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WATER POLICY

Presented by

Djalila, UMUTANGAMPUNDU

**EFFECT OF NON-REVENUE WATER (NRW) ON THE OPERATION OF
AFRICAN WATER UTILITIES**

Case studies: Cote d'Ivoire and Burkina Faso

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OF AFRICAN WATER UTILITIES
CASE STUDIES OF COTE D'IVOIRE AND BURKINA FASO**

**By
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September, 2020

STATEMENT OF THE AUTHOR

I, **Djalila UMUTANGAMPUNDU** by my signature below, I declare that this dissertation is my work. I have followed all ethical principles of scholarship in the preparation, data collection, data analysis, and completion of this dissertation. I have given all scholarly matter recognition through accurate citations and references. I affirm that I have cited and referenced all sources used in this document. I have made every effort to avoid plagiarism. I submit this document in partial fulfilment of the requirement for a degree from Pan African University. This document is available from the PAU Library to borrowers under the rules of the library. I declare that I have not submitted this document to any other institution for the award of an academic degree, diploma, or certificate.

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DEDICATION

This study is dedicated to all Africans who strive for the Agenda 2063 of the Africa We Want.

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ABBREVIATIONS AND ACRONYMS

AfWA	African Water Association
COVID-19	Coronavirus Disease of 2019
GWOPA	Global Water Operators' Alliance
IWA	International Water Association
NRW	Non-Revenue Water
MDGs	Millennium Development Goals
SDGs	Sustainable Development Goals
O&M	Operations and Maintenance
ONEP	Office National de l'Eau Potable
ONAD	Office National De L'assainissement Et Du Drainage
MOH	Ministry of Hydraulics
ONEA	Office Nationale de l'Eau et de l'assainissement
MEA	Ministere de l'Eau et de l'Assainissement
PPP	Private-Public Partnership
Nbr	Number
SODECI	Société de Distribution d'Eau de Côte d'Ivoire
UFW	Unaccounted For Water
USAID	United States Agency for International Development
WBI	World Bank Initiative
WHO	World Health Organization
WOP	Water Operator's Partnership
WSP	Water and Sanitation Program

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ABSTRACT

Non-Revenue Water (NRW) continues to be a threat to water utilities' technical and financial sustainability in African countries. However, the issue lies in paying little to no attention on the effect that it has on the performance of these utilities. In that regard, this study was conducted to understand the effect of Non-Revenue Water on operations of African Utilities. The study used a comparative approach, between ONEA from Burkina Faso and SODECI from Cote d'Ivoire, taken as case studies; with the aim at analyzing and identifying what could be the different challenges in solving the problems related to NRW. Questionnaires were used to assess the level of NRW management, the impacts of NRW on the technical, financial, customer and institutional performance and finally to do a SWOT analysis model for effective management of NRW. Results showed that SODECI's NRW level kept increasing within 7 years at 36% while ONEA's level of NRW was kept constant at 19.3% for 3 years. The reasons for this lie in the high number of frauds for SODECI (1092 frauds in Abidjan) while ONEA's number of frauds remains completely unknown. Each year SODECI allocates 1 million usd and 70 million usd for commercial and technical water losses reduction, respectively; while ONEA uses 200,000 usd. SODECI supplies water for 20 hours in a day while ONEA's supply is for 23 hours. Results also emphasized on the need for SODECI to establish a NRW department with defined duties and chef of service in charge of water losses reduction plans, budget and logistics. The SWOT analysis showed that SODECI's strength lies in being a private company with opportunities to attract investments for NRW through the Private-Public-Partnership. ONEA, as a public company, has an advantage of having a strong institutional and regulatory framework as well as a clear and detailed organizational structure with a chef of service in charge of NRW reduction. SODECI presented failure to have a good organizational structure while ONEA's weakness lies in the little knowledge of the number of frauds and high number of leaks. Both utilities declared that climate change, population growth and lack of investments are the major threats to their performance. The study recommends enforcement of policies on improvement of water revenues for cost recovery; capacity building for NRW management, adoption of ICT tools for data acquisition and community engagement as well as institutionalization of NRW within African water utilities. Finally, this study proposed an innovative model for the management of NRW in water utilities.

Keywords: Non-Revenue Water, performance, management, model

RESUME

L'Eau Non-Facture (ENF) continue d'être une menace pour la durabilité technique et financière des services d'eau dans les pays africains. Cependant, le problème consiste à accorder peu ou pas d'attention à l'effet que cela a sur les performances de ces services publics. À cet égard, cette étude a été menée pour comprendre l'effet de l'eau non facture sur les opérations des services publics africains. L'étude a utilisé une approche comparative, entre l'ONEA du Burkina Faso et la SODECI de la Côte d'Ivoire; dans le but d'analyser et d'identifier quels pourraient être les différents défis pour résoudre les problèmes liés à l'ENF. Des questionnaires ont été utilisés pour évaluer le niveau de gestion d'ENF, les impacts d'ENF sur la performance technique, financière, client et institutionnelle et enfin pour faire un modèle d'analyse SWOT pour une gestion efficace d'ENF. Les résultats ont montré que le niveau d'ENF de la SODECI a continué d'augmenter à 36% tandis que celui de l'ONEA a été maintenu constant à 19,3%. Les raisons en sont le nombre élevé de fraudes pour la SODECI (1092 fraudes à Abidjan) alors que le nombre de fraudes de l'ONEA reste totalement inconnu. Chaque année, SODECI alloue 1 million USD et 70 millions USD pour la réduction des pertes d'eau commerciales et techniques, respectivement; tandis que l'ONEA dépense 200 000 USD chaque mois. La SODECI fournit de l'eau pendant 20 heures par jour tandis que l'ONEA est approvisionnée pendant 23 heures. L'analyse SWOT a montré que la force de la SODECI réside dans le fait qu'elle est une entreprise privée avec des opportunités d'attirer des investissements pour l'ENF par le biais du partenariat public-privé. L'ONEA, en tant qu'entreprise publique, a l'avantage de disposer d'un cadre institutionnel et réglementaire solide ainsi que d'une structure organisationnelle claire et détaillée avec un chef de service en charge de la réduction d'ENF. La SODECI a présenté l'incapacité d'avoir une bonne structure organisationnelle. Les deux institutions ont déclaré que le changement climatique, la croissance démographique et le manque d'investissements sont les principales menaces à leur performance. L'étude recommande l'application de politiques d'amélioration des revenus de l'eau pour le recouvrement des coûts; renforcement des capacités pour la gestion ENF, adoption d'outils TIC pour l'acquisition de données et l'engagement communautaire ainsi que l'institutionnalisation d'ENF au sein des services d'eau africains. Enfin, cette étude a proposé un modèle innovant de gestion d'ENF dans les services d'eau.

