor passing out waste products from the body. Retending urine and feaces in the body has a lot of consequences as confirmed by Cunha (2014) which says that, urine retention causes urinary track infection, kidney damage, bladder damage and Urinary incontinence. All of the diseases mention here is able to occur in human who retend their urine and feaces for a long period of

time. This is cause by insufficient water in the environment especially for those using flushing toilets

Above are just some of the health problems we have as a result of not taking enough water. Normally there are times that the doctor will prescribe more intake of water to a patient. But it becomes difficult if an individual has to buy the water all the time because there is insufficient or polluted water. This reduces the income and makes life difficult for the individual.

**4.1.3 Sanitation issues**

Without access to clean water, there is no way to clean food, dishes, or good hygiene. When people do not given access to proper sanitation, diseases that are explained above ends up becoming much more of an issue than it would have been otherwise. It also causes mental health issues, including depression and anxiety (http://water.usgs:gov/edu/propertyyou.html).

Menstrual Hygiene Management (MHM) is defined as; "women and adolescent girls using a clean menstrual management material to absorb or collect menstrual blood. It can be changed in privacy as often as necessary for the duration of a menstrual period, using soap and water for bathing as required. It requires having access to safe and convenient facilities to dispose of used menstrual management materials. Furthermore, they understand the basic facts linked to the menstrual cycle and how to manage it with dignity and without discomfort or fear (drafted by WHO/UNICEF JMP Hygiene Working Group, 2012).

Approximately 52% of the female population is of reproductive age (Population Reference Bureau, 2011) experience menstruation which is a natural phenomenon of the reproductive cycle. Safe and dignified MHM requires education, knowledge, menstrual hygiene materials, and access to facilities that provide privacy for changing materials. Furthermore, washing and drying menstrual cloths, access to water and soap, access to disposal facilities and systems for used menstrual materials. The inability to adequately manage menstrual hygiene can have multiple and interrelated health and social effects (Kirk and Sommer, 2006). An informant in the field told us this concerning menstrual hygiene. This was her words:

> *Menstruation is a normal routine for a woman which needs to be handled with care. During this period, the woman needs extra hygienic care. She has to bath at least three times daily during this period. Water is needed for good hygiene. When there is no water, I cannot clean myself properly. When the blood*

> *accumulates, it produces odour that, one cannot stand my presence. I can imagine a woman menstruating and has no water to have her bathe. It is a terrible thing; those are some of the things we neglect that happens in our mist. Again, the woman reproductive system is fragile so much so that any carelessness can lead to complication or problem* (Evelyn, 7 May of 2020, Rondpoint express).

From Evelyn words, menstruation needs to be handled with care. This cannot be done without water, it is vital for good menstrual hygiene. This is because when it accumulates, it produces an odour that people cannot stand it. One can also see from T points that the woman sysyem is fragile and that any carelessness can lead to some complications in the reproductive system like infections because the blood that is being sent out is a waste product from the woman's body. Menstruation is a cultural process that occurs in everywoman, and water which is a natural and free gift is not available to be use. It becomes a challenge to the women in the community, the environment or the culture is supposed to meet the need of the people and it is not able to do so. Life threatening sets in because of some environmental factors that cannot support life.

Without improved sanitation, a facility that safely separates human waste from human contact, people have no choice but to use inadequate communal latrines or to practice open defecation. For women and girls, finding a place to go to the toilet outside, often has to wait until the cover of darkness.

In the immediate environment, exposed faecal matter will be transferred back into people's food and water resources, helping to spread serious diseases such as cholera. Beyond the community, the lack of effective waste disposal or sewerage systems can contaminate ecosystems and contribute to disease pandemics. In some parts of the world, there is little or no awareness of good hygiene practices and their role in reducing the spread of disease. However, it is often the case that even when people do have knowledge of good hygiene habit, they lack the soap, safe water and washing facilities they need to make positive changes to protect themselves and their community.

The lack of a proper sewerage system in the Yaoundé VI council area means that the majority of the population has to make their own sanitation facilities. The on-site, pit latrines are commonly used, which are normally simple constructions, four to six meters deep. Dried up shallow wells are also often converted into pit latrines during the dry season. The non-raised pit latrines in particular, tend to get flooded during the rainy season and high concentrations of pathogens infiltrate the aquifers, contaminating the groundwater. Moreover,

most of the latrines are unlined, thus constructed without waterproofing. Although this is not a criterion for considering the latrine improved, the result is that any liquid from the excreta can rapidly find its way underground. Since the latrines are typically situated close to wells, this contributes to frequent outbreaks of cholera, dysentery and other water-borne diseases.

**Fig 17: Spring source under a house**


*Source fieldwork: Matilda Musah (2020 April Mewoulu at "Centre")*

The figures A and B above show people fetching spring water from under a house structure. Under normal circumstances, this is not good. The house is a modern house with water system toilet. Waste product we sent out of the body is in liquid form that dissolves into the soil, where there is spring water. One can conclude that, the water from this place is not safe for any household activities.

### 4.1.4 Low agricultural production in Yaoundé VI

It takes a lot of water to grow food and care for animals. Experts say that globally we use 70% of our water sources for agriculture and irrigation and only 10% on domestic uses/purposes (WFP2012). Less water means farming and other crops that need water to grow have lower yield. It means farm animals will die and others will not do well without water and the result is constant hunger, thirst and low quality of life. If there is no water that can be used in order to help water the crops, then there are going to be people that will go hungry. Animals will also die, which will result in a lack of meat as well. Water scarcity, in short, causes starvation to occur in masse for both people and animals that are located in the area.

The United Nations Food and Agriculture Organisation, estimates that nearly 870 million people of the 7.1 billion people in the world, or one in eight, are suffering from chronic undernourishment in 2010-2012. Almost all the hungry people, 852 million, live in developing countries, representing 15 % of the population of developing countries. There are 16 million people undernourished in developed countries.

According to FAO (2012), it is very easy to think that people who are hungry in these countries are just lazy and hunger is the only result they deserve. That is not the case. It is just difficult for individuals to help themselves, especially if they are caught up in the usual conflicts, extreme climates, political or economic difficulties involved. A state, lasting for at least one year, of the inability to acquire enough food, defined as a level of food intake insufficient to meet dietary energy requirements. Aside from an obvious lack of drinking water, hunger is one of the biggest effects of water scarcity. This is what an informant told us concerning water and agriculture

> *There are times my family and I will go for days without food because we depend on the small garden we have to farm, so when there little or no water to watered the crops, it does not do well so we suffer from starvation this is because I donot have money to look for any alternative source of food* (Marbel, October 2019, "Centre").

According to Marbel point of view, just confirmed what the Swatuk (2002) explains that, since most crops are rained fed and human who depend on surface for survival might go hungry because there is no rain or water to feed the crops. When there is no water it is impossible for her family to survive because there is no water. So, one can conclude that the absence of water causes disaster to human health through starvation and malnutrition. Agriculture is a cultural activity in the environment and water is the most important factor that promotes good agriculture. So when there is little or no water, it becomes difficult for crops to grow. One possibly says that most of our malnutrition is as a result of insufficient water in our community.

### 4.1.5 Effects of potable water scarcity on education in Yaoundé VI

For many people in other parts of the world, children (and teen girls) have to be up at dawn to collect water for the family, they have to walk for several miles to get water. The children get tired and some have to miss school as a result. Doing this for many years takes away school times and the cycle continues. In other places, girls and women are not allowed to go to school at all so that they can serve the family by getting water and taking care of

other family needs. Water scarcity makes it difficult for people to get the education that they need or that they deserve. Mainly, because those children are either too sick to go to school or they are working to help get water for the home and family.

There is evidence to suggest that school absenteeism is related to a decrease in academic performance, dropout rates and delays in academic development (Lamdin, 199VI; Reid, 2003; Bener et al., 2007; Kearney, 2008; Moonie et al., 2008; Baxter et al., 2011). While the available evidence is focused primarily on middle and high-income countries, there is no reason to believe that these impacts are not relevant in low-income countries. The social and economic knock-on effects of reduced academic performance or, in some cases, drop-outs, are likely to be far-reaching for the individual, but also at the community, region and country. For example, under-attainment in school can affect a child's job prospects and their livelihood, as well as their social development, which in turn can hold back economic growth and social development in the locality.

The effect of water on school attendance or educational performance can manifest itself through pathways like:

- Pupil absence due to diarrhoeal disease and/or respiratory infections: It was estimated that 194 million school days would be gained due to less diarrhoeal disease if MDG targets for sanitation were met (WHO, 2004);
- Girls' absence due to difficulty of managing MHM: One contributing factor is a lack of appropriate WASH facilities, without which many girls are likely to miss school while they menstruate. Without the appropriate facilities, girls cannot adequately manage their menstrual hygiene, resulting in fear of embarrassment or teasing associated with unpleasant odours or stains (Sommer, 2010; McMahon et al., 2011)

Reduced cognitive function and performance associated with Non-transmissible diseases (NTD) infections and dehydration are some of the most severe consequences of chronic worm infections, which are strongly associated with WASH are those related to education, and intellectual achievement. Children subject to intense infections with worm miss double the number of school days as their infection-free peers (WHO, 2005). Similarly, heavy-intensity hookworm infections in children have been shown to produce growth retardation, impaired learning, increased absences from school and decreased future economic

productivity (Miguel and Kremer, 2004). Dehydration is another potential cause of reduced cognitive function and performance (Hunter *et al*., 2014).

Truancy associated with fear of assault, pupils of schools where WASH facilities do not provide adequate privacy and safety may fear assault or violence, which could lead to a decision not to attend school.

Pupil absence due to the need to fetch drinking water can cause them to missed classes, in particular if children have to make more than one trip per day to collect water (Fisher, 2004; Hemson, 2007). One study in 25 countries in sub-Saharan Africa estimated that, collectively, children spent 4 million hours per day collecting water, which made them unable to attend school (WHO, 2012b). In the field, we met an informant and this is what he said:

> *I have 3 children in my home, but we find it difficult in getting potable water here. There are times when the children comes back from school, instead of them reading their books, they are fetching water and at the end they will not be able read their books because of tiredness. Also they get up early at about 5am to fetch water which I know is not healthy for them, because they can catch cold and also be late for school. At the end, their performance drops from what they had before. But if we had water in our home, my children will do extremely well in school, because they will have more time to study rather than fetching water. But now they have to help me in those house chores especially in fetching water* (Laura, 7 August 2020, Melen).

According to Laura, her children's school performance drops, because they spend much of their time fetching water for the household because of the insufficiency they have in the quarter. She believes that if there was water available at all times, her children will not suffer all the time. Education is the best thing a parent can give to his or her children but in situations where the environmental factors are not conducive for the children to study, it becomes challenging for the children to study. This therefore brings down the quality of education for the school concerned.

### 4.2 Effects of water pollution to the inhabitants of Yaoundé VI

One will notice in the previous chapters and pages that water pollution is very harmful to humans, animals and aquatic life. The effects can be catastrophic, depending on the kind of chemicals, concentrations of the pollutants and where they are polluted. Below, we shall see a summary of the effects of water pollution. The effects of water pollution are varied and depend on what chemicals are dumped and in which locations. The quantity of

water needed by the people to survive also matters. It is also as a result of water pollution that leads to insufficient water.

Many water bodies near urban areas (Yaoundé VI) are highly polluted. This is the result of both garbage dumped by individuals and dangerous chemicals legally or illegally dumped by manufacturing industries, health centres, schools and market places. Effects of water pollution affect or causes the following; death of aquatic organism, disruption of food chain, agriculture in Yaoundé VI.

The death of aquatic (water) animals is the main problem caused by water pollution in that it kills organisms that depend on these water bodies. Fertilisers, waste, and ammonia turn into nitrate and phosphates, and when washed into nearby water bodies, the production of algae gets enhanced that reduces the amount of oxygen present in water, which results in the death of many aquatic animals (www.conserve-energy-future.com, 14 of May 2020). Even though this does not happened in Yaoundé VI because there are no big rivers.

### 4.2.1 Effects of water pollution on health of inhabitants in Yaoundé VI

Closely associated with the overall availability of water resources is the problem of water pollution and human diseases. At present, approximately 20% of the world's population lacks safe drinking water, and nearly half the world population lacks adequate sanitation (GEF 2002, UNESCO 2002). This problem is acute in many developing countries, which discharge an estimated 95% of their untreated urban sewage directly into surface waters (Pimentel *et al*. 2004). Downstream, the untreated water is used for drinking, bathing, and washing, resulting in serious human infections and illnesses. Overall, water-borneinfections account for 90% of all human infectious diseases in developing countries (Pimentel et al. 2004). The lack of sanitary conditions contributes to approximately 12 million deaths each year, primarily among infants and young children.

Approximately 40% of US fresh water is deemed unfit for drinking or recreational use because of contamination by dangerous microorganisms, pesticides, and fertilisers (UNESCO 2001b). In the United States, water-borne infections account for approximately 940,000 infections and approximately 900 deaths each year (Pimentel et al. 2004). In recent decades, more US livestock production systems have moved closer to urban areas, causing water and food to be contaminated with manure (BANR 2003). The quantity of livestock manure and other wastes produced each year in the United States is estimated to be 1.5 billion (Pimentel *et al*. 2004). According to the Centres for Disease Control (CDC) each year, more than 76

million Americans are infected and 5000 die as a result of pathogenic *Escherichia coli* and related foodborne pathogens, which are associated with this kind of contamination (Pimentel et al. 2004).

The incidence of schistosomiasis, which is also associated with contaminated fresh water, is expanding worldwide. Each year, this disease, caused by a parasitic worm, is contracted by more than 200 million people and causes an estimated 20,000 deaths (Hinrichsen *et al*. 1998). Its spread is associated with an increase in schistosome habitat, including the construction of dams and irrigation canals that are suitable for the parasite's intermediate host (a snail) and accessible to humans, allowing them to come in contact with the infected water).

Another serious infectious disease associated with poor water quality is tuberculosis, which can be transmitted through air, water, or food. At present, approximately two billion people are infected with tuberculosis, with the number increasing each year (Pimentel *et al*. 2004). In addition, about two billion people worldwide are infected with one or more types of helminth (tapeworm, liver fluke, leech), either through direct penetration of their skin or through the use of contaminated water or food (Hotez *et al*. 1996I. In locations where sanitation is poor and overcrowding is rampant, such as parts of urban Africa, up to 90% of the population may be infected with one or more helminth species (Pimentel *et al*. 2004).

In addition to helminths and microbe pathogens, many chemicals contaminate water and have negative impacts on human health and natural biota. The US Environmental Protection Agency also allows the application of sludge to agricultural land, and this sludge is contaminated with heavy metals and other toxins (Pimentel *et al*. 2004). Many of these agricultural chemicals, including nitrogen fertiliser, contaminate aquatic ecosystems through leaching and runoff, resulting in the eutrophication of aquatic ecosystems and other environmental problems. Worldwide, pesticides alone contribute to an estimated 26 million human poisonings and 220,000 deaths each year (Richter 2002). There are some streams at Mendong, Centre, Melen, that are being polluted by waste, fertilisers from the farm as rain water, dust and other animals and human activites that transport these materials into the streams. Water pollution on health, we will be talking on polio on infants and eye infection in Yaoundé VI.

### 4.2.2 Effect of water pollution on infants

Polio is a serious viral infection associated with the polio-virus. It spreads through water contaminated with faeces from an infected person. When the virus enters the blood stream, it destroys the nervous systems and results in extreme weakness of the body. In most cases, it causes paralysis. Those who miss to get polio vaccination in childhood are at great risk of being infected by the virus. The symptoms include seizures, fever, headaches, and later on paralysis. This is what an informant gave us concerning polio in infants:

> *I have had cases of children having polio as a result of water-borne disease/ infection. At this stage, the child needs extra care from the hospital and the family. If not, it can lead to paralysis at that early stage of the child. In our hospital very few cases of such happens, but it is good that we sensitize the population on the danger of water-borne diseases, especially on children. The fight against polio in Cameroon is at 95% meaning it has not yet been completely eradicated. So, more is still to be done to complete polio. Nigeria still suffers from it and children from 0-15years are still affaeted by polio in that part of the world* (Kinney, 12 of October 2019, Etoug-Ebe).

According to Kinney, this disease is real though some parents neglect it. Even though it is difficult to get potable water, we are called upon to take care of the water source. Cameroon and Yaoundé VI in particular is fighting against polio but there is the need to eradicate polio completely. That is why the people are called upon to take precautions against polio. The populations are supposed to take care of the environment especially for those who have infants in their home, their body or systems are very fragile that need intensive care from their care givers. If the environment is not well taken care of, our infants will always have issues of polio which is dangerous to their health. So our water sources most especially need a special care for survival and productivity. The analysis above is also substantiate by Water Aid (2002) which says that, exposure to to contaminated water sources is associated with pregnancy failure, and with infant, childhood development difficulties illness such as polio and mortality.

Trachoma, also known as eye infection, spreads through pathetic sanitation and hygiene, caused by inadequate safe water. It mostly affects children and women. About 6 million people worldwide have developed blindness because of the disease. Trachoma is the leading infectious cause of blindness in the world. Infection spreads from person to person, particularly from child to child, child to mother and mother to child. The disease thrives especially in crowded living conditions where there are shortages of water, inadequate

sanitation and where numerous eye-seeking flies are present. In affected communities, infection is often first encountered in infancy or childhood (WHO 2020).

This is what an informant gave us:

*"I have been working in the eye department for 6years now.The most contributing factor to eye infection is dirty water so I believe if the population can have good water then this illness can be reduced" (* Kinney, 12 October 2020, Etoug-Ebe Baptist hospital). From Kinney, most of the people who have eye infections are cause from polluted water that they use. He thinks that if the people can have good water then the rate of this illness will reduced. It is our activities in the environment we lived in that is able to make it unsuitable for us, the people need to take special care of their environment to avoid or reduces cases of eye infections.

In affected communities, infection is often first encountered in infancy or childhood. With repeated infection over many years, the cumulative effect of many inflammatory episodes may cause the upper eyelid to turn inwards, so that the eyelashes rub on the eyeball, resulting in intense pain and scarring of the front of the eye. This is called trachomatous trichiasis, and ultimately leads to irreversible blindness. The age at which people in a community start going blind from trachoma is related to the intensity of transmission of infection in the community. Environmental risk factors influencing the transmission of the disease include; poor hygiene, crowded households, water shortage and inadequate latrines and sanitation facilities (WHO 2020).

### 4.3. Water-borne diseases in Yaoundé VI

Cameroon is one amongst the several countries suffering from cholera outbreak. Between 29 October 2021 to 2022, a total number of suspected cases 134 including deaths have been repoted by WHO. Affecting Far North, South West, North, Litoral, and Center all as a result of limited access to safe drining waternin some areas, a seasonal pattern of cholera and inadequate WASH conditions. Communities are aware of many health issues concerning water-borne diseases and it has affected them in many areas of life. We met a number of informants who gave us various water incidents according to what they had faced or are facing. This is what one of the informant said:

> *Cholera is an illness contracted when one eats or drink contaminated water which causes stomach disorder. I have seen people who have been affected by cholera on the TV, heard from the radio most especially those from the North Region are caused by insufficient water. From the rumours and news, it seems that the country have acute problem with problem of getting access to potable water. Even though*

> *some of us are complaining, it seems we in the Southern part of the country are better than those in the Far North* (Edgar, 27 March 2020, Melen).

According to this informant, cholera is contracted by eating contaminated food or drinking contaminated water. Here, he points out the case of the Far North inhabitants that have been suffering from cholera for a long time now yet we don't know if the ministry or government in charge of water distribution are doing are aware of the situation. He compared the situation of the Far North and people from the South and concluded that, the South people are better than those people in the North. Cholera caused by eating food or drinking water contaminated with a bacterium called *Vibrio cholerae*. *Vibrio cholerae*, the bacterium that causes cholera, this virus is usually found in food or water contaminated by faeces from an infected person. Common sources include: Municipal water supplies, ice made from municipal water, foods and drinks sold by street vendors, vegetables grown with water containing human faeces, raw or undercooked fish and seafood caught from polluted waters. The point above is not inline with what cultural ecology theory is saying. When we looked at the cultural ecology that is culture to its relationship with the environment it is clearly stated that it study the relationship between man and its environment and it is also this environment that meets our needs. Instead of us taking care of the environment so that one can have a good relationship, we neglect the environment by having poor drainage, poor waste disposal and it becomes a nuisance to us using it.

The World Health Organisation reports that there are 1.3 million to 4 million cases each year. The disease is most common in places with poor sanitation, crowding, war, and famine. In addition to human suffering caused by cholera, cholera outbreaks caused panic, disrupt the social and economic structure and can impede development in the affected communities. This effect, one can find them in the Northern part of Cameroon. Unjustified panic-induced reactions by other countries include curtailing or restricting travel from countries where a cholera outbreak is occurring, or import restrictions on certain foods. For example, the cholera outbreak in Peru in 1991 cost the country US$ 770 million due to food trade embargoes and adverse effects on tourism (CDC 1991).

Another informant whom we met, gave his own opinion on dysentery and this is what he said:

> *Dysentery is course when we consume contaminated food or water from the environment. To me all of these things are as a result of poor hygienic condition*

> *and preservation of this food items. Mostly when you look at the people selling food stuff in the market the way those goods especially vegetables are being thrown on the ground but yet we the consumers have no choice but to buy them like that and at the end one is contaminated with dysentery. I have my sister who had suffer from cholera for about 3days, it was actually hell on her because she was helpless and her stole was mixed with blood. I tell this is not what anybody should have it is really a tough time and bad experience* (Nobert, 18 August 2020, Simbock).

To Nobert, dysentery is as a result of eating contaminated food and water. He exposes the issue of hygienic condition of food preservation and storage especially those selling these items. Again he has not only heard but seen the pains the sister went through when she was diagnosed of dysentery. Dysentery is a type of gastroenteritis that results in diarrhoea with blood. This illness comes from most of the fertilisers we use on our crops which becomes dangerous to our health if the crops are not properly washed and when consumed it leads to complications include dehydration. Other symptoms may include fever, abdominal pain, and a feeling of incomplete defecation.

Table 5 above by EPA (1993) confirmed cause of dysentery. It is usually the bacteria Shigella, in which case it is known as shigellosis, or the amoeba Entamoeba histolytica. Other causes may include certain chemicals, other bacteria, protozoa, or parasitic worms. It may spread between people. Risk factors include contamination of food and water with faeces due to poor sanitation. The underlying mechanism involves inflammation of the intestine, especially of the colon.

Furthermore, another informant gave us information on diarrhoea according to his own point of view as follows:

> *To me, Diarrhoea is caused by infected food when, consumed by an individual, it poison the body system normally called food poison. I have suffered from diarrhoea some few months ago but thank God, I got it treated. Also I think this issue of contamination is either from the farming area, houses and methods of food preparation. There is a need to be in clean environment and practice good method of food preservation and preparation* (Glory, 18 May 2020, Acacia).

In Glory's point of view is validating what Bhavnani *et al* said concluded that unimproved sanitation is another major risk factor of diarrhoeal. The issue of diarrhoea is cause of contaminated food and water even though those selling and doing food business have a greater role to play when storing these food items. Also, diarrhoea is the condition of having a loose, liquid stool. It often lasts for a few days and can result in dehydration due to fluid

loss. Signs of dehydration often begin with loss and irritable behaviour. This can progress to decreased urination, loss of skin colour, a fast heart rate, and a decrease in responsiveness as it becomes more severe. Our environment is the main cause of our illness today if it is not well taken care of, our food, water, homes needs a proper care if not the environment will continue to be a hazards to the population.

The most common cause is an infection of the intestines due to either a virus, bacteria, or parasite, a condition also known as gastroenteritis this is also found in the table 5 above by EPA (1993). These infections are often acquired from food or water that has been contaminated by faeces, or directly from another person who is infected. The three types of diarrhoea are: short duration watery diarrhoea, short duration bloody diarrhoea, and persistent diarrhoea (lasting more than two weeks, which can either be watery or bloody). The short duration watery diarrhoea may be due to cholera, although this is rare in the developed world. If blood is present, it is also known as dysentery. A number of non-infectious causes can result in diarrhoea. These include lactose intolerance, irritable bowel syndrome, non-celiac gluten sensitivity, celiac disease, inflammatory bowel disease such as ulcerative colitis, hyperthyroidism, bile acid diarrhoea, and a number of medications. In most cases, stool cultures to confirm the exact cause are not required.

This is what another informant told us concerning diarrhoea

> *Diarrhoea to me is caused by eating food that is contaminated and drinking water which is also contaminated. But in children of more than 3 months diarrhoea is caused by the teeth developing in the child. I have witnessed that in most of my children in short as long as the stages in the children develop they experience diarrhoea* (Larisa, 1 September 2020, Acaccia).

To Larisa, Concerning the adults, their own cause is different from that of the children which is from contaminated food and water from our natural environment. She brings out a pertinent cause of diarrhoea in children as they grow up especially the period when the child is about developing teeth. Culturally, in any development of a child, it is always characterised by diarrhoea and loss of weight. So she culturally interpreted that when one sees a child above three months with diarrhoea and loss of weight, it is concluded to be development in the child's life. The analysis is not confirming what Bhavnani (2014) said about water and unimproved sanitation in a community.

Diarrhoeal disease may have a negative impact on both physical fitness and mental development. Early childhood malnutrition resulting from any cause reduces physical fitness and work productivity in adults, and diarrhoea is a primary cause of childhood malnutrition. Further, evidence suggests that diarrhoeal disease has significant impacts on mental development and health, it has been shown that, even when controlling for helminth infection and early breastfeeding, children who had experienced severe diarrhoea had significantly lower scores on a series of tests of intelligence.

Diarrhoea can cause imbalances, kidney impairment, dehydration, and defective immune system responses. When oral drugs are administered, the efficiency of the drug is to produce a therapeutic effect and the lack of this effect may be due to the medication travelling too quickly through the digestive system, limiting the time that it can be absorbed. Clinicians try to treat the diarrhoea by reducing the dosage of medication, changing the dosing schedule, discontinuation of the drug, and rehydration. This point is also confirmed by what Ozkan (2007) said about dysentery diarrhoea, cholera, and typhoid as a result of inadequate safe water in the community.

In the field we got an informant who gave us his point on typhoid and this is what he said

> *Typhoid is caused by contaminated water when taken into the body by an individual; it provokes the body to experience joints and some body pains. I have suffered from typhoid for about 3 months and am not the only one but majority of the population are suffering from typhoid. It is on and off, reason being that it has to be treated traditionally as per what people are telling me. I have spent a lot of money trying to do this treatment. I just think of a case where what if this was to affect my whole family then I will go back to the village because it is money consuming, yet the quality of the water is not worth consuming and one has to spend money buying mineral water* (Belta, 4, November 2020, Biyem-Assi).

The point above is validating the study did by WHO and UNICEF on the cause of diarrhoea and dysentery and how it can be tackles. To F, typhoid has and is dealing with majority of the population and if care is not taken, it is going to render some people helpless. If one has to go by the biomedical procedure, one will need to spend a lot of money for medication. Again, given the situation of the country now, people are unable to get jobs, not to talk of good one and there is no money to recruit and pay people for work. Yet, the state of water is not good for people to drink. The environment instead of being a solution to the people challenges has now become an unsecured place for human beings. This is because we are not taking care of

our surroundings, because if care is given to our surrounding it will be difficult to have contaminated water and water scarcity. On the other hand, some of our cultural activities have made it difficult for us to cope or adapt to the environment.

Typhoid fever is an acute illness associated with fever caused by the *Salmonella enterica serotype Typhi* bacteria. It can also be caused by *Salmonella paratyphi*, a related bacterium that usually causes a less severe illness. The bacteria are deposited in water or food by a human carrier and are then spread to other people in the area. Typhoid fever is contracted by drinking or eating the bacteria in contaminated food or water. People with acute illness can contaminate the surrounding water supply through stool, which contains a high concentration of the bacteria. Contamination of the water supply can, in turn, taint the food supply. The bacteria can survive for weeks in water or dried sewage (https://www.webmd.com/a-to-z-guides/typhoid-fever#1, 17 April 2020).

A total of 1888 Cholera cases have been reported in five regions of Cameroon. Thirty-eight of the cases were confirmed between 4$^{th}$ -10$^{th}$ March 2022, in 24 Health Districts. According to a weekly report from the Public Health Ministry, 55 people have died from the disease nationwide, and 24 health districts have been affected. The case fatality is 2.96%. In Cameroon, cholera affects people averagely aged 25.Cholera Cases per Region, 65 cases Centre, 255 in the Littoral, 3 in the North, 1387 in the South West, 179 South, 8 Far North, 21% severe cases. The South West is the most affected region with 1387 cases, followed by the Littoral with 255 cases. Cameroon's North, the least affected region counts just three cases .Two cases, and 1 death have been reported in Yaoundé, Centre Region, for the first time. There are 6 cholera cases in the Nkoldongo and Soa Health Districts in Yaoundé.The Centre Region now joins the four other regions where cases have been reported since the epidemic broke out in Cameroon in January.

According to Lontou-Fogang report, from 2013 to 2017, 39.1% ($n$ = 8,124) of patients attending the four health facilities in Bamboutos were found positive for at least one WBD. The clinically diagnosed cases observed during this period were classified into four main groups. Typhoid fever took the lead with a prevalence of 24.4% ($n$ = 5,064), followed by dysenteries (*Shigella* sp. and *E. histolytica*) with 18.6% ($n$ = 3,859), then by gastroenteritis (*Ascaris s*p., hookworms, *Campylobacter* sp., *Giardia lamblia* and *E. coli*) with a prevalence of 4.2% ($n$ = 870) and lastly viral hepatitis (hepatitis A and E) with 0.2% ($n$ = 36). All these were laboratory confirmed cases. The overall prevalence of WBDs were year-dependent ($\chi^2$ = 16.55; df = 4; $P$ = 0.002) with the highest ($n$ = 1,964; 46.3%) prevalence recorded in 2016

while the lowest ($n$ = 1,803; 42.8%) was in 2017. In addition, monthly variations were not observed in the cumulative prevalence of WBDs throughout the study period ($\chi^2$ = 10.27; df = 11; $P$ = 0.51).

Majority of the people become carriers of the bacteria after the acute illness. Others suffer a very mild illness that goes unrecognized. These people may become long-term carriers of the bacteria even though they have no symptoms and be the source of new outbreaks of typhoid fever for many years. Typhoid risk is higher in populations that lack access to safe water and adequate sanitation. Poor communities and vulnerable groups including children are at highest risk. Typhoid and paratyphoid fever are most common in parts of the world with poor sanitation.

People visiting friends or relatives are more likely than other travellers to get typhoid fever because they may stay in the country longer, may be less cautious about the food they eat or the beverages they drink because they eat local food prepared in people's homes, and may not think to get vaccinated before traveling. For example, when people live the villages as a result of war, famine, earth quakes and move to new areas like Yaoundé VI. Because of the poor water condition, they are likely to be infected with typhoid and other water-borne disease which is as a result of change of environment.

In the following table, we will be seeing the various diseases received in Etoug-Ebe hospital, percentages and causes diagnosed by the doctors.Below is a table which will be showing the names of water-borne-diseases with their symptoms, agents and effects of the diseases.

**Table 6: Types of diseases received in a week at Etoug-Ebe hospital**

| **Diseases** | **Percentage** | **Causes** |
|---|---|---|
| Malaria | 450 | Plasmodium falciparum, Plasmodium vivax, Plasmodium ovale, Plasmodium malariae Plasmodium knowlesi |
| Hypertension | 70 | Too much salt in the diet, Too much alcohol consumetion (more than 1 to 2 drinks per day), Stress, Older age, Genetics, Family history of high blood pressure, Chronic kidney disease, Adrenal and thyroid disorders and Sleep apnea. |
| Diabitis | 125 | Pancreas doesn't make any insulin, when the pancreas makes very little insulin and when the body doesn't respond like it should to insulin |

| | | |
|---|---|---|
| Gastroenterisis | 500 | viruses such as norovirus, calicivirus, rotavirus, astrovirus and adenovirus, bacteria – such as the *Campylobacter* bacterium, parasites –such as *Entamoeba histolytica, Giardia lamblia* and *Cryptosporidium,* bacterial toxins – the bacteria themselves don't cause illness, but their poisonous by-products can contaminate food, chemicals – lead poisoning, for example, can trigger gastroenteritis and medication – certain medication, such as antibiotics, can cause gastroenteritis in susceptible people. |
| Typhoid | 450 | Bacteria called salmonella, if an infected person handles food without washing their hands properly after peeing, they can spread the infection to someone else who eats the contaminated food. Communities with poor sanitation, infected human waste can contaminate the water supply. |
| Bronchitis | 35 | Long term exposure to air pollution, dust, and fumes from the environment, genetic factors, repeated episodes of acute bronchitis and a history of respiratory disease or gastro esophageal reflux disease. |
| Hiv/aids | 30 | HIV infection is caused by the human immunodeficiency virus. You can get HIV from contact with infected blood, semen, or vaginal fluids. |
| Sickle cell | 15 | Sickle cell anaemia is caused by a mutation in the gene that tells your body to make the iron-rich compound that makes blood red and enables red blood cells to carry oxygen from your lungs throughout your body (hemoglobin). In sickle cell anaemia, the abnormal hemoglobin causes red blood cells to become rigid, sticky and misshapen. |

*Source fieldwork: Dr Kinney (2019, December, at Etoug-Ebe Baptist hospital)*

The above table shows the different types of diseases that the Etoug-Ebe hospital receives all the time. From the table, one can clearly see that malaria, typhoid and gastroenterisis are those with a higher percentage. When we want to look at the causes, we see that it is caused by infected water and food when taken into the body. The disease with higher number confirms their causes as contaminated water as validated by WHO and UNICEF on the study water-borne diseases.

According to Kinney (2019), one of the long lasting effects of water or food borne diseases is the perforated intestines. When the diseases is not treated as early as possible, it perforates the intestines, causing internal bleeding which can lead to anaemia and consequently death if the case is not well taken care. Even though it is rare that is what happens to poorly treated water and food borne diseases. Some of these diseases occur more in children because of the poor hygienic condition and nutrition. This therefore means that mothers should be careful the way they handle their children's food, especially those from the age of 0-2years.

The body system of the child is too fragile at this stage and needs to be careful because any contaminated food or water taken in will poison the child system. This disease occurs more in children as compared to adult this is because adults are capable and able to control everything they take in as food. But for children, especially those of 6 months and above, if care is not taken, they eat everything they see since at this stage most of the children are creeping and can move around easily.

The table below presents the various illnesses diagnosed on pregnant women at Biyem-Assi hospital.

**Table 7: Types of diseases and number of people received during prenatal consultation at Biyem Assi hospital**

| Diseases | Number | Percentage |
|---|---|---|
| Malaria | 35 | 35 |
| Ambiasis | 15 | 15 |
| Gastric | 20 | 20 |
| Typhoid | 30 | 30 |
| Total | 100 | 100 |

*Source fieldwork: Dr Cyril (2019 December, Biyem-Assi District hospital)*

The table above illustrates the number of pregnant women received in a week for consultation. One can see that, malaria, typhoid is having the highest number of people diagnose. Followed by gastric and ambiasis. The statistics above are mainly from the prenatal consultation at Biyem-Assi hospital. This is what one of the nurses told us during our interview with her:

> *The diseases with the highest percentages are malaria, typhoid which are followed by gastric and ambiasis. In a week, about 100-120 pregnant women*

> *come for consultation and most of them suffer from water and food borne diseases. The percentage increases during the dry season and reduces during the raining season* (Cyril, 22 December 2019, Biyem-Assi hospital).

From the above statement, one can conclude that during the dry season when there is insufficient water. Pregnant women are more liable to suffer from water-borne diseases more during the dry season but as the rainy season approaches or sets in, the rate at which they come for consultation reduces because there is water and they can best use it with good hygienic conditions. Rain is another natural water sources that is being use by the population even though it is periodically. Again if this water is not well preserved it becomes an issue to individual using the water. But if during the rainy season and pregnant women do have typhoid it therefore means that the water is not well preserved to be used by the people. The analysis above is also confirmed by Water Aid (2006) which says that, exposure to to contaminated water sources is associated with pregnancy failure, and with infant, childhood development difficulties illness such as polio and mortality.

Some of these diseases have the following effects on the foetus. Unfortunately, we have very limited information on how typhoid can affect pregnancy or unborn baby. However, we do know that typhoid can be a serious illness, which can make one sick if not treated promptly, and therefore cause complications. During our fieldwork, at Biyem-Assi hospital, another nurse gave us the effects of typhoid on foetus and this is what she said:

> *From the limited information we have at hand, typhoid infection can cross the placenta to cause infection,(and other water-borne infections) can increase the risk of having a premature birth, miscarriages, a low-birth-weight baby. For example, 25 cases of typhoid infection of pregnant women, one first trimester miscarriage, six pregnancy losses (in second and third trimesters), six premature births and 12 normal births. All cases of miscarriage and pregnancy loss were mothers who had typhoid symptoms without any treatment. Babies who were born with typhoid infection were treated with the drug ceftriaxone and made a full till when they were healed* (Blessing, 23 December 2019, Biyem-Assi hospital).

From this view, typhoid has a great effect on the foetus. Pregnant women need to be careful on what they eat or drink to avoid miscarriage or stillbirth. The environment we lived in is now presenting us with choices on how to live. This environment have both the negative and positive aspect meaning if human being wants to survive in an environment they need to take care of the environment if not they will be faced with challenges that can caused the life of human there by causing discontinuity of human being. This point is validated by what Water

Aid (2006) says about the wider impact of water shortages on hygiene and sanitation. Pregnant women need to be very careful of the environment they lived in if not reproduction will not be in the community. Some of these pregnant women might be lucky to have delivered in hospital where they can detect it earlier for the child to be treated. On the other hand, some who might not be detected early will eventually loss their babies because of negligence.

The table below shows the number of diseases received monthly at Biyem-Assi hospital in Children.

**Table 8: Months and types of diseases received in 2019 at Biyem Assi district hospital**

| **Jenuary** | **February** | **March** | **April** | **May** | **June** | **July** | **August** | **September** | **October** | **November** | **December** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Malaria | Malaria | Malaria | Malaria | Malaria | Malaria | Malaria | Malaria | Malaria | Malaria | malaria | malaria |
| Anaemia | Sepsis | Sepsis | Sepsis | Sepsis | Sepsis | Stomach disorder | Stomach disorder | Stomach disorder | Diarrhoea | stomach disorder | stomach disorder |
| Sepsis | Diarrhoea | Stomach disorder | Stomach disorder | Stomach disorder | Stomach disorder | | | | respiratory problem | typhoid | typhoid |
| Stomach disorder | | Severe anaemia | | | Typhoid | | | | | | sepsis |
| Intestinal problem (worms) | | Stomach disorder | Stomach disorder | | | | | | | | |

*Source fieldwork: Matilda Musah (December 2019)*

From the above table, one can see that January has the highest number of diseases recorded during consultation. The most common diseases here are malaria, stomach disorder, typhoid and septis which are all cost by consuming contaminated food and water.

The table below will be giving the number of people consulted and hospitalised during 2019 at Biyem-Assi hospital.

**Table 9: Months and number of infants consulted and hospitalised in 2019 at Biyem-Assi Hospital**

| **Months** | **Number Consulted** | **Number Hospitalised** |
|---|---|---|
| January | 938 | 222 |
| February | 542 | 184 |
| March | 625 | 216 |
| April | 1017 | 244 |
| May | 919 | 235 |
| June | 892 | 200 |
| July | 391 | 174 |
| August | 560 | 175 |
| September | 564 | 184 |
| October | 1506 | 306 |
| November | 1592 | 479 |
| December | 1742 | 515 |
| **Total in a year** | **11,288** | **3134** |

*Source fieldwork: Biyem-Assi district hospital (December 2019)*

The table above gives us the vivid number of patients consulted and those hospitalised in 2019. From the above table, December, November, October, April and January all have the highest number of people consulted and hospitalised in these months. During these months, one can see that October and November happen to be one of the transition periods from rainy season to dry season and many are being affected by climate, contaminated water and food they consume. December and January is already at the heart of dry season where there is water shortage and the available one is not reliable. Many are infected with more of these diseases and most often the children are more infected.

April happens to be another transition period from dry season to rainy season that affects the population by causing cold, diarrhoea and other illness because of new crops

which many at times contaminated by rain water from the farms and fertilisers used by the farmers. February and July records the lowest number of people who were consulted and hospitalised. This is because the immune system of the population is adapted to the type of environment and many develop defence system to fight against any bacteria or virus in the body.

Other factors like blocked gutters also promote the spread of diseases, causing environmental pollution which is not healthy to the human system. Most of the gutters are being blocked by ground, plastic bags, grasses and water that are being disposed of into the gutters. During our fieldwork, we carried out focus group discussion in one the neighbourhood. This was what we obtained during our discussion:

> *Gutters are blocked due to many reasons like poor planning construction in Biyem-Assi; there is a problem of inundation since gutters are blocked. We struggle to deblock the gutters with our bare hands because we do not have tools to work with. A series of gutters usually have a common junction in that people throw dirt and grasses that grow in it. To be honest with you, when it rains it is difficult to sit on our veranda because everywhere is filled with bad water and some houses which are not raised up, the water enter into the houses. This is a medium were, people are contaminated with typhoid, cholera and much other water-borne disease.The council or the government should see how they can help in doing towm planning in these marchy areas or even do follow-up of building in these areas to avoid cases of flooding when it rains. Again most of the houses along this area emptied their suckaway into the stream. The council should do sensitisation on the importance of town planning or having good construction of houses. This issue of good constructions may look very lightly but is important that the people should know especially those that emptied their feaces (sewage) directly into the streams. That is one of the highest point of water contamination in the environment today* (FGD, 12 May 2020, Centre).

From our discussion, one can say that people are just careless of what is happening in the environment. People do not care how they construct their houses even if it has to disturb the other occupants it has nothing to do with them. If the people could care about the wellbeing of others, I guess they will not construct or throw dirt that will be a promoting factor of diseases to others. It is really true that we are living in the environment and are responsible for any negative outcome we see or have in the community today. For instance, there are always laws that govern or guide the population when doing construction but yet we go against them and still complaining of poor urban planning. If the population could respect the roles on town planning there will the need for people cleaning or trying to clean or unblock gutters with bare hands knowing what it can caused to their health. Furthermore, the people use their streams for sewage disposal meaning most of the houses around the streams and

marchy areas do not construct septic tanks for sewage storage but rather emptied their sewage directly into the streams around the environment. The informants also believed that if the council or government do proper follow-up in the area such scenario will not be seen.The above data analysis validates what Chapman (1996) said about lack of potable water, inadequate sanitation and poor hygiene which account for millions of death per year in the world.

### 4.4. Effects of waste disposal on water in Yaoundé VI

There are so many sources of water bodies in Yaoundé VI area like the stream, wells, tap, rain just to name a few. Some of these water bodies are use as waste disposal sites polluting the water making it unfit for drinking. Below are some of the photos showing water sources as waste disposal site:

**Fig 18: Stream used as disposal site**


*Source fieldwork: Matilda Musah (November 2020)*

The above figures A, is a bridge build to channel a spring water sources to flow. But from the picture, one can see that instead of water flowing, the bridge has been block with ground and the other part of it with waste materials. Figure B shows clearly plastic waste deposited into water bodies that is being used by the inhabitantsof this quarter. This water is being polluted for those using it down the stream.

Given that sources of agricultural wastes are diverse, solid and liquid waste are aslo hazardous and detrimental to the terrestrial and aquatic eco-systems. Uncontrolled and improper handling can often lead to many situations where agricultural waste can become an environmental issue.

Water pollution from agriculture has direct negative impacts on human health; the water pollution is mainly the deterioration of water quality. When water loses its quality, it is no longer in use. River water is the surface water; this surface water is being polluted by natural and manmade sources. According to Stark "The quality of any body of surface or ground water is a function of either or both natural influences and human activities. Without human influences, water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, any hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water. As a result, water in the natural environment contains many dissolved substances and non-dissolved particulate matter. Dissolved salts and minerals are necessary components of good quality water as they help maintain the health and vitality of the organisms that rely on this ecosystem service" (Stark *et al*, 2000).

**Fig 19: Polluted springs**


*Source fieldwork: Matilda Musah (November 2020)*

From the figures above, one can clearly see that some of the springs are not well taken cared of that is why we can find dirt all over the water source.

Irrespective of one's socio-cultural background, perception appears to be tilted towards the biomedical point of view of typhoid, malaria and stomach disorder. This can be explained by the awareness created by the contact between the population and the health workers on the constant exposure to water-borne diseases. We perceive community as a

homogenous entity, sharing the same norms and values by actually presenting the point of view from the diverse socio cultural views or background.

Weeds are well known to create hurdles in the agriculture fields causing ecological and economic losses. They compete with crop plants for space, water, and nutrients and also harm the surrounding soil. All weeds cannot be used as animal fodder because of the toxic compounds present in them, which otherwise may cause health problems to animals. Different weeds have different allelopathic effects that negatively affect soil biodiversity and the surrounding environment. For example, parthenium contains phenolic acids and a toxic compound parthenin, which is a sesquiterpene lactone. Ipomoea is also a widespread weed with several bioactive compounds, which are toxic and may cause physiologic problem in human beings and animals (Teodorita 2004). This is what an informant told us concerning waste disposal and water:

> *In my quarter, most of the waste products from my home and many others around is being discard in the stream behind my home,, this is because the point allocated for waste disposal is very far away from me, and most at times the company responsible do not even pass around to collect the waste regularly,, so the stream besides me serves as waste discarding point* (Sandrine,16 August 2020, Centre).

From this point of view, the stream serves as a waste discarding point, because the collecting point is far off. This is just that the people are too tolerant towards the water from the stream that is why they do not care about what happens with the stream water. Culturally stream water is always known as source of water for its various uses, but people use it as waste disposal site which pollutes the water making it unfit for domestic purposes. This data authenticate the photos we have above showing dirt in water sources.

The people in Yaoundé VI council perceive typhoid, malaria, diarrhoea, stomach disorder as a disease related to contaminated water and inadequate sanitation but attribute their situations to economic hardship because they recognized that their environment is a health risk factor. The socio-economic situation alone is sufficient because, water from doubtful sources that could have been avoided by the little means the people have. Water-borne disease is considerably high but does not imply full knowledge of handling the health problem adequately. Partly because of the ignorance or the fact that people eat and drink food that is contaminated.

### 4.5 Effects of insufficient potable water in Yaoundé VI

Access to quality water is the key to economic prosperity and better living standards. Businesses and schools thrive when people come to work on time and do not have to spend all morning looking for water. Restaurants, hotels and shopping places need to keep clean to attract tourists and foreign investments. Manufacturing activities, commercial farms, and mining processes all need a lot of water to thrive. Lack of water means no economic activities will happen and the people will remain in constant poverty. Birongo and Lee (2008) also confirmed that deficient gricultural water management, missing water services are able to deliver poor growth among urban communities and households.

The lesson on poverty is a complex one because there is no easy way, or standard definition of who is poor and who is not, although one look at the living conditions of people to get an idea of their situation. Typically, it is when someone experiences a fundamental deprivation of well-being. Each time one see images on TV and on the internet with hungry people with no food, running water, often in tattered clothing and no shoes, living in mud houses in run-down communities (slums), people begin to have a sense of what poverty looks like. This lowest condition is called Absolute poverty.

During our fieldwork, we met an informant who gave us her point of view on insufficient water and poverty. This is what he said:

> *"When there is water insufficiency especially during the dry season, I need to buy containers in order that I can store a good quantity of water. Also I need enough space for the containers to stand. But I am in a single room so it becomes very challenging for me to keep the containers. The job I do, do not permit me to spend on buying containers to store water. Instead of me using the money for something tangible,i am forced to buy mineral water or containers"* (Carole, 19 May 2020,Mvog-Betsi).

According to the above point of view, what Carole does for a living is not enough for her to be spending more on buying water or containers. This can be because she has a lot of responsibility so to her spending money on buying containers is reducing her income for other things. Again, her room is too small for her to be parking those containers but she has no choice than to manage the way it is. This point is being confirmed by UNESCO (2006) that, household incomes might not support the buyingof water and containers from expensive alternatives, thus the household is cought up in the cycle of poverty due to lack of good quality water for drinking. Culturally water is from natural environment one is not expected to spend much in getting water.

### 4.5.1 Effects of water scarcity on the economy in Yaoundé VI

Water scarcity slows the overall economic output. When access to clean water is not guaranteed, it is very difficult to have a prosperous and dynamic economy. The prevalence of water-borne diseases can severely affect general health and worker productivity. Absence of water makes proper bathing and the cleaning of household items very difficult. Unhygienic circumstances foster poor living and working environments, slowing down economic productivity. Many businesses wish to have easy and convenient access to water resources. But they might not choose to go into certain areas if there is a dearth of water. They see water as a competitive advantage when it comes to their operations.

Global water scarcity can have a severe impact on the economies of many, if not all, nations. One area that will be impacted is bilateral international trade. For those nations experiencing water scarcity they will tend to produce less agricultural goods and fewer manufactured products and will have to import greater amounts of each but at significantly higher prices (Hertel et al., 2013). In this case, these nations will be at a severe disadvantage since they will have to borrow more funds at higher interest rates thus causing financial deficits that will not improve over time. This will also cause a dangerous imbalance in the global trade market causing certain nations to go deeper into debt while others become wealthier over time. Financial projections state that huge food and agricultural trade deficits due to water stress could occur in South Asia at $1.35 billion while the Middle East and North Africa (MENA) region will have a deficit of $0.6 billion and nations such as China will see a gap of $1.08 billion and India of $0.44 billion (Hertel et al., 2013).

Among the economic implications of water scarcity is the impact on businesses worldwide leading to higher operating costs and staying competitive. For global firms controlling costs is difficult but it worsens when the price of water increases exponentially to where margins shrink precariously. This causes firms to regard water access as a competitive advantage and relocate when possible. For example, a firm will give preference to relocating to areas where water risks are lowest such as moving to a city located by a lake, river, or river basin.

Cities such as Milwaukee, Chicago, and in Cameroon we have Limbe, Douala and Kribi are preferred by firms over a city far from fresh water. Many businesses want to have easy access to water resources that are healthy, reliable, and viable or else they cannot expand nor hire or maintain their workforce. A clear example is the situation in Flint, Michigan,

where the water supply has been severely damaged and will take years to remedy (Hertel 2016). In the meantime, firms that regarded Flint as a potential relocation area are now less likely to consider it. The lack of water will have a domino effect on communities: local commerce declines, incomes drop, tax revenues decrease, population declines due to lack of employment opportunities, cities and the surrounding communities shrink dangerously and the bottom line is that businesses need water. According to UNESCO, in high income nations, industry accounts for up to 59% of total water use.

Another key economic implication of water scarcity is the effect on agriculture. While agriculture contributes to water scarcity, it is also highly dependent on this resource. Water scarcity impacts India, China, and the Middle East which face serious drought conditions thereby causing farms to reduce their crop production and food prices to spike dangerously. In China in 2006, drought conditions affected or threatened 182 million hectares of farmland, 8.7 million livestock, and 95 million people (Huang 2016).

Increases in food prices and lack of water inflame regional conflicts and cause population migration to where water is readily accessible. Water scarcity leads to food shortages while raising commodity prices, thereby hindering trade with developing economies and in the long run cause civil unrest. Water scarcity has a direct impact on rain-fed and irrigated agriculture as well as livestock, and an indirect impact on food processing industries. This can also be seen as the population of Yaoundé in general and Yaoundé VI in particular is rising on daily basis due to insufficient basic commodities and socio-economic crisis in some part of Cameroon. We met an informant and this is what he told us:

*"In the Yaoundé VI area, economy activities like fishing, industries and agriculture cannot be practised in this area because of insufficient water but there are some people are doing fishing in small pools of water created by them like the Man Planned Organisation"* (Nobert, 18 August 2020, Simbock). According to Nobert, fishing is an activity that needs water sources like seas and lakes for the fishes to survive, thus, without water, they cannot survive. This type of activity cannot be carried out in this area. But on the other hand, we saw groups like Man planned organisation that has constructed artificial ponds for fishery. This organisation uses water from the well for fish to survival. But it is not in large quantity that can supply the whole of Yaoundé VI area. The environment which is supposed to have free water for cultural activities like fishing and agriculture, large body water are absent making these activities difficult to the population.

Fishing industries is not found in Yaoundé VI and cannot be created, because there is insufficient water. Water is needed by an industry for the cooling, washing and a waste disposal site for the industry. It might seem impossible for big industry to be established in this area.

Agriculture depends solely on water because when there is no water crops cannot grow. The agriculture practice in Yaoundé VI is just in smaller quantity and is mostly for home consumption because the people depend on rain water to water the crops. Again, agriculture which is an important aspect in the economy that provides income to the community cannot be practice in this area because of insufficient water.

When water runs dry, people can not get enough to drink, wash, or feed crops, and economic declined may also occur. Climate change too has cause enough harm as dry season becomes to long causing drought in so many communities. Drought is a natural inbalance of water availability and desertification is an inbalance man-made availability of water. Many urban dwellers are unable to survive the drought in their home regions. With no farming or pastoral opportunities in the countryside, many migrated to other places like moving from Ndu to Yaoundé, Ndu to Buea and many more, in search of greener pasture. The scale of these migrations, especially for the youths are already overburdened urban centres, is immense.

This is what one of the informants told us: "*It is as a result of long dry season that we do not have water to to use and also to cultivate. It is for this long drought periods that causes some of us to travel to other towns for a greener pastures*" (Christabel, 18 December 2019 Simbock). According to Christabel, drought is a set off a wave of migrations, contributing to instability around the community. This is because if there was no long drought, she will not travel to Yaoundé for greener pasture. This point validates what Pereria said concerning drought which result in diminishing water resources availability, and reduce carrying capacity of the ecosystem.

This internal migration exacerbated pre-existing social and economic strains caused in part of Cameroon like the North West, South West Region and Far North Region communities, which has pushed many to move to relatively calm area since the problem is yet to be resolved. The fact that urgent issues like water problem is still going on has served as a catalyst for a massive migration to other areas.

Poverty has fuelled increased civil unrest as marginalised citizens begin to feel abandoned by their government. The presence of poverty in Yaoundé VI, coupled with its lack of water security, had a serious impact on the rise of civil disorder and violence in the community.

Social costs are also associated with the restrictions that have to be imposed on small farmers, who are often poor, when access to irrigation water has to be limited. The abandonment of the area by populations migrating to locations where they expect to have better life conditions constitutes a major impact of over-use of groundwater. When springs dry out in rural areas, rural populations are obliged to increase their time investment in collecting water from distant locations, often in conflict with other villages that were previously using that source. This is happening to inhabitants of Yaoundé VI, where by people are moving to other areas where they think is better that where they are living.

Economic and social costs are also very high when the over-use of aquifers, coupled with uncontrolled land uses, facilitates the contamination of aquifers, thereby making them inappropriate for domestic and other high quality-requirement uses. Social costs are particularly evident when poor urban and peri-urban populations need to search for other water sources. In the case of degraded surface wells and springs in Yaoundé VI, they need to search for new sources at some distance, demanding additional time and increasing competition and sometimes conflicts with others.

**4.8. Water and gender problems in Yaoundé VI**

This is a delicate subject as it is impacted by cultural and traditional sensitivities. However, it is important because in most parts of the world, water collection is carried out by women and children. For many families in Yaoundé VI of water scarcity, the major expenditure of labour is on water collection which is done by women and children.

Report from UN (2015) Says across low-income countries, women and girls have primary responsibility for management of household water supply, sanitation and health. Often, fulfilling these roles precludes any other occupation or participation in education, and their marginalization is compounded by the indignity and insecurity. Addressing the needs of females in relation to water, sanitation and hygiene is a key driver in achieving gender equity and locking the potential of half of global society. Girls in Kuma Garadayat, North Darfur, celebrate the inauguration of their new school as part of the six development projects in the areas of education, sanitation, health, community development and women empowerment.

The pictures below will be showing women and children fetching water.

**Fig 20: Women and children in long queues waiting to fetch water Yaoundé VI**


*Source fieldwork: Matilda Musah (October 2020, Centre)*

The different pictures above clearly show that the women and children are responsible for water collection in this area.

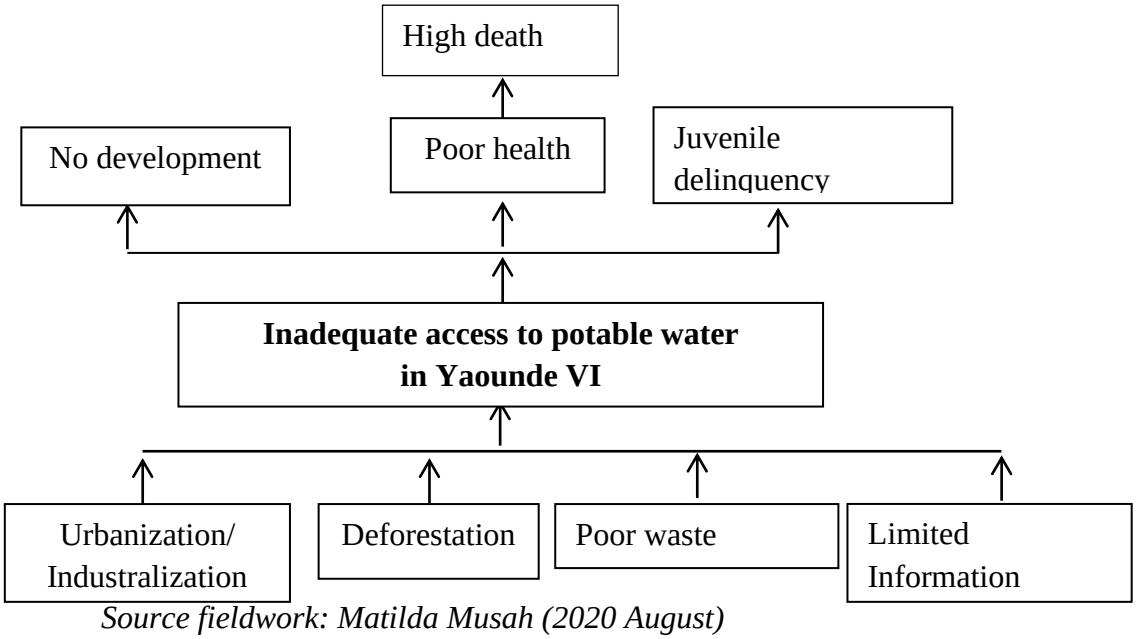
In Yaoundé VI, the presence or absence of a safe and sufficient water supply and improved sanitation facilities has affected the lives of women and girls for three main reasons. First, women and girls usually bear the responsibility for collecting water, which is often very time-consuming and arduous. Second, women and girls are more vulnerable to abuse and attack while walking to and using a toilet or open defecation site. And lastly, women have specific hygiene needs during menstruation, pregnancy and child upbringing.

Apart from the generalities of women and children collecting water, this is also applicable in the Beti land where women and children are responsible for water collection. This is what an informant told us concerning water collection:

*"In our culture, it is a taboo for a man to go and carry water that is why women and children are those who carry water"* (Mercy, 12 of May 2020, Rondpoint express). Accoding to Mercy, it is their tradition that only the women and children carry water. Naturally and culturally, a man is known as the head of a home that is how the culture and society has made it to be. There are certain house chorees that the men are not allowed to do especially fetching of water. So there is gender inequality in this case because water carrying is attributed to women and children alone. The analysis above confirmed what UNESCO (2019) said on world water assessment program, which validate that the majority of societys women and girls are responsible for fetching and carrying of water, and for using it for the health and wealth being of the family. These women and girls rarely have decision making power to take control on how water can be preserved in the community.

The tree diagram below will be showing the root (causes of water pollution and shortage), the core (inadequate access to potable water) and fruits (effects of water pollution and scarcity).

**Fig 30: Diagram showing the cause and effect of water pollution and water shortages**




*Source fieldwork: Matilda Musah (2020 August)*

The above diagram has just summarised the effects of water pollution and in Yaoundé VI area.

The interaction of individuals on environment has caused more harm than good to the environment in the case of Yaoundé VI council area. The environment which is meant to be a good habitat is now dangerous to the human being because of the kind of activities they do which is liable to render the population uncomfortable. Activities such as waste water pollution by man are able to cause water-borne diseases, which is one of the killer agents in the society today. This has been confirmed from the informants (5.1 talks on effects of water pollution) who gave some diseases caused by polluted water.

Water shortage has an effect on the environment and the population as well. Water shortages have led to poor hygiene in the environment, increased salinity, nutrition pollution and loss of wetlands which is usually used for agriculture, thereby reducing food production. This point is also confirmed by what Goerges Forester and Babara Anderson (1978) said on disease causing agents. Disease resulting from natural activities are known as naturalistic theory because is as a result of biological affect in the body like pathogens, malnutrition and organic deterioration.

To some people, water shortage affects their livelihood activities like switching from; selling of vegetable to groundnuts some reduced the quantity of cooking “Sha” which is the source of their income. Activities change like reduced sleep for a number of months before the rains return. Also the act of water fetching which is normally done by the children and mother is now handed over to the father who is the head of the family, it is his right to protect his family as he wakes up early as 4am to fetch water.

It has also affect social life of some people. For example, some people who could do their car washing now take their car to the washing point which reduces the income level. The same applies for those doing prostitution. They cannot live in areas where there is no water because they will not be able to clean up themselves every moment as it is needed.

In the study sample of 75 participants, it was found that most of the residents got water from a communal tap (61.4%), suggesting that the risk of public health exposure was high. Findings from the study clearly revealed that the residents had an overwhelming knowledge of water-borne diseases (94.6%). The familiar water-borne diseases to them include cholera, diarrhoea, dysentery, and typhoid fever. Although they had this knowledge, it was noted from the study results that most of the residents did not boil (62.2%) or add

chlorine (66.8%) to make the water safe for use. Therefore, this situation suggests that residents of Yaoundé VI are not doing enough to prevent outbreaks of water-borne diseases.

The housing arrangements in Centre are poor, people have constructed in areas prone to flooding which is risky during the rainy season. Densely populated neighbourhoods characterized by lack of properly functioning sewerage systems and solid waste collection, contributes to public health hazard. For instance, one of the key indicators of the status of women as indicated in an International Labour Organisation (ILO) briefing kit (ILO 1995). Furthermore, studies consistently show that educational attainment has a substantial effect on disease prevention measures, attitudes and awareness to hygiene (Zambia Demographic and Health Survey 2003). Level of education seems not to have any bearing to the knowledge of water-borne diseases and treatment of water by the people of Yaoundé VI. Furthermore, results show that women play a major role in securing water in the household. This can be explained by the cultural role by which females tend to be in charge of domestic roles more than their male counterparts. This finding seems to be inconsistent with education being a key determinant of the lifestyle and status individual enjoy in a society.

The work above clearly gives out the negative effects of water pollution and water scarcity in the environment of Yaoundé VI area. These has affected the population health, their activities and causing death to others due to improper treatment of water and infected patients. The work above has shown us the various water-borne disease especially, cholera, diarrhoea and dysentery being the major water-borne diseases. It also brought out some gender issues that exist in the community today when it comes to water fetching making the women and children more vulnerable in the society when it comes to water fetching. We have also seen the effect of water shortage some cultures (Beti) and how it affects them culturally. In the following chapter, we will be seeing the cultural practices responsible for water pollution and water scarcity in Yaoundé VI.

# CHAPTER V
# CULTURAL PRACTICES ACCOUNTABLE FOR WATER POLLUTION AND SCARCITY IN YAOUNDÉ VI

In this chapter, we are going to see how cultural practices can pollute and cause water shortage in urban areas. There are many types of pollution but we are going to focus on water and land pollution. Nowadays, water is becoming scarce not only in arid and drought prone areas, but also in regions where rainfall is relatively abundant. Scarcity is now viewed under the perspective of the quantities available for economic and social uses, as well as in relation to water requirements for natural and man-made ecosystems. The concept of scarcity also embraces the quality of water because degraded water resources are unavailable or at best only marginally available for use in human and natural systems (Pereira *et al* 2009). In doing this, we will focus on the natural and human causes of water pollution and water scarcity.

## 5. Pollution in Yaoundé VI

Pollution is generally understood as cases where our environment, water and air are not fit for our health as living organisms. Pollution is the process of making land, water, air or other parts of the environment dirty and not safe or suitable to man (Alina, 2018). This can be done through the introduction of a contaminant into a natural environment, but the contaminant does not need to be Tangeable. Things as simple as light, sound and temperature can be considered pollutants when introduced artificially into an environment. Toxic pollutants affect people worldwide. In some of the world's worst polluted places, babies are born with birth defects. In Yaoundé VI, there are children born with water-borne-disease infection that crossed from the mother to the child. At a young stage, it is very dangerious to the child because the immune system is not strong (Dr Keen 2020).

Pollution is the introduction of contaminants into the natural environment, causing adverse changes. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. Pollution is often classed as point source or nonpoint source pollution. In 2015, pollution killed 9 million people in the world (Beil 2017). In Yaoundé VI, there are individuals who have died as a result of poor environment caused by typhoid, diarrhoea and stomach disorder (Report from Etoug-Ebe hospital 2020).

Major forms of pollution include: air pollution, light pollution, littering, noise pollution, plastic pollution, soil contamination, radioactive contamination, thermal pollution, visual pollution, water pollution (Beil 2017). We will be looking at surface water pollution and underground water pollution.

### 5.1 Surface water pollution in Yaoundé VI

Surface water pollution is a type of pollution that occurs above ground, such as in oceans, streams, lakes and rivers. Pollution exists in different types, but we will be seeing more on water and land pollution in Yaoundé VI area. Water pollution occurs both on surface and underground water. Spengler (1983) focuses mostly on in-door pollution, their causes and effects to man. In-door pollution is generated by many activities inside the buildings. Six major types and forms of in-door pollution, there are combustion of by-products that is, burning of natural products like wood, natural gas, kerosene and candle. The second one is micro-organisms, including humid fires, air cooling towers, household pesticides and insects which live in dust and ventilation ducts.

Surface water pollution includes pollution of rivers, lakes, streams and oceans. This type is done by humans and nature. Some of the causes include waste disposal, agricultural activities and industrial waste. Natural causes include volcanic eruption and runoff.

#### 5.1.1 Waste disposal

According to the US Environmental Protection Agency (2009), waste is hazardous as it poses a substantial threat to human health or the environment. Although global attention has focused primarily on water quantity, water-use efficiency and allocation issues, poor wastewater management has created serious water-quality problems in many parts of the world, worsening the water crisis. Global water scarcity is caused not only by the physical scarcity of the resource but also by the progressive deterioration of water quality in many countries, reducing the quantity of water that is safe to use.

Wastes are unwanted products found in the environment, making the area uncomfortable to living organisms. It is also any substance discarded after primary use, or is worthless, defective and of no use. Examples include municipal solid waste (household trash/refuse), hazardous waste, wastewater (such as sewage, which contains bodily wastes (faeces and urine) and surface runoff), radioactive waste, and others (Davidson 2011).

According to the Basel Convention on the control of trans-boundary movements of hazardous wastes and their disposal of 1989, waste are substance or objects, which are

disposed of or intended to be disposed of or also required to be disposed of by the provisions of national law (UNEP 1989).

United Nations Statistics Division (UNSD, 1997) glossary of environment statistics describes waste as:

> *Materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and of which he/she wants to dispose. Wastes may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled or reused at the place of generation are excluded.*

According to European Union, Under the Waste Framework Directive 2008/98/EC European (Union 2020), waste is an object the holder discards intends to discard or is required to discard.

**Fig 21: Waste disposal in water bodies in Yaoundé VI**


*Source filedwork: Matilda Musah (November 2020 at Mvog- Betsi)*

The figure above shows the water contamination by waste disposal into the streams in the quarters in Yaoundé VI. These streams serve as homes for some organisms but when it is crowded with waste materials, it reduces the amount of oxygen present in water, suffocating most of these organisms. Most of these wastes are carried by heavy rain water and when they accumulate for a long period, they act a breeding room for vectors like mosquitoes, flies,

stray animals like dogs and cats. When they accumulate for a long period, the decaying process is incomplete, thereby polluting the environment. The pictures above confirmed the report by UNICEF (2008) which says that two-third of of waste release into water bodies are untreated which is due to large inefficiencies in the water infrastructure in which up to 40% of the water leaks out.

Generally, types of waste materials include liquid or solid waste and they are all available in Yaoundé VI and both of them can be hazardous. Liquid and solid waste types can also be grouped into organic, re-usable and recyclable waste. Some solid waste can also be converted to a liquid waste form for disposal. It includes point source and non-point source discharges such as storm water and wastewater. Examples of liquid waste include wash water from homes, liquids used for cleaning in industries and waste detergents. Solid waste predominantly, is any garbage, refuse or rubbish that is produce from our homes and other places. These include old car tires, old newspapers, broken furniture and even food waste. They may include any waste that is non-liquid (Davidson 2011). These wastes are all found in Yaoundé VI.

Hazardous or harmful wastes are those that potentially threaten public health or the environment found in Yaoundé VI. Such waste could be inflammable (can easily catch fire), reactive (can easily explode), corrosive (can easily eat through metal) or toxic (poisonous to human and animals). In many countries, it is required by law to involve the appropriate authority to supervise the disposal of such hazardous waste. Examples include fire extinguishers, old propane tanks, pesticides, mercury-containing equipment (example, thermostats) and lamps (example. fluorescent bulbs) and batteries.

Organic waste comes from plants or animal sources (animal rearing and agriculture). Commonly, they include food waste, fruit and vegetable peels, flower trimmings and even dog poop can be classified as organic waste. They are biodegradable this means they are easily broken down by other organisms over time and turned into manure. Many people turn their organic waste into compost and use them in their gardens.

Commonly, waste is classified into two types: Biodegradable and non-biodegradable waste. These two kinds of wastes are biodegradable waste and non-biodegradable waste.

Biodegradable wastes that come from our kitchen and it include food remains, garden waste, etc. Biodegradable waste is also known as moist waste. This can be composted to obtain manure. Biodegradable wastes decompose themselves over a period of time depending on the material. Non-biodegradable waste includes plastic papers, broken glass pieces, plastics, etc. Non-biodegradable waste is known as dry waste. Dry wastes can be recycled and can be reused. Non-biodegradable wastes do not decompose by themselves and hence are major pollutants all of these waste are produce in Yaoundé VI area.

### 5.1.1. Sources of waste material in Yaoundé VI

There exist various sources of waste materials that are industrial, commercial, domestic, and agricultural and hotel waste in Yaoundé VI.

Industrial wastes are the wastes created in factories and industries. Most industries dump their wastes in rivers and seas which cause a lot of pollution. Examples are plastic, glass, etc. Industrial wastes that are discharge into the water bodies compose of solid and liquid substance that pollutes the water. When these wastes are disposed into water bodies, it contaminates or pollutes the water body causing it unfit for humans to consume. And for aquatic organisms, it reduces the oxygen present in water and thereby causing the organisms to suffocate due to insufficient oxygen. Tertiary industrial wastes are produced from those who mould cement block for sale are able to cause water pollution when discard into water bodies.

Commercial wastes are produced in schools, colleges, shops, and offices. Commercial waste can be defined as any waste other than domestic waste. It may be generated as a result operation of a not-for-profit organisation or carrying out a business, including associated lawn and garden clippings from normal maintenance of the business premises. Commercial waste also includes rubbish produced by business customers (food wrappers and containers). Some waste facilities do not accept commercial waste.

Commercial waste is generated as a result of carrying out the following activities; manufacturing and industrial processes, mining, wholesale or retail trading, sorting, resource recovery, reprocessing and recycling operations. Activities carried out at domestic premises under a commercial arrangement include; accommodation services, hospitality services, catering, primary industries, including agricultural, forestry and fishing, veterinary services and educational services. These activities could be related to entertainment, recreation, sport, or any other activity (Safeopedia 2018). Commercial waste is different from agricultural or

domestic waste because in these two, there is no business angle to them. It is important to distinguish them because some waste removal companies will not handle commercial waste due to the stringent measures put in place to govern their disposal. Even grass and garden clippings from a commercial property like a hotel would also be categorised as commercial waste. The different types of commercial waste are categorised according to where they have been generated;

- Industrial and manufacturing plants generate rubbish in their day-to-day activities, so this can be categorised as commercial waste.
- Mining companies also generate commercial rubbish
- Wholesalers and retailers also generate commercial waste.

In Yaoundé VI area, there are a lot of commercial sites like markets, shops, mechanic work-shops, hair dressing, bars, tailoring that generate waste products. In this area, most of these waste products are not properly disposed and that is why we have water pollution.

Hospital waste come from the various hospitals, nursing homes and clinics has increased Yaoundé VI city over the past two decades. They generate waste containing infections and toxic material, which are deposited either in street waste bins or masonry bins built inside the hospital premises. According to normal regulations, each hospital should have its own incineration plant authority. In actual fact, few hospitals are equipped with such a facility due to the high costs involved. When they do have an incinerator, it is not always possible to use the machine due to regular repairs or power failure. The present study of eight hospitals has been taken to examine the ways in which hospital waste is disposed of. They include government, corporate and charitable hospitals, as well as a private nursing home. Most of the sampled hospitals have established service links with other hospitals.

In Yaoundé VI, there is Etoug-Ebe hospital that has a stream located close to the hospital. Some of the waste product discharge in this stream pollutes the water and makes it unfit for the people using the water.

Domestic waste refers to the different household wastes which are collected from household activities like cooking, and cleaning In Yaoundé VI, examples are leaves, vegetable peels and excreta.This waste can be non-hazardous or hazardous. Non-Hazardous waste can include food scraps, paper, bottles, etc. which can be recycled or composted. Examples of hazardous waste include batteries and household cleaners. It is important that hazardous waste is handled in a safe manner to ensure that they are disposed properly so they

do not cause harm. Some of these include food waste, paper, cardboard, plastic, textiles, leather, yard waste, wood, glass, metals, ashes, special waste like ( consumers electronics, white goods, batteries, oil tires and household hazardous waste) (Laura 1999).

The amount of household waste produced by household can vary depending on factors like revenue and lifestyle. There are many ways by which household waste can be reduced including donating clothes, eliminating single use plastics and buying sustainable options (bamboo toothbrush over plastic toothbrush).

In Yaoundé VI, there are many household, and each of them produces waste. These household wastes are disposed of into streams, due to the fact that some of the trash cans are located far away from their homes. This promotes water pollution in the area. Below is a stream used as waste disposal site.

**Fig 22: Polluted stream with waste products**

*Source fieldwork: Matilda Musah (November 2020)*

The figure above confirms what we got from the field as the streams are use foe waste disposal sites in most of the quarters with streams because of limited trash cans and some located far away from the some inhabitants homes. The figure above validate what WHO (2008) said about millions of urbanities live in low qualities shelters plaque with overcrowding and inadequate provision of sanitation services including potable water and safe waste disposal.

Agricultural waste is the practice of farming, including cultivation of the soil for the growing of crops and the rearing of animals to provide food, wool, and other products. In practicing this, many substances are being used both organic and natural substance for a great quantity of food production at the end. Agricultural runoff - carries fertilisers, pesticides, insecticides, herbicides and other pollutants into water bodies such as lakes, rivers, ponds). The usual effect of this type of pollution consists of algae growing in affected water bodies. This is a sign of increased nitrates and phosphates in water that could be harmful to human health. The type of agriculture that is being practised in the Yaoundé VI council area is known as urban agriculture. This is because it is not practised in large amount. It is meant just for consumption and the little that is sold, limit just around the vicinity for the inhabitants. These crops cannot be exported because it is not produced in large quantities. This helps to provide the family with variety of vegetable and little income from the sale of crops.

According to the United State Environmental Protection Agency (USEPA), agricultural waste and by-products are generated by the rearing of animals, the production and harvesting of crops or trees (USEPA 2018). Animal waste, a large component of agricultural waste, includes waste (examples like feed waste, bedding and litter, feedlot and paddock runoff) from livestock, dairy, other animal related agricultural and farming practices. Organisation for Economic Cooperation and Development (OECD) defines agricultural waste as waste produced as a result of various agricultural operations including manure and other wastes from farms, poultry houses and slaughterhouses, harvest waste fertiliser run-off from fields, pesticides that enter into water, air or soils; and salt and silt drained from fields (OECD 2001). In the context of this chapter, agricultural waste is defined as waste in the form of the crop residues in the farm, manure from livestock operations, including dairy and piggery effluent, with poultry litter.

Agriculture accounts for 70% of total water consumption worldwide and is the single-largest contributor of non-point-source pollution to surface and groundwater. Agriculture intensification is often accompanied by increased soil erosion, salinity and sediment loads in water and by the excessive use (or misuse) of agricultural inputs (e.g. fertilisers) to increase productivity. Pollution caused by agriculture can contaminate water, food, fodder, farms, the natural environment and the atmosphere. Pesticides and fertilisers used in agriculture can contaminate both groundwater and surface water, as can organic livestock wastes, antibiotics, silage effluents, and processing wastes from plantation crops.

Pollution caused by large scale industrial farming (including livestock and fisheries) is categorised as point source pollution, and pollution caused by small scale family sized farming is considered non-point source pollution. Excess loadings of nitrogen and phosphorus from agricultural waste applied to land that cause eutrophication of water bodies or contamination of drinking water have been well documented in the literature (Anderson et al 2002).

Commonly available manures include cow, swine and poultry. The highest nutrient values are generally found in the fresh manures and decreases as the material ages or is composted. Although fresh manures have higher available nutrient contents, an aged or composted material is sometimes more appropriately used to facilitate spreading, minimise burn potential or the presence of excess salts. Veterinary antibiotics that are fed to the animals during their life period are also excreted in the faeces and urine, which eventually end up in the oxidation effluent pond and finally onto the land as supplement to fertiliser or as disposal option (Boxall *et al.* 2004). We met an informant during the fieldwork, she told us how she cultivates her crops, where she cultivates and what she uses to facilitate her crops to grow. This is what she said:

> *I do cultivate crops behind my house. There is a stream there that helps me, especially during the dry season when there is no rain fall, I watered my crops using the water. During the farming period, I use degradable waste from my home such as vegetable waste. There is also this fertiliser I use know as 2010.I used it to fertilized corn. Am glad to have this place because there are people who want just a small place to plant even corn and it is not available so am really blessed having this place to work on (*Blessing, 18 October 2019, Mvog-betsi).

From this point of view, the stream behind her house has helped her a lot for cultivation. To her, it is really a privilege to have a place like that because many are longing for it to no avail. This also helps her to provide a variety of food in her family. But, she is not aware of the disadvantages that she is causing to the aquatic organism when it rain, sweeps the fertilisers into the streams, some of it mixes with the water and seep into the ground. The rest of is absorbed by the plant itself. The data above confirms what Tripathi (2009) said about modern agriculture. The application of modern technological process in the agricultural field affects the environment. The inorganic fertilisers that are being use are transmitted to ground water by leaching and to surface water by natural drainage and storm run-off. As a result, the local streams that supplied water from the ground become contaminated and dangerous to

human system. This cultural activity of farming becomes dangerous to our health because of the chemicals used. Our interaction with the environment has both the negative and positive impact on the population.

Further problems are caused by soil erosion and sedimentation. The soil is comprised of many layers and it is only the topmost layer that cannot support farming or grazing. Due to inefficient farming practices, this soil is exposed to erosion. This leads to declining fertility each year. Whether eroded by water or wind, all this soil has to be deposited somewhere. The resulting sedimentation causes the soil to build up in areas such as rivers, streams, ditches and surrounding fields. And so, the process of agricultural pollution prevents the natural movement of water, aquatic animals and nutrients to other fertile areas.

Nowadays, farmers would keep livestock as much as their land can support. The cattle, sheep, pigs, chickens and other animals were fed natural diets, which was supplemented by the waste left over from the crops. As a result, the animals contributed to keeping the farm healthy as well. As of now, livestock is grown in cramped conditions where it is fed unnatural diets and sent to slaughterhouses on a regular basis.

Fertilised soils, as well as livestock operations, are also vulnerable to nutrient losses to the air. Nitrogen can be lost from farm fields in the form of gaseous, nitrogen-based compounds, like ammonia and nitrogen oxides. Ammonia can be harmful to aquatic life if large amounts are deposited from the atmosphere to surface waters. Nitrous oxide is a potent green house gas. An informant gave us type of product produced from her home and where she usually discards them. This is what she said:

*"In my home, we have waste products like vegetable remains, dresses, shoes, glasses and waste water. Most of the times we do not do waste sorting. We carry them to a near-by stream where discard our waste materials"* (Carine, 12 June 2020, Mendong). According to Carine, her home produces all sorts of waste products and she does not practice waste sorting. Everything is been put in one bag then carry to the waste site at once. The waste that is being thrown in streams in the Yaoundé VI area helps to pollute the water hence causing water shortage to those depending on it. This is because the water is dirty and cannot be used by the inhabitants. Our environment which is supposed to be a source of life is now a source of negative impact to us because of the wrong usage of our environment so it is unable to satisfy

our needs. This point is confirmed from what we observed in the field during our ethnographic study.

We met another informant who sells in a bar, this was the information he gave us concerning the how is disposes of the waste produced from his bar. *"I do bar business, so most of my products here are bottles and waste water. So quite often, all the bottles are being taken to the waste collecting point whenever the waste bag is full*" (Nobert, 15, August 2020, Simbock). To Nobert, his bar produces solid waste like bottles and waste water, where the broken bottles are carried to the collecting point and the water is being discarded either in the toilet or into the environment. According to this man, he considers the environment as being part of him. That is why he discards his waste product at the collecting point.

**5.2 Ground water pollution in Yaoundé VI**

Groundwater in its natural state is generally of good quality because rocks and their derivatives such as soils act as filters. However, the natural waters are not pure and contain some amounts of dissolved gases, solids, and suspended materials (Fetter, 1994). The quality of groundwater depends on the composition of the recharged water, the interactions between the water and the soil, dissolved gases, geological conditions, the residence time and reactions that take place within the aquifer. Therefore, considerable variations may be found. So it is necessary to monitor all aspects related to provision of suitable quality of water for various purposes and a special attention needs to be made on identifying various physical, chemical, bacteriological and radiological parameters influencing water quality and for proper monitoring of parameters it is needed to set up appropriate mechanisms from top to bottom level in the council area concern.

In Yaoundé VI activities like mining and petroleum are absent. The main problem with respect to serious groundwater pollution has been human activities. When we improperly dispose of wastes or spill hazardous substances onto the ground, one threatened our groundwater and in turn public health. The way the toilets are constructed much closed to some of the spring sources acts as sources ground water pollution.

**Fig 23: spring source under a house**


*Source fieldwork: Matilda Musah (January 2020 "Centre")*

Figures A and B above show the means by which ground water is contaminated in the Yaoundé VI area. The house in this picture is a modern house with a modern toilet inside and it is constructed on a spring source. Figure B, it clearly show houses that are constructed besides the spring sources, and any dirty water or contaminated water can seeps or penetrate into the spring source easily. From the pictures one can see that the water is not only use for household chores but for consumption as well. It is easy for water to penetrate from the toilet to the source of spring water. It is also another way through which the ground water is contaminated. Instead protecting our environment because it is the solution to our needs, human beings have decided to make it unfavourable to the population. That is why there is an increase in water pollution and water scarcity is on the rise.The picture above also confirms what Tripathi (2009) said about ground water pollution. The fertilisers used in the farms contaminated the ground water through leaching and almost of them are toxic to humans and animals.

### 5.3 Insufficiency and scarcity of potable water in Yaoundé VI

Insufficient water is the limited fresh water resources to meet water demand according to a lay man definition. It affects every continent and was listed in 2019 by the World Economic Forum as one of the largest global risks in terms of potential impact over the next decade. It is manifested by partial or no satisfaction of expressed demand, economic competition for water quantity or quality, disputes between users, irreversible depletion of

groundwater, and negative impacts on the environment. Half a billion people in the world face severe water scarcity all year round. Half of the world's largest cities experience water scarcity (Postel 1996), and many people have problems with water scarcity.

Water scarcity is being driven by two converging phenomena that is growing freshwater use and depletion of usable freshwater resources. Water scarcity can be a result of two mechanisms: physical (absolute) water scarcity and economic water scarcity, where physical water scarcity is a result of inadequate natural water resources to supply a region's demand, and economic water scarcity is a result of poor management of the sufficient available water resources (Pereira et al., 2009; White, 2014).

Falkenmark (1976) argues that societies would experience water problems associated with pollution and dry wells. Between 600-1000 people per flow unit, societies suffer water stress. As societies approached 2000 people per flow unit, they would experience absolute water scarcity (Pallett, 1997). Expressed differently, it may be said that where available water dipped below 1700 cubic metres per capital (i.e. below the World Health Organisation minimum of 50 litres/person/day), societies would experience water stress. Below 1000 cubic metres per capital they would experience chronic water scarcity, and below 500 cubic metres per capital, they would be living beyond the water barriers (Falkenmark and Rockstrom, 2004).

According to the United Nation Development Programme, the latter is found more often to be the cause of countries or regions experiencing water scarcity. As most countries or regions have enough water to meet household, industrial, agricultural, and environmental needs, but lack the means to provide it in an accessible manner. The reduction of water scarcity is a goal of many countries and governments. The UN recognises the importance of reducing the number of people without sustainable access to clean water and sanitation.

In Yaoundé VI there is insufficient water to meet the domestic, agricultural, economic activities and environmental needs. This insufficiency is as a result of limited water points, long distance to water points, water pollution and dry wells. The cause of dry wells is a result of long period of dry season and urbanisation.

### 5.3.1 Causes of insufficient potable water in Yaoundé VI

Insufficient water has many causes which are natural and man- made causes. Man-made causes include: deforestation and urbanisation.

Deforestation is the cutting and removal of a forest or stand of trees from land which is then converted to a non-forest use. According to Bradford (2018), it is the permanent destruction of forest in order to make land available for other use. Deforestation can involve conversion of forest land to farms, ranches, or urban use. The most concentrated deforestation occurs in tropical rainforests. About 31% of the earth's land surface is covered by forests and according to Bradford 2015, it is estimated that 15% of all greenhouse gas emission come from deforestation. Yaoundé VI in the 1980s was covered with forest and vegetation. But as a result of farming and settlement, all the forest has been destroyed for the provision of space to the inhabitants.

Many reasons account for deforestation. For example trees can be cut down to be used for building or sold as fuel wood (sometimes in the form of charcoal or timber), while cleared land can be used as pasture for livestock and plantation. Disregard of ascribed value, lax forest management, and deficient environmental laws are some of the factors that lead to large-scale deforestation. In many countries, deforestation both naturally occurring and human-induced is an on-going issue. Between 2000 and 2012, 2.3 million square kilometres (890,000 sq mi) of forests around the world were cut down (Bradford 2015, Brown 1997).

The removal of trees without sufficient reforestation has resulted in habitat damage, biodiversity loss, and aridity. Deforestation causes extinction, changes to climatic conditions, desertification, and displacement of populations, as observed by current conditions and in the past through the fossil record. Deforestation also has adverse impacts on bio sequestration of atmospheric carbon dioxide, increasing negative feedback cycles contributing to global warming. Global warming also puts increased pressure on communities who seek food security by clearing forests for agricultural use and reducing arable land more generally. Deforested regions typically incur significant other environmental effects such as adverse soil erosion and degradation into wasteland in Yaoundé VI.

The water cycle is affected by deforestation. Trees extract groundwater through their roots and release it into the atmosphere. When part of a forest is removed, the trees no longer transpire this water, resulting in a much drier climate in Yaoundé VI. Deforestation reduces the content of water in the soil and groundwater as well as atmospheric moisture. The dry soil leads to lower water intake for the trees to extract. Deforestation reduces soil cohesion, so that erosion, flooding and landslides easily occur.

Deforestation may impair forest functions of safeguarding watersheds and river flow. To Hougton and hackler (2003), deforestation in the upper reaches of the Yangtze basin in China led to reduction of forest cover from 22% of the total area in 1957 to only 10% in 1986 and this has cause a lot of economic loss. Instead of trapping precipitation, which then percolates to groundwater systems, deforested areas become sources of surface water runoff, which moves much faster than subsurface flows. Forests return most of the water that falls as precipitation to the atmosphere by transpiration. In contrast, when an area is deforested, almost all precipitation is lost as run-off. That quicker transport of surface water can translate into flash flooding and more localised floods than would occur with the forest cover. Deforestation also contributes to decreased evapotranspiration, which lessens atmospheric moisture which in some cases affects precipitation levels downwind from the deforested area, as water is not recycled to downwind forests, but is lost in runoff and returns directly to the oceans.

Trees and plants in general, affect the water cycle significantly as follows: their canopies intercept a proportion of precipitation, which is then evaporated back to the atmosphere (canopy interception), their litter, stems and trunks slow down surface runoff, their roots create macropores large conduits in the soil that increase infiltration of water. They contribute to terrestrial evaporation and reduce soil moisture via transpiration, their litter and other organic residue change soil properties that affect the capacity of soil to store water and lastly their leaves control the humidity of the atmosphere by transpiring. 99% of the water absorbed by the roots moves up to the leaves and is transpired.

As a result, the presence or absence of trees can change the quantity of water on the surface, in the soil or groundwater, in the atmosphere. This in turn changes erosion rates and the availability of water for either ecosystem functions or human services. Deforestation on lowland plains moves cloud formation and rainfall to higher elevations. The forest may have little impact on flooding in the case of large rainfall events, which overwhelm the storage capacity of forest soil if the soils are at or close to saturation. Tropical rainforests produce about 30% of our planet's fresh water (Hackler 2003).

Deforestation disrupts normal weather patterns creating hotter and drier weather, thus increasing drought, desertification, crop failures, melting of the polar ice caps, coastal flooding and displacement of major vegetation regimes. In 2018, The Guardian reported that every second, a chunk of forest equivalent to the size of a soccer field is lost.

Often, deforestation occurs when forested area is cut and cleared to make way for agriculture or grazing. The Union of Concerned Scientists (UCS, 2016) reports that just four commodities are responsible for tropical deforestation: beef, soy, palm oil and wood products. UCS estimates that an area the size of Switzerland (14,800 square miles, or 38,300 square km) is lost to deforestation every year (UCS 2012).

Natural fires in tropical forests tend to be rare but intense. Human-lit fires are commonly used to clear land for agricultural use. First, valuable timber is harvested, and then the remaining vegetation is burned to make way for crops like soy or cattle grazing. In 2019, the number of human-lit fires in Brazil sky rocketed. In August 2019, more than 80,000 fires burned in the Amazon, an increase of almost 80% from 2018, National Geographic reported. Some of this fire is burnt by individuals so that the early rains will cause the grass to grow for the cattle to feed on after a long period f dry season.

An informant that we met gave us his own point of view concerning deforestation and reason why people do cut down trees. This is what he said:

> *To me deforestation has a lot to do when it comes to water conservation. Most of the water we have now is been trap in the soil by trees that we have around the water sources and all over the environment. When we cut our trees without replacing them, the water that was trap is being evaporated into the atmosphere. Again most of this deforestation happens because inhabitant want to use the land for agriculture and also for construction without knowing the importance or the part the trees play as water conservation is concerned* (Christable, 19 December, Simbock).

According to Christable's view, deforestation is one of the causes of water scarcity because the trees are able to hold and store water in the soil for a longer period of time but when it is destroyed, the water is dried off leaving the area dry and prone to erosion which also makes it unfertile for cultivation. Our environment needs protection and if we cut down trees without replacing them it turns to dry up the water since there are no trees to store the water.

Urbanisation too has been one of the factors that promote deforestation because people want to build, trees are been destroyed. It is a process through which cities grow higher in population, development of the town characterised by industrialisation, good roads, educational facilities just to name a few. The population movement is mostly from the rural areas to urban areas. It is predominantly the process by which towns and cities are formed and become larger. As more people begin living and working in central areas, urbanisation

(people living together in groups), has been existing since ancient times. As populations rose and people mastered techniques to grow food in fixed locations, groups of people became settlements and then towns and cities. Causes of urbanisation include industrialisation, commercialisation, social benefits and services, employment opportunities, modernization and changes in the mode of living and rural urban transformation. The effect of urbanisation includes housing problem, overcrowding, unemployment, development of slums, water and sanitation problems, poor health and spread of diseases, traffic congestion and urban crime wave. The population of Yaoundé VI is increasing fast due to the social facilities around this area that is promoting people and investors to settle in this place.

The geographers will say it is not advisable to construct below the foot of a rock, but it is opposite of what the population of Yaoundé VI around this area are doing. Still on this rock, people are doing farming on the hill and crops are doing very well. As the population grows, there is the need for more construction which leads to deforestation. Rock acts as a water storage tank. Water flows out of this rock at all times, and is used by the people for consumption and agriculture.

The effect of urbanisation in Yaoundé VI council is manifested negatively in that; it has caused more buildings to be built. As a result, more pavement means less water will soak into the ground, meaning that the underground water table will have less water to recharge it. This will lower the water table. Some existing wells will not be deep enough to get water and might run dry. The runoff from the increased pavement goes into storm sewers, which then goes into streams. This runoff, which used to soak into the ground, now goes into streams, causing flooding. Changing a stream channel can cause flooding and erosion along the stream banks. More sewage is discharged into streams that weren't designed by nature to handle that much water. In Yaoundé VI at Etoug-Ebe, there are always cases of flooding during the rainy seasons.

The use of large wells can lower the underground water table. This can cause other wells to run dry. Urban areas currently give the home to approximately 50% of the global population, projected to reach over 60% by 2050. In this period, water demand will increase globally by 55% and around 4 billion people will live in water-stressed areas. This means that fierce competition is unavoidable among different water users particularly users in agriculture and energy sector, as well as urban dwellers.

If current tendencies are not changed, water security will be increasingly jeopardized. Due to rapid urbanisation, water scarcity and poor water quality in heavily overcrowded cities, as well as the lack of extensive and sustainable urban water management systems are problems affecting not only the poorest but the developed countries of the world. Cities are facing significant challenges such as mitigating water risk and securing financially sustainable water and sanitation services to the urban population.

Cities, consumes smaller portion of water when compared to agriculturure. Thus, the same consolidation of infrastructure that makes water more reliable for urban dwellers puts many people at risk when water cannot be adequately supplied. Urbanisation creates its own forms of water stress via increasing capital water consumption and rising incomes, as wealthier people use more water, energy, and water-intensive goods. Simultaneously, the urban poor in the developing world can face inadequate access to drinking water and basic sanitation. Cities in the developing world are, in other words, sites of both acute scarcity and high consumption Urbanisation also increases the demand for power generation, which itself requires a lot of water. This water-energy nexus is really a water-energy-food nexus, because a large portion of the energy (30%) and water consumption (70 %) is required to feed a rapidly growing and urbanising population. If the power sources for this are carbon-intensive, they will further sharpen the effects of climate change (Pandy 2009).

While in the field, we met an informant, and this is what he said concerning urbanisation and its negative impacts on water. This was his words:

> *The water insufficiency and pollution is caused by too much population for example, when we came into this quarter at first we had no problem of fetching water at the spring. And even in the dry season though the water reduced in its velocity but it was not what we have today. Again the issues of water pollution, people have come and build their houses haphazardly without taking the water into consideration. Like for example people will build house beside the spring and sent their toilet sewage tanks site just beside the spring tell me how the water will not be contaminated. When I see like this it really disturbs me because I know the effects of this. It might not happen immediately but surely it will be dangerous* (Jason, 16 July 2020, Mvog-Betsi).

From this point of view above is validated by Pandy (2009) who says that urbanisation is another major factor which contributes significantly toward environmental and water pollution in big cities. The informant says clearly the negative effect of urban growth on water. Like the case in their area, one can see that too much population without increase of water quantity is a problem because as the population increases, the quantity of water reduces

to a point that it cannot sustain the inhabitants in the area. Furthermore, the fact that everybody does not have the same thinking capacity, some build their houses without taking note of the area where their waste is supposed to be disposed and at this point they discard their waste into the water source or point polluting the water which is unfit for consumption.

**Fig 24: Population at the spring source**


*Source fieldwork: Matilda Musah (October 2019 at "Centre" (Mewulu)*

The pictures A, B and C above show the population present at a spring source to carry water. As the population increases, there is water shortage and it takes a lot of time to carry water especially when the water is not flowing with high pressure. With this, it delays some activities of house chores. Some children use this medium to meet up with their friends. This is another point for people to meet and gossip while some play at the stream instead of paying attention to carry water when it is their own turn. The population above proves that in this

area has increased to a point that the waiting time for water carrying is longer as compared to the previous years, according to what the informant gave us in the previous interview.

### 5.3.2 Poverty

Low-income in Yaoundé VI equally accounts for lack of access to safe water. Safe water means consistent access to adequate supply of clean water suitable for drinking, bathing, cooking, and cleaning. According to the World Health Organisation (2006), this means safe drinking water from a source less than 1 kilometer (62 miles) away and at least 20 litres per person per day to use. In some cases, safe water for irrigation or animals might be necessary to the extent that it affects individual human health and dignity.

An informant we met on the field gave us his own view on the poverty as a factor preventing him from having potable water and this is what he said:

> *My income level is too low for me to make use of alternative water source and to acquire facilities for obtaining alternative water source. Also the available water sources we have, we need to buy it before consuming or carrying the water, so it takes a lot of money* (Edward, 26 September 2020, "Centre").

According to Edward, lack of job and finances has cost him a lot to an extent that he cannot afford any water alternative sources if it has to do with money. Buying mineral water which is another option to replace any of the water sources which is said to be contaminated is a problem to him. So he has to consume the water that is available. Even getting good equipment like filter to be able to filter the water is a problem because of the insufficient finances. To him, the money he has is to pay bills which are quite expensive. The environment has offered just a little that the population can do in order to have enough finances to purchase potable water. The data analysis above corroborates or supported by Ako *et al* (2010), poverty is another major factor issue in Cameroon. He went ahead confirming that, the first national household survey that was done in 1996, estimated that 51% of the population were living in serious poverty. Misachi (2018) also confirmed that poor hygiene behaviour, lack of good quality water is as a result of lack of priority given to water sector and sanitation.

### 5.3.3 Natural causes of water pollution and water shortage in Yaoundé VI

Pollution also occurs naturally and affects our environment because of its regeneration ability. Sometimes, water pollution can occur through natural causes like volcanoes, algae blooms, animal waste, and silt from storms and floods.

Volcanicity is the processes associated with the transfer of magma and volatiles from the interior of the Earth to its surface. Current volcanicity is confined to regions of the Earth where lithospheric plates converge, diverge, or pass over possible mantle hot-spots (Crumpler 2001). Fresh water supply and wastewater collection and treatment become vulnerable during a volcanic ash fall, which can cause changes to water quality in raw water sources, create high water demand during the clean-up phase, which can in turn lead to water shortages and cause operational problems for water treatment plants.But in Yaoundé VI area, there is no natural cause like volcanicity that causes water pollution and insufficiency.

An algal bloom or algae bloom is a rapid increase or accumulation in the population of algae in freshwater or marine water systems, and is often recognised by the decoloration in the water from their pigments. The term algae encompasses many types of aquatic photosynthetic organisms, both macroscopic, multicellular organisms like seaweed and microscopic, unicellular organisms like cyanobacteria. Algal bloom commonly refers to rapid growth of microscopic, unicellular algae, not macroscopic algae. An example of a macroscopic algal bloom is a kelp forest (Smayda, 1997).

Algal blooms are the result of a nutrient, like nitrogen or phosphorus from fertiliser runoff, entering the aquatic system and causing excessive growth of algae. An algal bloom affects the whole ecosystem. Consequences range from the benign feeding of higher trophic levels, to more harmful effects like blocking sunlight from reaching other organisms, causing a depletion of oxygen levels in the water, and, depending on the organism, secreting toxins into the water. The process of the oversupply of nutrients leading to algae growth and oxygen depletion is called eutrophication. Blooms that can injure animals or the ecology are called “harmful algal blooms” (HAB), and can lead to fish die-off, cities cutting off water to residents, or states having to close fisheries.

In Yaoundé VI, because of the fertilisers used by the people for cultivation, the minerals run into the streams and are able to cause algae blooms. Because of these, there is water pollution and insufficiency since the people cannot use it.

According to Assallay (1998), silt is granular material of a size between sand and clay, whose mineral origin is quartz and feldspar. Silt may occur as a soil (often mixed with sand or clay) or as sediment mixed in suspension with water (also known as a suspended load) and soil in a body of water such as a river. It may also exist as soil deposited at the bottom of a water body, like mudflows from landslides. Any pollution of a watercourse is

already an offence under the Water Resources Act 1991. However, this does not just apply to industrial chemicals but many other substances that some people may mistakenly feel are innocuous. Eroded soil is a perfect example of one such substance that many do not take seriously as they consider it a natural substance. But, if a significant amount of this 'silt' enters a watercourse, it deoxygenate the water, block the gills of fish and some aquatic plants and invertebrates, starving them of light and oxygen. Any ill effects on spawn or spawning fish can also leave a company vulnerable to prosecution under the Salmon and Freshwater Fisheries Act 1975 (Moss 1975).

When a construction site strips the topsoil and thus removes the vegetative cover, it takes away the land's strongest defense against erosion. The remaining surface has no shield or binding element to protect it from rainfall and run-off which will erode away the soil. When there is no plant matter to slow it down and the surface has become compacted by the use of heavy machinery, the rate of run-off increases and the scouring effect is exacerbated. If machinery continues to operate in wet conditions, it churns up the ground, releasing soil particles that become suspended in the surface water. If this water is subsequently allowed to flow into a watercourse, then there is a risk of environmental harm and prosecution.

In the Yaoundé VI area, there are people who construct along the streams whereby the silt materials are melted into the streams. The water gets contaminated by the tiny materials which pollute the water making it unfit for any organism. Some of these chemicals are from construction sites, when a house collapse and where blocks are molded for sell. An informant gave us his own point of view concerning silts and minerals that runs into the water bodies. This is what he said:

> *The mud that runs down from the hill top is able to carry chemicals in it that when mixed with water, and makes it unfit for consumption. Also, when we look at areas where there is industry, construction site, those materials used for construction are not usually good for human health. When there is flooding, it carries some of these particles into the water bodies like streams and unprotected wells that is consume by the population* (Edwin, 12 August 2020, Jurvence).