Mots-clés: Eau Non-Facturée, performance, gestion, modèle

CHAPTER ONE: INTRODUCTION

1.0 Background

Water play a fundamental and vital role in sustaining human's life, health as well as to promote sanitation and hygiene. Spontaneous population increase coupled with the impacts of climate change have showed the need to have regular and equitable access to water. Water utilities however, are faced with the challenge of ensuring water supply coverage while maintaining their sustainability. One of the key performance indicators for water utility's efficiency is Non-Revenue Water (NRW) (Donkor, 2014). This refers to the difference between water volume that enters the distribution system to consumers and the volume of water that reaches to those consumers (USAID/WBI, 2010). (Liemberger & Wyatt, 2019)'s study shows that the level of NRW has reached 346 million m³/day or 126 billion m³/ year which represents US 39\$ billion. In Sub-Saharan African countries, losses account for 50-60% of the water supplied; more than 32 billion m³ of treated water does not reach subscribers due to numerous failures such as leaks, faulty connections or piping, errors in metering, you name it (USAID/WBI, 2010). An audit report carried out on some 19 water companies in Africa by a mission of African experts reveals that unbilled water represents one third of the total volume of water produced (AfWA, 2017).. This high rate of Non-revenue Water leads to significant reduction of water provision to the non-connected parts of the population, and affects water utilities' financial sustainability due to losses in revenue and increased operating costs. More so, NRW reduces the ability to fund service expansion, especially provision to the poor.

1.1 Problem statement

Management of water resources has been a major challenges to many countries across the world. Although some countries make improvements in order to attain the SDG 6 of access to water and sanitation for all, more than 2 billion people still lack access to safe water when countries still struggle to finance this sector, according to the report of the United Nations. The equitable water supply challenge lies in the fact that water utilities do not handle the issue of high water demand at the same pace. Some water utilities struggle to meet water supply coverage to its customers while others have already met the coverage and now struggle to reduce the possible arising Non-Revenue water within the sector. Each year more than 32 billion m³ of treated water does not reach subscribers due to numerous failures such as leaks, faulty connections or piping (USAID/WBI, 2010).

According to the report from (AfWA, 2017), An audit carried out on some 19 water utilities in Africa by a mission of African experts revealed that unbilled water represents one third or 37% of the total volume of water produced. This high rate of Non- Revenue Water represents weakness to the water utilities, ranging from governance, and technical as well as financial performance. Consequently, utilities fail to provide or expand water services to the consumers. This study investigated the effect of non-revenue water (NRW) on the operation of African water utilities. Data of two utilities from Burkina Faso and Cote d'Ivoire were used to conduct a comparative study of both utilities technical, financial, customer and institutional performance, taking into consideration the strength, weakness, opportunities and threats for the utilities to manage NRW.

1.2 Significance of the study

This study is directly in line with the AU agenda 2063, Aspiration 1 of ensuring a prosperous Africa based on inclusive growth and sustainable development. It is also in line with the SDG 6 which is to “Ensure availability and sustainable management of water and sanitation for all”.

To that:

- The findings will help increase the percentage of water and sanitation coverage in line with Africa Water Vision 2025, by helping policy makers understand how to address the technical and financial impact of Non-Revenue Water.
- More importantly, this study will be an added value to the literature on the subject of NRW and the models to be used for the sustainable reduction of this NRW.
- It will encourage the Governments of Burkina Faso, and Cote d'Ivoire to put in efforts on projects related to the reduction of NRW as well as to establish good practices as well as policy strategies; hence serving an example to other countries that face similar NRW management challenges.
- Lastly, the study's findings will bridge the gap existing between the water supply coverage and actual water consumption. The two countries' utilities will draw lessons from this study to ensure better planning of projects that aim to sustainably reduce the water losses in general to be able to provide regular water supply and expand water services to customers.

1.3 Scope of the study

This is a comparative research conducted within two countries Burkina Faso and Cote d'Ivoire. Data were collected by filling out questionnaires which was done by the staff members from Office Nationale de l'Eau ET de l'assainissement (ONEA) and Ministere de l'Eau et de l'assainissement (MEA) in Burkina Faso; as well as the staff members from Ministry of Hydraulics, SODECI, ONEP and ONAD in Cote d'Ivoire. Some of the data were retrieved from other sources (IBNET and GWOPA) with the aim at analyzing the NRW management in SODECI and ONEA and their performance in NRW management (technical, financial, customer and institutional); a SWOT analysis model will be used for best practices exchange between both utilities. Finally, a tool will be developed to understand effective management of NRW in African water utilities.

1.4 Research objectives

1.4.1 Main objective

The general objective was to analyze and identify from a comparative point of view between ONEA and SODECI what could be the different challenges in solving the problems related to NRW

Specifically, the study sought to:

1. Review the Management of NRW in SODECI and ONEA
2. Study the financial impact of NRW and the technical capacity of each of these utilities to manage NRW
3. Conduct SWOT analysis for exchange of best practices between SODECI and ONEA
4. Propose a model for effective management of Non-Revenue Water in African water utilities.

1.5 Research Questions

1.5.1 General Question

To what extent two very different water utility management models, one public in the case of ONEA in Burkina Faso and the other private in the case of SODECI in Cote d'Ivoire could have a similar or divergent impact on solving the challenge of NRW? In all cases, consideration shall emphasize in the technical and economic performance of these companies

The study answered the following specific questions:

1. How is the management of NRW in SODECI and ONEA?

2. How is NRW affecting the technical, financial, customer and institutional performance of SODECI and ONEA?
3. What can be a model for effective management of NRW in African Water utilities? Based on the strength and weakness identified in each country/utility and considering the opportunities and threats in the sector?

1.6 Research hypothesis

1.6.1 General Hypothesis

The Strength, Weakness, Opportunity and Threats in Management of Non-Revenue Water have direct impact on the technical, financial, customer and institutional performance of the water utilities in Burkina Faso and Cote d'Ivoire

The study stated three hypotheses:

1. The management of NRW in SODECI is different from that in ONEA
2. Increased NRW has direct impact on technical, financial, customer and Institutional performance of SODECI and ONEA
3. The strength and challenges in management of Non-Revenue Water have direct impact on the technical, financial, customer and institutional performance of the water utilities in Burkina Faso and Cote d'Ivoire

1.7 Risk analysis and feasibility of the research

During this study the main obstacle was the spread of the pandemic of COVID-19 which forced almost all the countries across the world to undergo the lockdown that lasted 2-4 months depending on the country.

Among the challenges I faced there is one on collecting data which was supposed to be done by conducting the interviews with the staff members of water utilities but unfortunately couldn't do that because of the lockdown. Another challenge was to have a one-on-one session with my supervisor and the supporting team from AfWA which did not happen from March to June due to lockdown. These challenges slowed down the process of data collection and analysis. However, the problem was resolved by using online communication with the respondents, my supervisor and the supporting team until the lockdown was eased.