According to Edwin, most of the dust particles from the industries and construction sites, the materials used are not good for the people to inhaled or consume it because they contain materials that are toxic and corrosive to the body. To him, most of the silt materials dissolve in water when there is runoff from rain water that is able to carry the find particles into water

bodies. It is always advisable to always protect water sources or point from things flooding this is because our environment is made up of soil that is easily dissolve when it comes in contact with water. In relation to our cultural environment, the population needs to protect their environment because it is the where they will always get their needs as they interact with the environment. This is also validated by Tripathi (2009) saying that, industrialisation along with development brought with it a danger to the human civilisation-the problem of environmental pollution.

With the unrolling of the Water Framework Directive (WFD), the political spotlight is very much on the water quality of our streams and rivers. There is speculation that the testing of water quality before, during and after construction projects will become far more vigorous in the future with the consequence that, construction companies will find themselves increasingly at risk of prosecution.

Climate change is a change in the pattern of weather, and related changes in oceans, land surfaces and ice sheets, occurring over time scales of decades or longer. Climate change, also called global warming, refers to the rise in average surface temperatures on Earth. An overwhelming consensus maintains that climate change is due primarily to the human use of fossil fuels, which releases carbon dioxide and other greenhouse gases into the air. The gases trap heat within the atmosphere, which can have a range of effects on ecosystems, including rising sea levels, severe weather events, and droughts that render landscapes more susceptible to wildfires**.** Crops that depend on rain are therefore more vulnerable than irrigated ones due to changes in precipitation, infiltration, evapotranspiration and soil moisture regimes. Food security is therefore threatened in more vulnerable regions and countries of the world. Changes in rainfall regimes will induce changes in stream flow regimes and lower base flow is expected. Moreover, the water quality regimes will also change and contamination impacts may be larger, affecting public health. The latter may also be impacted due to increase of frequency and severity of heat waves and wildfire confirmed by IPCC (2007).

The dry season in Yaoundé VI is short but very intense in a way that most of the wells and springs in these areas dry off because of the intense sun. This has caused insufficient water to the people. During out field study, we met an informant and this is what he told us concerning climate change:

> *Climate change is one of the greatest reasons why we are having water scarcity. Like what we have now even in Cameroon, we are having more of the rainy season than dry season. But the irony is that the short period of dry season that we have is very harsh that it is able to the dry streams and wells that we depend on. When the period of rainy seasons appear, it has its own disadvantages that it softens the soil to a point that, the water from the well becomes muddy that we cannot carry it. Further when it falls heavily, it has a tendency of flooding to those living at the foot of the hills.* (Victor, 15 April 2020, "Centre").

To Victor, climate change is an important cause of water scarcity like what we have now in Cameroon. We are experiencing very harsh dry season that causes streams, rivers and wells to dry off. Due to this, we do not have enough water to sustain us during this period that is why people will always complain of water shortage during this period. There are also cases where people complain of water being too dirty especially those drinking from the well and spring water, because of the heavy rain in the environment. Again, the weather forecast of last year shows that 2019 has been one of the hottest and dry periods the world has ever experienced. Another informant in the field gave us a disadvantage of climate change on water. This was what he said:

> *I can say that climate change has caused a lot of harm than good. These days we don't have good water to use all because the climate has change from what it used to be. Though the dry season is very short as compared to raining season but yet there is insufficient water during this period, the sun absorbed all that we need to survive* (Tina,16 July 2020, Mendong).

To Tina, climate is causing a lot of harm to people by reducing the quantity of water that is to be used by them. Due to this absence, they have to suffer a lot in order to get the precious liquid to survive. When one look at the point above, it can be concluded that the population has manipulated the environment such that it has affected the climate negatively and they are once suffering from its negative way of interaction. The above analysis from the informants on climate change confirmed that it is another factor causing water shortage, is supported by report from IPCC (2007). It concludes that the impact of climate change has a diverse nature and biodiversity due to changes in environmental conditions affecting the ecosystem. Changes in rainfall induce changes in stream flow and lower base flow is expected.

Global climate varies naturally over time scales from decades to thousands of years and longer. These natural variations can originate in two ways: from internal fluctuations that exchange energy, water and carbon between the atmosphere, oceans, land and ice, and from external influences on the climate system, including variations in the energy received from

the sun and the effects of volcanic eruptions. Human activities can also influence climate by changing concentrations of $CO_2$ and other greenhouse gases in the atmosphere, altering the concentrations of aerosols and altering the reflectivity of earth's surface by changing land cover.over extraction of water also contributes to significant to water depletion as confirmes by Gok (2004).

The topography of Yaoundé VI and the drainage systems are poor as compared to other quarters in Yaoundé. Runoff is a major cause of water quality issue that is affected by topography in Yaoundé VI, unlike many of the other aspects dealing with topographic features in the entire watershed. Rainwater drains into a body of water by first passing over, under, or through several landmarks. Many chemicals, pollutants, minerals, and sediments present where the rainwater falls can be carried to the body of water with precipitation. This can adversely affect water quality or bring essential nutrients to it. This happens in hilly areas like Centre and Mvog-Betsi.

In the event that the runoff flows over rural areas, many fertilisers and pesticides are moved along toward the body. In highly urban areas, chemicals from industrial factories litter from just about any source, and even overflowing sewers may contribute to the runoff. The geography also plays a crucial role. If the water needs to seep through soil to reach its final destination, many of the chemicals may become filtered out. Furthermore, if the place where the rainwater initially lands is uphill from the water body, much more run-off will occur than if the opposite is true. This is what an informant gave us in the field concerning topography:

> *To me I know that our topography, infiltration and precipitation is one of the reasons we don't have pipe born-water. When you look at this place is very enclave or too hilly that it becomes hard to dig a pipe born water if not we would have had water long time ago. Also when it rains there is no way water can stand here it will always rundown stream due to the nature you can also see that even crops do not do well here because all the water run down the hill into the low lands* ( Victor, 22 April 2020, "Centre").

Victor believes that it is because of the nature of the area that they cannot have potable water. By just looking at the area, he concludes that there is no way they can have pipe borne water. More so, he concludes that the reason why crops do not do well in that area is because it is too hilly and the ground cannot hold water for cultivation since all the water and nutrients runs down the slope. The natural environment of some quarters in Yaoundé VI is hilly and it is the hilly nature of the environment that the population is able to have some

natural springs which serves as sources of water. But due to this hilly environment, the area is unable to have pipe borne water, since it becomes difficult for technicians to work through the hilly site.This analysis is confirmed by the report from IPCC (2007) which says that changes in rainfall regimes induce changes in stream flow making it difficult for people in hilly areas to have access to water.

Sedimentation in Yaoundé VI is not naturally strong due to human activities. Most human activities lead to increased soil erosion, and eroded materials eventually find their way to stream channels water storage reservoirs and ponds in Yaoundé VI. Human activity, including farming and herding, involve removal of vegetation and disturbance of the soil surface. Subsequent wind and rainfall set surface soil grains in motion move or flow to the natural drainage system, the river. Increase in sediment delivery changes the character of the river. The sediments build up on the river bed, reducing the channel cross-section and changing the hydraulic gradient. Natural energy processes will then work to develop a new state of equilibrium between bed-slope, channel cross section, discharge and sediment movement (Osborne, 1990).

The river channel may widen to accommodate the risen bed level, thus introducing more sediment from eroding banks, and/or the gradient may increase, to provide energy to move the increased sediment load. Whatever occurs, the character of the river channel will change, certainly downstream, but possibly upstream as well, as a result of changed gradients. Property of landholders downstream may be greatly affected. Banks may be eroded and the river may even change its course. During floods large amounts of sediment may be deposited on the floodplain, which may be beneficial, but is more likely, at least in the short term, to be unwelcome. This discussion does not apply to perennial rivers but it applies equally to rivers which flow for only short periods, such as the wadies, and for most of the time are characterised by dry channels.

Human activities in Yaoundé VI promote the littering of the sediments to low lands where there is reservoir. It helps in polluting the water because the materials are very soluble in water. This is because most of the areas are hilly in nature and that permit easy movement of sediment to the low lands. Agriculture is another factor that promotes easy washing of sediments to low lands. When the top soils are deposited down the lowlands, especially where there are water sources like streams, it helps in contaminating water used by the inhabitants.

With regard to the geology of Yaoundé VI, rainfall flows down to the rocks beneath the ground. Some rocks are permeable and allow water to flow through them. Permeable rocks can lead to less surface water. For example, limestone landscapes often have dry rivers; the rivers only exist when rain has just fallen. When water is taken from aquifers, groundwater levels fall. If the amount of water taken is greater than the amount of water falling as rain, it is called over-extraction. An informant gave us some reasons why is difficult to have water in their area. This is what he said;

> *It is challenging for people here at Ako-Ndoe one to get water, especially a well water. If I want to dig a well, it is going to cost me more because, the rocks that hold water here deep into the earth and I do not have money to spend on that. But in other areas, in less than 3meters deep one finds water easily. May be I would have done the digging by myself but because of my ill health, it is impossible for me to do it* (Walters, 12 July 2020 Mendong).

From Walters's point, to dig a well in their area is difficult because the rock that contains water is very deep into the earth, and he cannot do that by himself because of his health issues. This has caused his home to always have limited water supply. One can equally say that if the rocks were not deep into the earth, it will have been easy task for him to dig up his well. It is because of the hilly nature of the environment that makes the area so rocky making it difficult for the population to drill their wells.

Rainfall variability in time and space in Yaoundé VI and the pattern of their occurrence vary considerably in different climate regimes. In general, the lower the annual rainfall amounts, the greater their variability from one year to the next. In semi-arid and arid regions, the rainfall is irregular and unreliable. In these regions, the rainfall variability and spatiotemporal difference are very pronounced. Many hydrological and hydro meteorological studies give evidence of such behaviour (Agnew and Anderson 1992, Lin 1999, Kalma and Franks 2000). Most of the world's arid and semi-arid regions have climatic regimes in which precipitation is characterized by some or all of the following:

- One, rarely two, short rainy seasons, followed by long and often hot dry periods;
- Short rainy periods, rarely more than two days, unevenly scattered throughout the season;
- Violent showers, having high rainfall intensity and large spatial variability over a small area, even at a scale of ten square kilometres, and

- Irregular inter-annual rainfall depths and great local differences that often render the usual statistical tools in climatology ill-adapted, e.g. asymmetric or multimodal frequency/probability histograms.

As concerns physical characteristics and processes leading to water scarcity, lack of rainfall has varying significance in the different climatic regimes in the world. In some of the arid zones, there may be several years in which no measurable precipitation occurs and the flora and fauna are adapted to these normally desiccating conditions. In other arid areas, where very little rainfall occurs, the deficiency of the rainfall below the normal results in serious water shortages, requiring a number of measures to be taken. Low annual amounts of rainfall in a region may result from its geographical location relative to the general circulation of the atmosphere, its location on the lee-side of a mountain range, or absence of a topographic high that would favour the formation of precipitation from clouds passing over it.

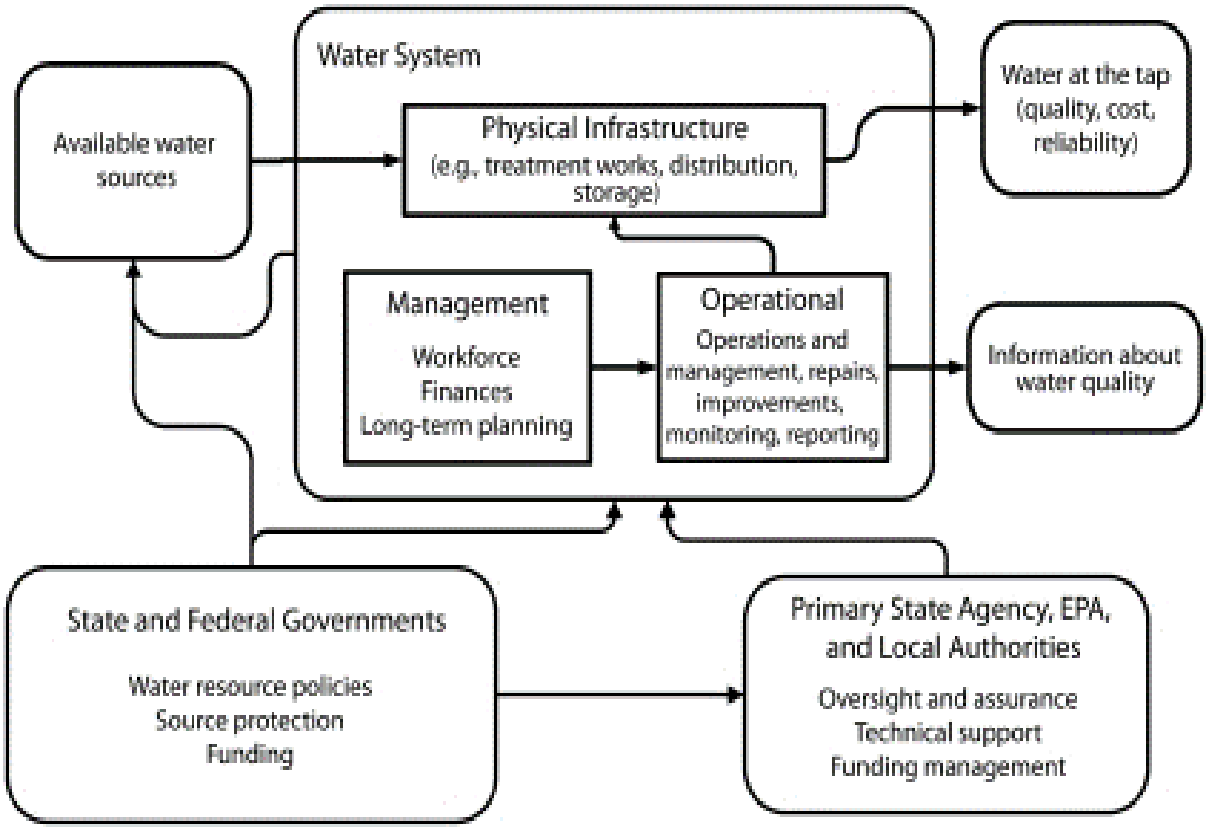
In Yaoundé VI, the rainy season period is longer that the dry season period. But during the dry season, the climate is too harsh such that the water table reduces drastically. This has cause a lot of insufficient water in the area. At times even in the raining season, when rain falls heavily it turns to pollute the underground water especially the wells and spring sources. This is because the soil is soft and easily dissolves in water as rain falls.

Infrastructure of water services in Yaoundé VI are in crisis or approaching crisis conditions due to their neglect, particularly underground water mains and sewers. This can largely be attributed to political unwillingness to allow charges to be set high enough to achieve sustainable cost recovery. In developed countries, the solutions are relatively affordable but the situation is more serious due to a combination of neglect and rapidly growing urban populations. Without doubt, infrastructure is essential for sustainable water development. But infrastructure alone will not contribute to the improvement of the quality of life unless it is part of an overall framework, development, economic growth, social equity and environmental protection.

Pipelines are needed to safely move water from place to place. Sealed pipes reduce the potential for leaks and pollution. Some places do not have these pipes in place. They can be expensive to lay as they need to be buried underground. Water pumps also form part of the water infrastructure.

The infrastructure that produces water is conceptualised as 4 components which are: available water sources, the physical infrastructure (treatment facilities, transmission, and storage), operational/managerial capacity, and government policies and agencies that regulate, assist, and financially support system operators as seen below:

**Fig 25: Framework of the components of drinking water infrastructure.**




*Source: Environmental Protection Agency (EPA 2011)*

Source water quality, location, and reserves drive the technical requirements for water treatment, transmission, and storage. Operation of this system to reliably needed to produce drinking water that meets public health standards at reasonable cost. This requires adequately trained operators and sufficient administrative capacity to ensure sustainable financial and operational performance. The Yaoundé VI council serves many roles in this infrastructure: setting policies for water quality regulations and access to sources of water, providing oversight to assure that systems meet water quality, treatment, and monitoring requirements, offering technical assistance and training, and allocating resources to repair and upgrade physical infrastructure.

Each aspect of water infrastructure might ultimately affect water quality, reliability, or cost. To the extent that any of these aspects of the water infrastructure differed as a function of race and income of the communities they served, racial/ethnic or income disparities in water quality, reliability, and cost (as well as the other attributes valued by consumers) might manifest. For example, disparities in the availability of construction funds might lead to fewer improvements in the physical infrastructure, leading to more problems in water quality or reliability.

Disparities in the quality of management might impact the level of operator training, the reliability of water treatment, or the level of compliance with sampling requirements. These factors might directly, or indirectly, affect the reliable provision of high quality water in Yaoundé VI. The level of oversight and technical assistance by the primacy agency might impact the management and operations of the utility, and ultimately, the quality, reliability, and cost of the water produced. We met an informant in the field who gave us his own point concerning the community development:

> *The formal institutions for water supply are too weak to function effectively, Community work too weak to make water more available, Social cohesion in my community is not strong to face water scarcity challenge. I have been living in this area for more than 17years and this water point have being like this and nobody cares about it* (Jason, 16 July 2020, Mvog-Betsi).

This informant believes that the institution, ministry or councils are too weak to carry out their functions when it comes to water distribution. Again, the community too would have looked into the issue of the water and think of what to do, but no one seems to care. To her, the people using the water should look for a means to better up the water source that is available so that everybody can afford to get good water. This therefore leads to the conclusion that there is no team spirit in the community. This is what another informant said concerning the organisations role on water distribution. Where there is no unity things are always going backward, but if the community or the people decide to work together, they will know how to fight against this issue of water pollution and water scarcity.We met an informant and this was his words:

*"Local water resources exploration and exploitation technologies are too weak. Modern water resource exploration is complex"* (Nyada, 2 May 2020, Carrifou Vogt). To Nyada, the modern way of exploitation is too expensive to an extent that, if the organisation do not have enough money for construction, if becomes very difficult for the inhabitants to have water. Its

expensive nature hinders some of the community members who have good will of helping the people to in-need of water. Some of the technologies of are so complex that when one think of it, it becomes so boring in carrying out the work. From this point one can conclude that someone cannot be doing a job that he or she does not like because at this point it needs those that have the people at heart to do the work. Some of the people are responsible for making acesss to good water costly, thereby scaring the population of trying to do their best.

The data on technologies and water management is substantiate by Msangi (2008) saying that, weak leakages, between different sectors, weak information flow, and inadequate institutional capacity, limites appreciation of the finite nature, economic value of water by some population is a problem in solving water crisis.

### 5.4 The cause of gender inequality on water wanagement in Yaoundé VI

Water management and waste management in most parts of Africa have been largely focused on the technical issues of waste disposal with little attention paid to the social and economic aspects of households. Thus for effective and equitable services, there is need for a paradigm shift in the approach of the service provider. The effects of the different social status of communities especially the role of household is significant and thus planning is crucial for the provision of effective and acceptable service delivery.

One of the key areas that need to be addressed when reviewing the impact of social factors on service delivery is the gender issue. In all societies especially Africa, women have a different role from that of men. Their multiple roles as mothers, homemakers, educators, entrepreneurs and producers place a heavy demand on them particularly the non-elite ones, at a special disadvantage by United Nation Development Fund for Women (UNDFW, 1998). It is worth noting that information on the socio-economic status is critical to the solid waste planning process. As a result, if household disposal practices are known, it will be easy to introduce measures to reduce the amount of waste generated by the affected community. Also, an understanding of the diversity of the local culture of home-owners can assist the planning of a domestic solid waste management system **(**Poswa, 2004).

Research across many cultures has shown that women handle waste in their homes although richer women delegate this task to servants. In most cases, women are not paid to handle waste while men do so when they are to be paid. As a result of their less mobility and

access to public space due to cultural and religious reasons, it makes it difficult for them to deliver waste to neighbourhood collecting point. Therefore, taking the specific needs of women into consideration in order to ensure their equitable and affordable access to facilities and services is imperative when orientating and directing policies (UNDFW, 1998). The differences between men (drop off centre) and women (door-to-door waste collection system) on the choice of type of waste collection service system is attributed to cultural traditions, which govern gender relations in the households. In most African societies and other developing countries, women are responsible for domestic work like shopping, cooking, cleaning, child care and wellbeing of their husbands (World Bank, 1999).

During our fieldwork, we met an informant and this is what she told us *"In my home, my children are responsible for waste disposal. But when they are not around I do it. To me, since men are always considered to be the head of the family, it is very difficult to see a man doing such activities*" (King, 12 October 2019, Etug-Ebe). According to this point of view, it is difficult to see a man who will carry waste product to the collecting sites. This is because culturally or naturally, men are considered to be the head of a home. They only bring in income for the house, so the children and women do this as part of their household chores. In most cultures and communities, it is a taboo seeing man carry water, that is has the environment has made them to be and the rules is strictly followed by everyone. When a man carries water for his home, it is looked upon as the woman is maltreating the man. With this, the work load of fetching water lies mostly on the women and the children. Meaning if there are no children or women in the houdehold, the house will definitely go for days without water because the responsible are not available to fetch water.

A comprehensive description of socio-economic factors according to Mayet (1993) stipulates that these factors relate to the state of infrastructural development in a residential area, lifestyle and value systems, aspirations and attitudes, migratory patterns, levels of education and willingness to recycle or reduce waste output. This includes the ability of people to pay for services based on income and willingness to pay (Sadler, 1997). According to the White paper on local government by Development Coordination Disorder (DCD,1999), suggestions are made that municipalities should promote job creation and boost local economies by empowering them and developing their capacity to enhance service delivery process.

Addressing social and economic issues require an in-depth review of the existing situation and thorough planning in order to develop performance management plans. This can be achieved by involving affected communities which is vital for the understanding of priority areas (DCD, 1999).

This chapter revealed some of the causes of water insufficiency and water pollution in Yaoundé VI council area. The findings were both from authors and fieldwork that we carried out in Yaoundé VI area. This was reveals the cultural cause of water scarcity and pollution is caused by, urbanisation, deforestation, poor waste management, inequalities in gender, climate change and poverty. The following chapter will be illustrating or describing the various methods and ways used by the inhabitants to cope and adapt in the environment.

# CHAPTER VI
# COPYING STRATEGIES TO WATER POLLUTION AND WATER INSUFFICIENCY IN YAOUNDÉ VI

In every challenge, there are always means to adapt or cope during such moments in life or activities. The case of water pollution and water shortages in Yaoundé VI area, the population is facing a lot of difficulties, and need to strategise to fight against such conditions and how to adapt in cases of water shortage. The adaptations strategies in response to water scarcity in Yaoundé was found to revolve around getting water from alternative sources or limiting water use in the household. The different strategies could be reflected on the physical, geographical, socio-political responsibility and socio-economic level and these strategies tend to vary between households. In many cases, the more the number of strategies adopted in response to adverse condition, the more stable is the situation or the more less vulnerable is the respondent. In this study, water scarcity adaptation strategies were assessed in terms of vulnerability to water scarcity. This chapter will also show the effect of these strategies on the population as they try to cope with the immediate environment.

## 6. Adaptation

Adaptation is the physical or behavioural characteristic of an organism that helps it to adapt and survive better in the environment. Living things are adapted to the habitat in which they live. This is because they have special features that help them to survive. The development of these special features is the result of evolution due to gene mutation. These mutations aid in the survival and reproduction, then pass on from one generation to the other. Adaptation theory, also known as survival theory or survival of the fittest, is an organism's ability to adapt to changes in its environment and adjust accordingly over time (Moore 1983). Darwin also refers adaptation to the adjustments in the fit between organisms and the environment as evolutionary adaptation, or simply adaptation. Adaptation is the root concept that grew into Darwin's theory of natural selection. Natural selection is the mechanism that explains how things change; adaptation explains why they do (Darwin 1830).

Adaptation is either planned or unplanned. From a biological point, changes to our physiological, morphological and cultural characteristics to enhance survival in given habits or environment termed “Adaptive strategies” (McElory 1990:249).

The theory of adaptation was proposed by Charles Darwin (1830) which states that an organism that is able to adapt to the changing environment will survive and the rest will be eliminated and this is known as survival of the fittest. According to the adaptation theory, there are different changes that take place when the habitat changes. These changes are: habitat tracking, extinction and genetic changes.

Habitat Tracking refers to when a species finds another environment similar to the environment it lived in before. Movements to new areas in response to a changing climate can depend on suitable habitat being available within those areas. Extinction is when the species is completely removed from the earth surface because the environment was or is not conducive for living. Species extinction is usually, though not always, caused by the failure of a species in competition with other species. Genetic Change occurs when organisms with slight mutations are able to survive in a changed habitat with the best access to food and mates (Eyre-walker 2007).

The population of Yaoundé VI have gone to other places or quarters to live to be able to have their basic need like water. Some of the human system of the population of Yaoundé VI have adapted to the poor water quality in the environment. We also have cases where people die as a result of poor water quality or contaminated water when consume.

### 6.1 Types of adaptation in Yaoundé VI

According to Darwin (1830), there are three types of adaptations which are: structural, behavioural and physiological adaptations.Structural daptations involve the physical features of an organism that help them to survive in the environment including the different types of terrestrial habitat. The physical changes are related to the changes in the physical environment. For example, camouflage, which is the protective colouration that helps an organism to blend in its environment. This protects them from predators and increases their chances of survival. In Yaoundé VI, these structural adjustments can be attributed to physical strategies like buying of more containers to store water in times of water scarcity.

A behavioural adaptation is the change that affects the behaviour of an organism. This could be caused by to the changes in the surrounding environment or due to the actions of other species. Physiological adaptations also involve physical changes in the species. However, physiological adaptations are not always seen in the organism’s appearance. This type of adaptation can either be due to changes in the environment or due to the behaviour of other species. The human system have adapted to the poor water quality.

### 6.2. Adaptation to water pollution in Yaoundé VI

Nowadays, it is easy to purify water because of the numerous methods that are available and affordable for everyone to use. There are easy and simple ways to purify water that one will find along trails and others to make water suitable for drinking purposes. One can purify water by treating it with a chemical chlorine or iodine, filtration and ultraviolet light. Another simple way is to boil the water. All of these methods are effective provided they are done properly. Anyway, one only needs to choose one method with which he/she is more comfortable. Below, includes few out of the many ways to purify water at home, be it for emergency purposes, outdoor survival, or, as some of the methods warrant, everyday use in Yaoundé VI.

#### 6.2.1. Boiling

The simplest and most common method to purify drinking water is to boil it. Heat the water over a stovetop burner or open flame until it reaches a full, rolling boil, and continue to boil for a minimum of five to ten minutes to be safe (the longer the water is boiled, the purer it will become). Since boiling contaminated water will remove all oxygen from the liquid, the resulting purified water may end up tasting flat. However, boiling uses fuel and could take a while. Furthermore, one will need to filter the water to remove all solid particles especially if was taken from a doubtful water source. This is a very minor negative that can easily be fixed by simply shaking the purified water up a bit. Also, to improve the taste, a pinch of salt may be added to each quart of drinking water (Taylor, Robert A.; Phelan, Patrick 2009).Taylor and Patrick, describe the various types of boiling methods as follows:

Nucleate boiling, which is characterised by the growth of bubbles or pops on a heated surface, rises from discrete point on a surface, whose temperature is only slightly above the temperature of the liquid. Critical heat flux is the thermal limit where phase changes occur during heating which suddenly decreases the efficiency of the heat transfer, thus causing localized overheating of the heating surface.

This is what one of the informant told us concerning boiling of water:

> *I do treat my water by boiling because I know it is contaminated, so I need to kill the germs in it before drinking. To me, it is the safer way for me because it is less expensive. If I have to buy chemicals for purification it will be heavy on me since I will not be able to do that on daily basis* (Edwin, 14 August, 2020, Jouvence).

Edwin boils his water because it is one of the cheapest methods he can use because his income status does not permit him to use other means of purification. Water boiled before

drinking it is one of the recommended practices by health officers and it is commonly used on daily basis. The environment we lived in is not so clean that is most of the water sources are contaminated that is why water is being boiled by some of the inhabitants. This is recommended especially in third world countries where their source of drinking water is not safe and sometimes the causes for some incidence of common illness for children. Those living in the remote areas like ours today, in the farms and far flung barrios, are the victims of these infectious diseases infected by water-borne diseases because of using unsafe water. The above data analysis is confirmed by Feachem et al, (1983), and Pejack (1996), saying that, heating or boiling water to a sufficient temperaturefor a certain period destroys harmful mircro-organisms and the process is term pasteurisation. Even though this process takes a lot of gas, kerosene and firewood but one have no choice but to do it to be able to have potable water.

Killing bacteria, viruses, cysts and worms, by boiling is the simplest and easiest method of disinfecting to remove pathogens from water it removes some microorganisms, some chemicals and other components that can be present in drinking water. It is effective in destroying several classes of water-borne pathogens like, bacterial spores, fungi, protozoan, and helminth ova. No need for a skills training in boiling water as long as it is boiled at the right heating temperature to kill water-bornediseases. It is safe as against the fresh tap water, drinking boiled water everyday increases your blood circulation. There are still lots to learn about the importance of boiling water for the safety of our body against some major diseases that cause illness to some people especially children and adults who are vulnerable by drinking unsafe water.

### 6.2.2 Filters

There are natural and artificial ways of filtering water for consumption. There are quite a few ways to filter water for safe drinking. Porous materials such as sand, allowing water in a bucket or container to settle, cotton, cloths may be used in the event of an extreme emergency. Filters, on the other hand, are highly successful in removing almost all tannins and soil from contaminated drinking water.

Water filters range in size, shape, colour and cost, yet most of them work by pushing the water through a charcoal or ceramic filter and then chemically treating it. Water filters can remove bacteria in water. Carbon on the other hand gets rid of the chemicals and awful tastes while iodine coated screens can further remove viruses (James 2011). Treated water

can be consumed after the treatment and the water has no taste. However, they are heavier than iodine or chlorine, more costly and needs manual pumping. The most common drawback to this method is the filters can easily become clogged. Some may need to be cleaned for reuse, while others may require one to buy a filter replacement.

A water filter removes impurities by lowering contamination of water using a fine physical barrier, a chemical process, or a biological process. Filters cleanse water to different extents for purposes such as providing agricultural irrigation, accessible drinking water, public and private aquariums, and the safe use of ponds and swimming pools. Filters use sieving, adsorption, ion exchanges and other processes to remove unwanted substances from water. Unlike a sieve or screen, a filter can potentially remove particles much smaller than the holes through which its water passes. Fuller (1902) and James (2011) describe the various water filters that can be used to filter water using activated carbon, ion exchange, reverse osmosis (RO), mechanical, chemical and biological filtration.

Activated carbon filters are small pieces of carbon, typically in granular or powdered block form, that have been treated to be extremely porous. It is so cavernous, in fact, that just one gram of activated carbon can easily have a surface area of 500m2 or higher. There are many benefits associated with using activated carbon filters. These purifiers can be used to rid the air of unwanted or harmful contaminants that can pose a hazard to your health. Carbon filters also help eliminate unpleasant odours so one indoor air remains fresh.

Ion exchange is a water treatment process commonly used for water softening or demineralization, but it also is used to remove other substances from the water in processes such as dealkalisation, deionisation, and disinfection. As the name suggests, ion exchange filters consist of a substance that will exchange one ion for another as water flows through it. For example, ion exchange will replace calcium or magnesium ions, which cause water hardness, with sodium ions. This will “soften” the water.

Reverse osmosis (RO) is a special type of filtration that uses a semi-permeable, thin membrane with pores small enough to pass pure water through while rejecting larger molecules such as dissolved salts (ions) and other impurities such as bacteria. Reverse osmosis is used to produce highly purified water for drinking water systems, industrial boilers, food and beverage processing, cosmetics, pharmaceutical production, sea water desalination, and many other applications.

Chemical filtration removes toxic or unwanted chemicals as the water passes through a chemical media or resin. There have been a number of advancements in the past years, giving us new products that are targeted at removing specific chemicals or excess nutrients from the water. In biological filtration, different types of bacteria convert the toxic chemical byproducts produced by the aquarium inhabitants into less toxic nutrients. This breakdown process by the bacteria is called the Nitrogen Cycle. Ultraviolet water purification is the most effective method for disinfecting bacteria from the water. Ultraviolet (UV) rays penetrate harmful pathogens in water and destroy illness-causing microorganisms by attacking their genetic core (DNA).

From the above methods mentioned by James (2011), they are rarely used in Yaoundé VI. But the inhabitants have their own means of filtering their water. According to one of the informants we met on the field, this was what she said on water filteration:

"*We use filter to filter our water though I cannot say is 100% good but is better*" (Carine, 12 June 2020, Mendong). To Carine, she and her family uses filter to get rid of dirty particles in water even though she is not confident of the filter, but to her is it better than having nothing. To her is not actually the best means of filtering water but she has no choice than to use it though she can say is 100% safe, this is because she has either exxperienced water-borne diseases or seen cases where, even with the use of filters, people are infected with water-borne-diseases.

Cotton which is used in hospitals because of its absorbent nature is used for surgical dressings, cosmetic purposes etc. It is also known as Surgical Cotton or Cotton Wool, mainly used for medical purposes in hospitals, dispensaries and nursing homes to absorb the body fluids. Apart from medical purposes absorbent cotton is also used for making conventional type of sanitary napkins or pads. It is also used in removing make-up and dirt at beauty parlours and salons, in business organisations and households. Again it is used for sanitary purpose, for padding of clothing items, quilts etc according to United Nations Conference on Trade and Development 20019 (UNCTAD). Apart from the above mentioned uses, cotton is also used for water purification (filter).

We met an informant in the field and this is what she told us concerning water filtration using cotton:

> *I use local way of filtering my water for drinking; I use five litre gallon, a Tangui container that is cut into two and cotton. The cotton is placed inside the Tangui bottles which i used as a funnel and I put it at the month of the five litre container.*

> *When I poured water into the Tangui containing the cotton, the cotton acts as filter because it is able to trap the dirts found in water. But I think the chemical composition remains the same and at the same the colour of the water changes to pure or clean water. This is because with the presence of the particles in water, it gives its own colour but as these particles are removed, the water gains its original color of being clear. I use this method because I don't have a filter in the house also it is less expensive as compared to a filter* (Divine,17 November 2019, Mendong).

According to Divine, using his Tangui, cotton and a 10 litre container is the only way he can be able to filter his water. From his words, he is doing this because his finances are limited to buy other filtering machines. Using this method is a cultural way of filtering water in the environment even though the population is not actually using, some people are ignorant and some people know but do not want to use it. The cotton is actually gotten from the environment even though cotton is not grown in the Yaoundé VI area, but is a very good method of filtration.

**Fig 26: Local water filtration in Yaoundé VI**

*Source fieldwork: Matilda Musah (January 2020 at Mendong)*

The figure above confirms what Divine always uses as filter in his home. According to Carine, commercial filter is expensive for him to buy. So he prefers using the local methods of cotton and containers he has in his house. He is satisfied using this because the cotton is able to trap or filter all the waste particles in the water. Fortunately, water filtration and purification systems provide a convenient and cost-effective way to make sure one have clean, refreshing water in the home. According to the EPA and the Water Quality Association, 40% of Americans use some form of water filtration in their homes to enhance the quality of their water. Below, we will discuss the importance of purifying or filtering drinking water and show you the benefits of doing so.

This is what another informant told us concerning water filtering:

> *I use filter which is an electric one even though it is expensive but I prefer using it because I know that it is the best means of water filtration. To me I know that any thing that is using current gives the best result, that is why I went for the one that uses current to be able to filter the water* (Stella, 17 August 2020, Mendong).

From this point of view, she uses electric filter because she has that conception that anything that operates or function using electricity gives out the best result or outcome. At this point one can say that she is of the high class in the society because it is generally known that anything that uses current to function is very expensive and for one to have that will definitely needs a lot of money. So if one sees any individual using such filter in some homes it clearly give a class of that individual in the society.

**Fig 27: Various water filters in Yaoundé VI**


*Source fieldwork: Matilda Musah (June 2020, Mendong)*

The pictures above gives the different types of filters people do use in their homes. Figure A, is a common one and easy to find in the market. It is cheap, and it varied depending on the sizes to afford and needs no electricity to function. It needs just constant washing of the candle after using it for a long period. Figure B is another type easily found in the market, but it is expensive to afford to those with low income level. The one in figure B is connected directly to the tap connected in the kitchen where the water goes directly into the filter for filtration and whenever one needs to drink, he opens from the filter directly. It is not a manual one but it uses battery to function until when the battery cannot function any longer. Figure C, uses electricity. The container above contains water that passes through into the filter machine. The filter has two openings that is one for hot water and the other for cool water. Someone can decide to mix the two depending on what he/she want. One can easily get the scent and texture of the water when it is not filtered.

### 6.2.3 Slow sand filtration

Another way of purifying water is through a technique called slow sand filtration, which has been employed by commercial farmers for many years. Sand filtration is a very effective procedure, consisting of, in simplest terms, different layers of sand that remove suspended solids in water. What sets slow sand filters apart from all other filters used to clarify water is that they work by using not the sand itself, but rather a complex, gel-like film that is naturally produced on the surface of the sand. There are several advantages to slow sand filtration. Also, the sand filters are contingent upon little to no mechanical power, chemicals or replaceable parts, and they do not require much operation or maintenance. However, slow sand filters have a low filtration rate, and a proportional land area is required for the optimal treatment of drinking water, though it is not mostly use as drinking water.

In the field, this is what another informant told concerning sand filtration. This was her words:

> *During the rainy season, I have drums that I put at the edge or corners of my house where the pipes that direct the rain water into the drums. In the drum, I have sand in it because I know it is going to filter or trap the dirt from the rain water since most at times our zincs are not clean or the rain falls with wind that is able to transport dirt from one place to another* (Sandrine, 16 August 2020, "Centre").

To Sandrine, she uses sand filtration only during the rainy season when she collects rain water. The main benefit of a sand filter is the simple system which, in many cases, can be

used to obtain considerable yields. A sand filter can be placed in various phases of water management as a pre-treatment, as side-stream filtration and as a polishing filter. A sand filter often provides an effluent with potential for re-use. However, chemicals sometimes need to be added to improve the yield of the sand filter. Culturally sand has always acts as filtering substance that is why some people still use it even though not everybody uses that method.

### 6.2.4 Bleach

Water bleaching is another process of removing undesirable chemicals, biological contaminants, suspended solids, and gases from water. The goal is to produce water fit for specific purposes. Below we will see how water can be purified using chemicals like bleach, iodine tablet, chlorine, fluorine tablet are some of the water purification methods use in Yaoundé VI.

It might sound a little odd, but bleach can, in fact, be used for emergency water purification. However, because it is a chemical, working with bleach can be dangerous, and one must follow careful instructions in order to ensure proper safety and successful water treatment. First, check to make sure one is using soap-free and unscented chlorinated bleach. Use a new sterile medicine amount of liquid bleach to the contaminated water.

From one of the informant Emmanuel we met on the field, this what he said:

"*I use eau de javel but not all the time, because I feel it is not too good for the body. Whenever I add drops of bleaching agent in my water, I allow it for 4-5 hours before using the water"* (Edward, 26 September 2020, "Centre"). To Edward, bleaching agent is not too good for the system so he chooses the time he wants to add bleaching agents into his water. He always allows it for some hours so that the bleaching agents kill whatever germs or bacteria that were in the water making it fit for drinking. Health wise he knows that the bleaching agents he uses are not too good for the body so he uses it periodically. Another issue could be that he uses it because that is what he can afford and he is comfortable with it.

### 6.2.5 Iodine and chlorine tablets

This is an effective and more convenient method. It is also available in different forms that suits to everyone who wishes to use it. It has the ability to kill viruses and bacteria. They are lightweight and easy to use. However, it takes about thirty minutes before you can drink the treated water. Small amounts of liquid iodine or iodine tablets can be used to kill toxins in water. However, like bleach, iodine is a chemical, and it is intended only for short-term use. Use a medicine dropper to add five drops of liquid d iodine to each quart of water, if the

water is clear. If it is cloudy, use ten drops. Iodine is also available in the form of water purification tablets (Geldreich E 1989).

These can be used two tablets per quart of water. Let the solution sit for an absolute minimum of thirty minutes to an hour at room temperature. Shake thoroughly before drinking. Additives such as lemon juice, lemonade powder, and even vitamin C tablets may be stirred into the purified water kill the bitterness taste from the iodine. It is also not suitable for pregnant women, it has an aftertaste that one might not like. Once a drop the tablet into the water container, shake the container and hold the bottle upside down and have the lid slightly unscrewed to let the iodine to flow into the threads of the bottle cap. Chlorine tablet can be usesd as follows;

- 4 to 6% chlorine (most common household bleaches) Add 8 drops of bleach to each gallon of water like 5litres of water
- 1% chlorine – Add 10 drops of bleach to each 20litres gallon of water
- 7 to 10% chlorine – Add 4 drops of bleach to 20litres gallon of water.

The population of Yaoundé VI hardly used this method. But the company incharge of water production uses it in large quantities for purification.

This is what an informant told us told us:

*"I have a well in my house so most at times when I want to purify my water; I drop the iodine and chlorine tablets in the containers that water is being pump into before consumption. It is less time consuming and less stressful too."* (Sylvie, 15 March 2020, Simbock). According to Sylvie, putting chlorine and iodine tablet in water is the best means of water purification. To her, this method is good because is not time consuming as compared to other methods like boiling and sand filtration.

Solar disinfection is a convenient, inexpensive procedure when boiling water for purification is just not possible. As opposed to using direct, extreme heat, solar disinfection employs the heat from the sun to aid in the purification process. To experience success using this method, you will need bottles, the contaminated water, and direct sunlight. Be sure to use plastic bottles, and fill them with water until about three-quarters full. Shake the bottled water for about 20-30 seconds before filling the remaining quarter of each bottle with water. Close tightly and put in the direct path of the sun's rays for an absolute minimum of 6-8 hours before drinking. To the best of our knowledge, the application of solar purification at

households level in sites at latitude more than 45◦ (Inamdar 2008). This method is eco-friendly and effcicent method as it uses solar energy.

Non-Chemical Stabilised Oxygen above is one of the quickest and, easiest ways to purify water is to add drops of Stabilized Oxygen. This natural antibiotic can be bought on the market and is labelled with instructions for use. As Stabilized Oxygen provides clean drinking water that can be consumed immediately, it would be a good idea to keep a few bottles on hand in case of any natural disasters or outdoor emergencies. Yaoundé VI populations do not use this method.

### 6.3. Disinfecting polluted water in public areas of Yaoundé VI

Public places include health units, churches, schools, markets, gynasums, clubs and sport fields.

#### 6.3.1 Health units

People expect hospitals or clinics to always have good equipment and a clean environment since they are responsible in saving the lives of the people. To that most of the people expects them to always have good materials in their surrounding.

On the field, this is what an informant told us concerning water purification in a hospital is done. This was what she told us:

> *At health units of Etoug-Ebe, we use both the borehole and CAMWATER in our premises. We clean water tanks after every one month and also treat the water after every three months using chlorine tablets and claur. We do this because we know our patients deserve the best we can offer them and moreso the water sources we have are not that reliable, so we have to reinforce the water treatment for the safety of the patients* (Theresia, 20 November 2019, Etoug-Ebe hospital).

To Theresia, the health of the people is their priority. That is why they have to reinforce water treatment so that their patients get the best they can offer. To her the treatment last only one month, because the materials/chemicals they use, has an expiring date so they are careful in using those materials. The hospital takes into consideration the health of the population. That is why they make sure the water is purified, at least, once in a month.

This is what another informant from St Pius clinic told us:

> *In St Pius clinic at TKC, we use CAMWATER here. As for the purification means, we have placed filtering cup for water purification at the egde of our water metre*

> *so that each time the water passes through this filter, the dirt and germs are being trapped immediately as we use the water* (Emmanuel, 05 May 2020, TKC).

From Emmanuel, they put filtering cup containing the purification agents at the meter where water passes through the pipes before distributed to all the pipes that are being used in the clinic. To him, it is one of the best ways to treat tap water because it does not consume much time and it is less expensive to use. From the view, one can say that filtering tap or putting filter in all the wards in his clinic is expensive. So has to device a means of filtering his water from the metre, making it less expensive.

**Fig 28: Filtered water from the meter**

*Source fieldwork: Matilda Musah (May 2020, TKC)*

The picture above is just confirming what Emmanuel said earlier on how he filters his water for his clinic to make sure that his patients are safe from contaminated water.

### 6.3.2 Educational Milieu

The educational milieu is considered as the start or foundation of every community to succeed, the population must have some knowledge in them. So these areas are supposed to have all the important facilities that the pupils or students need in order to study well. Again if the students or pupils are not in good health, studies cannot be effective. By so doing, some schools have taken into consideration the health of the pupils and students to be their priority.

This is what an informant gave us on how water is being purified in some schools:

> *"In our campus, we are using both bore hole and CAMWATER. In order to keep safe our pupils from water pollution, we disinfect our water quarterly every year to make sure that what the students are consuming is in good condition to avoid*

> *water-borne diseases. We do this because we are not sure of the water sources we are using especially the CAMWATER. The water always has colour and particles in it which is not good for the students to drink without being disinfected* (King, 12 November 2019, CBC primary school Etoug-Ebe).

From King, one can conclude that the health of the students and pupils is their priority. So they will not want to take chances of providing polluted water to their pupils which they know is not fit for the body. The tap water, they filter it while they use salt, “eau de javel” and chlorine tablet to purify their water that they use.

Other strategies used by the population of Yaoundé VI are as follows:

Protection of water sources such as rivers, streams, lakes, reservoirs, springs, and groundwater can provide water to everyone. Everyone understands that clean water is important and can avoid issues with household chemicals and pesticides by not buying products that contain persistent and dangerous chemicals in the first place. Many companies now sell non-toxic cleaners and biodegradable cleaners and pesticides. Spending a little extra money on those products automatically cuts down on neither water pollution. Support environmental charities, nor matter where one lives in the country, there are going to be charities working on watershed protection, water pollution clean-up, and similar causes.

The above analysis on water purification from the informants is validated below by figure we got from the field.

**Fig 29: Purification chemical “Cleaur” and Aluminium sulphate**

*Source fieldwork: Matilda Musah (January 2021)*

The figure above confirmed the chemicals used in purifying water in public mileu and home. The cleaur on the paper has no effect of the human system that is the water can be consume immediately when it is put into a bucket of water or well.

This is what an informant gave us:

> *I tried to avoid throwing plastics into water sources around my home like streams, springs. I do this because it is the same water am using and if I dirty it, it will not be good for me to consume it because of health issues even though some people maltreat the water source by throwing dirt into it. For meto clean drums and well too, I mix aluminium sulphate and cleaur in a tangi container for 24hours for the two chemicals to mix well for the cleaning* (Larisa, 1 September 2020, Acacia).

Larisa says that it best for her to avoid discarding dirt into the water sources around her home because it will not be good for her health. From her point, one can see that she is trying to interact well with the environment so she too will not be hurt and the environment too is in good shape. By this she is protecting the environment while protecting herself too. On the other hand, some people who do not care about their water sources and the environment will always have their way of discarding unwanted products in to the water sources.

**Figure 30: Mixed chemical use for water purification**

*Source fieldwork: Matilda Musah (Mendong 2021)*

The abaove figure clearly confirms what some individuals use in their homes and public places for water purification and what the informant said above.

Cleaning up beaches and rivers, inhabitants should not use our rivers and stream place where we dispose of our waste because many aquatic animals and humans depend on this water to be able to survive. More of this waste will cause some organism to die while some go to extinction. Polluted water is able to cause water-borne diseases to those that consume it either directly or indirectly.

From the above analysis, if everybody could take into consideration this, we believe our environment and water pollution will reduce limiting effects of water pollution.

**6.4 Importance of filtered water**

Filtering water is important for both aesthetic and health-related reasons. Filtered water helps provide these essential benefits (http://homewatersystems.ca/why-a-water-filtration-system-is-important/ 15 of May 2020).

Filtered water generally tastes better than unfiltered water. Chlorine, pesticides, bacteria, and heavy metals can all contribute to water that has an unpleasant taste or after taste. Municipal tap water is usually safe to drink. But just because the water will not harm the health does not mean it is of high quality. Safe tap water may still contain contaminants that give ones an unpleasant taste, smell, or cloudy appearance. A water filtration system reduces these contaminants to provide clean, great-tasting potable water.

Lead, chlorine, pesticides, viruses, and more all these contaminants can have serious adverse effects on one's health if they make it into the home's drinking water. Water can also contain microbiological contaminants such as bacteria, giardia and cryptosporidium. A water purifier can help protect against these harmful microorganisms so that they do not get sick from ingesting these organisms. Do not forget about cooking, too. If the water is unsafe to drink, it is also unsafe to cook with, brush your teeth with or wash vegetables in.

Filtering water also helps protect the health in these often-overlooked areas. And showering in contaminated water can also make you feel rundown. If your water contains chlorine, inhaling chlorine as one shower can lead to respiratory ailments. On the other hand, hydrating yourself with clean, clear water leaves you feeling refreshed and energized. The peace of mind one feel from knowing the water is safely filtered along with the crisp, clean

taste of filtered water will often encourage you to drink more water and feel healthier. Filtered water is good because, it keeps the children and family healthy and thriving.

### 6.5 Strategies put in place to adapt to insufficient water in Yaoundé VI

Though we all rely on water for our survival, we also contribute to the rise of water scarcity. The vitality of rivers, lakes, and other bodies of freshwater is threatened by a variety of causes, many of which are the result of human activity. These include pollution, climate change, industrial agricultural practices, unsustainable energy production, and population growth. There is no denying that the challenges are enormous. Factors such as population growth, urbanisation, increasing water demand and climate change are holding back the move toward adaptation.

However, in the long term, adaptation is essential, it require fresh investments and programmes that are directed specifically to building the capacity of institutions and society to embrace new green technologies in water management. The end result is that more and more people around the globe face water shortages. While water scarcity is predominantly a man-made creation, we also have the capacity to develop solutions to mitigate the rise of water scarcity. Involving projects like urban water supply has contributed funds for the rehabitation of deterioted sanitation Ako et al World Band and AFD (2010)

#### 6.5.1 Protecting wetlands

Water saturation largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favour the growth of specially adapted plants and promote the development of characteristic wetland soils.

Wetlands are disappearing at an alarming rate, but conserving wetlands could have a major payoff. More aggressive conservation measures are required if the inhabitants want wetlands to assist our efforts to reduce water scarcity. Restricted Activities within the wetlands include reclamation, setting up industries in vicinity, solid waste dumping, manufacture or storage of hazardous substances, discharge of untreated effluents, any permanent construction. The major functions of the authority include identification of new wetlands for conservation, ensuring that the Rules are followed by the local bodies, issue

clearances by International Centre for Environmental Audit and Sustainable Development (ICED 2015). Though some individuals in Yaoundé VI will try to protects wetlands, the majority of the people do not see that to be important.