In addition, NRW is a broad and complex topic which requires a combination of engineering and policy studies. Due to the pandemic and hence limited time, more details were left unassessed.

1.8 Structure of the study

Five chapters compose this thesis. **Chapter one** provided a background to the study and also highlighted the problem statement, research objectives, questions and hypotheses, significance of the study and the structure of the study. **Chapter two** explored the literature review, which included the global water supply and sanitation, the historical background of SODECI and ONEA, management of NRW, performances of African water utilities and SWOT analysis model. **Chapter three** discussed the research methodology, including research design and method as well as the case studies. **Chapter four** presented and discussed the results of the findings in the study. **Chapter five** concluded the study with key findings, limitations and recommendations for further research. Then, followed by References, Bibliography and Appendix.

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter gives an overview on the impact of increasing Non-Revenue water to water utilities' operational efficiency. In this chapter relevant sources of literature were chosen from google scholar, research gate, and series of scientific database as well as policy reports and published citations. The study also used trusted websites as well as peer-reviewed articles.

2.1. Global Water Supply and Sanitation

It is undeniable that water and sanitation sector has seen a tremendous progress since 1990 (UNICEF&WHO, 2019). A UN report (UN website 2017) shows that since 1990 to 2015 countries tried to put in efforts to attain the Millennium Development Goals with its target 7 C of halving by the year of 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation. To that, (UNICEF&WHO, 2019) indicates that by 2015, 71 per cent of the global population were using safely managed drinking water and 39 per cent were using safely managed sanitation services.

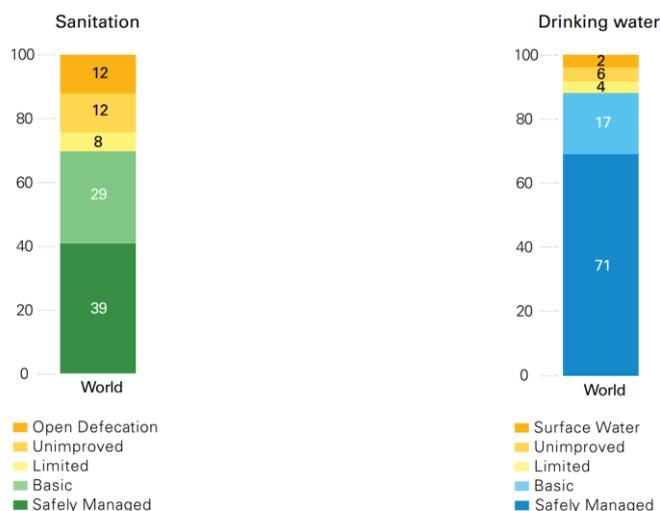


Figure 2.1 Access to Sanitation and Water

(UNICEF&WHO, 2019)

Despite those efforts, a number of population as big as 29 % which is approximately 844 million still lack safely managed water and 61% still lack safely managed sanitation as defined by Sustainable Development Goals SDGs (Water.org, 2019). To improve access to safe water and sanitation, it is necessary to understand what actions countries and external support agencies are undertaking in the water, sanitation and hygiene (WASH) sector.

WASH SECTOR GOAL	SDG GLOBAL TARGET	SDG GLOBAL INDICATOR
Ending open defecation	6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation , paying special attention to the needs of women and girls and those in vulnerable situations	6.2.1 Population practising open defecation
Achieving universal access to basic services	1.4 By 2030, ensure all men and women, in particular the poor and vulnerable, have equal rights to economic resources, as well as access to basic services ...	1.4.1 Population living in households with access to basic services (including basic drinking water, sanitation and hygiene)
Progress towards safely managed services	6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all	6.1.1 Population using safely managed drinking water services
	6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	6.2.1 Population using safely managed sanitation services 6.2.1 Population with a basic handwashing facility with soap and water available on premises

Figure 2.2: Global goals, targets and indicators for drinking water, sanitation and hygiene (UNICEF& WHO, 2019).

2.2 Concept of Non-Revenue Water

A definition by (Lymphate Infra,2019) states that Non-Revenue Water is referred to as the difference between the amount of water put into the distribution system and the amount of water billed to consumers. In other words, it is water that is produced and supplied but lost without generating any revenue to the water utility.



Figure 2.3 Non Revenue Water representation

(Lymphate Infra, 2019)

Non-Revenue Water is composed of water losses which is the difference between System Input Volume and Authorized Consumption (Lambert et al., 2014; Alegre, 2000).

(Daniel, 2016) describes the physical losses as the annual volumes lost through all types of leaks, bursts and overflows on mains, service reservoirs and service connections, up to the point of customer metering; they result from poor operational practices and maintenance of tanks, pipes and underground assets also known as ‘real losses’. Commercial losses on the other hand, consists of unauthorized consumption such as the general water theft and all types of metering inaccuracies and data handling; and finally there is unbilled water which results from policy choice of subsidizing for a certain group of citizens as well as public work purposes such as firefighting (Frauendorfer, 2010).

According to the International Water Association (IWA)’s water balance (Alegre, 2000), NRW lies into the category of water losses and unbilled authorized consumption. The water balance enables water utilities to assess the level and magnitude of water losses with the aim at minimizing those physical and commercial losses (Washali et al., 2020).

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption (Including Water exported)	Revenue Water
			Billed Unmetered consumption	
		Unbilled Authorized Consumption	UnBilled Metered Consumption	Non-Revenue Water (NRW)
			Unbilled Unmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Customer Metering Inaccuracies	
			Systematic Data Handling Errors	
		Real Losses	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to point of Customer metering	

Figure 2.4 IWA Water balance Concept

(Hirner and Lambert, 2000)

Therefore,

$$NRW = \text{System input volume} - \text{Billed authorized consumption} \dots \text{measured in } m^3$$

Non-revenue water (NRW) is the difference between the volumes of water delivered into a network and billed authorized consumption.

$$NRW = \text{“Net production”} - \text{“Revenue water”}$$

Or NRW can be explained as: water loss (thus, Unaccounted-for-water) + water which is accounted for, but no revenue is collected (thus, unbilled metered and non- metered authorized Consumption).

The water balance developed by IWA enables utilities to effectively and efficiently minimize water losses (Washali et al., 2020). One key strategy is to set up a diagnostic plan for Non-Revenue Water (NRW), so that policies and action plans to reduce water loss to a level which is much more appropriate, achievable and practical can be formulated (WOP/GWOPA/AfWA, 2019).

2.3 The Global Non-Revenue Water Challenge

The global volume of non-revenue water (NRW) has haunted the water sector for a long time. In some low-income countries this loss represents 50-60% of water supplied, with a global average estimated at 35% (USAID&WBI, 2010) , a very high number compared to the standard one given by American water Works Association which states that any water loss less than 10 % is acceptable (Al-Bulush et al. 2018; through Naik, 2017). Hence, in general, NWR causes technical and financial instability in water sector (Karamage, 2016). Worse so, (Liemberger & Wyatt, 2019)'s study brought new statistics on how the level of NRW has reached 346 million m³/day and 126 billion m³/ year. In Africa, each day, 45 million m³ of treated water are lost through leakage from distribution network and this represents a total annual cost of over 6 billion US\$ (USAID&AfWA, 2015). An additional 16 billion m³ per year are delivered to customers but not invoiced because of theft, poor metering, or corruption (USAID&WBI, 2010). This increase tremendous increase shows that the problem of NRW needs to be tackled with seriousness.

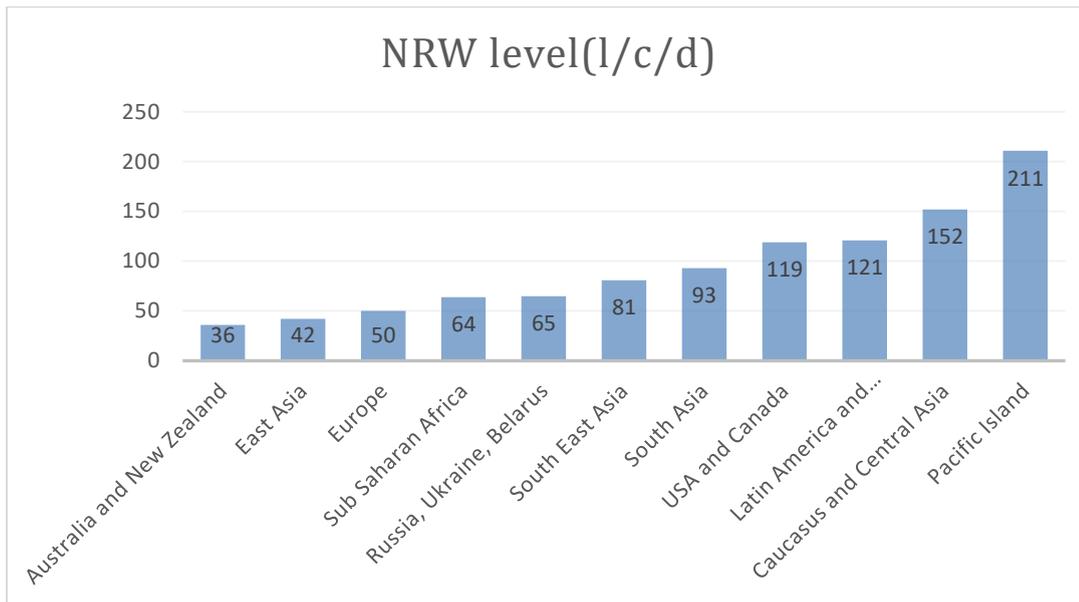


Figure 2.5: Global Non-Revenue Water
Liemberger & Wyatt, 2018

Quoting (Miriam, 2011), “Water losses lead to rising unmet water demands, together with the imperative to exploit more resources and incur higher costs in the operation and maintenance of infrastructure; high water losses mean high pumping costs, as well as increased demands for the repair and maintenance of reticulation systems and leaking storage facilities”

2.4 Overview of the Non-Revenue Water in developing countries

Over the years, Non-Revenue Water has been a big challenge facing every water utility across the world (AWWA, 2019). In developing countries, roughly 45 million cubic meters of water are lost daily with an economic value of over US\$3 billion per year (Kingdom et al., 2006). The question lies on how to manage it which differs from one utility to another and from one country to another. (Kingdom et al., 2006) carried on stating that most developing countries still lag behind when it comes to solving the issue of NRW. The report of the (World Bank, 2016) study shows that the reason for this is mainly due to weak capacity of water utilities, lack of incentives, poor financial discipline and the effort required to find and fix leaks compared to building new treatment facilities.

High levels of NRW reflect huge volumes of water being lost through leaks, not being invoiced to customers, or both (USAID/WBI, 2010). NRW has been a difficult issue to all water utilities and the way of dealing with it depend on each utility’s performance, which can also depend on different aspects of internal as well as external management of that water utility.

A study conducted by (Appiah et al. 2017) states that Non-Revenue Water results from different causes of water loss and requires proper mix of mechanisms ranging from technology, institutional structure, financial to management of them. For this reason to deal with the issue of Non- Revenue Water management requires proper understanding of the reasons and factors that influence Non-Revenue Water in the water sector. With that, design of technics and policy strategies to tackle those factors can then be implemented (USAID/AfWA, 2015).

2.5 Management of Non-Revenue Water in Africa

The principal challenge for Africa in the urban sphere is to address how its cities and towns respond to the massive challenges of rapid urbanization, urban expansion, increased demand for services, threats to water supply, constrained and failing urban planning systems, and institutional practices that work in isolation (Jacobsen, Webster, & Vairavamoorthy, 2013). Without the presence of capable institutions, effective infrastructure, and policy frameworks to address the challenges, large numbers of households in urban areas in Africa will continue to have no or limited access to one of the most basic of human needs—a safe and reliable supply of drinking water (Zeraebruk et al., 2014). Water losses indicate the performance of water utilities and the country’s level of financing water works especially for water supply, maintenance and repair as well as other loss management. Climate change and population growth have resulted in large requirements of water in domestic, industrial, and agricultural purposes (USAID/AfWA, 2015).