This is what an informant told us as expert working in the council:

> *For us as experts in the field, we encourage the population to stop encroaching into wetland with farming, and construction. When you look at most wetlands in Yaoundé VI area, it has occupied by the population for other activities and this tends to dry up all the natural water bodies present in the area* (Laurent, 15 November 2020 Biyem-assi).

According to Laurent, water bodies are drying up because most the populations have misuse the water bodies by doing activities like farming and construction. This means that if the population can stop encroaching into the wetlands with these activities, there will be enough water to be use by the population. This is just to make the population know that those water bodies need to be taken care of if the people need to survive in their environment. This information is validated by what (IECD 2015) is saying above, the government should identify the various wetlands and prevent people from constructing or farming in such areas.

### 6.5.2 Increasing water storage tanks and reservoirs

Tanks can be use or is use in times of drought. Storage vessels vary from large capacity overhead tanks to smaller vessels such as pots and buckets. While overhead tanks can fill up automatically whenever the municipal supply becomes available (Choe *et al.*, 1996), the storage process for smaller vessels can be tedious. It also reports that households got up at dawn when the municipal water supply became available in order to start filling up drums, pots and buckets. Households may spend 38 minutes storing water, or several hours if the water is to be collected from an alternative source over several trips.

This is what an informant told us on how water is reserve in her home:

> *Increasing water reservoir is one of the best things I do and some individuals whom have seen doing it. But for now, we are able to control the water by using pipes for people to carry water in a proper way. As you can see, the water is from the ground and with this we are able to carry the water. Even though there is no tank to store the water but we hope in some few months we will be able to do that* (Esther, 5 November 2020, Superiette)

From Esther, one can conclude that, before the water was flowing without any control. But today a small wall is built to make a proper channel for the water to flow, making it easy for people to carry. To her, a tank will be built later for water to be reserved for future use because the water flows down for nothing when there is no one to carry. Culturally people use to know that clay pots are use in storing water especially when they are placed on sand so that it will remain fresh for drinking. But now in towns, it is difficult to get those traditional pots, they use buckets and containers for water storage.

Another informant told us how she reserves water in her home. This was what she said:

> *In order for me to have enough water in my home, I have bought enough gallons and drums to be able to store a good quantity of water. These drums help me a lot during the dry season when there is water shortage. I can store water in those drums for about a week so whenever I have them, I have no problem of water shortage* (Laura, 7 August 2020, Melen).

According to Laura, she uses drums and containers to store water in her home and this can take her at least for a week before she thinks of fetching water again. According to her, the business of gallon and drums is really booming because more people are into it to be able to store a good quantity of water to avoid water shortage in their homes.

We had another interview with an informant, and this was what she said:

> *In order for my family to have water, I need to get up in the early hours of about 4-5am in the morning to be able to carry water if not I will not get the chance to carry. This is because the population is much and the pressure of the water is very low due to long dry period. So when I get up at early hour, am able to collect more water for my house chores* (Happiness, 15 May 2020, Rondpoint express).

From Happiness's point of view, getting up in the early hours to carry water is not a problem to her so long as she gets enough water for her family. If she does not get up that early, it is possible she will not have anything to use in her home for that day. In most villages people use to get up early in the morning to their streams to fetch water they believe that at that time the water is very pure for usage. That is why even in the urban areas they still get up early to make sure that they carry their water before others could get up and this happen most especially those using well water.

We met another informant and this is what she said:

> *When there is no water, I take my containers to other quarters where I know am going to get water. I don't carry it on my head so I use bike to carry water. Even though there are time I will not have money to fuel my bike but, but I used to manage* (Ann, 17 Febuary 2020, TKC).

From what Ann said, he uses a bike to carry water from other quarters when there is no water. Even though there are times he faces problem of not having fuel in his machine to transport water to his house. In some communities people to trek for long distances to get water but they did not use to complain instead some children like doing that especially with their friends. Now in urban cities like Yaoundé VI council area, they find it difficult trekking but prefer to use either taxi or bike to carry water from distant places. Below is a figure that confirms what our informant gave us.

**Fig 31: Bike as a means of water transportation**

*Source fieldwork: Matilda Musah (February 2020 Centre)*

The figure above just confirms one of the means the inhabitants of Yaoundé VI use to carry water from other places. Others will use their private car, taxi and some will trek to those places to get water.

These tanks sometimes serve the households for a number of days depending on their capacity. Assuming that an individual in the household uses an average of 20 litres of water per day, households with a large population will have to spend much on water. Those using forage well during this period are considered to be the richest people in the quarter because not everyone can afford constructing forage well.

The analysis above concerning storage water tanks is confirmed by Choe et al (1996), which says that households got up at dawn when the municipal water supply became available in order to start filling up drums, pots and buckets. This is to make sure that their homes do not run out of water as they do their demostic activities. Since the water at times might not flow all the time, serving some in large containers actually serves the people for some weeks. Kamani *et al* (2007) also confirmes that people with money have special storage tanks to collect water during those times, which in turn allows them to have water round the clock. People without storage tanks collect water in cans, jugs and buckets and often have to take bucket baths when the water is not turned on. Erratic water adaptation strategies also involve the use of storage containers to store water to ensure availability when needed for use. Most people globally have resorted to storing water because of its scarce nature.

**Table 10: Quantity of potable water stored and duration**

| Quantity | Duration/days or weeks |
|---|---|
| 3000 litres | 1 week |
| 2000 litres | 5days |
| 1000 litres | 3 days |
| 500 litres | 2 days |

*Source fieldwork: Matilda Musah (August 2020)*

If each household can carry at least 500-3000litres a day then it can last for 2days to a week depending on the number of people in a household and the activities the people are doing. It also depends if it is an institution like schools, hospitals, market, museums, sport complex just to name a few because each of them have different quantities of water they can use each day.

**Fig 32: Tanks for potable water storage**

*Source fieldwork: Matilda Musah (November 2020 Etoug-Ebe)*

From the table above and figure, the quantity of the water pumped into the tanks and is used in less than four hours (4hours).

From what we were informed, by an informant and this is what he said *"Water is pumped into this tanks 3times a day. This is because there are a lot of people who come to the hospital for one problem or the other"* (Theresia, 16 December 2020, Etoug-Ebe Hospital). From the above photo and interview, the tanks above carry 3000litres of water that is pumped after three hours of the day. This is because the number of people who come for consultation uses this water and the personnel also uses water for their effective services.

### 6.5.3 Affordable price of potable water

These costs typically arise from installation and maintenance of storage facilities, time spent collecting water from alternative water sources, drilling wells and installing pumps, purchasing water, household water treatment and treatment of water-related disease.

This was what an informant told us in the field concerning water prices:

> *There are more companies responsible for water supply. This has caused a lot of competition in the community in such that the price of water has reduced to a point that everybody can afford good water to drink. Like in my home, we take mineral water like the Tangui or Supermont. These two companies, I believe they have good water quality to drink and their prices too is not expensive because if*

> *we want to compare with the money we spend in the hospital because of water-borne diseases, it will be more than the amount used to buy mineral water* (Gilbert, 3 March 2020, Acaccia).

From Gilbert's point, the companies responsible for the provision of mineral water, has placed a price affordable for everyone who will like to buy, water from them. To him, these two companies are just the best as compared to other companies when it comes to mineral water supplies. One can conclude that only those with high standard of living can resort to Tangui and other mineral water. Companies responsible in producing mineral water have been able to produce water in smaller containers such that even with a hundred France one can still get mineral water. This is just to encourage even those in the lower class to have mineral water in their homes.

An interview with an informant on the field, and this was his own point of view of water that she buys. This was what she said:

> *I used to buy water from the people who use local means to purify water and sell. I go to them because their price is ok for me and I can afford that easily. They sell one (1) Tangui bottle for a hundred francs and this is less expensive to me* (Belta, 4 November 2020, Biyem-assi).

To Belta, those small retail homes that use local means of water purification sell water at a very low cost and she is able to afford it. From her point, one can see that those that retail this water are exceling in this business because it is very cheap and everyone can afford it. For those who are lower class status they prefer this other means of water purification since they cannot do it for themselves.

This is what another informant told us:

*"I use to buy mineral water for drinking especially when there is a water crisis other sources like well and tap water becomes difficult to get and even if available will not be suitable for drinking"* (Yanick, 16 March 2020, Melen). From this point of view, he buys mineral water when there is water crisis because the one that is available is not good for the body. One can say that the environment at this point provide what is not favourable for the human system and man have to look for another alternative which is technologically produced to suit the human health.

**Table 11: Percentages of adaptation strategies**

| Adaptation methods | Percentages |
|---|---|
| Boiling | 5% |
| L'eau de javel | 18% |
| Sand filtration | 1% |
| Filters | 17% |
| Salt | 16% |
| Cotton filtration | 5% |
| Mineral water | 16% |
| Spring and well water | 20% |
| Chlorine and iodine tablets | 2% |

*Source fieldwork: Matilda Musah (January 2021)*

The table above clearly illustrates the adaptation percentages use by the inhabitants of YaoundéVI. From the table, one can see that the majority of the population uses spring and well, l'eau de javel, filters and mineral water for adaptation. It is followed by cotton filtration boiling and lastly the chlorine tablets and sand filtration methods.

### 6.5.4 Enhancing flow rate

There is some overlap in the needs that some coping strategies fulfil. For instance, the installation of overhead tanks enables households to store large quantities of water and also have such water flow into the water supply pipes at a reasonable pressure. King (2006) also said that cultivation and aeration of turgrass soils will maintain high rates of infiltration and soil drainage. Other pressure-enhancing strategies are installing electric pumps to convey water from storage tanks or installing motors directly onto municipal water connections to boost the flow rate. There is also solar panel that helps in pumping water from a river source to various homes or farms when it is being used.

This is what an informant told us on how to enhance water flow:

> *The rate at which water can flow from the well to the tanks or pipes we have in our homes is slow so with the help of generator it is able to pump the water from the ground to the various reservoirs that we have in the house. And without electricity we cannot have water since the machines need electricity to be able to function properly* (Claris, 12 of November 2019, Mendong).

To Claris, the electricity enhances the flow of water from the drilled well and tanks to all the pipes in her home. If there is no light, they will have to suffer from water insufficiency which can or always last for some days. Others will prefer to use good equipments for water generation. This is because there are a lot of poor or fake equipment that is been sold in the market at a very cheap price. So for an individual to use good equipment, one need to be rich to be able to get good equipment.

### 6.6 Cultural ways in adapting to insufficient water and water scarcity in Yaoundé VI

In the Beti culture, these people use large rivers and stream to be able to carry out their cultural rituals but in Yaoundé VI where there are no large water bodies they use the one that is available. This is an informant told us on how they adapt to the environment

*"In the absence of large water bodies we the streams, tap, well and even the mineral water to do out traditional practices and most at times we travel to the village to perform other activities that we know we cannot do them here*"( Arnauld, 15 April 2020, Mvog-Betsi). To Arnauld, they use the available water that environment is offering them or they travel to their village if need be. In using the tap, well spring and mineral water is just to say the Beti man has acquired a new style of urban dwellers possibly it has influence their tradition a lot.

In as much as there is ways in which people adapt to water pollution and scarcity, the Beti man has its own means of adaptation. During our field study we met an informant and this is what he told us:

> *When our water is dirty, it is always considered to be spiritual thing. Only ritual practices like purification and supplication is able to make the water clean by the gods. The ritualist calls everybody in the land both home and others who are not residing in the village at that moment. This ritual takes place in an open junction or centre of the village. There is a fire that is being burnt surrounded by the crowed and the ritualist in the middle of the population. He uses food items, salt, palm wine and red wine. After his incantations on the the things, the chief or fon also moved in the middle speaks words of blessing. The ritualist drinks the blood of a flow, mixed the rest with water which is used to prepare the food item that is there. The food is shared to everybody that is present and none have the right to reject the food. After these sacrifices, it takes about a week after, the water returns to normal with agricultural products doing well* (Arnauld, 20 April 2020, Mvog-betsi).

According to Arnauld, sacrifices are all what it takes to clean or purify their community in cases like this. In as much as the people do not respect the laws of the place, the whole

community is affected both home and out of the community. That is why when it is time for purification everybody is expected to be present in the village. After which things return to normal.

This is what another informant told us how water show love to his people.

> *When the chief must have made peace with hois subject, he goes to the stream with his calabash and his chindas, he dips it into the riverand waits for it to be send back to him. When the calabash is send back to. If the calabash is send back rub with palm* oil *on it, it means the fon has made peace with his people. At this point the village is free to do their annual dance which is ususlly done in December* (Neh, 18 of July 2020, Jouvence).

From Neh point, the water validates annual dance in the village by sending out the calabash that is dip into the river by the fon, rub with palm oil. At this point, the village is blessed with food, harmony and peace.

This is what another informant told us on how their culture appeaced the gods for water to be provide backinto their community.

> *When the wimbum community lacks or have insufficient water caused by the fons against the gods, the people or the fon is exiled from the village making sure that he does not return to the village. Some sacrifies like sluttered goats and fowls are offered to the gods to appeaced them so that the community can have its normal living conditions* (Ngwang, 10 Oct 2020, Simbock).

From Ngwang point, if the gods are not appeaced with the required elements, life in the community can never be normal. The fon or the people involve are not allow to come back because it is believe they have a bad spirit that can imfluence others.

Apart from the practiced by the different cultures above, we also got information from other urban dwellers. Information gotten from the informant gives us some local ways of fighting against insufficient water. Some of the responses were as follows;

This is what an informant told us how she fights against water insufficiency. This was her words:

> *I reduced water use in cooking corn beer (sha). Like now which is the rainy season, I cook sha 4 times a week, but when there is no water, I cook two times a week. I reduce the quantity of sha I cook because of water shortage and I make sure that I do not cook food that will consume more water just so that I keep some emergency use* (Tina, 16 July 2020, Mendong).

To Tina, she reduces the amount of corn beer "sha" she cooks just to have water to do other activities. This is because if she has to maintain the rate at which she uses water because it will be difficult for her to get water and might tend to spend more on water which will not yield her any profit. "Sha" is a cultural drink that is consum in some cultures as their traditional drink. But because people have migrated and settled in urban areas of the same or similar cultures, some people have decided to engage in that business, causing the people to feel at home while in town.

To continue, this was what another informant told us:

> *I have to reduce the number of times i bathe once a day even though it does not say well concerning hygiene. I use to bathe 2times a day, but I tell you I have no choice than to reduce it to one time a day. This is because if I continue like that, I will have to spend extra money in purchasing water just for bathing and I do not have enough money for that* (Frank, 17 October 2020, Mvog-Betsi).

According to Frank, bathing becomes a problem to him because he has to reduce the rate at which he bathes from two times a day to one time a day. This is because there is insufficient water to keep up his hygiene practices of bathing. Normally a human being is supposed to bathe twice a day but in our today condition, if one is able to bathe at least once then it is ok. Hygienically, for human to adapt well into their environment, they need to keep their bodies clean so they can only manage what they have at their disposal.

With another informant, this was his own point of view:

*"I reduce the quantity am using and when I get in to the bathing room, I make sure that I scrub my body well. So when I throw water on my body, it will just be all" (*Norbert, 18 August, 2020, Simbock). To Nobert, he does not change the number of times he bathes but he reduces the quantity of water the he uses. In such a way that the little he takes in to bathe, it is sufficient for him to use that he can bathe twice a day. Well, most at times, one uses water according to the quantity of water one has in the house. When there is excess water people use it excessively and when there is shortage they also manage the water.

The interview continued with other informants. This was what another interview told us:

*"I reduce the number of times of I do laundry, because if I have to do it every day, the dresses will not be clean because I will not have enough water to rinse the dresses"* (Sylvie, 15 March 2020, Simbock). To F, she reduces the number of times she does her laundry. Having water to do the laundry everyday as it is supposed is a problem so in other to cope with this, she has to reduce the way she use water for laundry. This is because the water

sources in the environment are not doing well that is why there is water shortage. So he has to adapt a new style of living that is not doing laundry on daily basis.

Another interview with an informant and this were her words:

"*I put on dresses that will be easy to wash and will not consume much water. I make sure that; I put on dresses that are nylon in nature that is not difficult to wash"* (Emeka, 10 April 2020, Melen). To Emeka, he has no choice than to put on light dresses that will not use too much water whenever he wants to do laundry. In this case he cannot put on cotton dresses but nylon ones that are easy to wash.The various point above about bathing and domestic cleaning, is confirmed by what Sheard (1999) said, one can conserve water by bathing in a partially-filled tub or by taking shorter showers or ones using less water in a basin. Replacing 16 shower head, consider one of the new Automatic Super Water Saver Showerheads which uses only 2 gallons per minute. Close the bathtub drain before running water instead of waiting for the hot water to arrive.

Another informant gave us her own point, and this was what she said:

> *During the rainy season, I resort to rain water. Whenever there is no water in the house we wait till when its rains and we collect the water. Even though we do not store it for a longer period but is serves us from walking up and down in search of water* (Stella, 10 August 2020, Mendong)

To Stella, rain water seems to be the only option she resorts to during the rainy season whenever there is no water in her home. In some cases, the populations rely on the use of water from well or they harvest rainwater. It should be noted that water harvesting would have been a very good option for the population, but unfortunately, the storage capacities are very limited. So, the quantity of water trapped during rain episodes could not even solve the immediate needs of the household, talk less of it being stored for subsequent usage.

This is what another informant told us on how she stores her water. This was her words:

*"In our church, we have large tanks that helps us to store water in case of water shortage and in school, we only store water for one or two days because we do not have big containers or drums to store water"* (Clotilda, 17 December 2020, Biyem-assi). According to Clotilda, their church have their storage tanks, large enough to store water that can be used in the church during service so that they do not run out of water. They store their water for one to two days because their containers are not large enough to store enough water.

### 6.6.1 Using ground water

Ground water is considered potable to many users in Yaoundé VI council area. This is what some informants gave us on ground water in one of our FGD concerning ground water:

> *There is a spring source beside my house that it never gets dry even in the dry season so when others are complaining of water shortage, I am ok in my area.Many of us living in this area do not really suffer of water crisis during the dry season. But we only have difficulties when people come from distant laces to carry water. It becomes so populated that it delays some of our activities we are suppose to be doing in our various homes. So many people come from different places to carry water from this place and many at times they come with disorder at the source site especially the children who will always want to fight the position of carrying before the others that they met at the spring source. The only good thing is that the spring flows through out if not with the number that carry this water during the dry season, we living beside this spring will suffer even though it is right in our compound* (FGD, 14 April 2020, Mvog-betsi).

According to the informants, there has been no time that they experience water shortage; this is because the natural source with is the spring never runs dry. Informants happens to lived in a favourable environment where they donot have challenges with water. So one can actually see that the environment one lives in could be favourable and another not favourable depending on the natural area. One can also say that the water table of this may not be too deep that is why the spring source flows throughout the time. Furthermore, the populations too have decided to keep a positive interaction (no agriculture) around this spring not to disturb its availability.

**Fig 33: Spring source**

*Source fieldwork: Matilda Musah (November 2020, Mendong)*

The fig above shows the exact spring source that never runs dry during the dry season. So it serves the population in this area.

From the pictures and data on ground water, Gray (2008) at the point of demand at relatively validated that, ground water is much cheaper than surface water, as it ia available little cost and it does not require the construction of rersevoirs or long pipe lines. It is usually of good quality, free from suspended solid particles, free from bacteria and othe pathogens. Therefore it does not required extensive treatment before consumption.

### 6.6.2 Mineral water

Mineral water is sourced from springs known for their various minerals, such as salts and sulfur compounds. Mineral water comes from deep within the earth. Mineral water can contain levels of sodium, magnesium, zinc, and calcium, plus other good-for-you minerals, all of which must occur naturally. In this light, mineral water is considered potable for those using it. This is what informant we met on the field told us:

*"I use mineral for my family when ever there is no water in the house. I do not want to resort to other sources because I do not know where the water is coming from. But with mineral water, am sure of the source"* (Catherine, 17 July 2020, Jurvance). This point shows that mineral or bottle water is very good. Because of the mineral contents it has. To Catherine, mineral water is good to her because she knows the source of the water so there is know panic when consuming bottle water.

### 6.6.3 Economic operators companies

The economic operators companies in Cameroon and Yaoundé VI in particular, includes, Tangui company, Supermont company, Opur, Vital, oral and other smaller enterprises who sale purifies water and sell. According to one of the informant that we met on the field, this is what he told us concerning these companies:

> *From all of the economic operators companies who deals with water, their main aim is to make potable water available to everybody. Since we are aware that most of the water people consumed is polluted, we try to purify the water before selling them out. The purify water always last for a period of twelve months. And because we know that at times money seems to be another issue of buying water, we produce water in different containers like the 10litres, 1.5litres, 1 litre and 0.03litres. This is just to reduce the prices making it affordable for the people. Meanwhile some other companies will go as far as plastifying water which cost atleast 50 FRS for I sachet of water* (Walters, 12 July 2020, Mendong).

According to Walters, despite the fact that the companies are out to make profit, their aim too is make sure that treated water get to everyone. That is why they produced treated water different containers with different prices.

### 6.7 Adapation to waste management in Yaoundé VI

Waste management includes activities and actions required to manage waste from its inception to its final disposal. This includes the collection, transport, treatment and disposal of waste, together with monitoring and regulation of the waste management process. Waste can be solid, liquid, or gas and each type have different method of disposal and management. Waste management deals with all types of waste, including industrial, biological and household. In some cases, waste can pose a threat to human health (Gary 2011). Waste management is intended to reduce adverse effects of waste on human health, water and the environment.

Waste management practices are not uniform among countries (developed and developing nations); regions (urban and rural areas), residential and industrial sectors can all take different approaches. In Yaoundé VI and other council manage their waste is different from those in the other urban areas.

#### 6.7.1 Ways of waste management in Yaoundé VI

Waste management is the process that involves the collection, transportation, and recycling or disposal of waste. It encompasses management processes and resources that ensure proper handling of waste products. Management of the resources involves maintenance of the waste transportation trucks and the dumping facilities so that they comply with the environmental regulations as well as health codes. The primary objective of waste management is to avoid the adverse effects of wastes to human health and natural environment. Dumping and incineration, recycling, compositing and sanitary landfill are some of the methods used by the inhabitants of Yaoundé VI to dispose of their waste products.

The most common waste dumping methods include landfill and incineration. A landfill is a conventional dumping method, which involves burying of wastes in a common pit. Incineration is a fancy way to describe burning waste as a disposal method. This process generates heat, which is then used for energy. Incineration also creates by-products, including various gases and inert ash. The incinerator design and the waste material being burned dictate how much pollution this method creates. Filters can minimize the pollution.

Incineration is financially better than recycling because it is cheaper to burn waste for energy than the expenses involved in recycling. But it is more expensive than disposing of trash in a landfill. Incineration reduces waste volume by up to 90% of the original amount Davidson (2011).

If organic waste is incinerated, the resulting ash can provide nutrients for hydroponic solutions. Incineration is the preferred method for disposing of toxic chemicals and hazardous wastes. The landfill should be economical and far from the residential areas. On the other hand, incineration is a dumping method which involves combustion of the waste materials. The method is used to convert waste materials into steam, gas, ash, and heat. The advantage of using incineration method is that it can be conducted at individual level.

During our fieldwork, we met some informant who gave us their point of view on waste disposal. This is what one of them said:

> *Most of the waste that comes out from my home especially bottles, dresses, shoes and papers, I do burnt them because to get to the collecting point it usually takes me a lot of time and due to my health, I cannot really trek that much to the site. But there are times that I sent some children around me to throw the waste for me* (Felicia, 18 December 2020, Simbock).

To Felicia, most of all her waste, she burns them up because she cannot trek and she also has some children around her that help carry the waste to the collecting point. This burning of waste is able to pollute the atmosphere making the air unfit to inhale by the inhabitants and the individual herself and it is another negative way of interacting with the environment that has its consequences. This point is confirmed by what Davidson (2011) said about waste inceneration being another way of discarding waste materials. Naturally she is aware that used bottles and dresses cannot be thrown carelessly that is she burnt or ask some children to help her discard them. Instead of burning this kids acts as her legs to the site where waste is been kept for easy transportation.

The figure shows how waste is discarded in the Yaoundé VI

**Fig 34: Waste disposal**


*Source fieldwork: Matilda Musah (November 2019 Mvog-Betsi)*

Figure A above shows, an open space where waste product is being deposited by the inhabitants. In this picture, one can see that there is no trash cans here so the people are forced to throw on the streets or pathway made for pedestrians. This waste pollutes the environment when it is kept for long periods without being carried by the company in charge. Figure B, on its part, shows the work of the company in charge of waste collection. This type is called door-to-door collection. This truck moves around from street, to street collecting dirt. This helps the people not to walk to any collecting point for waste disposal so it saves time for most people. As the vehicle move, it calls the people by tooting, drawing the attention of those who have waste products in the homes. The figures above also make us to understand that the people do not do waste sorting. Everything is being mixed together and this can take a lot of time if the waste were to be recycled or treated for another use.

Recycling materials is turning the use materials in another usable form. The most common recyclable items are plastic, paper, glass and aluminium. Recycling bins are available for home, office or public use to collect recyclables before being taken to recycling centres. Many communities also offer curbside pickup of recyclables to make this option easier. Recycling is the most environmentally friendly method because it doesn't add any waste material. The downside of recycling is that only certain items can be recycled, and processing plants are expensive to operate and maintain.

Another informant gave told us how she make use of waste bottles and this is what she said:

> *I do sell fried groundnuts and foleri and in doing this activity, I need to use glass and plastic bottle to preserve my groundnut well. So most of the bottles I used are the ones that have been used already either from the bars or homes, especially Tangui bottles that have been emptied* (Mercy,11 May 2020,Rondpoint express).

From Mercy, one can see that she uses bottles that have been used already. So these bottles help her to store her groundnuts that she sells. This is another style of making use of the bottles that wound have been a nuisance to the environment if not catered for. Making use of use bottles for another purpose is helps a lot in keeping in the environment clean. If one can go round the community or area, it can be clearly seen that these plastics is not properly discarded. So, reusing the plastics is making sure that the environment is not polluted.

An informant told us how she sells bottles as her job and this is what she said:

> *I have my children who walk around and collect these containers on daily basis, they help me gather them. I also have some people whom I pay them to gather the containers for me when my children are busy. This is my own business so I sale them on daily basis. I have to wash the containers with clean water and detergents because, I don't know where the containers are coming from. So to keep my customers safe I have to wash them well. This buisness is what am able to do, to support my husband is providing some need to my children and I* (Pricilia, 15 May 2020, Melen).

From this point of view, these containers that she sales, is as a means of employment to her and not only her but many others are into the business. It is a good job to her since she is able to take care of herself and her family. This is a form of recycling that should be encouraging in the community especially some of us who complain of not having jobs. This woman is also aware of the environmental effects on the plastics that is why she has to wash them before selling it to those who are using the plastics.

**Fig 35: Women selling plastic containers**

*Source fieldwork: Matilda Musah (May 2020)*

The figure above shows how plastic containers are being washed and soled. These women do this as a source of income to their family. These plastics are gathered from different sources so they need to be washed properly before using. These days we find people complaining of no jobs not knowing that this alone is able to put food and sustain some families around. This job is able to make some families adapt to their environment as they are able to faint for themselves.

Composting is a natural process where organic wastes break down into nutrient-rich compost perfect for one garden plant. Microbes decompose the organic materials as they sit in a compost pile or bin for months. Composting preserves more nutrients than incineration and is the preferred method for organic waste disposal. The main drawback is the amount of time it takes for the organic materials to break down into compost. This method also requires one to have enough space to make a large compost pile, which is challenging if people live in a multi-family dwelling or have a small yard.

This informant we met on the field told us how she disposes of her waste products. This was her point of view:

> *Most of the waste product from my house, I usually burnt them up especially dresses, shoes, plastics. But those that can decompose easily I take them to the garden where it serves as fertiliser on my crops. In my quarter, we hardly have cars that carry our dirt so I try my own best to see that I dispose of the waste to avoid polluting the environment* (Carole, 19 May 2020, Mvog-Betsi).

From Carole point of view, she tries to dispose of her waste by burning and the one that can be used as manure. Culturally she knows that back in the days waste products were taken to the farm as fertiliser that is why she is practicing in town and this helps grows her crops. Burning itself causes air pollution but at this point she has no choice because the HYSACAM which is in charge of waste collection does not reaches where she is. So burning is just the best option for her to dispose of her waste that cannot easily decompose in the farm.

A landfill is an option for items that one cannot get rid of through other methods. A protective lining beneath the waste helps to prevent harmful chemicals from leaking into the groundwater and polluting drinking water. A layer of earth goes over the compacted waste. Soil with low permeability is preferred for landfills to cut down on the potential for leakage. Some landfills use hardening materials such as cement or asphalt to seal each layer of waste. Landfills are usually located in areas without flooding or high groundwater levels.

These are the most common ways of waste management but when one looks at our society today, it is not being practiced especially those of the developing countries like Cameroon and Yaoundé VI in particular. From another informant, he told us where her waste product is usually disposed, and this was her words:

*"When I have waste products in my house, I do take them to the trash can that our quarter and I do that as often as possible to make sure that it does not promote vectors like mosquitoes, rats and even dogs"* (Desmond, 11 July 2020, Rondpoint express). From Desmond's point, she takes her waste product to the collecting point whenever the bag is full. This is to avoid insects that will promote or fasten the transfer of germs from the dirt to humans. In times like this, that we are facing the issue of Corona Virus, everything around us becomes suspicious.

Another informant, gave us his own way of waste disposal, and this was what he said:

> *"All of the waste product I produce in my house is taken to the stream in my quarter. Everyone in this quarter throws dirt there because the vehicles responsible for waste collection do not come here and even if it does, it is once in two weeks. So I cannot keep the dirt in my house for that long period"* (Janet, 7 Febuary 2020, "Centre").

To Janet, because of the absence or inefficient work of the company responsible for waste collection, he cannot keep waste products in his home for more than a week just to wait for them. He has to find a way to dispose of his waste to avoid pollution. So the only place he has to dispose of the waste in a stream. In that area, he is not the only one but most of the people in that place do the same thing. The company responsible for waste disposal in Yaoundé VI area is actually doing their possible best to see that their work is done effectively. They have many trucks that help them carry out their work effectively. From F point of view, she is trying to adapt to the new urban system of depositing waste products into the trash cans for waste collectors to collect later on.

This is what another informant told us:

*"For me to gid ride of of my body waste when there is no water, I make sure that I get to my offices as fast as possible to liberate my self from the pressure of waste product that has been retend for long*" (Zita, 14 July 2020, Jurvance). From Zita point, she retends her body waste until when she gets to the office to release it off her body. This point is being confirmed from what we had from the field and we observed from different people. Some people will even

visit their relatives, friends and neigbors who have water so that they can relief their selves from the stress of urine and feaces retention.

During our fieldwork, we met an informant from the HYSACAM Company, and this is what he told us:

> *"The HYSACAM company, have many trucks that are being used to carry waste product from the sites to area where it is discarded. We have vehicles of different categories like the one which is used for sweeping tarred road. There is another one which carries the container of about 6m$^2$ to site chosen for waste collection point and one which carries container of 1m6$^2$ to their collection sites called Ampirol. There is Grue with fingers, is able to carry dirt, the Bom and Mini-Bom is used to compact waste materials when it is being carried.Furthermore, there is another one that carries waste bags from the quarters and Calabraise work only at the road sites. There is Benne it ends at the main road and it is the bigger. But at most collecting sites, the public do not respect the bin by using it correctly. So, we have deviced a means by putting at least 5 persons at each collecting site, who will always gather the dirt when the trucks stops at each collecting point. Most of the payment comes from the council and the state and if the council does not collaborate with us we will not do their work. Most of the places where the trash cans are kept are being directed by the council* (Laurence, 16 December 2019, Mendong).

From this point of view, most of the trucks help them to carry waste products from the quarters. It is the state and the council that is responsible for their finances. So, if any of the stakeholders do not collaborate, they will not be able to work effectively. The above adaptation strategy for waste disposal is to make sure that individuals do not pollute water with waste materials. That is why there is a company in charge of waste disposal. From the above point, the company responsible is trying to help people adapt to the urban new style of living because the available is insufficient for people to do farm work that they can use their waste product as manure.

### 6.8 Strategies used in fighting water-borne diseases

Health has always been a major concern for community development. It is a basic requirement, not only for the fulfilment of people's aspiration, but also for the employment of a better quality of life. For the Yaoundé VI council, ill health is identified by the change of behaviour and the absence from normal social life by the group or individual. This deviation can normally distort the smooth function of particular activity and health care provision is done with regards to the health system present in the vicinity.

With medical anthropology, a distinction is often made between biomedicine, ethnomedicine and the local system of indigenous beliefs and practices surrounding health and illness. The notion about health among the Yaoundé VI council population is mainly influenced by biomedicine and ethnomedicine. During our interview with some of the informants, we were informed of the different health care systems present in this council area. They practice biomedicine, ehtnomedicine and auto-medications meaning the health care system here is pluralistic. The utilization of many health care systems depends on the available information the individuals have concerning the services provided or the availability of the resources in the system depending on what they think could have been the cause of the illness.

Concerning the causes of an illness, we could have both natural and supernatural cause as explained by some authors as:

> *Personalistic causation: the perception of this belief is deeply rooted in their cultural beliefs. According to this view, illness or diseases are attributed to evil power possession like witches, wizards, sorcery or supernatural entity. In this case the healers must be people who see beyond what a normal man can see, to be able to know the cause and how the treatment can be done. Naturalistic cause, the belief of this cause is based on natural factors like pathogens, malnutrition or organic deterioration of the human body, examples like heart failure, malaria and many more are course naturally* (Georges and Babara 1978).

Using many health care systems however increases their chances for better health outcome. These health care systems operate side by side and it differs greatly because of the different perceptions they hold on the causes of diseases and illness and the way treatments are provided.

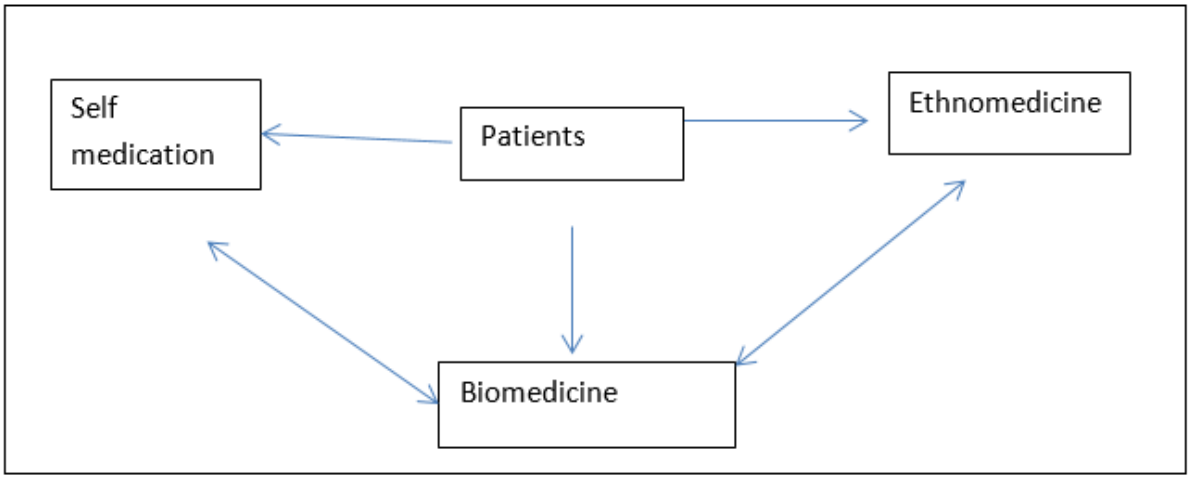
Another study from an anthropologist says;

> *Medical anthropological studies have proven that even though the biomedicine has spread all over the world and different cultures, its spread has not caused the disappearance of the traditional medical system and local practices otherwise called ethnomedicine (*Mishra *et al* 2013:23).

From Mishra's point, one can conclude that anthropology is that science that will help us to always remember our culture, which is the most important thing in life. This culture involves everything we do as a group like beliefs, norms, it could be dressing mode, eating habit and many more.

The different health care systems include; biomedicine, enthnomedicine and automedicine this gives the patient the opportunity to choose which of the treatment will be favourable to anybody.

**Fig 36: Therapeutic methods used by patient in Yaoundé VI**




*Source fieldwork: Matilda Musah (August 2020)*

### 6.8.1 Self medication

Self-medication can be defined as one self-treatment without consulting biomedicine nor ethnomedicine for the treatment. According to Khantzian (1990), it is a human behaviour in which an individual uses a substance or any exogenous influence to self-administer treatment for physical or psychological ailments. The most widely self-medicated substances are over-the-counter drugs used to treat common health issues at home, as well as dietary supplements. These do not require a doctor's prescription to obtain and, in some countries, are available in supermarkets and convenience stores. According to WHO, self-medication is the selection and use of medicines by persons to treat self-recognised illness or symptoms. This broadly includes old prescription, referring prescription, consulting friends, and acquiring medication without prescription, consulting friends and relatives, neighbor's social group sharing medicines.

Self-medication is the first option for minor illness. It is a common practice worldwide but may vary from one person to the other and country to country. One way it is useful, is that, it reduces cost of health care and allow health workers to concentrate on emergency cases. Self-medication provides a lower cost alternative for people who cannot afford the cost

of clinical service and bill. But on the other hand, the side effects of self-medication may be very dangerous in that it is bad taking drugs that have not been prescribe by the doctor.

This is what an informant told us concerning self-medication:

> *I always do self-medication any time I have symptoms of typhoid and malaria and when it does not work, that is when I try to visit either the biomedicine or ethnomedicine. Most at times what I take relieves me from the illness. I mostly take Okoabong leaves, guava leaves, paw-paw leaves mixed with limes and garlics for my own treatment and I do this even to my children who are in the house. To me, I prefer it because it is less expensive and easy to see around the environment. Also, when I think of the process and procedure, I have to go through at the hospital or clinic it always discourages me because, some of the nurses do not take proper care of the patients and some times, the manner of approach too to the patients also matters* (Catherine, 12, July 2020, Jouvence).

From Catherine's point of view, she does self-medication because it is cheaper for her to have and easily seen around the environment. Meaning if it was not cheap, it will have been easy for her to consult any medical practitioner for the treatment of disease. Also she raises the point of negligence of some practitioners in some health units, which is not good towards the patients. This definitely scares patients away from visiting particular hospitals or herbalists for treatment. Because of the low income level of population in Yaoundé VI council, most of them always start from the self-medication before looking for other alternatives when the illness persists. This is because our natural environment is able to provide the people with natural herbs that are used as medication and this environment needs to be protected so that the inhabitant's do not run short of the herbs.

### 6.8.2 Ethnomedicine

It is a study of traditional medicine based on bioactive compounds in plants and animals and practiced by various ethnic groups, especially those with little access to western medicines. Often, these traditions constitute significant interactions with insects as well, in Africa or around the globe, ethnomedical research is interdisciplinary. In its study of traditional medicines, it applies the methods of ethnobotany and medical anthropology. It is also a term that refers to a wide range of healthcare systems/structures, practices, beliefs, and therapeutic techniques that arise from indigenous cultural development. Ethnomedicine is also taken to mean the study of these systems and techniques more so from the sense of placing them into an anthropological context rather than evaluating their effectiveness using the scientific method. Such healthcare systems do not necessarily follow the structure of

modern or Western medicine. Instead, they are based on the unique culture that has arisen from native/indigenous groups of people.

Ethnomedicine is not limited to the obvious things, like using indigenous plants and ingredients to treat the sick. It also involves studying how a disease/illness arises, according to the native's cultural point of view. Indigenous beliefs about what a person's signs and symptoms really mean the way by which a disease/illness progresses and the best ways by which a disorder should be managed and who should manage it and how. Ethnomedical systems tend to see the mind and body as one entity and they focus on preventative techniques, such as the use of massage therapy, exercise, spices, herbs, and food to heal an individual (Thomas M. Johnson 1996).

In the case of Yaoundé VI council area during our fieldwork, it was discovered that most population used ethnomedicine for most diseases that affect them especially water-borne-disease. This is what an informant gave us in the field:

> *I use natural herbs like backs of mango, pear, guava leaves, mango leaves, paw-paw leaves, roots of paw-paw tree, okong obong juice, lemon, limes and galics. Most of these are in dried or fresh texture which is easy to mix with any liquid substance like honey, small Guinness though is not a traditional medicine but we are advised to mix it with okong obong juice for the treatment of typhoid. I always consume herbs and give some to my family members whenever they have malaria or typhoid when I discover just the sign of malaria in my children, I do not need to take them to the hospital but I immediately give them these herbs which it usually helps them. To me, taking my children to the hospital for consultation, before any treatment, is time wastage and takes a lot of money. If I want to compare the traditional herbs and the drugs I would say the drugs from the hospital are more expensive than the herbs. From what I take, if it does not help me, then I have consults any body in the quarter and not the hospital for help* (Edgar, 27 March 2020, Melen).

According to Edgar, he always takes herbal treatment whenever any of her family members is down with either malaria or typhoid. To her, this treatment is more effective than the drugs from the hospital. That is why she will always go for herbs instead of drugs. Also, the drug itself is more costly as compared to the herbs according to her. It is time consuming and so she has no time to be going to the hospital for any consultation. One can also conclude from her point that she does not have the financial means to always go for proper check up at the hospital. The population respect their culture that is why when one falls ill, the first thing they think is to get their traditional herbs before any other thing and most of these cannot be prepared without using water. So, water is very important wherever one finds his or her self.

### 6.8.3 Biomedicine

Is a branch of medical science that applies biological and physiological principles to clinical practice. Biomedicine stresses standardised, evidence-based treatment validated through biological research, with treatment administered via formally trained doctors, nurses, and other such licensed practitioners. Biomedicine also can relate to many other categories in health and biologically related fields. It has been the dominant system of medicine in the Western world for more than a century. Depending on the severity of the disease, biomedicine pinpoints a problem within a patient and fixes the problem through medical intervention. Medicine focuses on curing diseases rather than improving one's health. The biomedical model is an integral part of western cultures and the way health and healthcare are perceived. It is, in many instances, an efficient and effective model of healthcare (consider broken legs, tumours, tuberculosis, slipped discs and a host of other illnesses or physical problems) (Thomas M. Johnson 1996).

Most people have their different reasons of going for biomedical treatment instead of the ethnomedicine and others. In the case of Yaoundé VI council indigenes, some prefer biomedicine more to the other treatment methods.

We had an interview with an informant and this is what he said:

> *Whenever am infected with any illness or disease, the first place I go to is the hospital. To me I believe that there they will be able to detect the cause of my illness and the right prescription will be given for the treatment. There I know not only one test can be done but many at the same time just to make sure that I am given the right drugs. Also I think money should not be the issue here because we cannot buy a life that is lost though it might be expensive but is better there than any other therapeutic means to me* (Edgar, 27 March 2020, Melen).

To Edgar, biomedicine is the best place he can go for any treatment whenever he is sick. He prefers it because he believes the doctors and nurses are able to diagnose what the problem is and the right drugs prescribed for him. No matter the cost, he will always prefer the biomedicine. The new style of urban living has made some of the people to forget or neglect their culture. If not individuals will not think of going for biomedicines when there available herbs to treat people who are infected with water-borne diseases.

### 6.9 Importance of coping strategies or adaptation startegies

Adaptation is essential for the survival of living organisms. As the environment changes, the animals that cannot adapt die out. These adaptations are a result of genetic changes. The animals that survive pass on the mutated genes to their offsprings. This is known as natural selection. These adaptations make it possible for a variety of creatures to thrive on planet earth.

Every organism has features which enable them to survive in unfavourable environments. This occurs naturally and it is called adaptation. It differs depending upon the place where an organism lives. Adaptation is brought about by a change in an organism's body or activities to survive. These adaptations are necessary for the functioning of living organisms, where survival of the fittest plays a major role. Water is unquestionably vital to human life. Most of the surface of our planet is made of water and the majority of the human body (Darwins 1930 and Moore1983).

In Yaoundé VI, water is expected to be pure and sufficient to the inhabitants but pollution, pesticides, other chemicals, heavy metals, and organic waste that seep into our water supplies, contaminates it. In other to adapt to these conditions, the population developed strategies in order to adapt to the environment. The strategies have made most of them to survive in the environment which is the most important part of it.

### 6.10 The effect of the coping strategies

The coping strategies will not normally favour some people depending on their economic and social status.

#### 6.10.1 Effect of coping strategies on water

The effect of water rationing hammers more on poor people who are forced to trek over long distances and often overcrowded public stand taps or doubtful streams. This problem is further compounded by the fact that the nearby streams which would have served as backup to the water demands of the population during times of prolonged water cuts are also facing pollution due to increased human activities, car washing points and the development of mini-markets whose waste are dumped in the stream.

The reliance on either doubtful water sources or on well water has a deleterious effect on the population. It is a major factor that is responsible for the persistent outbreak variety of water-borne diseases. Most of these wells are not protected. They are open wells which are

liable to any stray animals, dirt from the environment to run into the well. With this, it easily pollutes the water, making it unsafe for usage.

In some cases, the populations rely on the use of water from well or they harvest rainwater. It should be noted that water harvesting would have been a very good option for the population, but unfortunately, the storage capacities are very limited. So, the quantity of water trapped during rain episodes could not even solve the immediate needs of the households; talk less of it being stored for subsequent usage. The reliance on either doubtful water sources or on well water has a deleterious effect on the population. It is a major factor that is responsible for the persistent outbreak of typhoid and stomach disorder in Yaoundé VI council area.

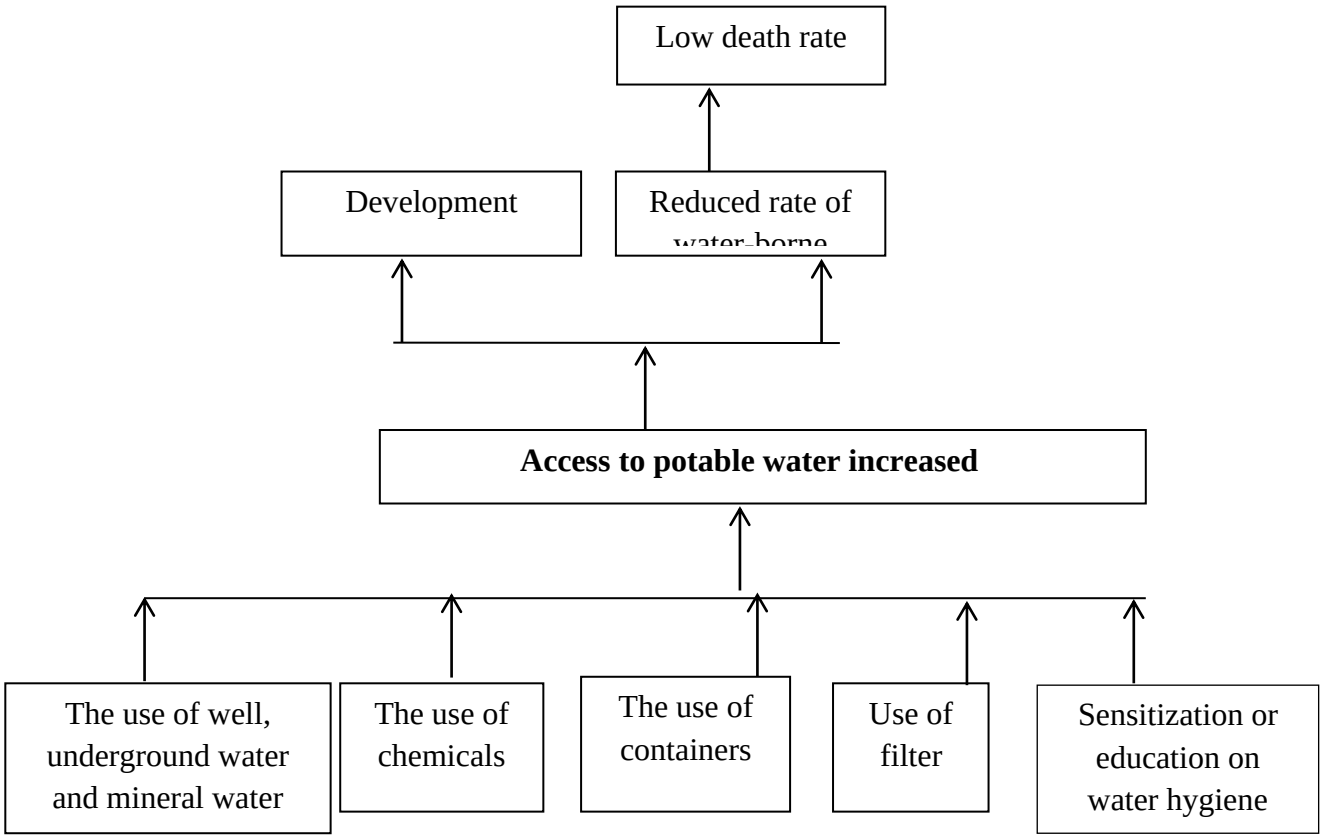
### 6.10.2 Effect of coping strategies on medication

Effects medication especially self and ethno-medicine will always fall the poor people in the community because they do not have enough money to go for proper check-up and screening.Self- medication is associated with risks such as misdiagnosis, use of excessive drug dosage, prolonged duration of use, drug interactions and poly pharmacy. In addition to this, some of the road side drug sellers are not trained and will not know the exact quantity to give to a patient when they come for the drugs. This was what an informant told us after an interview with him:

"*Taking unprescribed drugs in large quantities, like paracetamol, large doses can cause liver failure because of its toxicity*" (Carine, 12 June 2020, Mendong).To Carine, diagnosis may be wrong, the drugs may cause side effects that the seller will not know how to explain or control when it starts manifesting and finally financial losses because individual must have spent a lot in the self-medication.

Most of the plants in urban area are contaminated with poisonous pollutants such as lead, which is very dangerous for human health, so it must be considered that they are never used for oral purposes. Although some of the medicinal plants have beautiful flowers or leaves but they may have some toxic components in their aerial parts so they must be kept away. Some of medicinal are allergenic and can be harmful for people so they must be kept away.

**Fig 37: Showing the strategies and the effects on the population**




*Source fieldwork: Matilda Musah (September 2020)*

The general relationship of the major subdivisions within human ecology is the study of the ways in which culture is used by people to adapt to their environment. Human beings and natural forces have made the environment unsuitable for organisms to survive in. As long as the ecosystems is dynamic, so too human beings have to be dynamic in order to survive in the environment. Human beings have developed strategies for treating polluted water using, “eau de javel”, and filter to be able to cope with contaminated water. Also strategies like recycling plastic bottles, using the gabbage bin placed in public areas for waste disposal is another method to cope with waste management.

There is also a change in social roles. In many cultures, with social division of labour, parents now get up early to fetch water at 4am. This is not what the culture prescribes.

Concerning water shortages, humans have resorted to well, mineral water, buying of big gallons are some ways of adapting to water shortages in the environment. All of this is because humans need to survive in the environment, so the need to device any means so as to cope in the community. Furthermore, humans have to interact with the environment especially getting what is present in the ecosystem to treat him or her self from some diseases

caused from the environment like using green leaves for medication. The effect of these strategies on water pollution is that people who are not well to do will not be able to buy filters, gallons for water storage and filtration, all because of their low income level.

Furthermore, the effect is that there is a gap between the poor and the rich. If one is not well to do, it will be difficult for one to survive in area which is hostile. The concept of natural selection by Darwin 1859 applies in this case much like breeders choose which of their animals will reproduce and thereby create the various breeds of domesticated dogs, pigeons, and cattle, nature effectively "selects" which animals will breed and creates evolutionary change just as breeders do. Such "selection" by nature, natural selection, occurs as a result of the struggle for existence and, in the case of sexual populations, the struggle for mating opportunities. In this case, only those who have the means will likely survive in areas of water shortage while those who do not have suffer the consequences, which can eventually cause some to have health and eventually death.

There is also the distance between the doctors and the patients. This means that, before the doctor treats patients, there must be money before he is been taken care of. There have cases in hospital where when some nurses discover that the patients back ground is well to do they take care of that patients while expecting some benefits from the family concerned. So there is really that gap between the poor and the rich.

The review of how households in developing countries cope with unreliable water supplies has shown that households engage in a variety of strategies, with storage being a common one. The factors influencing the choice of strategies vary, but income, level of education, tenure and extent of unreliability appear fairly significant. The costs of these coping strategies vary widely, and are in some cases comparable to water utility bills. The evidence that is available indicates that the poorest sections of society suffer most from the impacts of unreliable water supplies and are least able to develop effective coping strategies. Consequently the poor in the society may be missing out on the health and other benefits of access to safe water supplies even when they are reported as being served by improved supplies, and efforts aimed at mitigating unreliability of water supplies would do well to target them. The following chapter provides an empirical assessment of households coping strategies, and the implications on the population, as they apply the coping strategies and their challenges they faced as per using those methods to cope in their environment. The following chapter will be showing us the place of stakeholders in these coping strategies put in place by the population.

# CHAPTER VII
# THE ROLE OF WATER ACTORS IN YAOUNDÉ VI

Chapter seven reveals the role of the stakeholders or actors responsible for water production and distribution in the community in general and Yaoundé VI council in particular. This is because actors are necessary to support a project if need be, given the need for development. These could be internal and external actors who are able and capable to render services to the population. In projects that concern water and hygiene, we can talk of actors like the Ministry of Water and Energy, councils, Non-Governmental Organisations, Ministry of Public Health and the population who are the beneficiaries. We will be seeing the role played by these actors in the community in general and Yaoundé VI in particular. Again, we will look at some of their short comings and way forward.

## 7. Stakeholdes

A stakeholder is an individual, group or organisation who is impacted by the outcome of a project. They have an interest in the success of the project, and can be within or outside the organisation that is sponsoring the project**.** Stakeholders can have a positive or negative influence on the project. According to Freeman (1983), a stakeholder is a constituency in terms of a group on which the organisation depends for its continued survival. It also ensures constant focus and communication in established within all stakeholders. A Stakeholder is a party that has an interest in a company and can either affect or be affected by the business. The primary stakeholders in a typical corporation are its investors, employees, customers and suppliers. However, the modern theory of the idea goes beyond this original notion to include additional stakeholders such as a community, government or trade association.

There are a lot of people involved in getting a project from inception to a successful completion. Project owners need to know how to manage each and every worker, learn how to deal with personalities, making sure they have a productive dialogue with stakeholders to know their project goals.

### 7.1 Importance of stakeholders in Yaoundé VI

Whether internal or external, all projects that one manages have stakeholders. One of the main reasons projects fail is that the deliverables were not what the customer wanted or they did not meet the customer's needs. To ensure project success, it helps that one knows all of the key stakeholders on the project, how they prefer to communicate, what their needs are, and what the acceptable end results are (Post, James 2002*)*. Engaging stakeholders during and especially at the beginning of a project, will help to reduce and uncover risks and increase their "buy-in." When stakeholders are adequately engaged, their influence spreads far and wide. The importance of stakeholders also depends on the power and status (political, social and economic) of the stakeholder, the degree of organization of the stakeholder, the control the stakeholder has over strategic resources, the informal influence of the stakeholder (personal connections, etc.) the importance of these stakeholders to the success of water management. Below is a table showing the various ways by which stake holders participates in project.

**Table 12: Types of stakeholder participation**

| **Types of Participation** | **Characteristics** |
|---|---|
| Manipulative participation | Participation is simply a pretence |
| Passive participation | It has been decided or has already happened. Information shared belongs only to external professionals |
| Participation by consultation | People participate by being consulted or by answering questions. No share in decision-making is conceded and professionals are under no obligation to take on board people's views |
| Participation for material incentives | People participate in return for food, cash or other material incentives. Local people have no stake in prolonging practices when the incentives end |
| Functional participation | Participation is seen by external agencies as a means to achieve project goals, especially reduced cost. People may participate by forming groups to meet predetermined project objectives |
| Interactive participation | People participate in joint analysis, which leads to action plans and the formation or strengthening of local groups or institutions that determine how available resources are used. Learning method is used to seek multiple viewpoints |
| Self-mobilization | People participate by taking initiatives independently of external institutions. They develop contacts with external institutions for resources and technical advice but retain control over how resources are used |

*Source: Dalal Clayton B, Bass S (2002)*

The table above clearly stating the types of activities stakeholders that stake holders do insupporting other management teams in realising their project.

Some of the ways stakeholders are important to a project are as follows;

### 7.1.1 Providing expertise

Stakeholders are a wealth of knowledge about current processes, historical information, and industry insight. Many times these team members have been at the company or on the project longer than the project manager or project team. It is important to involve all key stakeholders when gathering and documenting requirements to avoid missing major deliverables of the project. Project managers, or others who are in charge of deliverables, may not be experts on every project. Key stakeholders can provide requirements or constraints based on information from their industry that will be important to have when understanding project constraints and risks. In Yaoundé VI council, there are experts who can train people on hygiene and its importance.We met an informant in the field and this is what he said:

> *In Yaoundé VI council, we carry put different activities including water management and hygiene and sanitation activities. I am one of the expert in water management, most of the times we go out, check the various water point, where there is no water and as a team that we are, we try to see how to provide water in those areas. Making sure that at least but not all of inhabitants should have water. We equally want to know the burden of the population to be able to know how to go about sloving their poblems.* (Bless, 16 November 2019 Etoug-Ebe).

From Bless point, one can see that they actually work in team making sure that they provide water to the population of Yaoundé VI area. This above is validated Freeman (1983) saying, a stakeholder is a constituency in terms of a group on which the organisation depends for its continued survival. It also ensures constant focus and communication in established within all stakeholders. It is also difficult when a team cannot work together; they also work incollobration with the population to be able to know their problems. Stakeholders need to participate because management decisions taken unilaterally by the regulatory agency without social consensus are often impossible to implement. Essential management activities (such as monitoring, inspection and fee collection) can be carried out more effectively and economically through cooperative efforts and shared burdens.

### 7.1.2 Reducing and uncovering risk

The more you engage and involve stakeholders, the more you will reduce and uncover risks on a project. When discussing initial requirements, project needs, and constraints, stakeholders may bring up issues or concerns about meeting those things. Uncovering risks and then discussing a plan to mitigate them before issues arise will dramatically increase the success of your project. Involving knowledgeable stakeholders during this process will help like for example, in Yaoundé VI, the beneficiaries are involved in pointing out where waste bins can be placed so that it is accessible to everyone. This is what an informant told us:

> *We as the Yaoundé VI council staffs also have other stake holders that work with us sharing our burden, supporting us both financially and materially. Some of these stakeholders are PNDP and CAMWATER just to name a few. With these stakeholders, we are able to bear the burden not living it to the population by themselves. When they work together, conflict is manage* (Bless, 16 November 2019, Etoug-Ebe).

From the point above, Bless is working with other stakeholders help in managing water project especially when it comes to financial and material supports from other stakeholders. By involving stakeholders, this helps to improve overall governance of the resource by giving credibility and accountability to the management process. Stakeholder involvement should be seen as an on-going, long-term process that adapts to the contextual conditions and needs, and changes therein. It is in this context that the catchment or aquifer 'authority' should consider and value the input from and the needs of the stakeholders.

### 7.1.3. Increasing project success

By gathering and reviewing project requirements with stakeholders, one will get their "buy-in," which will in turn help increase project success. If it cannot meet stakeholder needs, due to conflicting needs or priorities, set expectations early in the project life cycle. This will help you to manage the relationship throughout the project, instead of there being surprises at the end. Stakeholders should always be aware of the project scope, key milestones, and when they will be expected to review any deliverables prior to final acceptance. We did an interview in the field and this is what an informant told us:

*"Working together with other stakeholders accelerates the process of providing and distributing water to the inhabitants of Yaoundé VI area*" (Bless,16 November 2019 Etoug-

Ebe). This point is just saying that when two or three stakeholders are involved in project management, it facilitate the task and completing project in a very short period of time.

### 7.1.4. Granting project acceptance

The more regularly one engages and involve stakeholders from the start, the more likely you will have a positive project conclusion. By the end of the project, the team members should have already been aware of delivery expectations, risks, and how to mitigate or manage the risks. They also should have reviewed draft deliverables along the way. This process always helps avoid any surprises at the end of the project. The final acceptance is just their final stamp of approval during the project closure phase. All stakeholders should be considered as a part of the project team and will bring value and expertise to help ensure the project is a success.

The above importance of stakeholder participation in project management is confimed by Dalal in the table above on the type of participation stakeholders in project. The table above confimed, Yaoundé VI council have stakeholders who do the functional participation, interactive participation and self-mobilisation participation.

## 7.3 Stakeholders involved in water production and distribution in Yaoundé VI

There are many ways to involve stakeholders in water management. The following list provides one example of the actions needed to initiate such a process. It is based on the five general steps of Local Agenda 21 planning (ICLEI, 1996) Building Partnerships, Community-Based Issue Analysis, Action Planning, Implementation and Monitoring, and, Evalation and Feedback. Actions include: securing the buy-in of key actors, creating a context for action, inviting everybody, elaborating a common vision, goals, objectives and the group structure to be used, communicating with public (an on-going fea, mobilizing resources, implementing actions, monitoring successes/ failures, evaluating and receiving feedback from participants and the public.

Importance to successful participatory action is the need for open and transparent invitations to participate in the process. Stakeholder involvement processes can be easily undermined by disenfranchised groups and a wide representation of the public is needed to build the trust of the general (not directly participating) public in the process. A mechanism to welcome new stakeholders into the process is needed, as individuals and groups will both

join and leave the process over time.Another important element of stakeholder involvement is the need for early, successful action at the beginning of the process (Karen 2003).

Safe and readily available water is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes. Improved water supply, sanitation, and better management of water resources, can boost countries economic growth and can contribute greatly to poverty reduction. Everyone has the right to sufficient, continuous, safe, acceptable, physically accessible, and affordable water for personal and domestic use. Stakeholders involve public health, ministry of water and energy, national and international NGOs, councils and beneficiaries

The target to any stakeholder is to tracked with the indicator of safely managed drinking water services drinking water from an improved water source that is located on premises, available when needed, and free from faecal and priority chemical contamination.

Sharp geographic, sociocultural and economic inequalities persist, not only between rural and urban areas but also in towns and cities (Yaoundé VI) where people living in low-income, informal, or illegal settlements usually have less access to improved sources of drinking water than other residents. Such cases are found in Cameroon and Yaoundé in particular. Like the Bastos neighbourhood, one cannot compare the quality of water there with that of Mvog-Betsi or “Centre”.

The combination of safe drinking water and hygienic sanitation facilities is a precondition for health and for success in the fight against poverty, hunger, child deaths and gender inequality. It is also central to the human rights and personal dignity of every woman, man and child on earth. Yet, 2.6 billion people, half of the developing world lack a simple improved latrine (WHO 2017). One person in six more than 1 billion of our fellow human beings has little choice but to use potentially harmful sources of water.

In adopting the Millennium Development Goals, the countries of the world pledged to reduce by half the proportion of people without access to safe drinking water and basic sanitation. Drinking water and sanitation access is the key to disease prevention. Diarrhoeal disease alone is responsible for the deaths of 1.5 million people every year, including 360,000 children under the age of five, mostly in low-income countries (WHO 2017). It is estimated

that 58% of diarrhoeal diseases can be attributed to unsafe water supply, sanitation and hygiene (WHO 2017b).

### 7.3.1 State actors (Ministry water and energy) in Yaoundé VI

In 1968 was the creation of National Water Supply Company of Cameroon (SNEC: Société Nationale des Eaux du Cameroun) to whom the state granted the operation of public water supply networks in the towns for a period of 40 years. In 1988 reorganisation of the ministry in charge of water that becomes the Ministry of Mines, Energy and Water (Ministère des Mines, de l'Énergie et de l'Eau), responsible for WSS for the whole of the country through the Directorate of Rural Water Supply. Direction de l'Hydraulique Rurale (DHR) and the Directorate of Urban Water and Sanitation: Direction de l'Eau et de l'Assainissement Urbain (DEAU). In 2008 Conclusion of the SNEC privatization process with the establishment of a leasing contract for the management and operation of urban facilities between the state, CAMWATER, and Camerounaise des Eaux (subsidiary of ONEP, national water supply company of Morocco) (Nyada, 2 May 2020, Carrefour Vogt).

Despite the restructuring of the water sector that has taken place in Cameroon over the course of the last few years, the scorecard (CSO2) results for enabling conditions are below the average for Cameroon's economic peer group, comprising middle-income countries (MIC) participating in the CSO211. Although the rural water supply subsector is based on solid foundations in terms of sector context (there is a policy, an action plan, soon a water law, and a draft programmatic approach), it still lacks a sector mechanism for bringing together stakeholders that share the same priorities (there is no sector review, few stakeholders have any contact with the ministry).

Furthermore, the extremely hesitant implementation of decentralization is hindering the clear redistribution of roles between stakeholders. The ministry no longer has sufficient resources to act as the main contracting authority for the sector and the communes are not yet operational as far as this aspect is concerned. Lastly, there is little organisation within the sanitation sector. It has no set targets to be met, no subsector strategy, and no dedicated institutional body. In terms of developing access to water supply and sanitation services, here again Cameroon is lagging behind its peer group countries, with the exception of the urban water supply subsector.

Cameroon is a country with very few WSS DPs: ever since the contested 1992 elections, bilateral and multilateral donors have been small in number, although they are now slowly returning (particularly to urban areas). International nongovernmental organisations (NGOs) are virtually absent (only one NGO is noticeably active in the water supply sector). The capacity to mobilize and absorb funds remains limited, particularly in relation to the level of investment that has actually been made over the course of the last few years. The reasons for this include the fact that there is a technical ministry that is understaffed and still too centralized, plus administrative procedures are cumbersome (obtaining signatures for financing agreements, public procurement procedures, recruitment, and the reorganisation of local offices) which severely hampers the transformation of funding obtained into operational facilities.

Finally, the capacity for sustaining water supply and sanitation (WSS) services is very low; there is little maintenance in rural areas. There are few local private operators, improvements in hygiene practices are taking place very slowly; and there are very few stakeholders driving innovation (UNICEF/WHO Joint Monitoring Programme 2010).

According to the joint monitory program (JMP), access to improved sanitation in urban areas regressed between 1990 and 2008, moving from 65 % down to 56 % (WHO/UNICEF 1990). As a result of this and the lack of progress in urban sanitation, Cameroon is certain not to reach the sanitation MDG target. This worrying situation can be explained by the very high population growth experienced in Yaoundé and Yaoundé VI in particular, and by the virtual absence of funding allocated to the subsector. Due to a lack of maintenance and rehabilitation, the sewerage systems in Yaoundé VI, which date from the colonial era, are blocked, whereas newer PVC systems in the new neighbourhoods cannot be used as there is no operational treatment plant.

The majority of the population therefore relies on traditional way of hygiene and sanitation. Urban sanitation and hygiene priorities are to;

- Ensure the completed texts differentiate between urban sanitation (wastewater) and drainage (stormwater) so that the former is attached to MINÉE via a specialized directorate that is given full responsibility for the subsector.
- Develop strategic plans for sanitation in urban areas.

- Establish an agreement with the lessee of the concession area to implement the actions set out in the strategic plan. Latrines with a slab and, perhaps, a septic tank, or even unimproved latrines (which are then not included in the JMP access rate calculation). In contrast to rural areas, urban sanitation comes under the remit of two well-defined structures.

The lease contract signed between the state, CAMWATER, and Camerounaise des Eaux entrusts the operation of wastewater sewerage systems to the latter, in the same way as for storm water drainage. However, at the moment, the two entities (CAMWATER and CDE) are not active in this area (Yaoundé VI). They have neither carried out an inventory of existing facilities nor monitor the access rate. In addition, the term sanitation (though probably referring more to storm water drainage) is also present in the texts allocating responsibilities to the Ministry of Urban Development and Habitat; this potentially creates a conflict of responsibilities. An urban sanitation policy, which is currently being prepared, should resolve this issue.

The mission of CAMWATER is as follows; Preparation of government water and energy supply strategies and plans, water prospecting, exploration and exploitation in the urban and rural area, quantity and quality improvement of water and energy production, promotion of investments in the water and energy sectors, promotion of new energies. Also, regulation of water use in agricultural, industrial and health activities, monitoring of groundwater management, monitoring of water basin management; and monitoring of the downstream petroleum and gas sector as well as regulatory companies in the water and energy sector.

In the field, we met with a CAMWATER worker who gave us most of the information we needed to have known as far water in Yaoundé in general is concerned and Yaoundé VI in particular. This were his words:

> *From the visions ministry of water and energy, CAMWATER is responsible for water production and distribution to all the Yaoundé inhabitants. By so doing, Yaoundé has two main water sources which are Mefou at Nkomnyanda and Nyong at Mbalmayo. The first dam was constructed in 1987 to cover all the inhabitants in Yaoundé by providing at least 2000meters cube per day, but today it was added by rehabilitating that of Nkomnyanda that was abandoned to increase the flow of water in Yaoundé city. River Mefou studies or survey started in 2010, the work began in 2012 and was completed in 2014. Actually Mefou is ongoing and it produces or supplies 15meters cube water into Yaoundé city.*

> *Mefou supplies to Messa reservoir which is main office, from there is goes to complex Ntingha and two reservoirs which supplies to part of Yaoundé. River Mefou supplies water to Ntingha, Mbankolo, Etoudi, Mokolo and Nkomnyada. Water arrives at Nkwayos, is distributed to all the reservoirs in Yaoundé. Reservoir at Ngoa-Ekelle called Atemengue distributes water to the administrative centre of Yaoundé, Reseroir at Etoudi supplies to Messassi and Emana, Etoug–Egbe reservoir which supplies to Simbock, Nsimeyong and Mendong. We have reservoirs at Nkomo which supplies Nkomo, Ekounou, Odza, Lekie, Messa-Mendongo and Tropicana. Water needed in Yaoundé is estimated to be 200.000meter cube perday and two stations are unable to supply water in the whole of Yaoundé town. 150.000meters cube per is provided a day, Mefou provides 50meter cube perday. So with that Yaoundé is basically receiving 180 meter cube of water per-day which is insufficient"* (Francoise, 15 March 2020, Messa).

To Francoise, as a ministry, they are responsible for the production and distribution of water to all the inhabitants in Yaoundé. Water is one of the most important basic necessities that humans cannot do without. Also, for any development to be effective, the population has to be in good health and all of these starts from having potable water and good hygiene which is able to eliminate most of the diseases around the community. In the whole of Yaoundé, they have two important water sources which are Mefou River and Nyong River that have been constructed and they are functioning. Even though these two rivers are unable to supply to the satisfaction of the population, they have their own way of resolving their issues while waiting on what the actors concern can do to help out.

### 7.4 Provision and treatment of polluted water in Yaoundé VI

The Swiss Association for Technical Assistance (SATA-HELVETAS) came to Cameroon to support rural communities in self-help efforts as a means to encourage community initiatives. They establish a partnership in Cameroon with the Cameroon Government and open centers for training technical personnel for different jobs such as mason, caretaker, technicians, building contractors and supervisors for sustainability purpose. They worked with communities that:

- Have urgent needs
- Villages/communities that make considerable contribution in cash and kind
- Projects concerning the whole population in the village
- Project in disadvantaged area and remote areas
- Village respecting the environment and are able to maintain supply systems

For village to be qualified for assistance from HELVETAS, they have to meet the following conditions: Contribute 30% of investment the in cash or kind, In case where system need extension, village has to contribute 40%, Be able to maintain system 100% financially on completion, and be able to contribute 50% for extensive repairs (Chia 2011)

Water is vital for everyday life and serves as an essential element to our health, hygiene and the productivity of our community. Water treatment is any process that improves the quality of water to make it more acceptable for a specific end-use. The end use may be drinking, industrial water supply, irrigation, river flow maintenance, water recreation or many other uses, including being safely returned to the environment. Water treatment removes contaminants and undesirable components, or reduces their concentration so that the water becomes fit for its desired end-use. This treatment is crucial to human health and allows humans to benefit from both drinking and irrigation use. The water treatment process may vary slightly at different locations, depending on the technology of the plant and the water it needs to process, but the basic principles are largely the same.

In Yaoundé VI, many people live close together and they all need water. This creates a demand for large volumes of safe water to be supplied reliably and consistently, and this demand is growing on a daily basis. As populations of Yaoundé VI increases, there is a need to find new sources to meet the growing demand. If groundwater is available, this can often be used with minimal treatment but any surface water source will need to be treated to make it safe. For towns and cities, the water supply is then best provided by large mechanised water treatment plants that draw water from a large river or reservoir, using pumps. (Mechanised means that machines, such as pumps and compressors, are used). The treated water is then distributed by pipeline, to all the entire population (Lindsten 1984).

Drinking water sources are subject to contamination and require appropriate treatment to remove disease-causing agents. Public drinking water systems use various methods of water treatment to provide safe drinking water for their communities. Today, the most common steps in water treatment used in Yaoundé VI by CAMWATER include:

### 7.4.1 Collection point (water sources)

The municipal surface water treatment plant is typically a local river, lake, or reservoir. There is always a method to get water to the water treatment plant. Quite often, a

series of pumps and pipelines transport the water to the treatment plant. As the case of Yaoundé VI, water is connected from Mefou and Nyong being the main source of water in Yaoundé and Yaoundé VI in particular. At the water plant, large pumps are used to transfer the water up to the treatment facility. Treatment facilities are often engineered to utilise gravity water flow as much as possible to reduce pumping costs. Many water treatment plants utilise water from more than one source. Blending groundwater with surface water is a method often used to improve the quality of the final product.

### 7.4.2 Screening and Straining

If one thinks about surface water sources, that is, lakes, rivers, and reservoirs, one will realise they contain varying amounts of suspended and dissolved materials. This material may include turbidity, colour, taste, odour, micro-organisms, fish, plants, trees, trash, etc. The material may be organic or inorganic, suspended or dissolved, inert or biologically active, and vary in size from colloidal to a tree trunk. Some of these larger items can impede equipment in the treatment process, such as a tree limb getting stuck in a water pump impeller. So the first process in conventional water treatment is to screen or strain out the larger items. This is often accomplished using a large metal screen, often called a bar-screen, which is placed in front of the water source intake. Large items are trapped on the screen as the water passes through it. These screens must routinely be raked or cleaned off. This is done in Mefou and Nkonyada where water is being distributed from the to storage tanks which is later send to the various homes in Yaoundé VI area.

### 7.4.3 Chemical addition (Coagulation and Flocculation)

Once the pre-screened source water is received into the treatment plant, chemicals are added to help make the suspended particles that are floating in the water clump together to form a heavier and larger gelatinous particle, often called floc. In this process, a chemical is added that reacts with the natural alkalinity in solution to form an insoluble precipitate. There are many different chemicals on the market that are used in this process. These chemicals are called coagulants. One of the most common chemical that has been used for many years is aluminum sulfate or alum. Some other very two popular coagulants are ferrous sulfate, ferric chloride, sodium aluminate, activated silica, and compounds called polymers that are manufactured chemicals made up of repeated small units of low molecular weight combined into molecules with very large molecular weights. These polymers are classified as cationic

polymers (positively charged), anionic polymers (negatively charged), and nonionic polymers (neutrally charged). Regardless of which coagulant or combination of coagulants is used, they must be mixed very well with the water before they can form a heavier floc.

### 7.4.4 Sedimentation

During sedimentation, floc settles to the bottom of the water supply, due to its weight. This settling process is called sedimentation.

### 7.4.5 Filtration

Once the floc has settled to the bottom of the water supply, the clear water on top will pass through filters of varying compositions (sand, gravel, and charcoal) and pore sizes, in order to remove dissolved particles, such as dust, parasites, bacteria, viruses, and chemicals.

### 7.4.6 Disinfection

After the water has been filtered, a disinfectant (for example, chlorine, and chloramine) is added in order to kill any remaining parasites, bacteria, and viruses, and to protect the water from germs when it is piped to homes and businesses.

### 7.4.7 Storage

Once the disinfection process is complete, the water is stored. Storage usually takes place in an underground storage tank called a “clear well”, and also in elevated storage tanks that are visible around town. There are ways for ample supply of water available in the event of emergencies. These can include power outages, fires, floods, etc. Storage reservoir for Yaoundé VI is located at Etoug-Ebe.

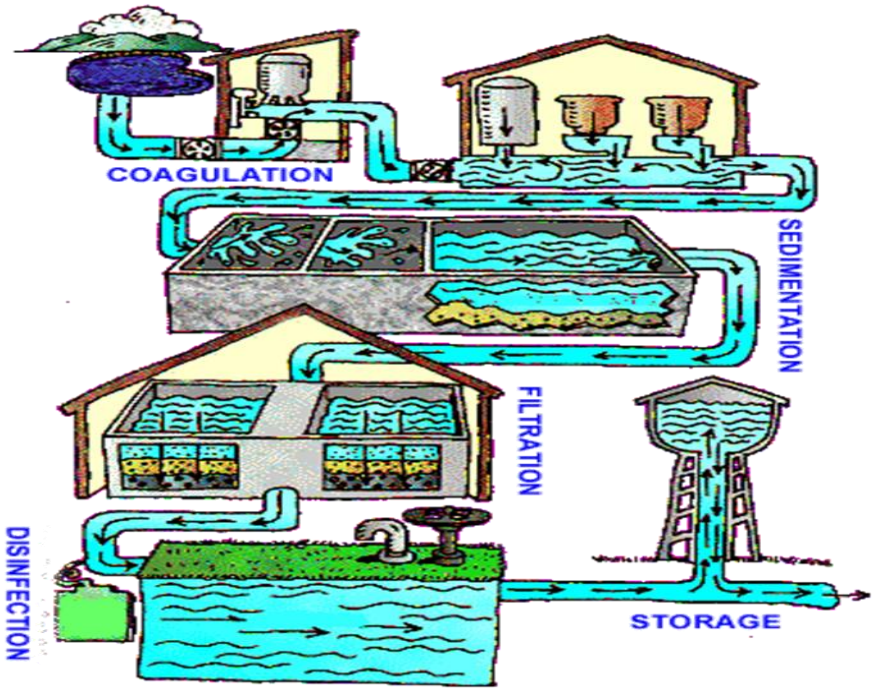
### 7.4.8 Distribution

The stored water is pushed through underground pipelines all over town in what is called a “distribution system”. The distribution system consists of large water pumps at the treatment plant, overhead water storage tanks, large pipelines, smaller pipelines, fire hydrants, valves, and water meters located in any part of the yard. It is from the storage tank or reservoir that the water is distributed to all the quarters and homes in the Yaoundé VI area.

Water treatment by CAMWATER differs from those in the developed world. These procedures depend largely on the sources of the water. Water treatment is adapted to the quality of the water supply which means the sources determined the types of treatment. There are three types of treatment procedures are;

- $T_1$, meaning water that is being treated has a good source and does not need long procedure for treatment. Chlorine is added to the water to kill the bacteria found in the water such as forage water or drilled well.
- $T_2$ this require that we decant, filter, and disinfect to attain a good quality using water from rivers like that of Mefou
- $T_3$ that we have need to be decant, filter, affirm because we have medication, use ultra-filtration, use active carbon we affirm them and distribute to all the reservoir. Mbalmayo have innovative technology better to affirmer water by ultrafiltration.

**Fig 38: Flow chart of water production**




*Source: EPA (1999)*

The various process of water treatment as explained above is done in Yaoundé as a whole especially in those source area where water is tapped and send to storage tanks where it is later distributed to various homes for domestic usage.

### 7.5 The role of the Yaoundé VI council in water provision

The principal roles of Yaoundé VI Council are to provide and management water in its area at the local levels. Specifically, Councils are required to: act as a representative, informed and responsible decision-maker in the interests of its community, provide and coordinate various public services. They need facilities to develop its community and resources in a socially just and ecologically sustainable manner, encourage and develop initiatives within its community for improving the quality of life of the community. They need the interests of its community to the wider community and exercise, perform and discharge the powers, functions and duties of Local Government under this and other Acts in relation to the area for which it is constituted. It is the council who know where and when to dig a borehole for the community and provision of CAMWATER. The council also: promote agricultural activities, management of touristics sites in the council area, construction, equipping, maintenance of market and road, they also undertake town planning and housing. They promote sensitisation on health and social development as well as educational, sports and cultural development (Nyada 2019).

### 7.6 The role public health on water and sensitisation in Yaoundé VI

Public health has been defined by Winslow (1920) as "the science and art of preventing disease", prolonging life and improving quality of life through organised efforts and informed choices of society, organisations, public and private, communities as well as individuals. Analysing the determinants of health of a population and the threats it faces is the basis for public health, is an interdisciplinary field. For example, epidemiology, biostatistics, social sciences and management of health services are all relevant. Other important subfields include environmental health, community health, behavioural health, health economics, public policy, mental health, health education, occupational safety, gender issues in health, and sexual and reproductive health.

Public health aims to improve the quality of life through prevention and treatment of disease, including mental health. This is done through the surveillance of cases and health indicators, and through the promotion of healthy behaviours. Common public health initiatives include promotion of hand washing and breastfeeding, delivery of vaccinations, suicide prevention, and distribution of condoms to control the spread of sexually transmitted diseases

Typically, water quality (Links to an external site) is determined by comparing the physical and chemical characteristics of a water sample with water quality guidelines or standards. Drinking water quality guidelines and standards are designed to enable the provision of clean and safe water for human consumption, thereby protecting human health. These are usually based on scientifically assessed acceptable levels of toxicity to either humans or aquatic organisms.

Water and sanitation: it serves health expenses, disease transmission reduction and decreases the mortality and morbidity. Furthermore we have environment, maintenance and improvement of natural resources, good management of the resources to avoid overexploitation and avoid contamination. Lastly we have the dignity and human welfare which contributes to promote the right for all human beings in accessing clean and safe water, improvement of the quality of the communities, women and children, short distance to access the water point less time invested to obtain water and more time available in order to go to school.

Lack of safe water, sanitation and hygiene remains one of the world's problems and Yaoundé VI in particular are most urgent health issues. Almost one tenth of the global disease burden could be prevented by improving water supply, sanitation, hygiene and management of water resources. Ensuring poor people's access to safe drinking-water and adequate sanitation and encouraging personal, domestic and community hygiene will improve the quality of life of millions of individuals. Better managing water resources to reduce the transmission of vector-borne diseases (such as viral diseases carried by mosquitoes) and to make water bodies safe for recreational and other uses can save many lives and has extensive direct and indirect economic benefits, from the micro-level of households to the macro-perspective of national economies (WHO, 2008).

This is what one of the health personel told us concerning sensitization:

> *Most of the times we sensitised the population on the importance of keeping the environment clean, using clean water and the local ways of disinfecting water for consumption. This is because the population lacks information most attimes and they do not know what is happening in their community especially during an outbreak of water-borne disease like cholera which is rampant in the community today. We do this by improving knowledge meaning that we inform people about an issue (water-borne disease) making sure that they have the correct information to truly understand the issue. Getting our target audience to think critically about the issue and actively process information. Changing people's*

> *behaviour towards the issue of water crisis. We explain to them how new behaviours and attitudes will have an impact and maybe even change cultural norms and beliefs. Focus on skills making sure people have the skills to go with the challenge they are facing. Changed behavior, attitudes and building social support by sensitizing them know where they can get support, or give support, to other people facing the same issue* (Blessing, 23 of December 2019, Rond point Express).

To Blessing point, sensitisation is very necessary to the population because they might not have information on what is happening in the community. Some of the inhabitants do not even have the knowledge on local purification methods of water so need to be sensitised for their benefits. From her words, one can see that they try to talk to the community on the importance of altitudes, having skills, having new knowledge or information and givingthe population where they can give or ask for supports.

### 7.7 External stakeholders in Yaoundé VI

#### 7.7.1 World bank

The World Bank is an international financial institution that provides loans and grants to the governments of developing countries for the purpose of pursuing capital projects. It comprises two institutions: the International Bank for Reconstruction and Development (IBRD), and the International Development Association (IDA). The World Bank's most recent stated goal is the reduction of poverty. This institution was created at the 1944 Bretton Woods Conference, along with the International Monetary Fund (IMF) (https://www.worldbank.org/en/about/archives/history). The intention behind the founding of the World Bank was to provide temporary loans to low-income (LLC) countries which were unable to obtain loans commercially. The Bank may also make loans and demand policy reforms from recipients. From 1974 to 1980 the bank concentrated on meeting the basic needs of people in the developing world. The size and number of loans to borrowers was greatly increased, as loan targets expanded from infrastructure into social services and other sectors (Bergsen 1999).

Cameroon joined the World Bank on July 10, 1963, becoming the 86$^{th}$ member of IBRD. The government subsequently joined IDA (April 10,1964, becoming the 92$^{nd}$ member) and sign as the 29$^{th}$ member of the ICSID Convention on February 7$^{th}$, 1967. On October 1, 1974 Cameroon joined IFC, becoming the 100$^{th}$ member of the Corporation. On October 7, 1988 Cameroon joined MIGA, becoming the Spraying fungicide as the 45th member. (https://www.worldbank.org/en/about/archives/history,13 June 2020).

At the completion of the project, the following outcomes are expected to: Increase access to infrastructure and water, strengthen capacity and accountability of local governments, particularly of Douala, Yaoundé, Bamenda, Mbalmayo and Maroua to plan, implement, and maintain the delivery of infrastructure and water and strengthen sustainability and capacity to manage and develop water supply services.

Environmentally, the project has been classified as category B. All activities identified under the project are not expected to have major adverse environmental impact. Investments will include small infrastructure works (mainly secondary/tertiary roads and drainage), as well as construction or repair of social facilities such as classrooms or health centres, and extension of water networks and social connections.

### 7.7.2 China relations

In January 1960, the Cameroon established "diplomatic relations" with the Taiwan Authority and "severed the relations" after the establishment of the diplomatic ties with the people's. Since then the relations between the two countries of China and Cameroon have witnessed a steady development with sincere and friendly cooperation carried out in every aspect. This is the third set of gifts from China. They will significantly improve the living standards of people in beneficiary communities. Cameroon is quite satisfied with the quality of work carried out.

China has contributed in supporting water projects in Cameroon by providing boreholes in 101 communities in the Centre region and 44 communities in the South region. Cameroon secured a 366 billion CFA franc loan from the Export-Import Bank of China to fund a water distribution project. The programme was able to reach 2 million people in the capital city Yaoundé and villages along the pipeline, marking a significant infrastructure boost for the central African state in which the United Nations says only half the 19.5 million population have access to clean water. Cameroons government hired the China National Machinery and Equipment Corporation on a 28-month contract for the water project, which will involve construction of a 56-kilometer pipeline from the Sanaga River (Austin, Bradley C 2013).

Douala water project in Cameroon is an important construction project funded by the Export-Import Bank of China. Upon the completion of the first phase, Douala water supply project has increased the water supply capacity up to 170,000 cubic meters per day. Phase 2 officially started in 2012, the completion of which will significantly improve the situation of

drinking water in Douala City. Douala urban water supply project is one of the projects, featuring eight China-Africa aid measures in Cameroon. The project has always drawn full attention from the two governments. The local media commented on the project as such: “Douala water supply project is the living example of the China-Africa cooperation, dedicated to addressing pressing livelihood issues in Africa and to delivering practical benefits for the people of Africa" (https://en.wikipedia.org/wiki/Cameroon%E2%80%93China_relations, 8 July 2020).

### 7.7.3 Agence française de developpement (The French Development Agency)

Agence française de developpement (AFD) has been operating in the country since 1960 and supports these national priorities. It mobilizes a number of financial tools: Debt Reduction-Development Contracts (C2Ds), loans to the public and private sectors, guarantees to banks and grants. With over 50 years of partnership, Cameroon is one of the main beneficiaries of AFDs financing in Africa. For Cameroon, the Debt Reduction-Development Contract (C2D) is the main program for the cancellation and reconversion of its external debt. In practice, the Cameroonian State continues to repay its debt and once the repayment has been made, France transfers the corresponding amount in the form of grants so that it can be allocated to poverty reduction programs selected by mutual agreement with Cameroon. This has been able to support Cameroon on water project by providing funds to the country (www.developmentaid.org).

### 7.7.4 African Development Bank

In order to control flooding in Yaoundé and Yaoundé VI and address the difficulties inherent in its increasing filth, the government prepared a Yaoundé City Sanitation Master Plan (PDA), which was financed by the African Development Bank Group (Report 2013). As a follow-up, a project was conducted on the emergency phase of Yaoundé City Rain water Drainage, consisting mainly of the re-calibration of the Mfoundi Canal and the cleaning of the collectors. An update of the project engineering designs was also financed by the African Development Bank Group. The Bank Group is also financing the entire foreign exchange cost of the Yaoundé Sanitation Project. This project is to: contribute to rain water drainage in Yaoundé City, contribute to improving the living conditions of the city’s population and build the capacity of the sectors stakeholders.

The project comprises the development of sanitation infrastructure, capacity building and project management. Specifically , it involves a study for landscaping along the Mfoundi

Canal; the establishment of a project monitoring and evaluation system ; construction of a canal4.32kilometres long, protection and cleaning of three underground collectors , about 2.35kilometres long, development of two maintenance road neither side of the canal and the construction of access ramps, construction of two footbridges, a rail bridge and a road bridge; construction of four disposal structures at forks in the canal; construction of 50 containers. and installation of 50 garbage bins along the canal; development of the areas around the canal (4 kilometres of paved footpaths, planting of trees and gardens, installation of 54 public benches and public lighting, construction of two parkings are as of 400 square meters each and two shelters); and training Cameroonian sanitation professionals and other staff. The project is being implemented over four years, starting January 2006 and scheduled for completion in December 2010. These projects have been completed as scheduled.

### 7.7.5 Centre pasteur

This institute was created in 1959 in Yaoundé and includes an annex in Garoua that was created in 1985 and another one in Douala created in 2004 (Pascal, 14 of August 2020). It operates directly under the umbrella of the Ministry of Public Health and Finances. The Pasteur Centre in Cameroon is a member of the Institute Pasteur International Network (IPIN) with whom they shared the main mission: the containment of infectious diseases in Cameroon and in the sub region. The core activities are: Public Health, Research and training (https://research.wipo.int/member/centre-pasteur-du-cameroun-cpc).

Services or activities carried-out for the benefit of the local population include biomedical analysis, vaccinations, and toxicological analysis among others. They also carryout water analysis to control the quality of water before it is being distributed to the inhabitants. Many of the analysis and examination is being done here in Cameroon. The Inhabitants of Yaoundé VI go there for examination and other analysis when need arises.

This is what one of the council workers told us during our fieldwork:

> *The water use by the inhabitants of Yaoundé VI especially the natural springs, was examine to see the level of bacteria found in the water. It resulted that the water is 95% free from bacteria making it fit for drinking. The analyses were done at the Centre Pasteur* (Bless, 16 of November 2019, Etoug-Egbe).

From this point of view, one can say that this centre is of great help to the population especially to those of Yaoundé VI area.

### 7.7.6 Local population or beneficiaries of Yaoundé VI

Because of widespread failure of many developmental projects in Africa and some developing countries in the 1960s and 70s, there was need for a re-assessment of approach for implementation of such projects with critical examination of success factors (Wilson,1993). Many reasons have been suggested for this phenomenon; possibly the most important has been lack of sufficient involvement of the communities in planning, implementation and the administrative phase (Asuming, 2001). This has seen the utilization of non-professionals in development projects so as to address the social problems associated with such projects. Local population or beneficiaries are those whom projects are conceived. There are four kinds of beneficiary who participate in developmental activities. Their contribution at the community is important for them because:

Decision making is the initiative stage of any program. In this early stage, many things are discussed regarding a programs vision, mission and goals. Here, beneficiaries' participation is an important factor because the beneficiaries can play a vital role through their practical experiences in finding the authentic problems of their known community.

Participation in implementation can play an important role by putting the beneficiaries first. Their active involvement ensures a good start and tends to stimulate the program. Since the beneficiaries are the ones who have a better knowledge of their own societies, there is a greater possibility of steering the program in the right direction to solving the problems.

Participation in benefits is an important factor among four separate kinds of participation. Because, benefits or the ends products is what need to satisfy the population concerned. Once beneficiaries start receiving benefits from the project/programs activities, their participation in the activities becomes much stronger.

Participation in evaluation is the last stage of the program. It has a direct relationship with the other three stages, particularly decision-making. In this final stage, the beneficiaries' participation in evaluation is to improve the services for delivering them, and to link the evaluation process closely to decision-making. Each discipline has its own ideas for conceptualising participation. Participation of the beneficiaries in the program is a dynamic approach because beneficiaries experienced has leads to greater understanding to increase

capacity building and awareness creation. These experiences later help then to discover their own problem-solving capabilities.

In Yaoundé VI, the population has to participate in any decision making in a project because they are the ones the project is directed to. This is because if the population allows the funders to decide for them, their end product may not be what the population needed. That will waste of time and resources so it is always advisable to involve the beneficiaries in all projects.

Community participation can be seen in different forms. The following forms highlight some of the participatory features of a rural water supply scheme in Malawi (Kleemeier, 2000). Consultation getting community opinion to meet community needs through consultation with community leaders or representatives with all sections of community Cost sharing collection of cash within community as contributions for projects implementation and management. Such contributions indicate that the service is valued and that the community is committed. A contractual arrangement, community participation involves formulation of contract that is documented with details of rules and responsibilities of the various stakeholders in the design and implementation process. The stakeholders include. Decision-making, through participatory community education, genuine support and commitment is achieved by involving all community members in decision making. This will benefit community for long term sustainability and increase use of service. Cheap labour, cheap labor refers to contribution locals make through community works were groups, families and individuals contribute their labor. The unskilled labor are clearing grass, digging, carrying materials etc. To conclude, participation has been seen as a tool to facilitate management to enhance sustainability in most communities .

There have two types of local actors which are individuals for individuals and individuals for the community Individuals for individuals are those who are able and capable of providing water for themselves. For example those who are rich and living in quarters that do not have water, are able to meet their basic needs by using their finances. They are able to buy a good quantity of mineral water for their families; they can afford to construct a borehole for their family which is able to provide them with a good quantity of water. During our fieldwork, this is what an informant told us:

> *I live with my family, and accessing potable water was a difficult issue for us. So we had to scarify many other things just to make sure that we constructed a well. This has been serving us for some time now. Well we do not share our well with other people because when I want to clean and ask for money it becomes a problem. So I try as much as possible not to involve people in using my well* (Janet, 13 Febuary 2020, "Centre").

According to Janet point of view, sharing her well with other people is not advisable because when it is time for cleaning the well not every body participate. So she does not want that to be a problem to her and other people. To her the best thing is to stop people from using her well (forage). The assertion of UBUNTU by Thadius Medz does not support what "B" is saying above. The UBUNTU theory states that "Person hood which preaches that man should live by man. The dictum according to Medz, I am because we are there Iam". According to Medz, an individual cannot live alone therefore we exist because of others and others exist because we are there.

Individual for community, these are actors who are rich, but they satisfy themselves first before looking out to help others who are around the neighbourhood. For example, the rich people will drill a well, estimate the quantity they can use in their home before giving out to the community. Reason being that, they do not want to suffer in times of shortages and so, precaution is being taken before engaging in any act of sharing.

Some people will share their water on conditions that the population will have to buy from them. So they decide to sell their water and in most cases it is being sold at 50frs for 20litres of water, some will give for free but on a condition that every month each person donate 500frs for the cleaning and purification of water. Lastly, some individuals will just give for free no matter the cost of purification or construction. This is what another informant gave us during an interview with him:

> *I have been living in this quarter for 4years now. The water issue is really bad given that there is no pipe born water in this area. So the people depend on well, rain, spring for water. Most at times the volume of the spring reduces due to long dry seasons. So when I constructed my house, I made forage that can suspend some people around the quarter. So I send one of the pipes out of my gate so that the people can carry water whenever they want to. To me, it is a means of meeting the needs of the neither people nor matter how small or insignificant it is. It gives me joy when I see the people happy because of that* (Clitton, 14 January 2020, Mendong).

From this point of view, sharing is part of him, no matter how small it may be. He finds pleasure in sharing his water with the population. This is because he understands what the people are going through and how difficult it can be without water. From Clitton's point of view supports the UBUNTU theory which says "Person hood which preaches that man should live by man. The dictum according to Medz, I am because we are there I am". That is why we have people in the community who love to share, support and love others, notwithstanding the challenges they also have. Like for example there are situations there are individuals who gives water to the population for free and when the tap gets bad, the people using it have no in repairing but the owner will still do the repairs for the people. That is how we are supposed to show love to one another as long as we are in the community.

Normally in African culture, we have things like food and water which is naturally given freely to the people whether related or not. But now our days, the Africans have enculturate the western culture and forgotten their culture of living together. That is why we can see people who will deliberately deny sharing with one another. The UBUNTU theory should be emphasised for people to see the need of living together.

In managing waste disposal by the inhabitants to avoid water pollution, some of the people respect their environment by discarding in the appropriate place which is in the dust bin can. There are several ways involved in waste collection is done Yaoundé VI and this includes: door-to-door and fixed point collection. Thisis what one of the informant told us:

> *There are some children who do door-to-door, other method consist of mobile waste collection trucks (open or compaction), which give out peculiar hooting signals inviting residents to bring out their waste, which is loaded directly into the trucks for transportation. For efficiency, pickup days are fixed. However, truck break-downs can sometimes seriously disrupt services. In this system, waste is usually stored at the points of generation for a very limited period and once loaded into the trucks. They are immediately taken off to the disposal site. This method relies on good roads and is a method of choice in markets and during the clean-up campaigns, but is not that common for some quarters in Yaoundé VI like new quarters in Mvog-Betsi, sub quarters in Centre and sub quarters at Mendong. Their roads make it difficult for the vehicles to move* (Carine 12 June 2020, Mendong).

From the point above, one can see that there some people actually take care of their environment by not littering dirt around. So they take their waste to the dust bin where it is suppose to be kept for companies responsible to take charge.the informant also made us

understand there are also some places where roads are not good that is why some big vehicles cannot access some areas for waste collection. That is why we might find dirts in some areas more than others.

Fixed point collection consists of siting large communal bins in designated locations for scheduled pickups. The choice of skip type, size, location and frequency of pickups is determined by the rate of waste generated, access and activities carried out in the area. This is the most widely used collection system in Yaoundé VI council, which inevitably depends on the participation rate of the residents in the community. In contrast to door-to-door collection, waste is stored for a longer period of time, along the road, providing habitats for rats, vermin and also exposing the waste to the population. Scavengers usually visit refuse dumps to recover materials that they can sell in the market. Municipal waste collection from these sites will vary, with smaller portable bins emptied on the same schedule as door-to-door collection, whilst the heavier skips maintain a separate pickup schedule (a decision based on the type of transportation vehicle available and the access arrangements).

Cameroon adhered to the principles of primary health care (PHC) in the Alma Ata Declaration in 1978. This declaration emphasized on the importance of community participation in addressing population health problems. To this end, communities were invited to take ownership of the initiative through participation in the analysis and decision making on health issues. The initial implementation of this reform has encountered some difficulties. In 1993, the Cameroon adopted the policy of reorientation of primary health care. This policy proposed to the communities a partnership based on co-financing and co-management, which should be underpinned by dialogue structures at all levels. The stakeholders did not have the same understanding of the concept of community partnership. The final evaluation of SSS 2001-2015 states that “Since the reorientation of primary health care, few dialogue structures are involved in the implementation of the principle of co-financing and co-management, which reduces accountability between stakeholders”. Community involvement and their inclusion in the decision-making processes still remain very weak.

The number of functional dialogue structures in most regions is not known at the legislative and regulatory level, the absence of a legal framework for community participation and a policy on community participation remains a brake on its optimal implementation. At the operational level, the support of decentralized territorial units for the

development and implementation of a process of community capacity-building by civil society organisations is an opportunity to be seized. Since 2016, MOH has launched the Community Integrated Management strategy (PECIC) through priority programs (malaria, HIV / AIDS, tuberculosis, nutrition, WASH) through community based interventions (ISDC). The issue of community participation should be the concern of decision makers for effective community involvement in governance (UNICEF 1999).

### 7.8 Relationship between these Stakeholders

In order for a project to be successful, the collaborators need to relate with one another for a successful end. But when there is no relationship it is very difficult for any project to be successful. Examples like in a family, like the saying goes “a family that stays together succeeds but any one that is divided will always fall”. This is applicable in every domain where one or the community finds his or herself.

#### 7.8.1 Ministry of water and energy with external actors

CAMWATER and external actors like china, have a cordial relationship. That is why chines are able to part take projects in Cameroon especially that which involves water production. Cameroon itself is not able to meet the need of its citizens without the help of other countries. This relationship has been a great help to the country because some parts of the country have benefits from the borehole that was provided by the Chines in Cameroon. Not only water, Chines have also engaged in exporting most of their good into Cameroon at a lower rate that makes it possible for Cameroonians to live a better living standard. Goods like, kitchen utensils, electronics, dresses, shoes, food and many others are imported into the country at a lower price such that even the poorest person can be able to afford some of these basic needs for survival.

CAMWATER and international NGOs like World Bank and Agence Française de development, all have a cordial relationship with Cameroon. The World Bank on the project of supporting developing countries to attain the millennium development goal supports Cameroon with funds to develop their country. Water project is one of the projects that if carried out effectively, will be able to reduce the incidence of water-borne-diseases in the community. It also reduces poverty because many will not spend on hospital bills, the economic situation will rise and consequently development will take place because

everybody will be in good health, to be able to carry out different responsibilities for the development of the community.

### 7.8.2 State actors and Yaoundé VI council

The state actors involve organisation controlled by the government like CAMWATER, Councils and many others.

During our fieldwork we met an informant from CAMWATER and this is what he said:

> *Relationship between the council and CAMWATER is cordial. Our DG helps to work with the council especially now that corona virus is out and we have to fight it. CAMWATER supplies water to all the inhabitants that have pipe-born connections in their homes. Also it is the council that helps us to know which quarter needs water and pipes that need repairing. It is the council that has to tell us where to pass our pipes for water distribution. CAMWATER is collaborates with the council, to see how they can help in meeting the need of the population when it comes to water project and others* (Nyada, 2 May, Carrefour Vogt).