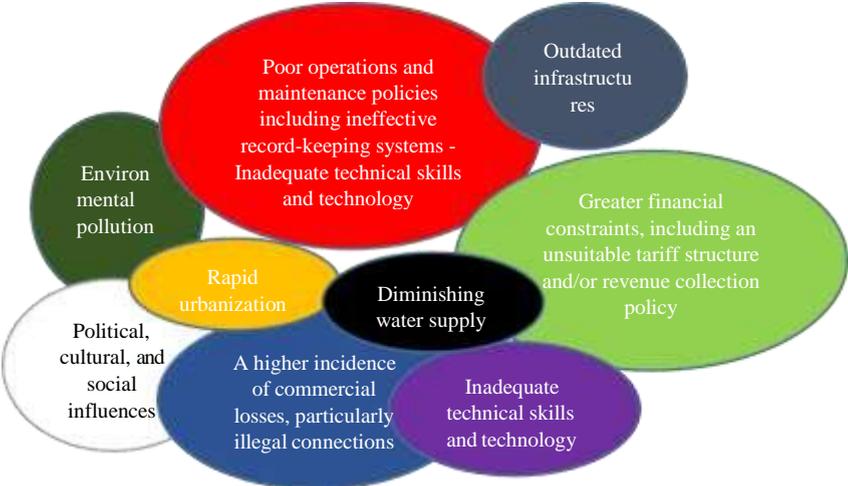
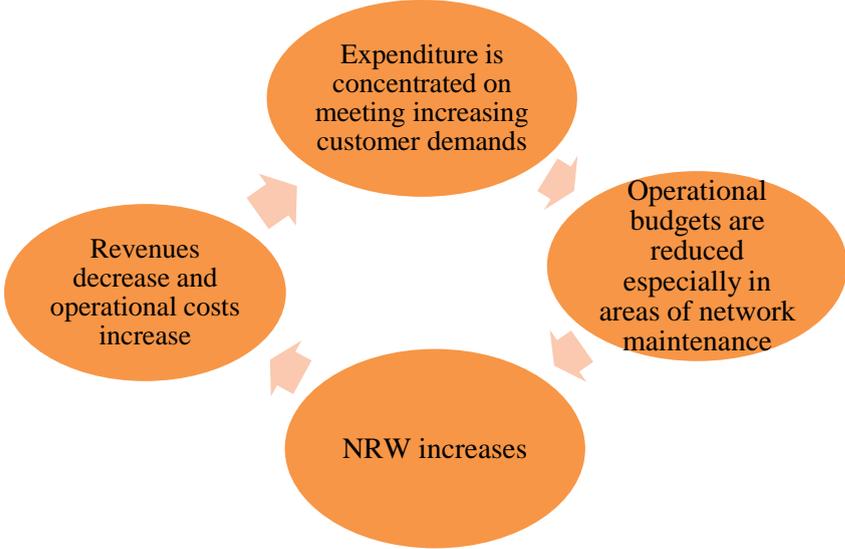


Figure 2.6: Challenges facing African Water Utilities in NRW management.
(USAID/AfWA, 2015)

Although the predictions show the over increasing water demand in the coming year (Donkor 2014) , water distribution networks are subject to deterioration over time, according to the report by (Caroline, 2014), and this usually leads to difficulties such as decreased capacity of hydraulic facilities, increased volume of water loss, service disruption, and lower water quality. Hence, trying to meet the increasing demand of water can be a major challenge for the utilities that still struggling to minimize the water losses (Kingdom et al., 2006). For instance, water losses in Germany and Japan are just single digit while in developing countries the NRW can reach 50% (Pratap, 2018). This has been argued upon by (USAID/WBI, 2010) mentioning that there are two types of tackling the impact of NRW. The utilities decide to look at it either in a vicious cycle or in a virtuous. The vicious cycle of NRW management represents all the struggle utilities go through to increase the expenditures to meet the increasing water demand, consequently the operational budgets are reduced especially in areas of network maintenance which results into NRW increase leading to revenue decrease and operational costs increase. In contrast, the virtuous cycle shows measures taken by utilities to invest in NRW reduction program and this helps them to increase revenues, and be able to finance further water distribution connections hence reaching out to many customers. Following are the illustrations comparing two NRW management cycles:



THE VICIOUS CYCLE OF NRW

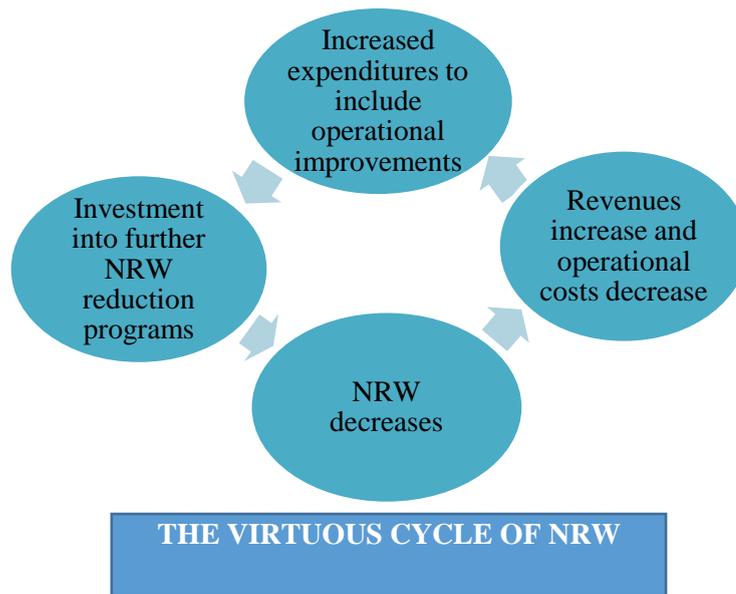


Figure 2.7a&b: NRW management cycles

Source: (USAID&WBI Report, 2010)

For example, in South Africa, the focus of NRW management is on pressure management due to the encountered water losses through leaking pipes (Adedeji et al., 2017). This is a way of dealing with the technical management where the interventions focus on Pressure management, Active Leakage control, Infrastructure and asset management as well as speed and quality of repairs (Adedeji et al., 2017); Wu et al., 2011).

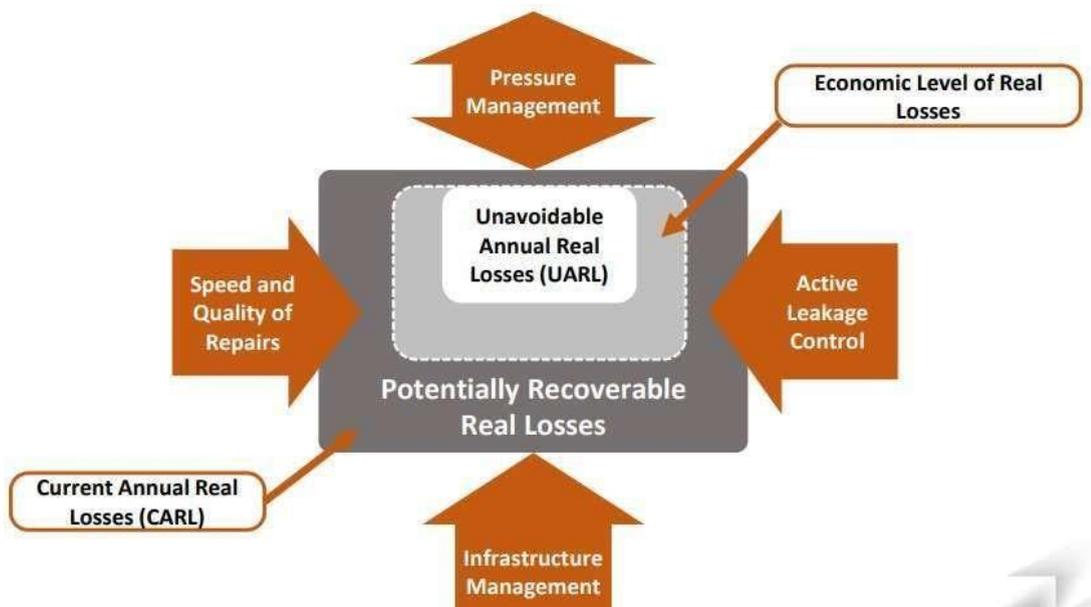


Figure 2.8: NRW intervention strategies

(Wu et al., 2011)

2.6 Measuring Performance of the Water Utilities in Africa

In a water utility NRW can have effect on almost all sectors of operational performance (Appiah, 2017). Caroline, 2014 stated that not all the performance indicators are accurate. However, some indicators have shown to be strongly related to NRW (Zeraebruk, 2014) and are significantly impacted by NRW management as indicated within the performance assessment and benchmarking report done by Water and Sanitation Program in 2009 (WSP-Africa, 2009).