According to Nyada, CAMWATER can only work effectively if the councils collaborate with them. From his view, it is the council that knows what the quarters need at a time and place.

### 7.8.3 State actors and local population

From our fieldwork, we discover that, the relationship between the state and the local population limited. It is a kind of two conflicting issues. We interviewed an informant in the field and this is what he said:

> *I believe we have a good relationship with the local population, if not all the project we have need doing will not be successful. We need the help of the local population to be able to go through those activities. So I know the population too is ok with what the government is doing to help them survive especially in times like this that we have this pandemic crisis. We wish the population should continue work with us so that together we will stand and move together for a better tomorrow* (Edward, 26September 2020, Centre).

To Eward, the State has a cordial relationship with its citizens and there are limited problems they face with the population. To him, they can only survive with project when the local population is involved, so they count on the population to support them in their activities for

better development. To Eward, this in relation to what the country is facing at the moment like this Corona pandemic. The state has taken measures to make sure that everyone is safe.

In the field, we met another informant who had his point of view contrary to what other informant had said. These were his words:

> *To me, there is no cordial relationship between the State and the local population and if the relationship is existing, then it is between the rich and the state because when I look at us, the commoners in the society, I do not see what actually the State is doing to survive some of us down here. Look at our environment; we have been suffering from water crisis for a very long time now. I have been in this quarter for more than 18years, but there is no water, and the State do not care of what to do to help us. They came some years ago looked at the natural springs that we have here and told us they are going to build it and protect the spring from contamination and stray animals, but up till now, nothing has been done. But the rich in this quarter, they have no problem since they can drill their wells and use sophisticated materials and chemical to clean, purify their water, what about some of us who cannot do that. This simply means any man for himself and God for us all. This Government is not what we can depend on. At times they start a project and allow it half way, and who they expect to come and finish the project. Am really ashamed of this Government that we have, like now, since we do not have water, it is their right to even provide us with boreholes, to at least help us have water, but yet nothing is being done. We are all going to die of water crisis and many more if the State do not react fast* ( Nadine 18 July 2020 Mvog-Betsi).

To Nadine, there is no relationship between the poor and the state. From what she has observed the State deals mostly with the rich and not the poor. She points out the issues of water problems that the State is unable to solve for many years now whereas they expect the people to survive and for development to happen in the land. There is no development if the population is not happy with what the Government is doing. The government is doing what one can call a film show, this is because when the government wants to execute a project or has started a project in a particular place, and we realize that, many of the people who are interviewed are those not even living in that area appraising what the government is doing.

The majority of the population in Cameroon and Yaoundé VI in particular are living below expected standards and they cannot afford for daily necessities. The environment we live in is enough to either add our years or reduce the number of years we are supposed to live on this planet earth. If the government could give little priority to the poor I believe the society will be a better place for all. Cameroon is talking of emergence in 2035. But when we look at what is happening in the society one begins to doubt how it is going to happen when the rich continue to get rich and the poor continue to get poorer but we want to develop.

From all what the local population of Yaoundé VI is going through, it is difficult for the community to develop. Another issue is that the people are living individually, meaning they did not care for one another because if we could be one another's keeper, we believe the country would have been a better place. We lived in quarters but we do not know the next person who is living close to us, that does not make us united.

### 7.8 Problems faced by the stakeholders in Yaoundé VI

Many stakeholder groups fail because they are: involved in a long-term planning process that appears to be going nowhere. In the business, community, this need for initial, successful action is known as "picking the low-hanging fruit". Doing the easy things first is an important way in which stakeholders can learn to work together, build a common base of experience, and become results-oriented in a short period of time. This will encourage stakeholder groups to take on more difficult tasks (which may be less readily visible (i.e. policy changes) in the future.When initiating a stakeholder involvement process, the issue of scale is particularly important as it will determine both the kind of stakeholders and the type of interventions (Karen 2003).

A common problem that arises with having numerous stakeholders in an enterprise is their various self-interests may not all be aligned, in fact, there may be in direct conflict. The primary goal of a corporation, for example, from the viewpoint of its shareholders, is to maximise profits and enhance shareholder value. Since labour costs are a critical input cost for most companies, a company may seek to keep these costs under tight control. This might have the effect of making another important group of stakeholders, its employees, unhappy. The most efficient companies successfully manage the self-interests and expectations of their stakeholders.

Organisation politics, hidden agendas of stakeholders (which cause them to block a long term vision due to their short term needs), behaviours ( that is self-centredness) of some stakeholders, and cases where people in the organisation do not want clear decision making due to selfish reasons Lack of long term planning example long term effects may not be considered as part of the business case or project goal, members of the architecture project (business and IT staff) may be unknown, project managers maybe assigned late when projects are already on critical path. Social complexity of an organisation, conflicting agendas or interests of stake-holders, differences in stakeholders' perception about ambition levels, and the ladder of inference that is stakeholders over reacting or quickly drawing conclusions

based on personal beliefs, insecurities and limited of methods, tools, and techniques for supporting collaboration (Patrick 2009).

Hindrances above arise due to lack of a shared understanding (among stakeholders) of the aspects pertaining to the problem or challenge the organisation is facing, and aspects pertaining to the (possible) solutions to ad-dress the problem.

### 7.9.1 Problem faced by public health as a stake holder in promoting good health to the population in Yaoundé VI

Cameroon is one of the African nations experiencing a crisis in human resources for health.

In Yaoundé VI there exist public and private hospitals in which they have their own challenges in meeting the need of the patients. During our fieldwork, we met some informants and this is what they told us:

> *In our institution, we faced the problem of financial constraint from the patients. Many at time we receive patients who do not have money for treatment especially in times of emergency cases. It makes our work slow because it is difficult to get drugs for free at that present moment. There are some cases where the patients will die because of financial problem* (Blessing, 23 December 2019, Rondpoint Express).

From this point of view, it is difficult to treat patients who do not have money for treatment. This is just to tell one that if you don't have money don't boarder going to the hospital because you will not be treated.

This is what another informant gave us;

> "*There is limited finance such that getting all the equipment the hospital need is a problem. When patient comes when there is no material to it makes our work difficult. Another point is the fact that there are specialists that we do not have in the hospital. There is also the problem of the negligence by the nurses. Some nurses are so care free that they don't have time to attend to the patients when they come for treatment* (Emmanuel, 18 of December 2019, Etoug -Egbe).

According to Emmanuel, limited resources hinder the work because purchasing some materials and equipment to be use in the hospital is a problem. So it cannot meet the need of a patient. Also the fact that there are no specialists in the hospital makes work slow. In cases where there is an emergency the patients have to work up and down looking for who to

attend to them. The issue of negligence of nurses in some hospital is problem. Because of the negligence causes some of the people not to visit a particular hospital because they are known for that.

The public health and its personel are supposed to be responsible for sensitisation and mobilisation on issues concerning health. For the case of cholera outbreak which is as a result of contaminated water, the personnel are supposed to alert the population on the epidermic and how it can be manage or prevented. From the analysis above, if there is limited finace, it will be difficult for the personel to do their work properly. It will not also motivate them to do their job well. Equally personel are supposed to be welcoming in their job site, but in as much they are not well taken care of, they careless and neglect the patients coming for treatment.

### 7.9.3 Challenges faced by external actors

The persistence of security problems, specifically Boko Haram, in the Far North and socio-political tensions in the North West and South West are affecting the economy, with transport, hospitality, telecommunications, and commercial agriculture, recording significant material and financial losses. In September 2019, the government initiated a national dialogue to address these challenges. Constraints remain in meeting needs in education, healthcare, poverty, and employment, and hold the country back from capitalizing on the potential of the demographic dividend. Imparting high skills and training sufficiently skilled labour feature among the country's biggest challenges.

Investors often seek a fair competitive business environment, thus they will mostly avoid investing in countries where there is a high level of corruption. Studies show a positive relationship between the level of corruption in a country and measurements of the competitiveness of its business environment. If the economy is corrupted, there may be some business owners who can use their connections and money to bribe government officials, as a result not only policies but also market mechanisms are manipulated and such companies could become a sole provider of goods or services. In other words, those companies could become a monopolistic or oligopolistic company. Monopolistic companies do not have to compete against others. Thus they tend to set prices high and do not have an incentive for innovation and improving the quality of goods or services example CAMWATER, SONEL in Yaoundé VI.

The nation's economy is progressing toward becoming more advanced, usually through significant GDP growth and industrialisation, is much higher than it is in developed countries. This may be due to the strong relationship between political institutions.

Insufficient infrastructure, citizens do not have access to fundamental resources and are marooned from diversified labour opportunities. In Yaoundé VI, 43 % of the population has little or no formal and primary education. What is more, 67 % of the population that is of working-age, has received no further training in developing job sectors, leading to a significantly higher level of unemployment among youths.

Confidence, investment is riskier than saving. Firms will only invest if they are confident about future costs, demand and economic prospects. Confidence will be affected by economic growth and interest rates, but also the general economic and political climate. If there is uncertainty then firms may cut back on investment decisions as they wait to see how event unfold. Evaluation Confidence is often driven by economic growth and changes in the rate of economic growth. It is another factor that makes investment cyclical in nature.

### 7.9.4 Beneficiaries in Yaoundé VI

The duties of undertaking regular visits to waste sites to monitor regulatory compliance is devolved between four ministerial departments and this often results in low levels of enforcement due to a lack of clarity in definition of responsibilities. Many of the inspectors interviewed in this study have cited lack of manpower, finances, expertise, testing facilities, and equipment as impediments to their enforcement of the regulations. Incomplete regulations, lack of clarity of roles and the absence of coordination are evidence of poor administrative planning. This arises as a result of inadequate technical training, which is reflected in the production of overly ambitious by-laws which lack surveillance and control mechanisms, creating a great gulf between policy and practice (Wilson *et al*., 2005). Thus, until these key issues are adequately addressed, it will be difficult to implement proper and sustainable waste management legislation and practices.

Despite Governmental efforts to create and implement legislation related to sustainable waste management and environmental protection, the current policy framework is not efficient. An inadequate legislative framework is a key reason for the lack of effective engagement of industry, commerce and the general public in more sustainable waste management practices. In the Yaoundé VI Municipality and Cameroon in general, this would

suggest the need for the implementation of more robust measures including learning from examples of best practice from other developing countries.

Interview was conducted with an informant and this was what he said:

> *Financial difficulties which some company faces, is due to insufficient finace for the entire or services. Thus, out of roughly hundred trucks meant to collect waste in the capital, 10 are barely in operation currently, and struggle to collect about 1,300 tons of waste produced by households on a daily basis in all the councils in Yaoundé. All the other vehicles are parked, either because they have broken down and need repairing, or because it has become a challenge for HYSACAM to fuel them. HYSACAM reveals that the delays in government's financial support are the reason why there have been problems in the waste removal services in towns such as Yaoundé and Douala. The waste removal company informs that 15% of its operating expenses are provided by urban communities and the remaining 85% should come from government. Furthermore, another issue we have is the fact that, the population throws dirt on the ground instead of using the can that is there. With that, we are forced to spend more time on a particular waste collection point. Another issue is most of the new quarters do not have roads so to access them is very difficult because our vehicles cannot go to those areas there-by rendering the people to use any means they can. Lastly there is no organisation that supports our work, may be if we had some NGOs supporting, we would have not been having problems like this. Having another company that can take charge of waste would have been good, rather than having only one organisation responsible for waste disposal* (Laurence, 16 Decmber 2019, Mendong).

From Laurence, one can see that the government itself does not promote the work of this company. Because if the government could realise that the health of the inhabitants depends on the hygiene of the environment, they will not waste time in providing what the company needs to keep the city clean. The population too is another problem because they do not respect the cans placed by the company. Instead of throwing dirt into the cans, they prefer throwing them besides. Also, the fact that there is only one company in charge of waste collection, it does not make the work competitive but if there were two or three companies, the work would have been competitive and each of them will be trying their best to see into it that they became the best for the benefit of the population.

Other obstacles towards municipal solid waste management include:

Financial obstacles: In Cameroon, most of the waste management taxes range from FCFA 30,000 to 50,000 (US$60 to $100) for private and public companies. These amounts are quite small in handling waste management services and this has turned the inefficiency of

waste management practices. This amount does not involve households that mean all households have personal responsibility in handling their waste of which majority, about 90% of the people are unemployed. (Parrot et al 2008) It is more evident that in the proper improvement of waste management, local communities in those areas, like in Limbe municipality need to be consulted. This is to help and introduce new systems that have been proven better in other places and of which they are more sustainable and cost effective since finance is a major obstacle when it comes to waste management in many African cities. (Couth and Trois 2010).In Yaoundé VI, the government contributes its own amount together with the council so that waste product can be transported to its sites.

Institutional responsibility: Due to the fact that many cities in Cameroon and Yaoundé VI in particular lack the responsibility lines between the various stakeholders, it has always been a conflict between the urban quarters and the community. The laws that create the assignment for the urban community to rule over hygiene and health, the urban quarters were in charge of domestic waste collection and processing. In the processes of upsetting municipal waste management, there was a conflict that came with disagreement between the stakeholders and politicians. These conflicts make the domestic waste collectors to suffer a lot since there were no laws to regulate waste management stages like pre-collection, collection and waste transportation to waste disposal dumpsites (Parrot *et al* 2008).

Physical obstacles: For municipal solid waste management to be effective there should be some factors to be taken into account in order to have efficient services. For example, in most cities in Cameroon and especially in Yaoundé VI council area, there are problems of paved roads in many areas, the distances to waste collection bins due to expansion of the settlement has led to inefficiency in the waste management systems in the city. In some cases, the distribution of the public bins does not take into consideration the number of people in that area and inaccessibility. This has also helped in the promotion of illegal dumping of waste in unwanted areas.

Role of legislation: The legal system or the laws is put in place to guide the country on what to do in order to keep the country in good situation. But if the laws are not respected, things will always go wayward. In Cameroon and Yaoundé VI in particular, most of the laws are just in theory and not in practice, many people turn to go against the laws and perform unlawful activities. Since there are many ministerial departments concerned with waste management and is regulations in Cameroon better regulations can be done by enforcing the

laws and implementing new laws and stronger regulations to improve waste management and it practices in Cameroon in general and Yaoundé VI in particular.

### 7.10 Way forward by the stakeholders in Yaoundé VI

#### 7.10.1 Ministry of water and energy

The Cameroonian government has targeted certain sectors as priority sectors for investment: transport, food industry, tourism and rural development. In order to attract more investors, significant programs are being implemented by the public authorities, with the support of financial backers. This is in order to improve judicial decisions, increase energy supplies, reinforce economic information, simplify procedures and support companies. This will also ensure the protection of the economic area against illegal threats. Cameroon also has free trade zones in which all export companies can be set up. The free trade zones are only for the use of companies that produce goods and provide services meant exclusively for export some of these countries include Angola, Egypt, Burundi just to name this few.

Indeed, steps are being taken and people across the country are calling for performance-based financing for educational institutions to drive up competitiveness and quality of studies. Also, many organisations, including Heifer International, an organisation that works to end global hunger and poverty, are working to increase jobs in the community. Regarding infrastructure, Cameroon recently launched a 10-year development plan focused on massive public investment in infrastructure, including roads. By understanding the roles of infrastructure and education in the causes of poverty in Cameroon, the country may be able to improve living conditions for its impoverished people (Joseph Dover 2017 new block).

The Bank has introduced a new Development and Business Delivery Model that will expand its operations by bringing the Bank closer to its clients. Under this model, the establishment of a Regional Office for Central Africa will improve the way the Bank works and thus increase development impacts for its regional member countries. Since 2014, the Bank has been making significant efforts to create a performance culture in project implementation, enhance transparency and strengthen accountability for performance. That these efforts are beginning to bear fruit is reflected in an improved lending performance and a modest improvement in portfolio performance. CSPs and project designs are given close scrutiny to ensure their compliance with the Bank’s objectives and standards of quality, and their implementation is closely monitored. This momentum will continue with the adoption

of new internal guidelines that will contribute to improved quality at entry, speed up implementation, and enhance the results-based management of projects (African Development Bank 2017).

This is what an informant told us:

*Going forward, Yaoundé VI council needs to address these challenges. First, it needs to stimulate private sector led growth, which will require an improved business environment and sector governance, lower cost of inputs (energy, transport, telecoms) and a better educated workforce. Then, while a major infrastructure effort is required and will help private sector growth, public expenditure needs to be managed more strategically and efficiently, and rely to a larger extent on complementarities with the private sector. It will also be key to maximize the benefits of the infrastructure effort through relevant sector reforms. Finally, specific poverty reduction efforts should be undertaken to address the multiple poverty traps affecting the northern regions. Such efforts should target, increasing agriculture yields and production, improving education and health outcomes, providing greater access to basic infrastructure and providing safety nets until overall conditions can be improved* (Nyakang, 29 October 2019, Etoug-Ebe).

According to Nyakang, the Yaoundé VI council have adress all their issues by improving the goodgovernance in their council area for their inhabitants to be able to survive in the environment. Weak governance cuts across all these issues and which represents an important development challenge for Cameroon, affecting economic transactions as well as service delivery and, as such, development outcomes.

### 7.10.2 Way forward by CAMWATER in Yaoundé VI

We met an informant from the CAMWATER who gave us what they do and are doing to make sure that Yaoundé in general and Yaoundé VI area in particular have water. This was what he said:

> *There is little amount of water to supply to the whole Yaoundé, but now CAMWATER has put in place a strategy to manage water in what is called rationalisation. This has permit CAMWATER to manage water in all the quarters while waiting that the big project of Sanaga to finish. CAMWATER has a problem in that there is a lot of construction going on in town which breaks the pipes that are there which penalizes many quarters which people have the impression that CAMWATER does not supply water. But when the pipes are bad and the services team has not replaced them, CAMWATER cannot allow water to be flowing like that. And it makes our work very difficult because the team that is working on repairing works 24/24 every day to repair the broken pipes. Equally CAMWATER is working on reconfiguration and reconstructing in zone of*

> *Yaoundé. This project will help CAMWATER to absorb all the water Sanaga will produce, all the new quarters that do not have pipe borne water. This is because, if water is send to all the new quarters now, those that are using water, will not have water again. We have a truck that carries water and supply to those quarters to people to have water.* Social *measure that CAMWATER can do. Permit people not have diseases. All project takes 5years, priority of cam water is providing continuity and amelioration, remove all the bad pipes. Also we need money to do this. But we have our strategic plan but for now we concentrating on the first vision which is to have continuity* (Nyada, 2 May 2020, Carrefour Vogt).

From the above point of view, even though the water is in small quantity, they are doing rationalization to make sure everybody have water even though it seems challenging.

### 7.10.3 Education on water and gender in Yaoundé VI

There is a need for widespread education on all aspects of water on methods of collection and storage, water quality and hygiene, the need to guard against contamination etc. In the 21st century, many of the traditional methods of water collection and storage are very inefficient and wasteful of labour, mainly female labour (UN 2015). One of the approaches that could encourage education on water issues is emphasis on the benefits for the whole family of developing more efficient, less labour intensive methods of water collection and storage. The cost of small plastic pipes is little more than the cost of electric wiring.

Report from world water day 2006 says, the Assembly also stressed the need to involve women in all water-related development efforts. In many cultures, including indigenous societies, women are the guardians of water. They are the ones who often spend long, arduous hours searching for and carrying water. They need to be able to participate more meaningfully in decision-making on how water is used and managed, so that their countries can make full use of their knowledge, skills and contributions. The reports goes further saying that people should recognize the cultural, environmental and economic importance of clean water, and strengthen efforts to protect rivers, lakes and aquifers.

In the world water day report 2006, the paper promotes the understanding that Water and Culture are inseparable elements of human life. Culture should be regarded as the permanently evolving set of distinctive spiritual, material, intellectual and emotional features of society or a social group. It encompasses in addition to art and literature lifestyles, ways of living together, value systems, traditions and beliefs. The way water is used and valued

constitutes an integral part of a society's cultural identity. Foster the dialogue of cultures to find solutions for water-related problems. Cultural diversity, stakeholder involvement and intercultural dialogue should be the guiding principles for the development of awareness raising, educational and capacity building material and methods.

Promote inclusive and solution-oriented water governance that takes into account all facets of cultural diversity and that seeks informed consensus. Indigenous knowledge holders should be involved as full partners to encourage the artistic expression on water issues as an important means of fostering understanding and sharing information. Drawings, photographs, audio-visual materials and the performing arts often help to get messages across cultural and language borders.

There is a need to distribute water more equitably, and increase the efficiency of water use, especially in domestic activities and cultural activities in the council area. There is also need for Yaoundé VI to mount a sustained effort among international bodies, Governments and local communities, and across traditions and cultures that will reach our goals.

From what the informant have given us, the stakeholders starts a project that do not go to completion which can be termed as Dramaturgy. Accounts of social interaction in everyday life depends on elements of human interactions are dependent upon time, place, and audience. The above stakeholders listed above provide support both financially and materially. The work above also point out some of the challenges they go through like not having enough finances for a project to go through successfully withour delay. The work also shows that the collaboration between these stakeholders are cordial and despite their challenges, they still device means of making sure that they meet the needs of the population.

# CHAPTER VIII
# CULTURAL REPRESENTATION OF WATER IN YAOUNDE VI

This chapter reveals the various perceptions people have towards water. Given that Yaounde VI sub-division is a heterogenous town with different cultural groups, we identify some of the cultural values and pefceptionsof water from the inhabitants. Examples of the vultures that we will be describing are that of Ewondo, Wimbum, Mankon, Muslim etc.

Culture directly influences how the values of water are perceived, derived and used. Therefore, the perception of the values attributed to water and its related benefits can be highly subjective.For any values, it is extremely important to understand the cultural background under which they arise and how culture influences how they are used. The values of water to human well-being extend well beyond its role in supporting life-sustaining functions, and include mental health, spiritual well-being, emotional balance and happiness. For example, water in landscapes has aesthetic values that contribute to mental health.

Unsurprisingly, life satisfaction and happiness depend to a great extent on water: water can appeal to people for spiritual reasons, or through scenic beauty, because of its importance for wildlife or recreation, among others. Water plays an important role also across faith-based traditions worldwide, symbolizing elements as diverse as life, purity, renewal and reconciliation, but also chaos and destruction. In some, water is seen as a gift for humans to care for, whilst others embrace a view that accentuates water's importance for the environment and wildlife. The connection between water and place, often categorized as 'relational values', can be strong in many indigenous cultures.

## 8.1 Culture and perception

Culture consists of the shared beliefs, values, and assumptions of a group of people who learn from one another and teach to others that their behaviors, attitudes, and perspectives are the correct ways to think, act, and feel. But according to Edward Tylor 1871, it is a complex whole which includes knowledge, belief, art, laws, morals, customs, and any other capabilities and habits acquired by man as a member of a society. When one looks at the definition above, the two theories stated above are all involved. The first theory which talks about cultural ecology is making us to understand that one need to have all the

characteristics listed above to be able to survive in an environment. This means if an individual is unable to acquire this, he/she cannot be called a member of the society. The second theory which talks about cultural interpretation is simply talking about thick description of water culturally, meaning that there are different cultural groups and its different cultural use of water in the environment like with the case of Yaoundé VI which is an urban setting. According to Mbonji (2010), La culture n'est pas une science de vivre, mais un art de vivre, une formulation et une solution au quotidien du problème de vivre, formulation et solution faites de réalités insérées dans un être-le-monde d'où elles tirent sens, cohérence et non vérité unique. From Mbongi definition, he sees culture to be that solution to every problem to what the human being face in the community. From the above definition, one can see culture in the various elements like, is culture is learned, culture is shared, culture is dynamic, culture is systemic and culture is symbolic.

Cultural perception is defined as how the beliefs, values, traditions, and societal norms shape the way a person views the world. People gain information based on their life experiences, which come from their culture. These cultural life experiences can influence people's perspectives, which is the way that people see the world. The world is made of many cultures, so cultural perception is prevalent in all areas of life.Perception is seen as a three-step process of selection, organization, and interpretation. Selection implies that individuals are exposed to multiple stimuli at a time. The human brain cannot comprehend all stimuli, so it selects specific stimuli to process on a subconscious level. This subconscious selection arranges these stimuli by importance based on cultural associations of important information, which differs from culture to culture. Language provides the symbolism that allows people to make these associations. Lastly, interpretation is the process of applying meaning to the selected and organized information. Similar cultures often apply similar meanings to organized stimuli.

Culture impacts how people think and the way that people understand the stimuli around them. As such, culture has a deep impact on the way that people see and experience the world, which is their perception of the world. The culture into which one was born shapes eating habits, physical habits, emotional expression, style, and all other forms of life experiences.One of the largest influences on cultural perception is communication. Some cultures are similar in communication style, but communication can always have slight

differences. Language helps people to think and understand, and if the language differs, then the meaning of the communication changes.

Wording is incredibly important in communication, a culture may have a word to describe a certain experience that does not exist in another culture. Therefore, the degree of importance a culture places on a specific thing or experience is evident in the existence of a particular word. In contrast, another culture may place less value on the same thing or experience, as shown by the lack of a word to describe it. This can, in turn, make the perception of one culture very different from that of another and as a people ages, culture impacts in different ways. It may be a slight influence or a large one, but it will always have some effect. Collectivist cultures can make adolescents transitioning into adulthood more family-focused, whereas individualist cultures encourage an adolescent to be more independent.

As people transition into adulthood, they may begin to experience new cultures in addition to their own, or they may leave their culture of origin to completely immerse themselves in another. This poses the question as to how a person's culture of origin will influence their view of a newly experienced culture. As an individual matures, one is more capable of understanding other cultures outside of their personal perception, even though they may sometimes rigidly hold to their original cultural perception.

### 8.2 Cultural names given to water in Yaounde VI

Water and culture are inseperable elements of human life. The way water used and valued costitude an integral part of a society cultural identiy. It encompasses of lifestyle, value systems, tradition and beliefs. Yaoundé VI council area being a heterogenous town has different cultures and different meanings and names given to water. This is what the various informants gave us.

According to Grek an Ewondo indigens, water is calleds “medim”,

According to Stella from the wimbum community, water is called “nmdip”,

To Arnauld from Bamileke water is “tfe”

To Carine from kom people called water as “Muu”,

To Sandrine from Nso, water is called “mindzev”,

To Euhene from Batibo, water is called “binip”,

According to Neh from Mankon, water is called “enkeh”,

According to Marcel from the Litoral, water is called “ndiba”,

According to Frank from Bakossi water is called “ndiba”

According to Moses from Mamfe, water is called called “ayep”.

From the few cultural names gotten from the informants, one can see that most of the names have similar way of pronouciation which can be concluded that culture cuts across everywhere.

In 2006, the world water day was celebrated under the theme “Water and Culture”. That of 2022 says “ground water” it draws attention to the hidden water resource that has always been critically important but not fully recognised in sustainable development policymaking.Water is not only essential for life but it is also a wide-ranging cultural presence an inspiration for artists, a focus of scientific research, and an indispensable element in the religious rituals of many traditions and faiths. The availability of ground water in Yaoundé VI council area gives us one of the reasons we choosed the area for the study site.

**8.4 The meaning of water in the various cultures**

From the perception of water in various cultures, one can say that there exists different perception of water in all cultures in Yaounde VI area. According to Merriam webstar, the liquid that descends from the clouds as rain, forms streams, lakes, and seas, and is a major constituent of all living matter and that when pure is an odorless, tasteless, very slightly compressible liquid oxide of hydrogen $H_2O$ which appears bluish in thick layers, freezes at 0° C and boils at 100° C, has a maximum density at 4° C and a high specific heat, is feebly ionized to hydrogen and hydroxyl ions, and is a poor conductor of electricity and a good solvent. The liquid that is made up of two parts hydrogen and one part oxygen is water. Water takes up over seventy percent of the earth’s surface. Your body is made of about sixty percent water.

Water can be a noun: it is the colorless, odorless liquid that all living things need to survive. Water can be a verb: as in watering the plants, getting teary, or urinating. When people talk about freezing and boiling, they are usually talking about the temperatures at which water freezes (32˚ F) and boils (212˚ F). Humans use water to bathe, cook, make

fountains in the backyard, and mix with lemon juice and sugar to make lemonade. This is what informants gave us as meaning of water in their various cultures.

*"Water is life in our culture*" (Grek, 16 July 2020, Mendong). To Grek, water is life according to the Ewondo man. as confimed by UNESCO 2021 that The values of water to human well-being extend well beyond its role in supporting life-sustaining functions, and include mental health, spiritual well-being, emotional balance and happiness. For example, water in landscapes has aesthetic values that contribute to mental health.Unsurprisingly, life satisfaction and happiness depend to a great extent on water: water can appeal to people for spiritual reasons, or through scenic beauty, because of its importance for wildlife or recreation, among others.

This is what another ingormant gave us

"*In our culture water means life*" (Stella, 17 August 2020, Mendong). According to Stella water means life. As confirmed by MELIA (2007), water is considered fundamental for life, as living creations can't survive for long without it. Egyptians, as religious people, drive lots of their culture features from their beliefs. The Bible referred that God instructed Profit Moses to strike a rock, and out of this flinty hardness flowed sufficient water to meet the needs of all people and their livestock, the Bible writers later saw this rock as a symbol of Christ.

From the various informants above, one can conclude that the various meaning of water is the same in all the cultures. This therefore means that culture cuts across meaning there are some aspects of life that is the same in all cultures.

**8.5 Cultural and traditional uses of water**

These ethnic groups have their own different ways in which they used water and the values and perception they have on it. According to Gretchen, water is use as cleansing agents in everything we do. In his words:

> *In the Muslim community, the process for cleansing body parts is a type of ritual purification, or ablution called Wudu. Wudu consists of washing the face, arms, then wiping the head and finally washing the feet with water. Wudu is an important part of ritual purity in Islam. It is governed by fiqh (Islamic*

> *jurisprudence), which specifies rules concerning hygiene and defines the rituals that constitute it before prayers* (Gretchen 2019).

According to Gretchen, the mulims puts a great value to water because of the cleansing ritual they do before praying. Meaning that, a Muslim most clean-up his/her body before praying doing ablusion. They do the cleansing to be pure before Allah so that their prayers will be answered as they pray.

When one look at the Ewondo people, it can generally be seen that most of these villages are concentrated around large or big rivers. This is very natural given that their water sources have not undergone any technological connection into the community. But today in Yaoundé VI, where we have the Ewondo as the indigenes of the area, their water is no more natural because technological knowledge has help them connect their water from distant sources to where they are. So, they have sources like streams, drilled wells, tap water, mineral water and springs. In the Ewondo culture, they give a lot of importance to the water sources because of the belief they have towards it. During our fieldwork, we gathered some of the importance of water to a Ewondo man. This is what some of the informants (Beti) gave us:

> *In the Beti land of, there are a lot of water sources like rivers, seas, lakes, rain water, bottled water, well and tap water. But when it comes to traditional practices in the land, more importance is given to the river which is flowing. Water to us is considered as life, centre of everything, divine substance because it heals. This water that we used is mostly from the river or sea. We used river water because it is moving and we consider it that it carries along our words to the "Gods" of the land where he hears and answers our supplications whenever we table them. If we use water from the lake or any small stream, we believe that our message will not reach the gods and our supplications or blessing will not be granted* (Grek,16 of July 2020, Mendong)

According to Grek, water is life, meaning if there is no water, there will be no life. They also consider it as a divine substance because it heals; this there therefore means the Beti man use water as medication. Culturally, the Beti man sees water as life meaning if there is no water then life cannot exist. So, they give a lot of value to water, especially that from the natural source like rivers and streams. They also believe that big streams or rivers are able to transmit their messages to their gods. That is why they give much value to rivers because of their belief.

Another informant gave us this concerning the restriction of people entering into a river:

> *In our village like the Eton, we have the Sanaga River which is strictly for the native who are initiated to enter the water. This is because we know that, the ancestral spirits live in it. There are sacrifices that we do in the water to please the gods of the land. So this does not permit anybody to do any activities like fishing, sand collection and swimming* (Grek, 16 of July 2020, Mendong).

From Grek this point of view, only initiated persons are allowed to enter into Sanaga River. Meaning even the sons of the soil who are not initiated cannot enter the river. To them, the river is a home for the ancestors who protect the community so they will not like any kind of person to pay them visit. The natural environment provides homes for the gods of Eton people; they believe that their gods live in the rivers. So, much respect and value is given to the rivers.

This is what another informant told us:

> *We used water to carryout purification rite called "TSOO". We do this purification when someone dies of accident, hanging and when an act of incest is committed. So water, fowls, goat and other herbs are used for the purification rites. The initiator kills the fowls with his teeth, drink some of the blood pour the rest into the pot containing water and other things. Some incantations and words are being spoken unto the pot. After this process, the use is used to wash the family of the deces, people who committed incest, the untimely death to prevent such death from happening in the family again. Also, in the case where a man is of age, the same rituals are being done but this time speaking long time and more to the deces family which is a blessing to them.* (Grek, 16 of July 2020).

From Grek, one can see that water is a very necessary in the culture of Beti people. All of their incantations and purification rites use water. It is this same water which is consider life that is able to stop untimely death and is also use to bless the people. Cultural interpretation water at this point, this people know that water is a purification agent because it is from the natural environment, so they are to adapt and survive in their land because nature is helping them to survive.

We met another informant and this is what he told us:

> *We used water to carryout widowhood practices. This happens when a woman loses her husband, she is being isolated for about 3months, the last day, she is rubbed with a mud, she walks naked to the stream where she is being washed by the initiator. This is mostly done prove to the innocent of the woman to show that she is not responsible for the death of her husband. If after the process and she is guilty a dreadly illness will attack her which will finally leads to her death. We also do rituals practices with new born babies. When a child is put birth, he or her first bathe is given by a woman who is considered to have spiritual powers more than the other women in the village.The water she uses is consider to be*

> *secred.after the bathe, the mother and father of the child, they walk together with the initiator to the river, as they pour out water into the river, incantations and words of blessings, success, open doors which will follow the child as he or she grows. In our farms, some incantations are being done using water and other herbs. After this this process, the water is being poured round the plantation or farming area so the the crops will do well. These also help to prevent the animals from eating the crops when they come close to the farm* (Frank, 17 of October 2020, Mvog-Beti).

From Frank's point, water still stands at the centre of everything. The water which is used for purification is also used for blessing of a child as he or she grows up. This water is naturally found in the environment and is interpreted differently as confirmed by the informant above in hios words.From Frank's point of view, the farm produce depends on the incantation that is done using water. One can say say when ever the crops are not doing well it clearly signifies that no ritual was performed. The assertion above is just confirming the cultural interpretative theory, where the absence of farm produce is said to be as a result of no incantation not done on the crops.

This is what another informant said about the use of water in their culture (wimbum community):

> *Water is used during traditional marriage ceremony. This is done when a father drinks of the cup and gives his daughter to show to the public he whom she has chosen to spend her life with. We use water because individuals have gradually accepted Christianity and so are avoiding palm wine which they think is alcoholic in nature. In our village, we sprinkle water around the Fons seat in every occasion believing that it drives away any evil spirit around the area. Water is also used for cleansing of the village every year using a peace plant and we believe that if that cleansing is not done, the things or activities in the village will not go on smoothly. Water is also used as medication in cases where biomedicine and tradition has failed. The head of the family carries the water in a calabash talk to it and gives it to the patients. After that the process the individual does not take long to get healed* (Marion, 15 of July 2020, Mvog-Beti).

According to Marion's words, one can actually see the various uses of water in their village. Water which is used in placed of wine is used mostly by the Christians who believe that wine has alcohol in it which is not permitted to be consumed by the Christians. At this point, one can see how culture is dynamic as time goes on. Secondly, they also believe that when the chief is going out to attend an occasion, there are always some evil spirits around the area where the fon will seat that is why they will use water to and sprinkle around the fons seat before he sits down. Thirdly, water is also a cleansing agent in the village, which traditional rulers use water to cleanse the village every year. They believe that as the year is ending,

there is a need to start a new year with purity that is why water is used for cleansing together with a peace plant which symbolises peace and unity in the community. Furthermore, one can also see that water is used as medication, especially when all other medicine has failed. This water is being given to the patient by the head of the family after he has spoken some words to the water.

This is what another informant from the Wimbum community said

> *In my culture, stream or a spring is a home for the gods of the land. The spring is the source where every member of the community fetches water, so its acts as the spiritual relationship between the inhabitants and the gods. Also the wimbum man will never urinate in the stream or any source of water. They believe that if you do it then you are not going to drink the water again. Furthermore there are some crimes in the wimbum land that when you do it, it definitely means you that you don't need to drink water from the land again like insulting the gods of the land. Water also acts as a medium of solidarity in the land, it is difficult to find a wimbum man selling water to another person or a stranger. When an individuals does that he or she is considered as an outcast. Fast flowing stream in the wimbum land is use as a means of disposal of evil children "obanjeh". This kind of children don't move or even creep, found saliva uncontroleable coming out of their mouth all the time. The obanjeh child is taken to this fast running stream with food like cocoyams and egusi soap in a calabash, the food is placed beside the child at the river banks by the parents and they leaved him or her there alone. After a day or two and the child is found at that position, it means the child has gone back to where he or she came from. Some traditional practitioner at time hide themselves to see if the child will want to come back to the society and if it is discovered like that they will send the child back to its spiritual world* (Ngwang,10 of October 2020, Simbock).

From Ngwang information, one can see clearly how water is use in the wimbum land as a means of solidarity, disposing of eveil spirit children, habitat for the gods and its also acts as the relay relationship between the gods and its people. This is confirmed by what Geertz is saying concerning cultural interpretation of water in different culture.

Another informant from the Bamileke said:

"*I my culture, water is used to settle disputes in the community, it is use to bless money and it is also use as medication*" (Angela, 10 of August 2020, Melen). To Angela, water is use in settling disputes in their community when people qurell or have an arguments or fight and its is also use as medication incases when an individual is sick. From the pont above, it confirms

what Cliford Geertz is saying about cultural interpretation, how different cultures interpret water in their various communities.

We meet another informant from Mankon and this is what she said, in my village,

> "*There is a palace water called allahgnhi meaning people water fin the village. This water use to bless the village with food, peace and harmony when the fon is living rihtly with his people and it is where disputes are being settled when they are brought in the palace"* (Neh, 18 of July 2020, Jouvence)

From Nehs point above, one can see that water is a center of peace and productivity in the Mankon land. This is because the water reacts when ever there is some wrong goingon in the village, and when there harmony and peace it has it way of reacting to the people. This pont is confirmed by Clifford in work of cultural interpretation of water in the Mankon village.

Cultural differences play a key role in the way water is perceived, valued and managed in different societies. World health and poverty eradication have cultural connotations, culture has positive and negative health impacts on individual well-being in particular women's health. Water management practices should be adapted to specific cultures as they constitute distinct systems of knowledge and behaviour. Water resources management strategies must take culture fully into account. Intercultural dialogue should be a guiding principle for raising awareness, promoting and developing educational tools. Cultural diversity is a source of sustainable practices and innovative approaches, and indigenous knowledge holders and scientists should cooperate in finding solutions to water-related problems.

Water is important in every aspect of life. The Beti man has his own way and importance given to water because of its value to the community. The Beti man values water because they use it for various activities like: cooking, cleaning, marriage rites, funeral rites, purification, initiation process, new born rituals and supplications and as medication.

The data analysis above validates what Clifford (1973) said about cultural interpretation. Water use by the Beti man shows how important water is in their culture, how they see and value water in their community. It further clarifies how the Beti man interacts positively with his environment. It is this environment that has water, and it is this water that the Beti man depends on for his purification, blessing and supplication.

The water we drink is absorbed by the intestines, and circulated throughout the body in the form of body fluids such as blood. These perform various functions that keep us alive. They deliver oxygen and nutrients to the cells, and take away waste materials, which are then eliminated with urination. When the body temperature rises, blood circulation to the skin increases, enabling heat dissipation though sweating, helping to keep the body at a constant temperature.

**Functions of body fluid**

| | |
|---|---|
| Transport (of body fluid) | Oxygen and nutrients are distributed throughout the body, and waste material is eliminated from the body. |
| Temperature regulation | Blood circulation to the skin and sweating increase heat dissipation, helping to keep the body at a constant temperature. |
| Maintain constancy of internal environment | Body fluid properties are kept constant to maintain an efficient metabolism. |

Source: OTSUKA (2020)

Apart from the various uses of water in the body, the fluid in the body is also use for fertilization. The sperms that comes out of the man body is in liquid form and that gives the importance of waterin the culture for reproduction is part of the community of human existence. This gives the importance of man in the society, for if a man is unable to give out sperms that are not fertile he is looked upon as a vegetable man because he cannot reproduce.

This what another informant told us concerning water as blessing.

> *In my family, my father uses saliva to bless his children. But before he does that. He speaks words of blessing to the children then go to each of his child and spit saliva into the chest of his children. So he believes that if his children are succeeding today is because he blessing that was saliva is working in for good towards his children* (Mildred, 10 September 2020, Mendong).

According to Mildret point of view, her father always blesses them with saliva from his mouth. He does that to when ever he feels all is not going well with his children and that has been working well for them. That is water which comes out from human system in the form of saliva is use for blessing.

### 8.6 The cultural effect of water pollution in cultures

In the Ewondo culture, when the water is dirty, it has its own effects on them aside from what the scientist will say. This is what an informant gave us during our fieldwork:

> *When water is dirty in our village, it means the gods are angry, their intention is to kill anybody who does not respect the laws. The water is not only dirty but it gets dry rendering the people to have water shortage. No rain which eventually causes the crops to dry, animals die and aquatic animals like fish also die* (Grek, 16 of July 2020, Mendong).

According to Grek, dryness of their river, no rain fall during the rainy season and dead of aquatic animals is as result of dirty water which means the gods are angry with the people. They do this just to cease water which is considered as life in their community. In their culture, they have their law and rules that need to be respected by the indigenes and when these cultural laws are not respected, it has its repercussion on the population. So, the environment they lived in need to be taken care of and it is guided by the laws put in place by the people for them to adapt to their environment.

This is what another informant gave us:

> *In our area now, there is no river here, so its makes it difficult for us to perform our traditional rites into town since we always use but river. This has been very difficult because we have to travel back to our village to be able to do some rites that could have been done in town* (Grek, 16 of July 2020, Mendong).

From Grek, one can say that there are some traditional rites that could have perform in town, but due to the absence of river in this area, it makes it difficult. So they have to go to their villages each time they have some traditional rites to perform, which is costly and time consuming. The Beti people love their culture such that the absence of big rivers makes it impossible for them to perform certain traditional rites in town. So some of them turn to neglect or not doing their tradition because of lack of rivers in Yaoundé VI area since some of them will not like to travel to their various villages for the rites.

This is what Neh told us concerning polluted water (allahgnki) in their village.

> *The allahgnki water in our village is the point where it confirms whether there is going to be annual dance in the village or not. The fon goes to this water holding a calabash with his chinda. At the water point, when the fon dips the calabash in the water and they send it out with wood ash robe on it, it means the fon is not living rightly with his people. At this point there is no annual dance and the village suffers from low food production and no peace in the community* (Neh, 18 of July 2020, Jouvence).

According to Neh point above, it is the water and the fons calabash that detect annual dance in the village. Meaning if the fon is not living rightful with his subjects, there will never be an annual dance in Mankon land. This is confimed by UNESCO 2021 that, The values of water to human well-being extend well beyond its role in supporting life-sustaining functions, and include mental health, spiritual well-being, emotional balance and happiness. life satisfaction and happiness depend to a great extent on water: water can appeal to people for spiritual reasons, or through scenic beauty, because of its importance for wildlife or recreation, among others. Water plays an important role also across faith-based traditions worldwide, symbolizing elements as diverse as life, purity, renewal and reconciliation, but also chaos and destruction

Most of the churches today use water for several reasons. This is what one of the informant told us concerning water.

*"In our church, water is use for baptism as a sign of washing away sins from an individual. It is water that links us to God meaning, God is living water. like a verse in the bible that says living water comes from the lord"* (Blessing, 14 of August 2020, Melen). According to blessing, water reperesent God since it is the medium through which people get access to God. This is conformed by MELIA 2007 The Bible referred that God instructed Profit Moses to strike a rock, and out of this flinty hardness flowed sufficient water to meet the needs of all people and their livestock, the Bible writers later saw this rock as a symbol of Christ.

### 8.7 The cultural causes of water pollution and water scarcity

Apart from what the science will talk about water pollution and water scarcity, culture has its own way of interpreting water pollution and scarcity. During our field study, we met one of the informants and this is what he told us:

> *When our river is dirty, it is considered that the gods or ancestors are angry or could be caused by the way we live in our villages. For example, before they die,*

> *they had set out some principles that none should go against it like incest, stealing and disrespect. When this rules or laws are not respected, they will decide to make the water dirty. Cutting life from the people since all of their activities depends on water. When water is dirty, it signifies that something negative is going to happen in the land. Even though this particular one does not last for long and only nobles in the village can notice it* (Grek, 16 July 2020, Mendong).

From the above point of view, the dirtiness of the river signifies that the people are not living by the laws that were put in place by their forefathers. It also signifies that something negative is going to happen to the people and this is just to prepare the people to what will happen to them. Culturally, water is life because if there is no water life cannot exist on earth. The way the Beti man values water because they know it is their source of life. They have their rules, customs that guides them to protect their water sources from being polluted or drying off. When issues like water pollution and water scarcity are observed in their area, it is concluded that the population or some individuals have violated their rules and need cleansing for the water to be useable.

Other than water and sanitation, socioeconomic status may affect diarrhoeal morbidity or mortality. Socioeconomic conditions like per capita income, occupation or literacy rate, as important factors affecting diarrhoeal morbidity found statistically significant difference in diarrhoeal cases in their study areas (Tripoli) which was correlated with the educational level of household head and financial status. Level of income and better socioeconomic conditions also have a lot to do with having better living styles (Malik *et al* 2012). It is also considered that people having better life styles and socioeconomic condition showed more acceptability to pay for water services in the rural communities of the developing countries. This eventually reduces the chance of getting water-bornediseases (Malik *et al* 2012). The interaction of inhabitants has caused a lot of negative impacts to the people. Instead of the environment being a solution to the people, humans have interacted with the environment in a negative way that is causing harm more than good to the people. Some of these activities occurred naturally while some are being caused by the human being.

Some of the interactions with the environment like improper disposal of waste materials, chemicals from farm lands have caused a lot of harm than good. All of these activities have polluted most of the water resources present in the environment. Making it unfit for human consumption and as well as aquatic organisms. This has been confirmed from

the informants we met in the field who disposed of waste in streams and rivers that are around their various homes.

This is what an informant told us concerning causes of water shortage in the wimbum land.

> *In the wimbum community, when the gods are angry, food production starts reducing and when it extend to water then it really means the crime is very grevoius. Crimes like sabotaging the gods, by the fon is a very serious issue against the gods. When ever this happens in the land, the people suffers a lot till when the gods anger most have calm down* (Ngwang, 10 Oct 2020, Simbock).

To Ngwang, before the stream dries off in the wimbum land the fon or the notables most have committed a grevious offense by insulting or sabotaging the gods. To this effect, the gods gets angry and purnish the people by drying off the stream cutting its links from the community until when they are apppeaced by the population.

### 8.8 Cultural adaptation to water scarcity and water pollution

Given that many cultures have their ways of interpreting water scarcity and water pollution, there are ways they also try to sorts out these issues of water pollution and water scarcity in their cultures. We met some informants and this they told us**.**

> *In our community, when there is long droughtness and polluted water, the elders of our land will have to do some sacrifieces depending on the cause of water pollution and water scarcity. In the case where some one committed incest which is consider to be a taboo in the land, the two people are called up for cleansing using palm wine, red oil and water is used to bath them. Slauters of folws and goat offered to the gods of the land for cleansing. And if it is that the gods where angry at the whole community, all the members of the community are called outside the village, everybody gathers at the market square where fowls, goats, salt red oil and palm wine is being scarifies to the gods of the land. After the process, the fowl and goat is being prepared and shared among all the community members cleansing the land for potble water to return in the community (* Grek, 16 July 2020, Mendong).

According to Grek, to make peace with the gods, a lot of fowls, goats, redoil, palm wine is offered to the gods of the land to appeace them so that the village can return to its norman activities of having potable water which is very vital to the society.

This is what another informant told us

> *In my culture, when there is water pollution or water scarcity, it means that the offense is very grevious. And for the gods to be appeace, the individuals who offended the gods are either send out of the village or they are ask to sacrifies fowls, goats, salt, palm oil and palm wine to the gods for cleanising. After all this is done, the water will return to its original state and there will be sufficient water in the land* (Ernest, 14 May 2020, Etoug-ebe).

To Ernest, most of the individuals or commits the grevious crimes rendering the community into challenges are sent out of the village. So that the rest of the community members do not suffer from the crime they know nothing about.

We meet another informant and this is what she told us

> *In my village, water always use to detect if there will an annual dance in the community. So when the water does not give the significance which is the calabash with palm oil rub on it, it signifies that there is a problem in the community meaning the fon has offended the people. And for this tobe resolve, the fon has to make peace with all this subject and the community members so that the annual dance can be held in his village. And when the fon most have appeace the gods, the calabash dip into the water cames out with palm oil rub on it which signifies unity, love and fruitfulness in the community* (Neh, 18 November 2020, Jurvence).

According to Neh, it is the fon behaviour with his subjects in the community that determines wether there will be an annual dance in the community or not. Menaing that if the fon wants peace in his community, he should always keep a cordial relationship with his people.

From the above analysis, one can see that this chapter clearly explains what water means in many, cultures, the various names, how it is been use, causes of water scarcity and water pollution and its adaption startegies.

# GENERAL CONCLUSION

Our research work is titled “coping strategies for access to potable water in urban areas: the case study of Yaoundé VI sub-division in Cameroon”. Efficient water management is important in maintaining the health and wellbeing of the population. This study focused on issues relating to vulnerability of water crisis and adaptation to water scarcity. This is to enhance understanding of the complex issues involved in global water scarcity and demand, especially in urban areas. At basic access level, the households are, therefore, very vulnerable to water scarcity meaning that the requirements for basic hygiene could barely be satisfied in urban areas especially in Yaoundé VI council area. With this, the State and some NGOs have been trying to meet up with the project to supply water to the community and ameliorating those that are bad and protecting those that need to be protected.

The following research questions were formulated to guide us during the field project. What are the coping strategies put in place by the inhabitants of Yaoundé VI council to resolve water?. The secondary research questions were; what are the various water crisis faced by the populations of Yaoundé VI?. What are the possible adaptations strategies put in place by the population to better cope with the water problem?. What is the role of water management actors (Water and Energy Office, NGOs, and the beneficiaries) in the study area in terms of responsiveness and accountability?.