2.6.1 Technical Performance

2.6.1.1 Water supply coverage (%)

Which may be defined as the percentage or number of households connected to the distribution network. This is important in measuring the impact of NRW because whenever there is possible leaks, the water supply is affected immediately (Veolia, 2016). Hence the target of 90% water coverage was set by (WSP-Africa, 2009) for a well performing utility.

2.6.1.2 Non-Revenue Water (%)

The technical performance looks firstly at the level of non-revenue water. This is important because if NRW is kept low, the performance of utility increases. It is to note that a zero level of NRW is not technically possible nor economically feasible (Washali et al., 2020). A target reduction up to 25% is expected (WSP-Africa, 2009), while the one set by the American Water Association is 10% (AWWA, 2019).

2.6.1.3 Metering (%)

This indicator is very important as it shows the number of connections with operating meters. It helps the utility to record the continuity of water supply throughout the day. And to manage the cost recovery through the set tariff structure. A target of 100% is expected (WSP-Africa, 2009).

2.6.1.4 Bursts and leaks

Bursts and leaks represent the technical weakness of a water utility (Caroline, 2014). Counting them will give an idea of what to repair and how much it will cost (WSP-Africa, 2009).

2.6.1.5 Water consumption

This indicator helps a lot in identifying how much of water is utilized per capita per day to be able to set the price with an aim at increasing production cost recovery therefore increasing the ability to fund for asset management. The target is 76 l/c/day (WSP-Africa, 2009)

2.6.1.6 Water quality and water quality management

NRW has a big effect on water quality and vice versa. There is a big chance for an old pipeline to burst causing leaks. If repair is not done in a short time, water quality can be affected. On the other hand, bad water quality affects the water meter's needle resulting into errors in the counter. The target is 100% (WSP-Africa, 2009)

2.6.2 Financial Performance

2.6.2.1 Collection efficiency and collection period

This is the key performance indicator that relates to the utility's ability to collect revenue from the bills it has issued to customers. The big number of people bills are issued to, the more revenue is collected. Collection period is the time it takes to collect the average bill. When it takes long to collect, it affects the financial stability of utilities. The target is 100% of bills collection. (WSP-Africa, 2009).

2.6.2.2 Operating cost coverage ratio

It is the ability of utility to recover the operation cost from the customer's bill. It is a good indicator because it helps the utility to measure its sustainability. According to (WSP-Africa, 2009) The internationally accepted norm is that operating cost coverage ratios (OCCRs) should be in the range of 130 % to 160 % or 1.2, with an allowance for asset rehabilitation and replacement, as well as debt payment. This may exclude the capital investment for expansions, additional water production.

2.6.2.3 Unit Cost of production

Understanding, managing, reducing, and reporting O&M costs (that is, costs of production and distribution) is the first key step in improving utility efficiency as it forms the basis for analyzing expenditure and income requirements. If a utility doesn't manage to keep the cost very low, it will be subjected to charging higher tariffs to be able to stay financially stable. Some of the practices of reducing cost includes but not limited, increasing the volume of water sold, reducing commercial and technical losses and increasing the number of metered connections (WSP-Africa, 2009).

2.6.2.4 Unit revenue

Total operating revenue expressed by annual water sold (WSP-Africa, 2009). This helps to quantify the water sales and revenues for billing purpose (Donkor, 2013)

2.6.2.5 Water tariffs and Subsidy

This indicator shows the utility's ability to subsidize for the poor. It involves the tariffs setting structure as well as all the resources or funds to subsidize water services either from the Government, Non-Governmental Organizations and people among themselves (WSP-Africa, 2009)

2.6.2.6 Service to the poor

This involves the number of connections expanded for the poor communities. Provision of service to the poor is still a major challenge to all African utilities (Karamage, 2016). This is mostly felt in urban areas where people are likely to move to in quest of money and development. Most of the time you find low income families congested in unplanned or informal settlements, sometimes not safe; which makes it difficult to expand water services to them (USAID, AfWA, 2015). This also becomes worse in case of repairing/replacing deteriorated pipes. In situations like this, people try to find other sources of water such as untreated water from rivers or lakes or worse theft of water, therefore increasing the rate of NRW. Improving service to the poor can make a great impact to the performance of water utility (WSP-Africa, 2009).

2.6.2.7 Overall Efficiency Indicator

This measures the volume of water produced for which a utility is able to recover revenue was termed the "overall efficiency indicator" (OEI). It is calculated as $(1 - \text{NRW}) * \text{Collection efficiency}$. Despite that it is intuitive, it is a good indicator because if a utility has low OEI, it encounters the high average cost per m³ of water sold, either an increase in tariffs to cover the cost or increased subsidies. There is also inability to sustain and/or extend services to the poor (WSP-Africa, 2009).

2.6.3 Customer Performance

2.6.3.1 Continuity of supply

This refers to the average hours of water supply services per day. The higher the NRW, the less continuity of water supply (USAID/AfWA, 2015). It is considered that poor continuity of supply is a disincentive to serve the poor as utilities are incentivized to seek to maximize revenues by selling water to higher income consumers (domestic and industrial). The target is 24 hours (WSP-Africa, 2009).