The main research hypothesis was: population uses different strategies like drilling of boreholes, treating of water before consumption. the secondary research hypothesis are as follows; Population faced problems like scarcity of water, water pollution, water-borne diseases and environmental pollution.The said population has diversified over the years by using nearby streams, tap water, wells, springs and lakes as sources of water in Yaoundé city is experiencing water shortages and poor management in terms of water quality and quantity.. The inhabitants have resorted in using filter, boiling of water, salt, detergents, and use of bottled and plastic water. The Government, Ministry of Water and Energy, NGOs and stakeholders should make sure that citizens have potable water in their localities.

The main objective of this research was to identify the different coping strategies put in place by the population to overcome water crisis. To identify and evaluate the different water sources, used by the population to cope with water crisis. The secondary research objectives were: To identify the various problems that have resulted from insufficient water, polluted water that is affecting the indigenes, to unveil different strategies used by the Yaoundé inhabitants to solve their problem of water.To analyse the role of potable water

management actors (Water and Energy Office, NGOs, and the beneficiaries) in the study area in terms of responsiveness and accountability.

Anthropological research methods were used to verify our hypothesis, the primary and secondary research methods. The primary research methods had to do with the fieldwork exercise with an extensive use of qualitative and quantitative research methods and its technics which consisted of direct observation, participant observation, in-depth interviews, historical inquiry photography and questionnaire. The secondary research methods had to do with the gathering of information from published and unpublished books, thesis, articles and journals.

The cultural ecological theory of Julian Steward, and interpretative theory by Geertz, came into relate the environment and the adaptation of the people in their environment despite the adversities they go through. Thus, assessment of vulnerability and adaptation to access to potable water is an integrated approach which requires social, economic situation and physical data. Consequently, the main indicators of vulnerability and factors influencing adaptation to water scarcity that have been identified from the literature using a deductive approach were adopted for use in this study. In Yaoundé VI, the maladaptation to the environment is more pronounced due to the harsh socio-economic situation of Cameroon today, characterised by high unemployment and socio-economic crisis.

Expenditure on water was found to be very high, mainly due to low income level and sourcing water from natural reservoirs which could be a health risk in terms of water- borne diseases. The sources of water were generally shared with other domestic demands such as livestock feeding, watering and general laundry. It is this situation that further exposes households to risk of water-borne diseases. The acquisition of water generally tended to involve long distance travel and time resulting in less water available for households' thus increasing vulnerability to water scarcity. Government support in limiting vulnerability to water scarcity was generally peripheral and the households relied on water supply without much water quality monitoring, management, funding and leadership from the state government.

From our research findings, we discovered that getting access to potable water in the Yaoundé VI council area is difficult and it is perceived by different people in different areas. Yaoundé VI council area has a lot of natural sources of water, that is, springs and streams.

Other sources include rain, mineral water, well and CAMWATER. This confirms what we had developed in our hypothesis. Urbanisation which is rapid growth of population, and Yaoundé VI is experiencing it. Example of such was found at Ako-Ndoe where some natural sources that were flowing at a high volume have now reduced due to increased in population. Sewage disposal is a weakness to Yaoundé VI council area. Most of the houses in these neighbourhoods do not have good access to toilets while some canalised theirs directly into the streams and environment used by many others in the community. Household waste is being disposed carelessly in the environment due to the fact that the company responsible for waste collection is unable to get to some of these quarters due to poor road network.

Access to potable water is really a problem because of the continuous seizure of water in the town by the CAMWATER. Hardship has also contributed to the poor access to potable water in that, it is difficult for the poor to get potable water given that they cannot afford to dig up a good well or forage. They cannot equally afford to get mineral water for themselves and those who can do that can only do for the new-born babies of 1-6 months, believing that the child's system can support any water from any source from 6months. The fact that there is no money is causing many of the population to consume polluted and contaminated water without filtration or any form of water purification which causes water-borne disease .These point above confirms what we had as research hypothesis.

The major constraints that were identified affecting households' ability to adapt to water scarcity in the study area included increasing aridity, low stream flows, siltation, poor aquifers, distortion of hydrological balances, desertification and high evapotranspiration rates, all of which collectively made up natural and artificial constraints in adaptation to water scarcity in urban areas.

The economic and technological constraints in adaptation to water scarcity were identified as inability to acquire appropriate new technology, inability to acquire alternative water sources. Also, high cost of water supply equipments, weak indigenous technology, low level of dissemination of modern technology and low skills on water resources management. Institutional constraints included weak formal institutions, weak social cohesion, and inadequate supply infrastructure. Lastly, there were legal and policy constraints including poor of comprehensive water policy and poor synergy in the various formal institutions addressing water supply in urban areas.

There is a general poor government policy on adaptation to water scarcity Yaoundé VI and this indicated poor governance in water supply. This was particularly illustrated by the lack of water pricing, which is a central factor in modern water supply situation. The socio-economic factors affecting adaptation to water scarcity in Yaoundé VI included high cost of modern technology, weak nature of local technology, weak community organisations, weak formal institutions, low income levels, lack of social cohesion and poor health conditions.

From the fieldwork, we found out some of the effects of water pollution and water scarcity are as follows: polluted water is one of the factors that are leading to the high mortality rate in the world. Some of these diseases include diarrhoea, typhoid, stomach disorder and cholera. Most of the inhabitants have suffered from these diseases a lot while some had effective treatment and some have taken it as their life time illness that has no cure and they called “my sickness” as if it was created by them. The fact that there is water scarcity, the population had to spend most of their time fetching water just to do domestic work like cooking and laundry. Most of the children spend their time carrying water instead of spending their time to study or resting, preparing for school the following day. This has caused many to have a drop in their school performance. Some parents will cut off their sleep just to make sure that they fetch water by 3-4am in the morning in order to get a good quantity of water. In effect, or body needs a lot of rest after a hard working day. So when the rest is not given, it tends to suffer from stress and body weakness. All of these points confirmed the hypothesis that was proposed.

Furthermore, the research also revealed some sociocutltural adaptive strategies used by the inhabitants to be able to cope with water pollution and water scarcity in the environment. Some of the strategies were as follows: for the contaminated water, some people boiled their water before drinking. This is in order to kill the germs or bacteria found in the water. But just few of the people do boil water for drinking. Some people used filter even though at different level depending on their income. But at least they could boast of something they could use to filter their water before consumption. Some inhabitants do purify their well water using salt and “eau de javel” before fetching it after every one month.

Concerning water scarcity, the population has developed a lot of strategies to make sure that they cope with the situation around. Some of the people who do not have springs around or CAMWATER, resorted to well water which is available in the neighboring

compounds even though some faced embarrassment whenever they want to carry water from their neighbors. Some people who are well todo are able to dig a borehole that uses an electric water pump to pump water from the well and whenever there is light failure, most of them resort to mineral water. Most of the natural sources are crowded with large population and farming around the area.

Some families could go for a hunger strike because they do not have water to cook food. Some reduce the number of times they do have their bath and reduced the rate at which they do laundry. Some inhabitants had to change their livelihood activities because of water scarcity like switching from vegetable seller to grandnuts. Women who are engaged in selling "Sha" had to change to other business and reduced the rate at which the "Sha" is being cooked.

We saw the different ways water is used in Yaoundé VI like domestic chores and cleaning. Apart from this, the Beti man uses water for purification, supplication, medication and that is why they hold a great value to water especially rivers. Because to them is life, centre of all things and a divine substance.

We found out that the rate of water-borne disease is still at a very high rate in most of the hospitals. In Etoug-Ebe hospital, out of the patients that consult in a week, 500 of the patients have gastroenterisis and typhoid. In Biyem-assi hospital, out of the pre-natal consultation in a week, 85% of the pregnant women suffer from water-borne disease. In 2019 at Biyem-assi hospital, a lot of children between 0-5years suffered from water-borne diseases.

In addition, some of the population, who are infected by water-borne diseases, device their own means of treatment. From the research, we discovered that just about 10% out of a hundred go to the hospital for treatment whenever they have typhoid, diarrhoea or dysentery. About 15% go for road side drugs for their treatment without consultation and lastly 75% of the populations do auto-medication. Their reasons were based on the fact that they do not have enough money to go to the hospital. Some do not like the waiting time in the hospital and some complained about the carelessness of some nurses in the hospital. They only go to the hospital when ethno-medicine has failed them.

Our fieldwork also revealed that most of these coping strategies are not effective due to the fact that some of the water sources are contaminated by the inhabitants who lived

around these sources and they are the same people who suffer from it most. Some of the people do not washed their filter for weeks or months. There are some filters that use battery and it has its expiring date. When it does and the user is not vigilant enough to discover that, the family will drink contaminated water. In all, the income level of the population has a lot to play when it comes to getting access to potable water. The poor continue to suffer from water problems while the rich have no problem with water. Water scarcity adaptation strategies are rarely used in Yaoundé VI mainly due to high poverty levels and carelessness about water and sanitation education.

There is general lack of comprehensive government policies on water scarcity that would be useful in creating an enabling environment for adaptation to water scarcity. Water pricing would not be an effective adaptation strategy as concerns dealing with water scarcity issue in urban areas. Lack of private investment incentives and its slow adoption and assimilation in development plans, with regard to water scarcity, is due to many socio-economic factors in decision-making. High cost of adaptation of technologies, high poverty levels, limited alternative water sources, large household size contribute to low adapting strategies. There is also lack of social organisation, cohesion in water scarcity management structure and poor health conditions of the people.

Factors influencing choice of coping strategies such as income, education and land tenure are reported to be significant determinants of choice of coping strategy. Households that are relatively wealthier more educated and or own the property they live on are more likely to drill wells and/or install storage tanks (Caprara *et al*., 2009, Choe et al., 1996). However, these perceptions are themselves mainly influenced by how households assess the reliability of their supply relative to that of their peers. The rate of high unemployment in the area has caused many to relocate to other quarters where they can have good water, while most of the youths go out of the country for greener pasture which is actually reducing the working-age group in Yaoundé VI and Cameroon in general. If the coping strategies were effective, we believe the rate of water-borne diseases would have reduced in this area. But from the statistics given to us from the different hospitals, the rate of water-borne diseases is increasing instead of reducing with all the presence of NGO and what the State is doing.

Some other key issues we discovered that, most of the public places like schools, markets and churches do not treat their water for the students and pupils. The council (workers) do not know some of the areas that really need water and some of them think or

know that Yaoundé VI council area all have CAMWATER so it really does not boarder them. In order to prevent water pollution by disposing waste proper, some of the inhabitants refuse giving out part of their land for site for waste collection cans to stand. The state or the council has limited or no cordial relationship with the population. Another issue is, the council it self-does not have powers on its own to carry out some projects.

The inhabitants also saw the needs that people should diversify livelihoods to limit vulnerability to water scarcity. Attempts should be made to improve income levels by investing in activities that would improve the economy of urban areas especially to those with little or no income that would directly impact on household income levels. This can be done through tax price reduction in some activities that will encourage the people to do petit business for themselves.

Policies on education, research and development for Yaoundé VI should include water supply in order to address vulnerability to water scarcity. Education on water issues is needed by the, managers and operators of water supply schemes. Since everyone in the population uses water and has a vital interest in any supply scheme, educational programs should be meant for the whole population. Everyone in the community is affected by water crisis, so the community needs to be targeted for any sensitization and education.

We discover that most religious bodies use water for blessing and cleansing of sins.some communities like the Bamileke use water for medication and to settle disputes in their land. The wimbum people use water as disposal of evil children, use water for medication, and it is a relay between the gods and the community. Culturally one can say that the population are suffering from the purnishment of the gods of Yaounde VI. Because they donot respect their home by keeping it clean but rather they use it as waste disposal site.

We found out that the population of Yaoundé VI is ready to be training on water technologies, especially those addressing inadequacies in indigineous water technology need to be encouraged through government interventions. The aim of any water education/public relations/information/propaganda program needs to be to develop both as a whole, and, in each individual, attitudes which will ensure supply of water of appropriate quality and quantity to sustain the community. The role of education is to inspire everyone in the community to be thinking about water in constructive ways. If each person can be encouraged to consider how they, personally, can save water and preserve its quality. How

they can contribute ideas to increase the community water resource and how they can contribute to the community effort to increase and preserve the available water resource, then the education system may be considered to have been a success.

It was also found out that, important issue that should be considered together with education is that of public participation. The more the local people are encouraged to involve themselves in the development of rules and regulations and development of policies concerning water use protection will be good for the community. Public participation is often seen as being slow and difficult, even obstructive to advancement, but when the public (the local people) are not involved in the decision-making, they have no right of ownership and most of the problems outlined above become the norm. Public officials and engineers often object to public participation.

We also found out the council Yaoundé VI do not have the full responsibilities. If the council is given the full responsibilities in making its decisions and projects, they will best know how to go about every activity and be responsible for their actions towards their inhabitants. There is need to increase research funding in the field of water supply in order to generate useful information for planning and decision making. Like in areas where there are a lot of natural water sources, there should be many ways to better the sources for the community. The governments do not provide enough funding to the councils so, they are able to carry out their duties effectively. Intervention measures need to take into account differences in households and their effects on vulnerability to water scarcity.

It was discovered that council has water and sanitation experts but their work is not visible to the population of Yaoundé VI. It is their duty to go about and inspect some of those wells that are not well constructed and give the people some education on how to go about it. Some of those open wells are dangerous especially in places or compounds where there are children. There have been many cases where children ran into the well while playing or want to carry water so these things need to be considered for the betterment of the community.

It was noted that in Yaoundé VI women and children are ones in water collection. Women have a great influence in shaping the attitudes of the young, the future majority of the population. Women often have an important role (with children) in water collection, where there is no direct household supply, women largely control in-house water use. Since women provide much of the labour in water collection and disposal, they have considerable incentive

to find and develop less labour-demanding methods to conduct these activities. It is therefore imperative that women be at least, as well educated on water issues as any other members of the community. They are not encouraged to contribute their ideas on ways to use water most effectively and therefore to maximise the benefits that can be gained from their labour. They are also best placed and have the greatest incentive to develop methods of water collection and distribution that minimise labour requirements and free them to make other contributions to community needs.

The water crisis is persisting in the area because of the maladaptive functioning and interaction the people have with the environment. Even though the farmers know that using high quantity of fertilisers helps in food poisoning and water pollution, they still use it in great quantity. The people are still heady disposing of their waste in streams. The rate at which the population is growing, compared to other councils, the situation will be worst in the next 5years to come if nothing is being done.

The implication of our finding shows that, CAMWATER has not been able to extend its tentacles to all the quarters in Yaoundé VI council area. It also implies that their aminities are limited or insufficient because their participation is limited to those quarters that have pipe borne water. This also implies that CAMWATER management team has not been replacing some worn-out pipes in the quarters and there is also lack of water management committee. Furthermore, it also shows that the town planning sector has done little controlling houses build in marshy or swampy areas. This also shows that the health sector is doing little as far sensitisations of water-borne disease is concerned and even the population careless about any campaign that is usually done quarters. This work identifies the various water points especially the natural spring sources that can be harnesses for the community. It also brings out the dilapidated state of the water sources in Yaoundé VI council area. Furthermore, it brings out the various water-borne diseases that the community is currently suffering from. This work also shows the various strategies the community or the Yaoundé VI inhabitants are using to cope with water pollution and water shortages.

We cannot say that our work is completely exhaustive because there are some challenges that made our work not to be complete. The fact that our work was limited just in Yaoundé VI is a point that the work is not exhaustive. This is because some of the result obtained from this area might be different in other council areas. Also the fact that Yaoundé VI is a heterogenous town also made it difficult to access all the cultural believes on water

and its values to the population. Furthermore, the point that most of the stakeholders do not related with the Yaoundé VI council directly made some of our finding difficult. Lastly given the fact that our work limits us only to identifying problem and adapting strategies without proposed solutions make our work incomplete.

The knowledge and experience obtained from this study shall contribute to the development of medical anthropology and revailing environmental health-related issues caused by contaminated water. For further research, this applies to students of human geography who find interest in researching on spontaneous urban settlement, one can also do research on water and development. It is going to be of help to the community, government and NGOs who will wish to know more about Yaoundé VI area concerning its water distribution.

# BIBLIOGRAPHY

## General books

**Collins, J., Thomas G., Willis, R., Wilsdon, J. (2003):** *Carrots, Sticks and Sermons*: Influencing Public Behaviour for Environmental Goals. Report Version 4.0.Demos and Green Alliance. DEFRA

**Darwin, C., (1871)**: *The Descent of Man and Selection in Relation to Sex*. London: John Murray.

**Darwin, C., (1872):** *The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (6th ed.). London: John Murray.

**Djouda Feudjio Yves Bertrand, Nguendo Yongsi H. Blaise & Socpa Antoine (Eds.) (2015).** Offres, recours et accès aux soins de santé « parallèles » en Afrique : Des acteurs enquête de légitimité médicale, sociale et institutionnelle. Québec - Canada, Différence Perenne

**Fanso, V.G., (1989**): *Cameroon History for Secondary Schools and Colleges, Vol. 1: From Prehistoric Times to the Nineteenth Century*. Hong Kong: Macmillan Education Ltd,.

**Foster, G., and Anderson B., (1978)**: *Medical Anthropology*. New York: John Wiley and Sons.

**Geertz, Clifford. (1973):** *The interpretation of cultures*. New York: Basic Books.

**Gwanfogbe, M., Meligui, A., Moukam, J., and Nguoghia, J. (1983):** *Geography of Cameroon*. Hong Kong: Macmillan Education Ltd.

**Honey, M. (1999):** *Ecotourism and Sustainable Development*: *Who Owns Paradise.* Washington DC: Island Press.

**Inhorn, M. (ed.). (2010):** *Anthropology and Public Health*: *Bridging Differences in Culture and Society*. Oxford University Press.

**Janakarajan, S., (2002)**: Conflicts over the Invisible Resource: Is there a Way Out? in Moench, Marcus,, Elizabeth Caspari and Ajay Dixit (eds.) *Rethinking the Mosaic: Investigations into Local Water Management*. Kathmandu: NWCF and ISET.

**Karen, M. (2003):** *Stakeholder involvement in water management: necessity or luxry?*. University of Guelph North York

**Khantzian, E. J. (1999)**: *Treating Addiction as a Human Process*. Northvale, NJ: Jason Aronson.

**Khantzian, E.J., Halliday, K.S., and McAuliffe, W.E. (1990):** *Addiction and the vulnerable self:* Modified dynamic group therapy for drug abusers. New York: Guilford Press.

**Lamikanra, A. (1999):** *Medicine and Microbiology*, 2nd ed. Lagos: Amkra books.

**Lyse. S. R., (1988):** *what is ground water*. Cornel University

**Millenium Ecosystem Assessment (2005):** *The Millennium Ecosystem Assessment*: *Ecosystems and Human Wellbeing: Synthesis*. Washington, DC: Island Press.

**Malinowski, B**. **(1913):** *The family among the Australian Aborigines: a sociological study*. London: University of London press

**Mbonji, E.**, **(2010):** *Les cultures vérités: Le soi et l'autre : ethnologie d'une relation d'exclusion*. Editions Etoile, 2000. ISBN 0403065410, 9780403065417

**Merton, R. K. (1968):** *Social theory and social structures*. Enlarged edition. New York: The Free Press.

**Moore,** L**., Judith, G. (1983):** *Adaptation to high altitude*. Annual review of anthropology.

**Mutanga, S., Pophiwa, N. and Simelane, T.,(2013)**: Cities as green economy drivers: Making a case for green cities in South Africa, in S. S. Mutanga, T. Simelane and N. Pophiws (eds), *Africa in a changing global environment: Perspectives of climate change adaptation and mitigation strategies in Africa*. Pretoria: Africa Institute of South Africa.

**Neba, A. (1999):** *Modern Geography of the Republic of Cameroon*, 3rd ed. Bamenda: Neba Publishers.

**Ngoh, V. J. (1996):** *History of Cameroon since 1800.* Limbé: Presbook.

**Peel, J.D.Y., Herbert Spencer (1971)***: The Evolution of a Sociologist*. London, 1971.

**Pickett, S., Kolasa, J., Jones, C. (1950)**: *Ecological Understanding: Ther Nature of Theory and the Theory of Nature.* Amsterdam: Elsevier.

**Socpa Antoine, Nkwambi Wilfred, Charpentier Cédr**ic (2008). *Analyse compréhensive de la sécurité alimentaire et de la vulnérabilité en République du Cameroun*. Programme Alimentaire Mondial

**Scott, J. (1828):** *On the disinfecting properties of labarraques preparation of cholrine*. S. highely

**Schutkowski. H (2001):** *Human Ecology*: *Biocultural Adapations in Human Communities*. Berlin: Springer.

**Watson, S. and Gibson, K. (1995):** *Post Modern Cities and Space*, Oxford and Cambridge, Mass.: Blackwell.

**SPECIFIC BOOKS**

**Abraamovitz, J (1996)**: *Imperiled waters, impoverished future: the decline of fresh water ecosystem.* Washington, DG: World Water Institute.

**ADB (2001)**: *Asian Water Supplies: Reaching the Urban Poor*. London: Alliance House Publishers Inc, ADB and IWA.

**Allan, T., (2003)**: *A New Sanctioned Discourse*: Occasional Paper 50, SOAS Water Issues Study Group, School of Oriental and African Studies/Kings College University of London.

**Alexander, L. C., Autrey, B., DeMeester, J., Fritz, K. M., Golden, H. E., Goodrich, D. C., and McManus, M. G. (2015):** *Connectivity of Streams and Wetlands to Downstream Waters: A Review and Synthesis of the Scientific Evidence.* Washington, DC: U.S. Environmental Protection Agency.

**Allen, R., Pereira L., Raes, D., and Smith, M. (1998):** *Crop Evapotranspiration*: *Guidelines for Computing Crop Water Requirements.* Rome: United Nations. FAO Irrigation and Drainage Paper No.. 56.

**Amit Kohli, Karen Frenken, Cecilia Spottorno (2010)**: *Disambiguation of Water Use statistics.* Paris: FAO.

**Anderson, E. N., and Marja Anderson (1973):** *Mountains and Water*: *The Cultural Ecology of South Coastal China*. Taipei: Orient Cultural Service.

**Austin S, Bradley C. Parks, Michael J. Tierney, Andreas F, Dreher.A, and Vijaya R. (2013):** *China's Development Finance to Africa: A Media-Based Approach to Data Collection*. Project 289. CGD Working Paper 323. Washington DC: Center for Global Development.

**Ballance, T. and Tremolet, S. (2005)**. *Private sector participation in urban water supply in Sub- Sahara Africa*. Frankfurt am Main: KfW Bankengruppe.

**Barkatullah, N. (1999)**: *Pricing, Demand Analysis and Simulation*: *An Application to a Water Utility.* Ph. D. Thesis, University of Sidney.

**Beil, Laura (2017):** Pollution killed 9 million people in 2015. *Science News*, October 20, 2017. Retrieved 1 December 2017.

**Bergsen, H., Lunde, L., (1999):** *Dinosaurs or Dynamos? The United Nations and the World Bank at the Turn of the Century*. London: Earthscan.

**Birongo M., and Nhi Q. L, (2005)**: *An Analysis of Water Governance in Kibera, Kenya*. Roskilde University, Denmark.

**Blomqvist, A. (1996)**: *Food and Fashion*: *Water Management and Collective Action among Irrigation Farmers and Textile Industrialists in South India*. Likkoping Studies in Art and Science, No. 148, Lippoking.

**Bradford, Alina. (2015):** *Deforestation: Facts, Causes and Effects*. https://www.livescience.com/27692-deforestation.html, Retrieved 13 November 2016.

**Burk, E.**, **(1990)**: *Thought and details on scarcity*. Indianapolis IN: liberty fund, Ink

**Buckley, R. (1994):** *The Battle for Water: Earth's most Precious Resource.* Linoln: European Schoolbooks Ltd.

**Burman R, Pochop L O (1994):** *Evaporation, Evapotranspiration and Climatic Data*. Amsterdam: Elsevier.

**Burrows, G., Acton, J., and T., Maunder. (2004):** *Water and Sanitation*: *the Education Drain.* London: Water Aid.

**Chambers, K. and Forbes, L. (2004)**: *Safe pipe water*. Swindon: WRc plc.

**Chapman, D. (1996):** *Water Quality Assessments: A Guide to Use of Biota, Sediments and Water in Environmental Monitoring* (2nd ed.). London: F and FN Spon.

**Chartres, C. and Varma, S. (2010):** *Out of Water*. *From Abundance to Scarcity and How to Solve the World's Water Problems.* Upper Saddle River, NJ: FT Press.

**Choe, K., Varley, R. C. G. And Bijlani, H. U. (1996)***: Coping with intermittent water supply: Problems and prospects.* Dehra Dun: Environmental Health Project.

**Cosgrove, B. and Rijsberman, F. R. (2000):** *World Water Vision*: *Making Water Everybody's Business*. London: World Water Council & Earthscan Publications Ltd.

**Davidson, G. (2011):** *Waste Management Practices: Literature Review*. Dalhousie: Dalhousie University Office of Sustainability.

**De Sherbinin, A.** (1997): *Water and Population Dynamics*: *Local Approaches to a Global Challenge*, Report on a Collaborative Initiative and Workshop at IUCN's World Conservation Congress, Montreal, Canada, October 1996. Gland, Switzerland: IUCN, the World Conservation Union; Washington, DC: Population Reference Bureau

**Diersing, N. (2009):** *Water Quality: Frequently Asked Questions.* , Key West, FL.: Florida Brooks National Marine Sanctuary.

**Diwakar H and N Nagaraj (2002):** Impact of Water Pollution on Food Security and Environment: Bearing the Brunt, *Wasteland News*, August-October .

**Endler, J., (1986):** *Fitness and adaptationnatural selection innthe wildlife*. Monographs in population. Vol.21 PPrinceton University press.

**Engelman, R. (1998):** *Profiles in Carbon: An Update on Population, Consumption and Carbon Dioxide Emissions*, Washington, DC: Population Action International.

**Falkenmark M. and Rockström J. (2004)***: Balancing Water for Humans and Nature: A New Approach in Ecohydrology*. London: Earthscan.

**Fetter, C. W. (1994):** *Applied Hydrogeology*. Third Edition. Upper Saddle River, NJ.: Prentice Hall.

**Fube, E. M. (2009):** *Insufficiency of Potable Water Supply and Typhoid Endemicity in Dchang (Cameroon): A Health Consequence of Rapid Urban Growth*.

**Galbraith, J.K. (1958):** "*Chapter 22: The Position of Poverty". The Affluent Society*. Boston: Houghton Mifflin.

**Gardner-Outlaw, T. and Engelman, R. (1997):** *Sustaining Water, Easing Scarcity*: *A Second Update*. Washington DC: Population Action International.

**Gleick P H., (2000):** *The World's Water*. Washington, DC: Island Press.

**Gleick, P. (1993):** *Water Crisis: A guide to the worlds fresh water resources*. New York: Oxford University Press.

**Gleick, P. (1993):** *Water in Crisis: A Guide to the World's Fresh Water Resources*. New York: Oxford University Press.

**Gleick, P. (2001):** *The World's Water, Waste Not, Want Not*: *the Potential of Urban Water Conservation in California*. Oakland, CA: Pacific Institute.

**Gleick, P. (2002):** *Dirty Water*: *Estimated Deaths from Water-Related Diseases 2000–2020.* Pacific Institute for Studies in Development, Environment, and Security.

**Goel, P.K. (2006)**. *Water Pollution: Causes, Effects and Control*. New Delhi: New Age International.

**Gray, N. (2008)**: *Drinking water quality*. 2nd ed. Cambridge: Cambridge University Press.

**Harrison, Roy M., ed. (2001):** *Pollution: Causes, Effects and Control* (4th ed.). Cambridge: Royal Society of Chemistry.

**Hinrichsen, DR, Obey, BU, Padhyay UD (1998*):* *Solutions for a Water-short World.* Baltimore: Johns Hopkins School of Public Health, Population Information Program. Population Reports, series M, no. 14.

**Hoffman G J, Evans R G, Jensen M E, Martin D L, Elliot R L:** *Design and Operation of Humio Tsunoda ... Environmental toxixology: biological and health effects of pollutants*. Boca Raton, London & New York: Taylor and Francis.

**Howard, G. and Bartram, J. (2003):** *Domestic Water Quantity, Service, Level and Health.* Geneva: World Health Organisation.

**Jacobson, M., Webster, M., Vaira, K.V. (2012):** *The Future of Water in African Cities*: *Why Waste Water*. Washington DC: Water Partnership Programme.

**Joyce, J., Granit, J., Hall, D., Haarmeyer, D., Lindstorm, A., (2010)**: *The impact of global Financial Crisis on financial flows to the water sector in Sub Saharan Africa*. New York: Oxford University Press.

**Kalma J D and Franks S W (2000*):* *Rainfall in Arid and Semi-Arid Regions*. The University of Newcastle Callghan, Australia.

**Kaluli, J., Wangeci., C and P. G., (2009):** *Home Biomechanical and Environmental Engineering*. Department, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya.

**Karanja, G., and Fissiha T., (1990)**: *Soil and Water Conservation in Bibliography with Annotations.* Nairobi: University of Nairobi, Department of Agricultural Engineering; and Stockholm: Swedish Agency for Research Cooperation with Developing Countries (SAREC)).

**Karanja, J., and Ng'ang'a E., (2008):** *Sanitation and Hygiene in Kibera Slums, Nairobi*: *Women Concerns and Nurses Promotional Tools*. Bachelor's degree project, Roskilde University.

**Kundell, J. (2008):** *Water Profile of Malawi*. Ontraio: Food and Agriculture Organisation.

**Lambi, C., and Ndenecho, E. (2010):** *Ecology and natural resources development in the Western high lands of Cameroon.* Bamenda: Langaa.

**LaMoreaux, Philip E.; Tanner, Judy T, eds. (2001)**: *Springs and bottled water of the world: Ancient history, source, occurrence, quality and use*. Berlin, Heidelberg, New York: Springer-Verlag.

**Lange, G. and Hassan, R. (2006)**: *The economics of water management in Southern Africa*: *an environmental accounting approach*. Cheltenham: Edward Elgar Publishing Limited.

**Langbein, W.B.; Iseri, Kathleen T. (1995):** *Manual of Hydrology: Part 1. General Surface-Water Techniques (Water Supply Paper 1541-A).* Reston, VA: USGS.

**Lenssen., (1991):***Nuclear Waste: The Problem that Won't Go Away*. Washington DC: Worldwatch Institute.

**Luis Santos Pereira et al (2009):** *Coping with water scarcity.*Technical University of Lisbon.

**Mafanny, G. T. and Fantony (2006).** *Ground water quality in Cameroon and its vulnerability to pollution*. Amsterdam: Taylor and Francis.

**M.J. and McKichan, K.A. (1981):** *Hammer, Hydrology and Quality of Water Resources*. London: John Wilkey and Sons Incorporated

**Malesu, M., Oduor, A., and Odhiambo, J., (2007)**: *Green Water Management Handbook, Rainwater harvesting for agricultural. Production and Ecological sustainability.* World Agro-forestry centre.

**Mark Q. Sutton., and E.N Anderson (1992)**: *Introduction to Cultural Ecology. 2nd edition.* Lanham. New York, Toronto, Plymouth: Lanham.

**Marsalek, J., Jimenez.C, B., Karamouz, M., Malmqvist, P.-A., Goldenfum, J., and Chocat, B., (2008)**: *Urban water cycle processes and interactions*. Leiden: Taylor and Francis.

**McCarthy, J.J. (2001):** *Climate Change 2001: Impacts, Adaptation, and Vulnerability*, Cambridge: Cambridge University Press.

**Mogaka, H., Gichere, S., Richard D. and Rafik Hirji (2006):** *Climate Variability and Water Resources Degradation in Kenya: Improving Water Resources Development and Management.* Washington, DC: The World Bank. World Bank Working Paper, No. 69.

**Molden, D., (2007):** *Water for food, Water for life*: *A Comprehensive Assessment of Water Management in Agriculture*. London: Earthscan/IWMI.

**Olley J, Wilson DC, Read A., (2006*):*** Getting results: realising the benefits of community participation in strategic planning for municipal waste management. Paper presented at ISWA Annual Conference 2004, Rome, October 2004.

**Olley JE, Wilson DC, Read AD, Vreede Vd.,(2004*):*** Building municipal capacity for strategic waste management planning. Paper presented at ISWA Annual Conference 2004, Rome, October 2004.

**Oscar E. (1923):** *Outline of ground-water hydrology, with definitions*. Washington, DC: US Geological Survey (USGS).

**Pallet J. (Ed) 1997):** *Sharing Water in Southern Africa*. Windhoek: Desert Research Foundation of Namibia.

**Pejack, E., (2011):** Solar pasteurization. In: Ray, C., and Jain, R. (Eds.), *Drinking Water Treatment: Focusing on Appropriate Technology and Sustainability*. New York: Springer.

**Pejack, E., Al-Humaid, A., Al-Dossary, G., Saye, R., (1996**): *Simple devices for solar purification of water.* Paper presented at Second World Conference on Solar Cookers, Universidad Nacional, Heridia, Costa Rica, July 12–15.

**Pennington, K.L and Cech, T.V. (2010)**: *Introduction of water resources and environmental issues*. New York: Cambridge University Press.

**Pidwirny, M. (2006):** *Fundamentals of Physical Geography*, 2nd Edition. http://www.physicalgeography.net/fundamentals/8j.html

**Payment, P. and Robertson, W. (2004):** *Safe pipe water Health* Canada, Ottawa, Canada

**Pimentel D, Berger B, Filiberto D, Newton M, Wolfe B, Karabinakis E, Clark Spoon E, Nandaopal A. (2004):** *Water Resources, Agriculture, and the Environment*. Ithaca (NY): New York State College of Agriculture and Life Sciences, Cornell University. Report 04-1.

**Post, J. (2002):** *Redefining the Corporation: Stakeholder Management and Organizational Wealth.* Stanford, Cal.: Stanford University Press.

**Poswat (2004):** The importance of gender in waste management planning: A challenge for solid waste management. *Proceedings of the 8th World Congress on Environmental Health,* Durban, South Africa, May 1995

**Sadler C. (1997):** *Guidelines for the provision of Township Engineering Services and Amenities in Residential Township Development.* Unpublished Discussion Document on Solid Waste Management. Rivonia: Bergman-Ingerop. 1VIp

**Savenije, H. (2000):** Water scarcity indicators; the deception of the numbers. *Physics and Chemistry of the Earth B***, No. 25**, pp. 199–204.

**Serageldin, I. (2010):** *Toward Sustainable Management of Water Resources,* Washington, DC: World Bank.

**Shiklomanov, I.A. (1998):** *World Water Resources*: *A New Appraisal and Assessment for the 21st Century.* Paris: UNESCO.

**Sipes, J.L. (2010)**: *Sustainable solutions for water resources*: *policies, planning, design, and implementation*. New York: John Wiley and Sons, Inc.

**Smet, J., Van Wijk, C. (ed.), (2002):** *Small Community Water Supplies: Technology People and Partnership* .IRC International Water and Sanitation Centre (Technical paper series 40), Delft, The Netherlands.

**Strang, V. (2023):** *Water Beings: from nature worship to the environmental crisis,* London: Reaktion Press.

**Strang, V**. **(2021):.***What Anthropologists Do,* revised edition, London, New York: Routledge.

**Strang, V**. **(2015):** *Water: nature and culture,* London: Reaktion Books; University of Chicago Press

**Strang, V.(2009):** *Gardening the World: agency, identity, and the ownership of water.* Oxford, New York: Berghahn Publishers.

**Strang, V**. **(2009).** *What Anthropologists Do,* Oxford, New York: Berg.

**Strang, V. (2004):** *The Meaning of Water,* Oxford, New York: Berg.

**Strang, V**. **(1997):** *Uncommon Ground: cultural landscapes and environmental values,* Oxford, New York: Berg.

**Strang, V. (1988):** *Citizen's Guide to Environmental Assessment,* Toronto: Government of Ontario Press.

**Tacoli, C., McGranahan, G. and Satterthwaite, D**. **(2015):** *Urbanisation, rural-urban migration and urban poverty.* London: International Institute for Environment and Development.

**Van der Leun, Justine (1 September 2009):** "A Closer Look at New Research on Water Safety". *AOL Health*. Retrieved 1 September 2009.

**Wada, Yoshihide; Van Beek, L.P.H.; Bierkens, Marc FP (2012):** Nonsustainable groundwater sustaining irrigation: A global assessment. *Water Resources Research*, Vol. **48, No.** 6, W00L06. Bibcode:2012WRR....48.0L06W. doi:10.1029/2011WR010562.

**Ward, A. and Trimble, S. (2004):** *Environmental Hydrology*. Boca Raton: Lewis Publishers.

**White, G., (1999):** *Drawers of Water Domestic water use in East Africa*. London: The University of Chicago Press.

**White, G. F. and Bradley, D. (2001):** *Drawers of Water*: *30 years of Change in Domestic Water Use and Environmental Health in East Africa*. Nottengham London and Boulder, Col. DFID, Design and Publishing Ltd.

**Zhang, G. L. (2002):** *China's Water Supply and Demand in the 21st Century.* Beijing: Water and Hydropower.

**Zhang, G. L. (2002):** Statistics Modeling of Daily Urban Water Consumption, Trends, Changing patterns and Forecast, *Water Resource Research.*

**Zhu, Q., Gould, J., Li, Y. and Ma (2015):** *Rainwater Harvesting for Agriculture and Water Supply*. Beijing: Springer.

**Zuane, J. D. (1990):** *Drinking Water Quality*: Standards and Control. New York: Van Nostrand Reinhold.

## METHODOLOGY

**Berg, Bruce Lawrence; Lune, Howard (2012):** *Qualitative Research Methods for the Social Sciences* (8th ed.). Boston.

**Bryman, A., (2012):** *Social research methods*. Oxford. Oford university press

**Creswell., (2012):** *Education research:Planning, conducting,and Evaluating quantitative and qualitative research*. Boston. M.A Pearson

**Marshall, Catherine and Rossman, Gretchen B. (1998):** *Designing Qualitative Research*. Thousand Oaks, CA: Sage.

**Savin-Baden, M.; Major, C. (2013):** *Qualitative Research: The Essential Guide to Theory and Practice*. London: Routledge.

**Taylor, S. J.; Bogdan, R. (1984):** *Introduction to Qualitative Research Methods*: The Search for Meanings (2nd ed.). Singapore: John Wiley and Sons.

**Shadist et al.,(2002):** *Experimental and Quasi-experimental designs for generalized causal inference*. Boston, Mass, USA: Houghton-Mifflin Company.

**Vermeulen**.H., (2008): *Early History of ethnography and ethnology*: Anthropological discours in Europe and Asia 1970-1801. Leiden

**ARTICLES**

**Abarca Guerrero, L., Maas, G., Hogland, W. (2013):** Solid waste management challenges for cities in developing countries. *Waste Management,* Vol. 33, No. 1, pp. 220–232. doi:10.1016/j.wasman.2012.09.008. PMID 23098815.

**Ako, A.A, Shimada, J., • Eyong, G. E.T. and Fantong, W. Y. (2010):** *Access to Potable Water and Sanitation in Cameroon within the Context of Millennium Development Goals* (MDGS). *Water Science and Technology*. online Abstract, Unpublished.

**Admassu, M., Wubshet, M. and Gelaw, B. (2004):** A Survey of Bacteriological Quality of Drinking Water in North Gondar, *Ethiopian Journal of Health Development*, Vol. 18, No. 2, pp. 112-115.

**Ahile, S. I, Udoumoh, E. F, Adzande, P. (2005):** Residents Coping Strategies with Water Scarcity in Makurdi Town, Nigeria Mediterranean. *.African Journal of Social Sciences*. Vol. 6, No. 4, pp.

**Alcamo, J., Doell, P., Henrichs, T., Kaspar, F., Lehner, B., Ro¨sch, T., Siebert, S., (2008)**: Development and Testing of the Water GAP 2 Global Model of Water Use and Availability. *Hydrological Sciences Journal*, Vol. 48, pp. 317–338.

**Alcamo, J., Floerke, M, and Maerker M., (2007*):*** Future long-term changes in global water resources driven by socio-economic and climatic changes, *Hydrological Sciences,* Vol. 52, pp. 247-275.

**Allen R G, Pruitt W O, Businger J A, Fritschen L J, Jensen M E, Quinn FH (1996):** Evaporation and transpiration. In: Wootton, T P, et al. (eds.) *ASCE Handbook of Hydrology.* New York: American Society of Civil Engineers, pp. 125–252

**Allen R G, Tasumi M, Morse A, Trezza R, Wright J L, Bastiaanssen W, Kramber W, Lorite I,Robinson C W (2007b):** Satellite-based energy balance for mapping evapotranspiration with internalized calibration (METRIC). – *Journal of Irrigation and Drainage Engineering,* Vol. 133, pp. 395–406

**Amawa S.G and Kimengsi J.N. (2009):** Accelerated Urbanization in the Buea Municipality: The Question of Sustainability in the Provision of Social Service, *African Journal of Social Sciences*, Vol. 8, No 3, pp.

**Allen R G, Wright J L, Pruitt W O, Pereira L S, Jensen M E (2007)**: Water requirements. In: Hoffman G J, Evans R G, Jensen M E, Martin D L, Elliot R L (eds.) *Design and*

*Operation of Farm Irrigation Systems* (2nd Edition). St. Joseph, MI.: ASABE, pp. 208 – 288.

**Allen, R., Willardson, L., Frederiksen H. (1997)** Water use definitions and their use for assessing the impacts of water conservation. In: de Jager J M, Vermes L P, Ragab R (eds) *Sustainable Irrigation in Areas of Water Scarcity and Drought.* Proceedings of the ICID Workshop, Oxford. Oxford: British National Commission of the ICID, pp. 72 – 81.

**Alley W M (1984):** The palmer drought severity index: Limitations and assumptions. *Journal of Applied Meteorology and Climatology*, Vol. 23, Issue 7, pp. 1100-1109.

**Amegble. J. S. (2018):** Waste**:** African problem, Togolese Jesuit Interrogates. *Spotlight Africa, 18 June 2018.*

**Anderson DM, Gilbert PM, Bukholder JM (2002):** Harmful algal blooms and eutrophication: nutrient sources, composition, and consequences. *Estuaries,* Vol. 25, pp. 704–726.

**Arrandale, J. (2002):** *World Water Dynamics: Global Modeling of Water Resources*, in *London Journal of Environmental Management* Vol. 66, No. 3, pp. 249-267.

**Assallay, A. (1998):** "Silt: 2–62 μm, 9–4φ". *Earth-Science Reviews*. Vol. **45, Nos.** 1–2, pp. 61–88.

**Batisse M. (2000)**: Forefront: the challenges of shared and sustainable development. *Foresight*, Vol. 2, No. 5, pp 461-469.

**Bhavnani D, Goldstick JE, Cevallos W, Trueba G, Joseph Eisenberg JN (2014)**: Impact of rainfall on diarrheal disease risk associated with unimproved water and sanitation. *American Journal of Tropical Medicine and Hygiene*, Vol. 90, No. 4, pp. 705-711.

**Bouwer, H., (2002):** Intergrated Water Management for the 21st Century: Problems and solutions. *Journal of Irrigation and Drainage Engineering*, Vol. 128, Issue 4, pp. 193–202.

**Brooks, N. and Sethi, R., (1997):** The Distribution of Pollution: Community Characteristics and Exposure to Air Toxics. *Journal of Environmental Economics and Management*, 32, 233-250.

**Bryan, E., Deressa, T., Gbetibouo, G., and Ringler, C., (2009):** Adaptation to Climate Change in Ethiopia and South Africa: Options and Constraints. *Environmental Science and Policy*, Vol. 12, No. 4, pp.413-426.

**Burgess J., Harrison C. M. and Filius P. (1998):** Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning*, Vol. 30, No. 8, pp. 1445 -1460.

**Boxall ABA, Fogg LA, Blackwell P, Kay P, Pemberton EJ, Croxford A. (2004):** Veterinary medicines in the environment. *Review of Environmental Contamination and Toxicology*, No. 80, pp. 1–91.

**Brown, R.R., Keath, N.,Wong, T.H.F**., **(2009)**: *Urban Water Management in Cities*: Historical, Current and Future Regimes. *Water Science Technology*, Vol. 59, pp. 847–855.

**Caprara, A., Lima, J. W. D. O., Marinho, A. C. P., Calvasina, P. G., Landim, L. P. and Sommerfeld, J. (2009*):*** Irregular water supply, household usage and dengue: a bio-social study in the Brazilian Northeast. *Cadernos de Saúde Pública*, Vol. 25, pp. 125-136.

**Chew, Sing C. (2001):** *World Ecological Degradation*. Oxford: AltaMira Press, pp. 69–70.

**Cordery I (2003):** A case for increased collection of water resources data. *Australian Water Resource*, No. 6, pp. 95–103.

**Courault D, Seguin B, Olioso A (2005):** Review on estimation of evapotranspiration from remote sensing data: From empirical to numerical modeling approaches. Irrigation Drainage Systems, No. 19, pp. 223–249.

**Couth R. and Trois C (2010):** Carbon emissions reduction strategies in Africa from improved waste management. *Waste Management*, Volume 30, Issue 11, November 2010, pp. 2336-2346. Available at: http://www.sciencedirect.com/science/article/pii/S0956053X10002229

**Crumpler, L. S., and Lucas, S. G. (2001*):*** *Volcanoes of New Mexico: An Abbreviated Guide for Non-Specialists.* New Mexico Museum of Natural History and Science Bulletin. No. 18, pp. 5–15.

**Cunha.J.P, F.,(2014).** *Urinary Retention: Get the Facts on Causes and Treatment.*MedicineNet.http://www.medicinenet.com/urinary_retention/article.htm(Accessed 7 Apr. 2015).

**Damhaug,T., Gilgan-Hunt, E., Grey,D., Okaru-Bisant,V. Rothberg, D., Sharma, N., Valentina Rothberg, D.** *African water resources : challenges and opportunities for sustainable development*. Washington, D.C.: World Bank Group. World Bank Technical Paper, No. 331. Africa Technical Department series. http://documents.worldbank.org/curated/en/867161468767675673/African-water-resources-challenges-and-opportunities-for-sustainable-development

**Davis, Gloria., (2004):** *A history of the social development network in The World Bank*, 1973-2003 (The World Bank).

**Dion, C (1998).** *Monitoring of Pollution Regulation*: Do Local Conditions Matter? *Journal of Regulatory Economics*. No. 13, pp. 5-18

**Duncan, D.F. (1974b*):*** *Letter: Drug abuse as a coping mechanism.* American Journal of Psychiatry, Vol. 131, No. 174.

**Dwight, T., (2014):** *Remembering Gods gift of water*. worldpress. org

**Eyre, W.A., (2007):** *The distribution of fitness effect of new mutation*. Nature review genetics. Article 8,610-618

**Falkenmark, M. and Widstrand, C. (1992):** Population and Water Resources: A Delicate Balance. *Population Bulletin*, No. 47, pp. 1–36.

**Falkenmark, M. (1997):** A Water Perspective on Population, Environment, and Development. In Dasgupta, P. and Mäler, K. (eds.). *Population, Environment and Development.* Oxford: Clarendon Press, pp. 33-56.

**Falkenmark, Marlin, and Jan Lundqvist (1995)**: *Looming Water Crisis*: New Approaches Are Inevitable. In Ohlsson, L. (ed.) *Hydropolitics: Conflicts over Water as a Development Constraint.* London: Zed Books, pp. 178-213.

**Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L, and Calford JM (2005):** Water, sanitation, and hygiene interventions to reduce diarrhea in less developed countries: a systematic review and meta-analysis. *The Lancet Infectious Diseases*, Vol. 5, pp. 42–52.

**Freeman, R.E. and Reed, D.L., (1983**): *Stockholders and stakeholders:* A new perspective on corporate governance. *California Management Review*, Vol. 25, No. 3, pp.88-106.

**Fojong, N.L and Abongwa N.M. (2014)**: *Challenges of Water Crisis on Women's Socio-Economic Activities in the Buea Municipality*, Journal of Geography and Geology, Vol.6, No 4, pp.

**Folifac, F. Lifongo, L. Nkeng, G, Gaskin,S. (2009):** Municipal Drinking Water Source Protection in Low income Countries: Case of Buea Municipality Cameroon, *Journal of Ecology and Natural Environment* Vol. 1, No. 4, pp. 073-084, July, 2009 Available online at http://www.academicjournals.org/JENE

**Fombe L. F, Agbortoko M. A. (2014):** *Housing Standards, Household Health and Disease Nexus in the Buea Municipality. Journal of Sustainable Development,* Vol. 7, No. 4, pp.

**Gbolahan, A.O. and Coster, A.S. (2012***):* Impact of Water Scarcity and Drudgery of Water Collection on Women Health in Ogun of Nigeria. *Journal of Human Ecology*, Vol. 39, No. 1, pp. 1-9.

**Geldreich E., (1989):** Drinking water microbiology new directions toward water quality enhancement. *International Journal of Food Microbiology*, Vol. 9, pp. 295-312.

**Gleick, P. (1996)**: Basic Water Requirements for Human Activities: Meeting Basic Needs. *Water International*, Vol. 21, pp. 83–92.

**Gleick, P. (1998):** An Introduction to Global Fresh Water Issues. In Peter Gleick (Ed.), *Water in Crisis*. New York: Oxford University Press, pp. 3-12.

**Gleick, P. (1999):** The Human Right to Water. *Water Policy*, No. 1, No. 5: 487-503.

**Gumbo, B., Van der Zaag, P., Robinson, P., Jonker, L., Buckle, H., (2004)**: Training needs for water demand management. *Physics and Chemistry of the Earth*, No. 29, pp. 1365-73.

**Guyer, J. (1980):** Female farming and the evolution of food production patterns amongst the Beti of south-central Cameroon. *Africa*, Vol. 50, No. 4, pp. 341 – 356.

**Hoekstra A. Y. (2000):** Water Supply in the Long Term: A risk Assessment. *Physics and Chemistry of the Earth (B),* Vol. 25, No. 3, pp 221-226.

**Hoekstra A.Y. (1998):** Appreciation of water: four perspectives. *Water Policy*, No. 1, pp 605-622.

**Hoekstra, A., and Chapagain, A., (2007):** Water footprints of nations: water use by people as a function of their consumption pattern. *Water Resource Management*, No. 21, pp. 35-48.

**Johnson, T. and Sargent, C. (1996):** Ethnopharmacology: The Conjunction of Medical Ethnography and the Biology of Therapeutic Action. In Sargent, C. and Johnson, T. (eds.). *Medical Anthropology: Contemporary Theory and Method*. Westport, Connect.: Praeger Publishers, pp. 132–133, 151.

**Jager J M, Vermes L P, Ragab R:** *Sustainable Irrigation in Areas of Water Scarcity and Drought.* Proceedings of the ICID Workshop, Oxford. Oxford: British National Commission ICID, pp. 72–81

**Joshi, D. and Fawcett, B., (2001):** Water Projects and Women's Empowerment. *Journal of Physical and Chemical Reference Data*, Volume 24, Issue 3, May 1995, pp.1377-138

**Kandji, S., (2006):** Drought in Kenya: Climatic, Economic and Socio- Political Factors, *New Stand Points* (November-December), pp. 17-19.