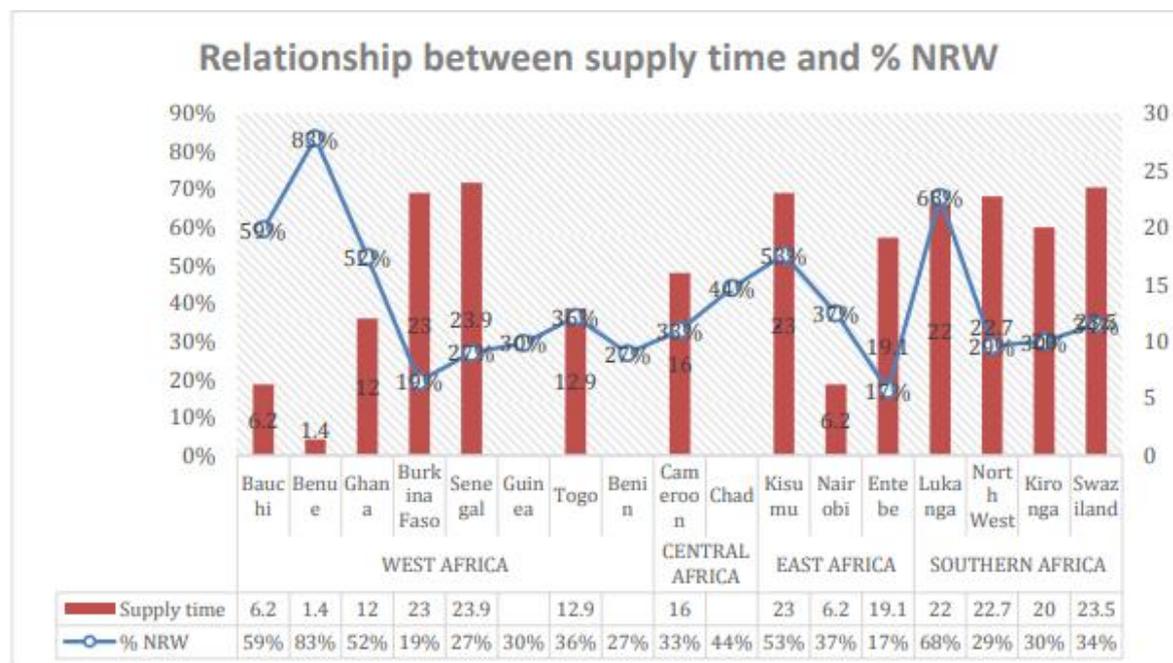


Figure 2.9: relationship between supply time and %NRW in Africa

(USAID/AfWA, 2015)

2.6.3.2 Customer satisfaction rate/complaints

Customer satisfaction on water supply service is the main target of every water supply utility (Donkor, 2013). In addition, knowing the number of all complaints made by customers for the services provided helps utilities analyze the services they are giving and hence draw measures for better performance. However this indicator is variable. It can range from the continuity of supply, tariffs set, broken pipes or leaks, non-operating meters, and so on (WSP-Africa, 2009).

2.6.3.3 Community participation

This indicator shows the rate of awareness and active community engagement towards ensuring better services (Lai, 2017). It includes best practices such as number of training offered by the community on how to reduce NRW, good communication as well as reporting the leaks, bursts, and possible thefts or errors in metering (USAID/WBI, 2010) and (Veolia, 2016).

2.6.4 Institutional Performance

2.6.4.1 Staff productivity

This indicator shows the total number of staff per thousand connections. A well performing utility needs less than 6 staff/ 1000 connections (WSP-Africa, 2009),

2.6.4.2 Capacity building

This shows a percentage of staff members that participate in training. The ability of a utility to offer training to its staff members helps to minimize all internal risks related to unskilled employees (Christiaensen et al., 2017). The more the staff receive training about NRW reduction, the more NRW will be well managed (WSP-Africa, 2009).

2.6.4.3 Water governance

These are policies and strategies to deal with NRW (USAID/AfWA, 2015). It can range from institutional and regulatory framework, to organizational structure as well as to setting out and enforcing policies towards reducing NRW. A well performing utility also have clear policies and practices.

2.6.5 SWOT Analysis

SWOT stands for Strength, Weakness, Opportunity and Threat. SWOT analysis is a technique for assessing aspects of utilities' performance with the aim at improving thematic areas in order to maintain the efficiency operation of the utilities. It consists of analyzing the current situation which (Wegelin, 2013) also named the status quo of the utilities which include their performance, the challenges encountered as well as identifying the opportunities to solve those challenges. According to the report of the diagnostic visit organized by AfWA and Water Operators Partnership, SWOT analysis helps utilities to set up short and medium-term strategies to improve the efficiency of water utilities (Wop ofid/gwopa/AfWA, 2019).

2.7 Review of water Supply and Non-Revenue Water in Burkina Faso

The National Office for Water and Sanitation (ONEA) is a company which was created by a decree n ° 85/387 / CNR / PRES / EAU of July 28, 1985 in the form of a public State establishment with character industrial and commercial (EPIC) with a capital investment of 3,080,000,000 CFA francs detained by the state.. It was transformed into a State-owned company on November 2, 1994 (decree N ° 94-391 / PRES / MICM / EAU).

Before 1960 and until 1977 (year of nationalization), the management of collective Drinking Water Supply (DWS) systems was carried out by private companies or with private holdings: Energie AOF (French West Africa), African Water and Electricity Company (SAFELEC), Voltaic Water and Electricity Company (VOLTELEC) and National Water Company (SNE). The National Water Company (SNE), created on January 1, 1970, managed seven centers (Ouagadougou, Bobo- Dioulasso, Koudougou, Ouahigouya, Kaya, Dori and Banfora). The water policy, drawn up in 1976, transfers water management to the public domain. In 1977, the management of collective water supply systems was nationalized with the creation of the National Water Office (ONE) in the legal form of a public industrial and commercial establishment (ordinance N ° 77/006 / PRES on 02/23/77). This office receives the monopoly of the management of all companies and of all storage, treatment, purification, transport and distribution of raw and potable water. In 1984, due to the reported problem of pollution, and the need to recycle wastewater, the Ministry of Water was reorganized and hence the birth of ONEA in 1985. The two main missions of ONEA are to create, manage and protect installations for the collection, supply, treatment and distribution of drinking water for urban and industrial needs; and also to create, promote and improve as well as manage collective, individual or autonomous sanitation facilities for the disposal of wastewater and excreta in urban and semi-urban areas. ONEA experienced challenges of 3 million cfa deficit during its first years. However it regained growth by recovering the capital investment through sanitation services. Some of the adopted practices included offering an installment system for water access to a large number of households; an awareness campaign which slowed down the wastage of water and the creation of a card which enabled customers to monitor their consumption.

2.7.1. Institutional operation of ONEA

ONEA currently manages 56 centers in Burkina Faso. Its relations with the State are governed by a three-year plan contract and a specification which sets the conditions for the creation, operation and protection of water and sanitation infrastructure under ONEA management. The relations between ONEA and the users of the public service are, for their part, governed by water and sanitation service regulations which inform users of the operation of the service and which define the rights and obligations of each party. Being a public utility, ONEA's technical operation is supervised by the Ministry of Water and Sanitation (MEA), while its management is supervised by the Ministry of Industry, Trade and Handicrafts, and finally the Ministry of Economy and Finance. Burkina Faso has become a benchmarking point for African water utilities due to its performance in water management (USAID/WBI, 2010).

Report from (USAID/WBI, 2010) states that Ouagadougou, capital of Burkina Faso and managed by ONEA, is well performing public utility for the region, with a management emphasis on efficiency. Basic data to construct a water balance is available and accurate such as a well-placed production metering, with electromagnetic meters installed after 2005; a customer meter replacement program was completed in 2007; customers are fully metered and there are no individual roof tanks; a service contract has resulted in a customer census, a meter workshop, improved collection efficiency and redesign of service connections; commercial losses from illegal connections, meter under-registration, meter tampering and meter reading and data handling errors could be quantified; and finally, verification of physical losses was done by carrying out measurements over 24 hours in one large zone.