**Karanja, J., (2011):** Improving water provision in Nairobi through control of non-revenue water. Global Water Summit 2011. Global Water Intelligence. pp.212–213.

**Katte, V. Y., M. F. Fonteh, G. N. Guemuh. (2003):** Domestic Water Quality in Urban Centres in Cameroon: A Case of Study of Dschang in the West Province, *African Water Journal*, pp. 43-54.

**Kimani, M.,. ,Wangui, E.,. and. Ngindu., A (2007):** Quality of Water the Slum Dwellers Use: The Case of a Kenyan Slum, *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, Vol. 84, No. 6 (November), pp. 829-838.

**Keshavarzi, A.R. et al (2006):** Rural Domestic Water Consumption Behavior*:* A Case Study in Ramjerd Area, Fars Province, I. R. Iran. *Water Research,* Volume 40, Issue 6, March 2006, pp. 1173-1178.

**Khawaji, A.D., Kutubkhanah, I.K. and Wie, J.-M. (2008):** Advances in seawater desalination technologies. *Desalinatio*n, No. 221, pp. 47–69.

**Kimengsi, J.N and Amawa, S.G (2015):** Water Rationing in the Buea Municipality: Patterns, Effects and Coping Strategies. *African Journal of Social Sciences*, Vol. 6. No 3.www. jhuccp.org/pr/m14edsum.stm.Assessed in April, 2015

**Kim, D.H. (2011):** *A review of desalting process techniques and economic analysis of the recovery of salts from retentates. Desalination*, No. 270, pp. 1–8.

**Kim, S.J., Ko, S.H., Kang, K.H. and Han, J. (2010):** Direct seawater desalination by ion concentration polarization. *Nature Nanotechnology*, No. 5, pp. 297–301.

**Kinney, Michael L. (29 January 2008):** Effects of urbanization on species richness: A review of plants and animals. *Urban Ecosystems*, Vol. **11,** 2, pp. 161–176.

**Lambi, C.M. and Kometa, S.S. (2009):** An Evaluation of Water Resources on the Eastern Slopes of Mount Cameroon, *Journal of Human Ecology*, Vol. 28, No. 1, pp. 47-55.

**Layzer, J. (2012):** Love Canal: hazardous waste and politics of fear. in Layzer, J. (ed.). *The Environmental Case*. Washington, DC: CQ Press, pp. 56–82.

**Lindsten, Don C. (September 1984):** Technology transfer: Water purification, U.S. Army to the civilian community. *The Journal of Technology Transfer*. Vol. **9, No.** 1, pp. 57–59.

**Lontou-Fogang et al., (2021):** *Trends of potential water-bornediseases at different health facilities in Bamboutos Division, West Region, Cameroon*: a retrospective appraisal of routine data from 2013 to 2017. Vol 19 . 19 (4): 616–628.

**Malik A, Yasar A, Tabindha AB, and Abubakar M.,(2012):** Water-bornediseases, cost of illness and willingness to pay for diseases interventions in rural communities of developing countries. *Iranian Journal of Public Health*, Vol. 41, No. 6, pp. 39-49.

**Manga, E, Tening, O and Read, D B. (2007):** Waste Management in Cameroon: A New Policy Perspective?. *Resources Conservation and Recycling Journal*, Vol. 10, No. 3, pp. 1-9.

**Maji, Kamal J; Arora, M; Dikshit, and Anil K., (2017):** Burden of disease attributed to ambient PM2.5 and PM10 exposure in 190 cities in China. *Environmental Science and Pollution Research*, Vol. **24,** 12, pp. 11559–11572.

**Matsuoka, N.; Murton, J. (2008)**: Frost weathering: recent advances and future directions. Permafrost Periglac. *Process*, Vol. **19, No.** 2, pp. 195–210.

**McDonald, R.I. (2008):** Global Urbanization: Can Ecologists Identify a Sustainable Way Forward? *Frontiers in Ecology and the Environment*, Vol. 6, pp. 99–104.

**McDonald, R.I. et al (2011**): Urban Growth, Climate Change and Freshwater Availability. *Proceedings of the National Academy of Sciences, U.S.A.*, Vol. 108, pp. 6312–6317

**McKinney, M. (29 January 2008).** Effects of urbanization on species richness: A review of plants and animals. *Urban Ecosystems*, Vol. **11**, No. 2, pp. 161–176.

**Mehta, L., (2001):** The Manufacture of Popular Perceptions of Scarcity: Dams and Water-related Narratives in Gujarat, India. *World Development*. Vol. 29, No. 12, pp. 2025 – 2041.

**Montgomery, M. (2008)**: The Urban Transformation of the Developing World. *Science*, Vol. 319, pp. 761–764.

**Moss, A. J.; Green, Patricia (1975*):*** Sand and silt grains: Predetermination of their formation and properties by microfractures in quartz. *Journal of the Geological Society of Australia*. Vol. **22, No.** 4, pp. 485–495.

**Molua, E. L and Lambi C.M. (2006)**: *Climate Hydrology and Water Resources in Cameroon*, CEEPA. (12)

**Mukuhlani, T. and Mandlenkosi,T.N.(2014):***Water Scarcity in Communities, Coping Strategies and Mitigation Measures*: The Case of Baluwayo. Journal of Sustainable Development; 7(1)

**Ndah A.B, Xue, Z. (2010):** *Water Logged but Thirsty*: A Case Study of the Relationship between Water Management and Health in Cameroon. Journal of Water and Resources Protection. WARP

**Ndi, H. N. (2009):** *Population Growth and Urban Agriculture in Yaoundé, Cameroon.* Journal of Applied Social Science Vol 8, No 2, 2009

**Nkwemoh, C. and Lambi, C.M. (2012):** *Water Crisis in the Yaoundé Metropolis, African Journal of social Sciences*. Vo. l3, No. 3, pp.

**OECD, (2003):** *Future Water Resources*: Towards a Demand-Side Solution. http://www.oecd.org/sge/au/highlight1VI.html. Accessed in January, 2015.

**Obatoyinbo, O. and Oyedotun, T. (2011*):*** Microbial/Bacteriological Analysis of Water Resources in Ikare and Arigidi Akoko of Ondo State, Nigeria, *Proceedings of the 1stEIT International Conference on Water Resources Engineering*, 18 -19 August, 2011, pp. 279 -284.

**Ochieng, G. M., Ojo, O. I, Ogedengbe, K., Ndambuki, J. M. (2011):** Open Wells, Sanitary Features, Pollutions and Water Qualities: Case Study of Ibadan Slums. *International Journal of the Physical Sciences*, Vol. 6, No. 13, pp. 3062-3073.

**Ohlsson, L (2000):** Water conflicts and Social Resource Scarcity. *Physics and Chemistry of the Earth (B),* Vol. 25. No. 3, pp 213-220.

**Okot-Okumu, J., (2015)**: Solid waste management in Uganda. In T. Simelane and R Mohee (eds). *Future Directions of Municipal Solid Waste Management in Africa*, Pretoria: Africa Institute of South Africa, South Africa, pp. 107-135.

**Oleg udouyk, Oksana Udovyk (2010):** *National Academy of science of Ukraine,Kyiv,Ukraine* Ozkan S, Tuzun H, Gorer N, Ceyhan M, Aycan S, Albayrak S, and Bumin MA. Water usage habits and the incidence of diarrhea in rural Ankara, Turkey. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, Vol. 101, No. 11, pp. 1131–5.

**Petraccia, L., Liberati, G., Masciullo S.G., Grassi, M. and Fraioli, A.,(2005):** Water, mineral waters and health. *Clinical Nutrition*, Vol. **25,** No. 3, pp. 377–385.

**Postel, G. C. Daily, P. R. Ehrlich., (1996):** Human appropriation of renewable fresh water. *Science*, Vol. **271**, pp. 785–788.

**Postel, S. L, Daily, G.C., and Ehrlich, P.R. (1996):** Human Appropriation of Renewable Freshwater. *Science*, Vol. 271, pp. 785–788.

**Ramires, Maria L. V.; Castro, Carlos A. Nieto de; Nagasaka, Yuchi; Nagashima, Akira; Assael, Marc J.; Wakeham, William A. (1995).** "*Standard Reference Data for the Thermal Conductivity of Water*". Journal of Physical and Chemical Reference Data. Vol. **24** No. 3, pp. 1377–1381.

**Rome. Farr, T.G., Rosen, P.A., Caro, E., Crippen, R., Duren, R., Hensley, Arouna, A. (2010)**: Determinants of Domestic Water Use by Rural Households without Access to Private Improved Water Sources in Benin: A Seemingly unrelated to bit Approach. *Water Resource Management*, Vol. 24, pp. 1381–1398.

**Stadler, B., (1998)**: *Linking aphid ecology with nutrients flues in a coniferous forest*. Ecology:75(5): 1514-1528

**Spengler, J.; Sexton, K. A. (1983)**: Indoor Air Pollution: A Public Health Perspective. Science. Vol. **221** (4605), pp. 9–17.

**Steward, J. (1955):** *The Theory of Cultural Ecology: The Methodology of Multilinear Evolution*. Urbana, Ill., University of Illinois Press, pp. 30-42.

**Swain A. (1998)**: A new challenge: water scarcity in the Arab world. *Arab Studies Quarterly* (ASQ), Vol. 20, No 1., Pp 1-11

**Swatuk, L. A., (2002):** The new water architecture in southern Africa: reflections on current trends in the light of 'Rio+10'. *International Affairs*, Vol. 78, Issue 3, pp. 507-530.

**Swatuk L. A. (2003):** From Rio to Johannesburg and Beyond: Ways forward for the Post WWSD Commonwealth. *The Roundtable*, Vol. 92, No. 1, pp 465-475.

**Taylor, Robert A.; Phelan, Patrick E. (2009):** Pool boiling of nanofluids: Comprehensive review of existing data and limited new data. *International Journal of Heat and Mass Transfer*. Vol. **52, No.** 23–24, pp. 5339–5347.

**Thompson, J. et al (2000):** Waiting at the Tap: Changes in Urban Water Use in East Africa over Three Decades. *Environment and Urbanization*, Vol. 12, No. 2, pp. 37–52.

**Tiwari, T. N. and Manzoor Ali (1988):** Correlations among water quality parameters of Industrial wastes I: Sugar Industry. *Indian Journal of Environmental Protection*, Vol. 8, No. 1, pp. 43-47.

**Tiwari, T. N. and M. Ali (1988):** Pollution of Subarnarekha River near Jamsedpur and the suitability of its water for irrigation. *Indian Journal of Environmental Protection*, Vol. 8, No. 7, pp. 494-497.

**Van der Leun, Justine (1 September 2009):** "A Closer Look at New Research on Water Safety". *AOL Health*. Retrieved 1 September 2009.

**Vörösmarty, C., Green, P., Salisbury, J., Lammers, R. (2000):** Global water resources: Vulnerability from climate change and population growth. *Science***,** Vol. 289, pp. 284–288

**Wagner, W.; Pruß, A. (June 2002):** "*The IAPWS Formulation 1995 for the Thermodynamic Properties of Ordinary Water Substance for General and Scientific Use*". Journal of Physical and Chemical Reference Data. Vol. **31, No.** 2, 398.

**Wallingford, H.R. (2003):** *Handbook for Assessment of Catchment Water Demand and Use.* Available at: www.hrwallingford.co.uk (accessed on 17 April 2012).

**Winslow, C, A., (1920):** "*The united field of public health" Modern medicine*. 2(1306):183-191.

**Wilson DC, Velis C, Cheeseman C., (2006):** Role of informal sector recycling in waste management in developing countries. Habitat International, Vol. 30, No. 4, pp. 797–808.

**Wilson DC, Whiteman A, Read AD.,(2003):** Strategic planning for solid waste management; an interactive toolkit for developing countries. *Waste Manage World*, pp. 55–60.

**Wilson, D.C. and Velis, C.A., (2014)**: *Cities and waste*: current and emerging issues, *Waste Management and Research*, No. 32, 797-799

**Winter, T.C. (2001):** The Concept of Hydrological Water Use. *JAWRA*, Vol. 37, No. 2, pp. 335-349.

**Wong, X.C. Chen, R. (2010):** Water Metabolism Concept and its Application in Designing Decentralized Urban Water Systems with Wastewater Recycling and Reuse. In: Hao XD, Novotny V, Nelson V (eds.) *Water infrastructure for Sustainable Communities*. London: IWA Publishing, pp. 199 – 211

**Wong, (2007):** Comparing Residents and Tourist Preference for Public Beach Access and Related Amenities. *Ocean and Coastal Management*, Vol. 53, pp. 245 -251.

**Yang H and Zehnder A.J.B. (2002*):*** *Water Scarcity and Food Import:* A Case Study for Southern Mediterranean Countries. *World Development,* Vol. 30, No. 8, pp. 1413-1430.

**Young, E. (2001)**: Global Population to Peak in 2070, *New Scientist.* http://technology.newscientist.com/article/dn1108. Accessed in June 2020

**REPORTS**

**AQUASTAT Database of FAO (2013):** *Water Resources Development and Management Service*. https://www.fao.org/aquastat/en/

**Bates, B., Kundzewicz, Z., Wu, S., and Palutik, J (eds.). (2006):** *Climate Change and Water.* IPCC Technical Paper 6. Geneva: IPCC Secretariat.

**BUCREP, (2010)**: *3e RGPH, Rapport de Présentation des Résultats Définitifs.* Yaoundé : Bureau Central des Recensements et des études de Population.

**Buea Council (2008)**: Gestion de l'eau de la commune de BUEA. Rapport de la mission ECTI de Juin 2008.

**Chelala, C. (2014)**: Water: A Big Challenge for Africa. *The Globalist*, September 21, 2014

**CAMWATER (2015):** We Engage Whole Heartedly to Serve You Better: Non-Stop Achievement... Available Online at:<www.camwater.cm>

**CBN (1999)**: Urbanization and Related Socio-Economic Problems in Ibadan Area. Research Department Occasional Paper No. 25.

**Central Groundwater Board (2007):** *Manual and Artificial Recharge of Groundwater. Central Groundwater Board.* Ministry of Water Resources of the Government of India.

**European Commission (2007a):** *Water Scarcity and Droughts*. Second Interim Report, DG Environment, June 2007.

**European Commission (2007c)**. *Addressing the challenge of water scarcity and droughts in the European Union*. Communication from the Commission to the Council and the European Parliament, COM (2007)414.

**EPA (1999):** *Water Use Standard, US Environmental Protection Agency*. Office of Water, Washington DC.

**EPA (1993):** *Preventing Water-borne Disease*: A Focus on EPA's Research [Electronic Version]. http://www.epa.gov/nrmrl/pubs/640k93001/640k93001.pdf. May 3rd, 2008.

**EPA (1999):** *Giardia: Risk for Infants and Children* [Electronic Version]. http://www.epa.gov/waterscience/criteria/humanhealth/microbial/giardiachild.pdf. Retrieved May 11th, 2008).

**EPA (2004):** *Understanding the Safe Drinking Water Act* . EPA 816-F-04-030.

**EPA (2016).** *What are Water Quality Standards?* Washington, D.C.: U.S. Environmental Protection Agency (EPA).

**FAO (2014)**: FAO and the Post-2015 Development Agenda Issue Papers Nourishing People Nurturing the Planet. Post-2015-Development-Agenda@fao.org www.fao.org/post-2015-mdg/

**Government of India (2002):** *The National Water Policy*. Ministry of Water Resources, New Delhi.

**Government of Karnataka (2000)**: Rural Water Supply and Sanitation in Karnataka. Strategy Paper 2000-2005. Rural Development and Panchayat Raj Department, Bangalore.

**ICCE (1996)**: *Erosion and sediment yield, global and regional perspective*. Walling B. W Webb

**IPCC (2000):** *Emission Scenarios: A Special Report of Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.

**IPCC (2007):** Water Scarcity and Global Warming: Time for Change. http://www.timeforchange.org/water-scarcity-and-global-warming.Accessed May 2014.

**Martin, N. (1999):** *Population, Households and Domestic Water Use in Countries of the Mediterranean Middle East International Institute for Applied Systems.* Analysis Report, Laxenburg, Austria.

**MELIA (2007):** *Water fundamental part of life* ( Access 14 December 2021)

**PAI (1999):** *Sustaining Water*: Population and the Future of Renewable Water Supplies. http://www.cnie.org/pop/pai/h2o-toc.htm. Assessed in June, 2014.

**Republic of Cameroon (1998)**: *Law No 98-005 of 14 April 1998 on Water Resources. Title I General provisions, 6th Legislature National Assembly.* Yaoundé: Republic of Cameroon.

**Schulze, R. and Perks, L. (2000)**: *Assessment of the Impact of Climate Change on Hydrology and Water Resources in South Africa*. ACRUcons report, 33. Pietermaritzburg, School of Bio-resources Engineering and Environmental Hydrology, University of KwaZulu-Natal.

**Turner K., Georgiou S., Clark, R., Bwker, S. (2004):** *Economic Valuation of Water Resources in Agriculture*. From the Sectorial to Functional Pespective of Natural Resource Management, FAO paper Report, No 27 Rome Italy.**UNEP (1996)**: *Assessing the Fresh Water Resources of the World.* https://www.unep.org/explore-topics/water/what-we-do/monitoring-water-quality/assessing-freshwater-quality

**UNDP (1994):** *Population and Water Resources Use.* New York: UNDP.

**UNDP (2006):** *Human Development Report: Beyond Scarcity: Power, Poverty and the Global Water Crisis*. New York: UNDP.

**UNDP (2011):** *World Urbanization Prospects: The 2011 Revision.* New York: United Nations Population Division.

**UNDP (2013):** *The Millennium Development Goals Report*. New York: New York. Availableonline:http://www.undp.org/content/dam/undp/library/MDG/english/The_MDG_Report_2012.pdf (Accessed on 8 March 2014).

**UNEP (2000):** Executive Director Calls on Cities to Adopt Integrated Water Management Strategy. Press Release UNEP/65. http://srch.1.un.org:80.

**UNEP (2012):** The UN-Water Status Report on the Application of Integrated Approaches to Water Resources Management. Available from: www.unwater.org/rio2012/report.

**UNEP and WHO (1998)**: The annotated digital atlas of global water quality. Global Environment Monitoring Sytsems (GEMS)/ water programme, Ontario.

**UNEP (2005).** Water assessment strategy, contribution to the overall implementation of the UNEP water policy and strategy.

**UNEP (1992):** The State of Environment: Saving our planet. Challenges and Hopes. Nairobi.

**UNEP (2002)**: Africa environment outlook, past, present and future: The State of Africa's environment and policy analysis.

**UNEP (2006):** *Water quality outlook*. Burlington: UNEP GEMS/Water Programme.

**UNESCO (2006):** Water Scarcity: The Importance of Water and Access (Retrieved online in December 2013).

**UNESCO (2009):** *Water in a Changing World.* http://www.unesco.org/new/en/naturalsciences/environment/water/wwap/wwdr/wwdr-2009/ (Accessed on 13 March 2012).

**UNESCO (2021)** : *Cultural values of water* ( Access on 21 March 2021)

**UNFPA (2009):** *State of World Population 2009: Unleashing the Potential of Urban Growth*. New York, NY: UNFPA.

**UN-Water and FAO (2007):** *Water Scarcity in Africa*. www.fao.com (Accessed in January, 20UNDP 2006).

**USEPA (2011b):** *Ground Water Rule (GWR).* Washington, DC: U.S. Environmental Protection Agency.

**Water Aid (2001):** Looking Back: the Long-term Impacts of Water and Sanitation Projects.

**Water Aid (2005):** National Water Sector Assessment, Madagascar.

**Water Aid (2006a):** Country Information, Madagascar.

**Water Aid (2006b):** Wider Impacts of Water, Sanitation and Hygiene Education Projects. Issue Sheet.

**Watson, R.T. and the Core Writing Team (eds). (2001*):*** *Climate Change: Synthesis Report. A Contribution of Working Groups I, II and III to the 3rd of the Intergovernmental Pan AR of IPCC on Climate Change.* Cambridge: Cambridge University Press.

**WHO (1993):** *Guidelines for Drinking Water Quality*. Vol. 1. 2nd edition. Geneva: WHO.

**WHO (2001):** *Water for Health: Taking Charge.* Geneva, World Health Organization.

**WHO (2004):** *Water, Sanitation and Hygiene links to Health: Facts and Figures.* Geneva: World Health Organization.

**WHO (2004):** *Guidelines for drinking quality water*. Geneva

**WHO (2008):** *Safe Water and Global Health.* Geneva: WHO.

**WHO/UNICEF (2012):** *Progress on drinking water and sanitation: Joint Monitoring Programme update 2012.* . https://www.who.int/publications/i/item/9789280646320

**WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation.** (2005). *Water for life: making it happen.* Geneva: World Health Organization.

**WHO and UNICEF, (2005):** *Water for Life: Making it Happen.* Geneva: WHO and UNICEF.

**World Bank (2001):** *World Development Report 2000/2001*: *Attacking. Poverty*. Washington, DC: World Bank.

**World Bank (2007):** *Water Rights and Compensation for Ecological and Environmental Services in River Basin.* http://www.worldwater.org (December, 2019)

**WRG (2009):** *World Resources 199VI-97: A Guide to the Global Environment*. Report by WRG, United Nations Environment Programme, United Nations Development Programme and the World Bank. Washington, DC: WRI.

**WRI (1995):** *World Resources Report*. New York: Basic Books &WRI.

**WWD (2006)**: *Water and culture*

**US EPA, OW (2015-11-18)***: Emergency Disinfection of Drinking Water*. US EPA. Retrieved 2019-01-11.

**UNICEF/WHO Joint Monitoring Programme (2010), Progresson Sanitation and Drinking Water:** *2010 Update: Household Water Treatment Guide*. Centre for Affordable Water and Sanitation Technology, Canada. March 2008

**DISSERTATIONS**

**Claude. C. K., (2011):** Stakeholders Participation: Myth or Reality?A Case study of Community Water Supply Management in Bambui-Tubah Village in Cameroon. Uppsala Universitet

**Epule, E, T. (1999):** Spatial Distribution of Wells and the Occurrence of Cholera in Douala: The Case of Bonabiri, Makepe and Bonassama neighbourhoods. Unpublished M.Sc. Thesis, FSMS, University of Buea.

**Folifac, F. (2003)**: Integrated Watershed Management in Cameroon: Institutional Aspect, Problems Identification and Solution Strategies: Case of mount Cameroon Region.Published Master Thesis. Universitat Stuggart, Germany.

**Katte, V. (2003)**: Domestic water quality in urban centers in Cameroon. incomplete

**Mafany, G. T. (1999):** *Impact of Geology and Sea Water Intursion on Groundwater Quality in Douala*. Unpublished M.Sc.Thesis, Department of Geology, University of Buea.

**Mawulikwame, M. (2011) Ph. D. Thesis** (Unpublished), Department of Theoretical and Applied Biology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

**Mumbe, M. (2013):** The Causes and Consequences of Water Shortage in Molyko Neighbouhoods, Buea Sub Division. Unpublished B.Sc. Thesis, Department of Geography, FSMS, University of Buea.

**Ninjeh, G. (2010):** Climate Variability and Water Resources Management in Santa Sub-Division. Unpublished M.Sc. Thesis, Department of Geography, FSMS, University of Buea.

**Tosam, H.N. (2009):**Population Dynamics and Socio-Economic Development of Buea Sub-Division.Unpublished M.Sc. Thesis, Department of Geography, FSMS, University of Buea.

**Wontany, E. N. (2006):** Saline water Intrusions into the Coastal Aquifers of the Mungo Basin, Cameroon: Effects on the Physicochemical and Microbial Quality of Water Sources, M.Sc Thesis, Department of Geology, University of Buea.

**INTERNET SOURCES**

**Alexandre, P, (1965) :** Proto-histoire du groupe beti-bulu-fang: essai de synthèse provisoire. *Cahiers d'Études Africaines*, Vol. 5, No. 20, pp. 503-560.

**Appiah, A. and Gates, H. (2010):** *Encyclopedia of Africa.* New York. Oxford University Press.

**Asante, M. and Mazama, A. (2009):** .Town?: SAGE.

**Encyclopedia of Pest Management. New York: Dekker.** Ewondo, Ethnologue Fang people, and Yaunde people, Encyclopædia

**Parrot L, Sotamenou J and Dia B. K, (2008**): Municipal solid waste management in Africa: Strategies and livelihoods in Yaoundé, Cameroon in developing countries. *Waste management.* Volume 29, issue 2, February 2009, pages 986-995.

# APPENDICES

## Appendix i: Oral Sources and Demographic Profile of Informants

| No | NAME | SEX | AGE | PROFESSION | PLACE AND DATE OF INTERVIEW |
|---|---|---|---|---|---|
| 1 | Kelvin | Male | 28 | Farmer | Simbock, October 2019 |
| 2 | Claris | Male | 33 | Teacher | Ako-Ndoe, 10 October 2019 |
| 3 | Leslie | Male | 39 | Builder | Mendong, 12 October 2019 |
| 4 | Marbel | Female | 28 | | Mendong, 12 October 2019 |
| 5 | Blessing | Female | 34 | Nurse | Mvog-betsi, 18 October 2019 |
| 6 | King | Male | 29 | Trader | Etoug-ebe, 12 October 2019 |
| 7 | Gerald | Male | 33 | Teacher | Mendong, 17 November 2019 |
| 8 | Divine | male | | Teacher | Mendong, 17 November 2019 |
| 9 | Voilet | Female | 33 | | Jurvance, 18 November 2019 |
| 10 | Laurence | Male | 43 | Trader | Mendong, 16 December 2019 |
| 11 | Christable | female | 31 | Student | Simbock, 18 December 2019 |
| 12 | Emmanuel | Male | 40 | trader | Etoug-ebe, 18 December 2019 |
| 13 | Julliet | Male | 35 | Teacher | Rondpoint express, 18 December 2019 |
| 14 | Nadine | Female | 25 | | TKC, 11 January 2020 |
| 15 | Esther | female | 33 | | TKC, 18 January 2020 |
| 16 | Chelsea | Male | 33 | Farmer | TKC, 18 January 2020 |
| 17 | Leonard | male | 44 | Farmer | Ako-Ndoe, 18 January 2020 |
| 18 | Clitton | Male | 26 | student | Mendong, 19 January 2020 |
| 19 | Edmond | Male | 33 | | Acacia, 19 January 2020 |
| 20 | Manuel | Male | 38 | Teacher | Etoug-ebe 24 January 2020 |
| 21 | Mariana | Female | 30 | | Acacia, 6 Febuary 2020 |
| 22 | Janet | Female | 38 | Tailor | Centre, 7 Febuary 2020 |
| 23 | Ernest | Male | 40 | Teacher | Etoug-ebe, 16 Febuary 2020 |
| 24 | Solange | Female | 44 | Tailor | Centre, 28 Febuary 2020 |
| 25 | Sharline | Female | 28 | Nurse | Rondpoint express, 13 May 2020 |
| 26 | Gilbert | Male | 45 | | Acacia, 3 March 2020 |
| 27 | Louise | Male | 44 | | TKC, 8 March 2020 |
| 28 | Yanick | Male | 32 | | Melen, 16 March 2020 |
| 29 | Edgar | Male | 32 | | Melen, 27 March 2020 |
| 30 | Arnauld | Male | 34 | bikerider | Mvog-betsi, 15 April 2020 |
| 31 | Samuel | Male | 45 | | Acacia, 11 January 2020 |
| 32 | Collins | Male | 26 | Student | Acacia, 12 March 2020 |
| 33 | Sylvie | Female | 46 | | Simbock 15 March 2020 |
| 34 | Francoise | Male | 37 | | Messa, 15 March 2020 |
| 35 | Emeka | Male | 32 | | Melen, 13 April 2020 |
| 36 | Erida | Female | 36 | | TKC, 14 April 2020 |
| 37 | Patience | Female | 29 | | Melen, 14 April 2020 |
| 38 | Victor | Male | 37 | Trader | Centre, 15 April 2020 |
| 39 | Sandra | Female | 25 | student | Centre, 20 April 2020 |

| | | | | | |
|---|---|---|---|---|---|
| 40 | Happiness | Female | 29 | | Rondpoint Express, 7 May 2020 |
| 41 | Mercy | Female | 33 | | Rondpoint Express, 14 May 2020 |
| 42 | Pricilia | Female | 44 | | Melen, 15 May 2020 |
| 43 | Mary | Female | 29 | | Rondpoint Express, 17 May 2020 |
| 44 | Evelyn | Female | 40 | | Rondpoint Express, 20 May 2020 |
| 45 | Ernest | Male | 42 | Teacher | Etoub-ebe, 14 May 2020 |
| 46 | Glory | Female | 30 | Journalist | Acacia,18 May 2020 |
| 47 | Carol | Female | 44 | Tailor | Mvog-betsi, 19 May 2020 |
| 48 | Hassana | Male | 45 | | Superitte, 4 June 2020 |
| 49 | Collins | Male | 36 | Shoe mender | Superiette, 12 June 2020 |
| 50 | Carine | Female | 34 | student | Mendong, 12 June 2020 |
| 51 | Odette | female | 36 | Farmer | Jurvance, 13 June 2020 |
| 52 | Catherine | Female | 33 | trader | Jurvance, 12 June 2020 |
| 53 | Desmond | Male | 37 | | Rondpoint express, 11 July 2020 |
| 54 | Walters | Male | 38 | | Mendong, 12 July 2020 |
| 55 | Zita | Female | 35 | | Jurvance,14 July 2020 |
| 56 | Jason | Male | 29 | teacher | Mvog-betsi, 16 July 2020 |
| 57 | Grek | Female | 57 | trader | Mendong, 16 July 202 |
| 58 | Nadine | Female | 35 | tailor | Mvog-betsi, 18 July 2020 |
| 59 | Frank | Male | 34 | Petit business | Mvog-betsi, 17 October 2020 |
| 60 | Marion | Male | | | Mvog-Betsi, 15 July 2020 |
| 61 | Tina | Female | 37 | teacher | Mendong, 16 July 2020 |
| 62 | Laura | Female | 33 | | Melen, 7 August 2020 |
| 63 | Edwin | Male | 33 | | Jurvance, 14 August 2020 |
| 64 | Pascal | Male | 38 | | Centre Pasteur, 14 August 2020 |
| 65 | Emile | Male | 45 | | Mvog-betsi, 15 August 2020 |
| 66 | Stella | female | 42 | | Mendong, 17 August 2020 |
| 67 | Nobert | Male | 37 | Student | Simbock, 18 August 2020 |
| 68 | John | Male | 47 | Teacher | Mendong, 18 August 2020 |
| 69 | Sandrine | Female | 36 | Décor | Centre, 16 August 2020 |
| 70 | Larisa | Female | 46 | | Acacia, 1 September 2020 |
| 71 | Fred | Male | 32 | student | Mendong, 13 September 2020 |
| 72 | Leonel | Male | 34 | | Superitte, 16 September 2020 |
| 73 | Edward | Male | 47 | | Centre, 26 September 2020 |
| 74 | Clovis | Male | 45 | | Jurvance, 28 September 2020 |
| 75 | Emmanuel | Male | 39 | | Superitte, 25 October 2020 |
| 76 | Belta | Female | 26 | student | Biyem-assi, 4 November 2020 |
| 77 | Esther | Female | 36 | | Superitte, 5 November 2020 |
| 78 | Francoise | Male | 37 | | Biyem-assi, 5 November 2020 |
| 79 | Laurent | Male | 50 | | Biyem assi, 15 November 2020 |
| 80 | Jones | Male | 37 | Teacher | Biyem-assi, 5 November 2020 |
| 81 | Felicia | Female | 34 | Tailor | Simbock, 11 December 2020 |
| 82 | Clotilda | Female | 37 | Teacher | Biyem-assi, 17 December 2020 |
| 83 | Elvis | Male | 45 | Army | Centre, 16 December 2020 |
| 84 | Neh | Female | 48 | Tailor | Jurvence 18 2020 |
| 85 | Ngwang | Male | 45 | Teacher | Simbock 10 October 2020 |
| 86 | Jibril | Male | 46 | Farmer | |

| | | | | | |
|---|---|---|---|---|---|
| | **Focus group discussion** | | | | |
| 1 | Marcel | Male | 37 | Driver | Centre, 12 May 2020 |
| 2 | Grace | Female | 36 | Tailor | Centre, 12 May 2020 |
| 3 | Guillaume | Male | 38 | Carpenter | Centre, 12 May 2020 |
| 4 | Sandra | Female | 40 | Hair dresser | Centre, 12 May 2020 |
| 5 | Gilbert | Male | 37 | Business | Centre, 12 May 2020 |
| 6 | Solange | Female | 36 | Petit business | Centre, 12 May 2020 |
| 7 | Marie | Female | 44 | Tailor | Centre, 12 May 2020 |
| 8 | Della | Female | 35 | Hair dresser | Centre, 12 May 2020 |
| 9 | Stephen | Male | 45 | Teacher | Mvog-betsi, 14 August 2020 |
| 10 | Donald | Male | 55 | Teacher | Mvog-betsi, 14 August 2020 |
| 11 | Hilaire | Male | 45 | Worker | Mvog-betsi, 14 August 2020 |
| 12 | Epanglo | Male | 39 | Bastketballer | Mvog-betsi, 14 August 2020 |
| 13 | Della | Female | 36 | Housewife | Mvog-betsi, 14 August 2020 |
| 14 | Beryl | Female | 34 | Teacher | Mvog-betsi, 14 Augist 2020 |
| 15 | Odile | Male | 34 | Tailor | Mvog-betsi, 14 August 2020 |
| 16 | Marie | Female | 47 | Farmer | Mvog-betsi , 14 August 2020 |
| | **Key informants** | | | | |
| 1 | Theresia | Female | 55years | Doctor (CMO) | Etougebe hospital, November 2020 |
| 2 | Kinney | Female | 52years | Doctor | Eotugebe hospital, 12 October 2020 |
| 3 | Cyrill | Female | 45years | Nurse | Biyemassi hospital, 22 December 2019 |
| 4 | Blessing | Female | 42years | Nurse | Biyemassi hospital, 23 December 2019 |
| 5 | Preferred anonymity | Female | 38years | Doctor | Hospital de souer, 14 January 2020 |
| 6 | Emmanuel | Male | 45years | Doctor | Unity clinic TKC, 5 May 2020 |
| 7 | Anni | Female | 28years | Nurse | Clinic Ako-ndoe, may 2020 |
| 8 | Bless | Male | 55years | Worker | Hysacam, Fouda, December 2020 |
| 9 | Nyakang | Male | 40years | Worker | Yaoundé vi council,29 October 2019 |
| 10 | Preferred anonymity | Male | 47years | Worker | Yaoundé VI council, 16 November 2020 |
| 11 | Preferred anonymity | Male | 39years | Worker | Yaoundé VI SDO office, june 2020 |
| 12 | Nyada | Male | 45years | Worker | Camwater, Messa, 2 May 2020 |

## Appendix 2: Interview Guide

I am TANTO MATILDA MUSAH a student in University of Yaoundé1. I am currently carrying out a research for the partial fulfillment of the award of My PhD degree in Medical Anthropology. I would like to know about the existing water supply situation and about the waste management in Yaoundé. Your response will help me in writing my research work and policy makers to Formulate an informed policy about the state of water supply services. The interview will take a few minutes and the answers will be kept confidential, strictly for academic purpose. Your name will not be seen in any newspaper or any radio house.

**INTERVIEW GUIDE**

The question guide simply gives us some directives on the research issues but further questions are been ask for better clarification and deepening the understanding on some particular issues

**Interview guide for Yaoundé VI subdivision Council workers**

- When was this council created?
- Location of the council? Is located at etougegbe
- Activities of the council
- Relation with the other councils
- Is there cam water in the whole of Yaoundé VI?
- How do you manage water distribution in these areas?
- Are they water resources in the council area?
- What do you intend to do with these water resources?
- Relationship with the population concerning water distribution and management?
- Do you have any NGO that support your council in projects that concerns water?
- Do you have problems in carrying out water project in these areas and how do you solve them?
- Do you train the population on how to preserve water and waste? If yes how often do you do that? If no why?
- How do you handle problems concerning water in your council?
  What we do is to construct borehold and well and forage we they don't have camwater.
- Is there any ongoing project in your council area towards water and sanitation
- What are your future project or plan concerning water distribution

**Interview guide for workers in Ministry of water and energy**

- When was the ministry created?
- Location of the ministry

- Relationship with the councils
- How do you deal with the issues of water distribution in Yaoundé?
- Do you have any NGO that supports you in water projects?
- Do you train population on how to preserve their water? If yes how often do you organize these training?
- Is the public satisfied with the activities you do?
- Why is it that some quarters do not have pipe born water? And why?
- Do you have any problem in the cause of carrying out your project in water? If yes how do you overcome those situations?
- How do you manage your problem concerning water issues?
- What is the way forward

**Interview guide for Households**

Access to water

- What are the various water supply in this quarter
- What is the source of your water?
- Is the source you are using good for you?
- Do you have any problem using the water you have choose above? If yes or no explain
- When do you experience water shortage in this area?
- What are the causes of poor water quality in this area?
- Do you purify your water?
- What do you use to purify your water and how effective it is?
- How do you overcome the problem of water scarcity?
- Who usually do the water carrying in your home and why?
- How long does it take for an individual to go and carry water?
- How long have you lived in this quarter
- How often do suffer from water scarcity
- Where do you dispose of your waste product and why?
- Are you aware of the disease cause by infected water?
- Have you ever been infected by these diseases?
- Where did you go for your treatment?
- Is there water management committee in your quarter?
- What are their functions?
- Have you had any campaign on water-borne diseases?
- Are you satisfied with what they do?
- What do you recommend that should be done for people to have potable water

**Interview guide for Health personnel**

- How long have you been working in this health facility:

- How many doctors and nurses are working here?
- How many patients do you receive here in a week?
- Name some of the diseases patient suffer from in this are?
- What is the percentage of patients suffering from water-borne diseases?
- Is there any long lasting effect that these patients have as a result of being infected by water-borne disease?
- What is the sources of water do you use here?
- How often do you treat your water?
- Some of the problems faced by health personnels
- What is your recommendation to the people and the government on how to better water problem?

**Interview guide for small enterprise for water purification**

- How long has this business be functioning in this quarter?
- Why in this quarter
- What motivated you to do this business?
- Do you have people (partner) you are working with?
- How much quantity you do purify in a day?
- How much quantity do you sell in a day?
- Do you have a substantial benefit from this business?
- Do you train others how to do this local purification?
- Does the population appreciate this business of yours?
- Do you face any challenges with this business?
- How do you overcome this problem?
- Any proposal to the population and government on how to combat water problems?

# APPENDIX 3

## OBSERVATION GUIDE

- Water sources
- Water purification systems
- Different water sources used
- People involve in fetching water
- Waste disposal

## INFORMED CONSENT FORM

## THE UNIVERSITY OF YAOUNDÉ 1

### Informed Consent Form for Yaoundé VI Population

This informed concernt form is for everybody in Yaoundé VI area and we are inviting everybody to participate in this research titled coping strategies for access to potable water in urban area a case study of Yaoundé VI area.

You may provide the following information either as a running paragraph or under headings as shown below.

Tanto Matilda Musah
University of Yaoundé 1
Family
Academic research on potable water

This Informed Consent Form has two parts:

• Information Sheet (to share information about the study with you)
• Certificate of Consent (for signatures if you choose to participate)

You will be given a copy of the full Informed Consent Form

### Part I: Information Sheet

### Introduction

Iam Tanto Matilda Musah a student from the University of Yaoundé 1. Iam doing an academic research on coping strategies for access to potable water in urban area a case study of Yaoundé VI area. I am going to you information and invite you to be part of the research.

You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.
This consent form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain. If you have questions later, you can ask them of me or of another researcher.

**Purpose of the research**

Access to potable water is a challenge to people in this area. We want to find out what the people do in order to have good water for drinking and other activities. So we believed you can help us by telling us what you water shortage and how you cope in situations like that. We also want to know some of the diseases caused by contaminated water from the people and equally how they manage to treat the diseases and they control water-borne disease.

**Type of Research Intervention**

This research will involve your participation both individual and groups. An individual can take about 15-20min while a group will take 30-45minutes of discussion.

**Participant Selection**

You are being invited to take part in this research because we know that you as a member of this community can contribute much to our understanding and knowledge on water shortage and coping strategies in this area.

**Voluntary Participation**

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate is ok it is by your will. You can equally ask me questions if you have any concerning this research

**Procedures**

We are asking you to help us learn more about coping strategies for access to potable water. We are inviting you to take part in this research project. If you accept, you will be asked to….:

Interviews

During the interview, my assistant and I will sit down with you in a comfortable place. If it is better for you, it can take place in your home or a friend's home. If you do not wish to answer

any of the questions during the interview, you may say so and we will move on to the next question. No one else but me will be present unless you would like someone else to be there. The information recorded is confidential, and no one else except me will access to the information documented during your interview. The entire interview will be tape-recorded, but no-one will be identified by name on the tape. The tape will be kept with me. The information in the tape will be deleted when I must have finished my work

Focus group discussions

The discussion involves 7-8 other persons with similar experiences. This discussion will be guided by my assistant and I. The group discussion will start with me, or the focus group assistant making sure that you are comfortable. We can also answer questions about the research that you might have. Then we will ask you questions about the water-borne diseases and give you time to share your knowledge. The questions will be about potable water in your community, how is it gotten, what people do to stop water-borne diseases and how to treat contaminated water.

We will also talk about community practices more generally because this will give us a chance to understand more about what people use in case there is water shortage. There are a number of questions we will ask that are not personal and not complicated.

The discussion will take place in anywhere of your choice, and no one else but the people who take part in the discussion and guide or by us and will be present during this discussion. The entire discussion will be tape-recorded, but no-one will be identified by name on the tape. The tape will be kept by with me since it is my school work. The information recorded is confidential and the information will be deleted after my data analysis.

**Duration**

The research will be for a year. During this time, we will visit you any time for interviewing and each interview will last for 15-20 minutes. The group discussion will be held as many times as possible and it will take 45min –1h.

**Risks**

We believe there is no risk involve in this research since the work is not too personal or confidential but we do not wish for anything to happen. You do not have to answer any question or take part in the discussion/interview/survey if you feel the question(s) are too personal or if talking about them makes you uncomfortable.

**Benefits**

There will be no direct benefit to you, but your participation is going to help us find out more about how to prevent water-borne disease and how to cope in cases of water shortage.

You will not be provided any incentive to take part in the research. However, we can give you anything just for your time not that we are paying you.

**Confidentiality**

The research being done in the community may draw attention and if you participate, you may be asked questions by other people in the community. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name.

**The following applies to focus groups:**

We will ask you and others in the group not to talk to people outside the group about what was said in the group. We will, in other words, ask each of you to keep what was said in the group confidential. You should know, however, that we cannot stop or prevent participants who were in the group from sharing things that should be confidential.

**Sharing the Results**

Nothing that you tell us today will be shared with anybody outside the research team, and nothing will be attributed to you by name. The knowledge that we get from this research will be shared with you and the community after the defense of this work.

**Right to Refuse or Withdraw**

You do not have to take part in this research if you do not wish to do so, and choosing to participate will not affect your job or job-related evaluations in any way. You may stop participating in the [discussion/interview] at any time that you wish without your job being affected. I will give you an opportunity at the end of the interview/discussion to review your remarks, and you can ask to modify or remove portions of those, if you do not agree with my notes or if I did not understand you correctly.

**Who to Contact**

If you have any questions, you can ask me now or later. If you wish to ask questions later, you may contact me, Tele: 673631342.You can ask me any more questions about any part of

the research study, if you wish to.

**Part II: Certificate of Consent**

I have been invited to participate in research about coping strategies for access to potable water in urban area a case study of Yaoundé 1.

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Tanto Matilda Musah

**Print Name of Participant_____**

**Signature of Participant _____**

**Date _____**

**Day/month/year**

If illitrate

I have witnessed the accurate reading of the consent form to the potential participant, and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

**Print name of witness_____** **Thumb print of participant**

**Signature of witness _____**

**Date _____**

**Day/month/year**

Statement by the researcher/person taking consent

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1.

2.

3.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Print Name of Researcher/person taking the consent_____

**Signature of Researcher /person taking the consent_____**

**Date _____**

**Day/month/year**

## APPENDIX 4: AUTORISATION OF RESEARCH

Université de Yaoundé I
******
Centre De Recherche Et De Formation Doctorale En Sciences Humaines, Sociales Et Educatives
******
Unité De Recherche Et De Formation Doctorale, Sciences Humaines Et Sociale
******
Faculté Des Arts, Lettres Et Sciences Humaines
******
Département D'anthropologie

University of Yaoundé I
******
Postgraduate School For The Social And Educational Sciences
******
Doctoral Research Unit For The Social Sciences
******
Faculty Of Arts , Letters And Social Sciences
******
Department Of Anthropology

### AUTORISATION DE RECHERCHE

Je soussigné, professeur **MBONJI EDJENGUELE**, chef du Département d'Anthropologie de la faculté des Arts, Lettres et sciences Humaines de l'Université de Yaoundé I, atteste que l'étudiante **TANTO MATILDA MUSAH**, matricule 10J014, est inscrite en doctoral dans ledit Département. Elle mène sa recherche universitaire sur le thème : **COPING STRATEGIES TO WATER AND WASTE DISPOSAL IN URBAN AREAS. THE CASE OF YAOUNDE, (CAMEROON).**, sous la direction du **Pr. Antoine Socpa .**

A cet effet, je vous saurais gré des efforts que vous voudriez bien faire afin de fournir à l'intéressée toute information en mesure de l'aider

En foi de quoi la présentation Autorisation de recherche lui est délivrée pour servir et valoir ce que de doit

UNIVERSITE DE YAOUNDE I
Le Chef du Département
Professeur Mbonji Edjenguèle

REPUBLIQUE DU CAMEROUN
*Paix - Travail - Patrie*
---
DEPARTEMENT DU MFOUNDI
---
COMMUNE D'ARRONDISSEMENT DE YAOUNDE 6
---
SECRETARIAT GENERAL
---
SERVICE DES AFFAIRES GENERALES

*REPUBLIC OF CAMEROON*
*Peace - Work - Fatherland*
---
*MFOUNDI DIVISION*
---
*YAOUNDE 6TH COUNCIL*
---
*GENERAL SECRETARIAT*
---
*GENERAL AFFAIRS SERVICE*

*BP : 3759 YAOUNDE – MESSA*
TEL / Fax (237)22.31.34.95
E-MAIL : yaounde6@yahoo.fr

# AUTORISATION DE RECHERCHE

N° 0 0 0 0 0 6 0 /ASA/19/CAY6/SG/SAG

***Le Maire de la Commune d'Arrondissement de Yaoundé VI.***

*Officier du Mérite Camerounais.*

Autorise l'étudiante **TONTO Matilda MUSAH,** inscrite à la Faculté des Arts et Sciences Humaine de l'Université de Yaoundé I, à mener des recherches dans les différents quartiers de l'arrondissement de Yaoundé VI **thème de la recherche : COPING STRATEGIES TO WATER AND WASTE DISPOSAL IN URBAN AREAS. THE CASE OF YAOUNDE, (CAMEROON).**

En foi de quoi la présente autorisation est délivrée à l'intéressée pour servir et valoir ce que de droit. /.

Yaoundé, le 18 SEPT 2019

**LE MAIRE**

Yoki Onana Jacques
Maire

**Ampliations :**

- SG /Ydé 6e
- SAG/Ydé 6e
- Services concernés
- intéressée
- Archives / Chrono

REGION DU CENTRE
*******
DEPARTEMENT DU MFOUNDI
*******
ARRONDISSEMENT DE YAOUNDE VI
*******
SOUS-PREFECTURE DE BIYEM-ASSI
*******
BUREAU DES AFFAIRES GENERALES
*******

REPUBLIQUE DU CAMEROUN
*Paix Travail Patrie*
*******

N° 016 /AR/J06.06/06/BAG

# AUTORISATION DE RECHERCHE

**Le Sous-préfet de l'Arrondissement de Yaoundé VI,** autorise Mademoiselle **TANTO Matilda MUSAH**, étudiante inscrite en Doctoral au Département d'Anthropologie de la Faculté des Arts, lettres et sciences humaines de l'Université de Yaoundé I, titulaire de la **Carte Nationale d'Identité n° 108825366 du 15/06/2011 à CE05,** à mener une recherche sur l'étendue de l'Arrondissement de Yaoundé VI sur le thème : **« Coping Strategies for access to potable water in urban areas : the case of Yaoundé VI. »**

Cette étude s'étendra du **09 septembre 2019 au 09 septembre 2020**.

En foi de quoi, cette Autorisation est délivrée à l'intéressée pour servir et valoir ce que de droit./-

Yaoundé, le 09 SEPT 2019

**LE SOUS-PREFET**

REGION DU CENTRE * Arrondissement de Yaoundé VI * La Sous-Préfecture Sous-Préfecture de Biyem-Assi DEPARTEMENT DU MFOUNDI

Dasse Mvondo Appolinaire
Administrateur Civil Principal

**Ampliations** :
*-Préfet Mfoundi/Ydé (ATCR)*
*-COMBRIGADE BIYEM-ASSI, MVOG-BETSI ET MELEN*
*-COMSECUPU 5e , 9e et 13e Arrdt*
*-COMPSPECIAL VI*
*- Intéresseé*
*- Chrono/Archives*

REPUBLIQUE DU CAMEROUN
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Paix –Travail – Patrie
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MINISTERE DE LA SANTE PUBLIQUE
---
DELEGATION REGIONALE DU CENTRE
---
DISTRICT DE SANTE DE BIYEM-ASSI
---
**HOPITAL DE DISTRICT DE BIYEM-ASSI**
---
*BP : 31 350 Ydé .Tél./Fax 22.31.64.05*

REPUBLIC OF CAMEROON
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Peace-Work-Fatherland
---
MINISTRY OF PUBLIC HEALTH
---
CENTER REGIONAL DELEGATION
---
BIYEM-ASSI HEALTH DISTRICT
---
**BIYEM-ASSI DISTRICT HOSPITAL**
---
*E-mail:hopital_biyemassi@yahoo.fr*

N°MM/AR/MINSANTE/DRSPC/DSBA/HDBA.

# AUTORISATION DE RECHERCHE

Le Directeur de l'Hôpital de District de Biyem-Assi à Yaoundé soussigné, donne autorisation de recherche à Madame TANTO MATILDA MUSAH, étudiante inscrite à la Faculté des Arts et Sciences Humaines à l'Université de Yaoundé I, dont l'étude est intitulée : ***« COPING STRATEGIES TO WATER AND WASTE DISPOSAL IN URBAN AREAS. THE CASE OF YAOUNDE (CAMEROON)».***

En foi de quoi la présente autorisation est établie et lui est délivrée pour servir et valoir ce que de droit.

Yaoundé, le 15 OCT 2019

**Le Directeur**

Dr Daniel Ateba
Médecin - Cardiologue

# INDEX

## INDEX OF KEY WORDS

## R



## S



## T



## U



## V

# TABLE OF CONTENTS