Reaching out to customers always help collect information on time, therefore reducing the NRW and improving the water quality as well as regular supply. Operating a 24/7 customer call centre with dedicated toll-free lines for customers to report leaks encourages the public to provide information on any problems with the water supply. In Ouagadougou, Burkina Faso, members of the public are encouraged by the water utility, ONEA, to report visible leaks using a readily visible, easy to remember and free number 11-11 (USAID/WBI, 2010). ONEA has 5 permanent repair crews, on shift at the same time as the call centre staff and available to react to leaks quickly. In 2005, in direct response to call centre leads, the teams repaired 1,090 mains leaks and 3,496 house connections all repaired within 4 hours from the time of receiving a call.

In Ouagadougou customers are fully metered, and, although there are no individual roof tanks customer meter accuracy was seen as a weakness. A service contract was initiated in 2001, resulting in: A customer census to establish correct billing records and improved collection efficiency; A meter workshop to support a regular customer meter sampling and testing program; A meter replacement program and total customer meter replacement; Redesign of service connections; Installation of a modern IT customer management and billing system; Improved control of metering and corruption at community fountains.

2.8 Review of Water supply and Non-Revenue Water level in Cote d'Ivoire

The government of Cote d'Ivoire has decided to secure drinking water supply in different towns of the country following the water crisis encountered in the region of Bouake in 2018 (Jean Marie, 2020). To this, investments for water extraction and treatment were put in place. SODECI is in charge of exploiting water resources and supplying water to the state except the villages (SODECI-RDD, 2018).

2.8.1 Institutional Operation of SODECI

Ivory Coast committed since 1973 to solve the problem of access to safe drinking water under the national program of hydraulics. With that, a contract was signed with Societe de Distribution d'Eau de la Cote d'Ivoire (SODECI) in 1987 with the aim of improving life of the population in Ivory Coast. SODECI installed 8 water treatment plants in the city of Abidjan with 77 forages with large diameters and the capacity of 312,000 m³/ day of potable water (Lazare, 2015; Thiriez et al., 2011). Despite the effort the government has put in, Access to drinking water in Côte d'Ivoire remains a major challenge, particularly for populations living in urban extension areas as (Djaliah, 2018) stated that this is associated with high cost of water distribution connections, as well as inadequate infrastructures that allow regular water supply to the increasing population and urban activities. In the wake of Millennium Development Goals MDG7 with its target 7C that seeks to halve by 2015, the proportion of people of Ivory Coast without sustainable access to safe drinking water and basic sanitation, the Government of Cote d'Ivoire (GoCI) invested an amount of 440 milliards F.CFA for a period of 3 years (2012-2015) with the purpose of reinforcing actions of sensitization and providing sustainable solutions in the sector of reducing Non-revenue water within water utilities (Diabagate, 2016). More so, the Government of Cote d'Ivoire incorporated the Private Public Partnership (PPP) with other stakeholders such as ONEP, SODECI, African Development bank as well as the World Bank (World Bank, 2019) with the purpose of enhancing the works of improving access to water supply and most specifically increasing infrastructure for water distribution and mitigating the impact of Climate change while also working on reducing the Non-Revenue water of which the increasing level has significant effect on the technical, financial, customer and institutional performance (World Bank, 2019).

SODECI water governance is under the supervision of the MCLAU and MIE delegated by the State of Cote d'Ivoire which has signed the contract of affermage for exploitation of water and sanitation in urban sectors, as illustrated in the figure 2.12 (SODECI-RDD, 2017). These two Ministries work with ONAD and ONEP respectively under the contract plan; where in return ONAD and ONEP are in charge of supervision of SODECI with performance based contracts. Finally, SODECI ensures the provision of water and sanitation to the customers under a contract of subscription.

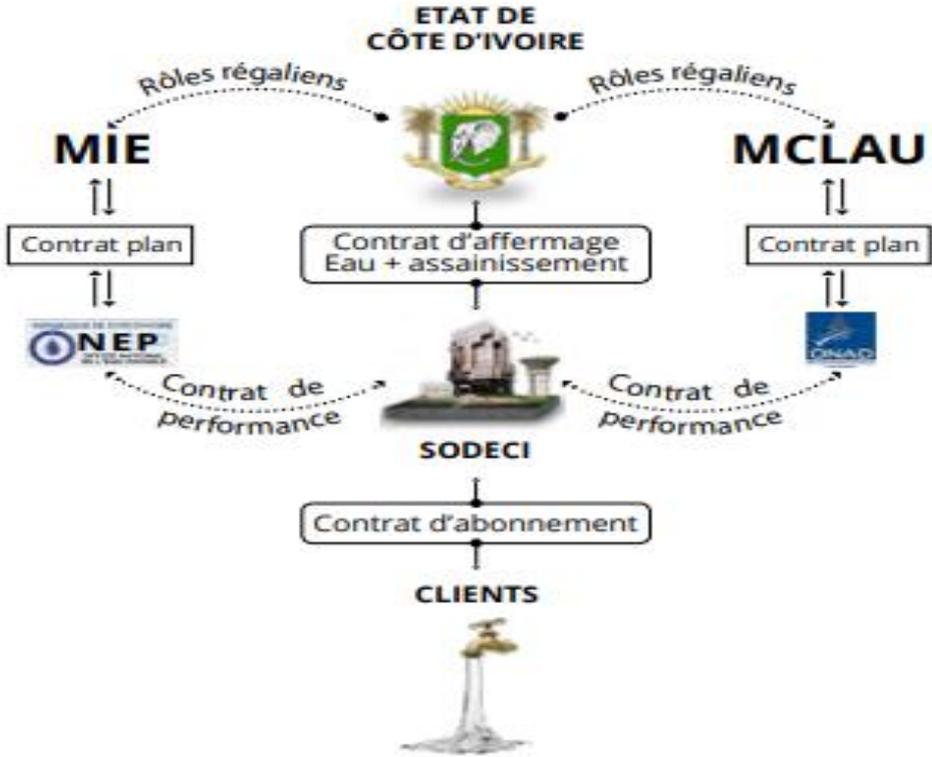


Figure 2.10: Institution framework and water governance of SODECI.
(SODECI-RDD, 2017)

CHAPTER THREE: MATERIALS AND METHODS

3.0 Introduction

This chapter presents briefly the socio-economic profile, environment, administration and population as well as the research methodology. This research was conducted in four Institutions mainly Ministry of Hydraulics, SODECI, ONEP and ONAD. Data were collected using questionnaires, tabulated and analyzed using SWOT ANALYSIS MODEL.

3.1 Overview of the study areas

Geographical situation

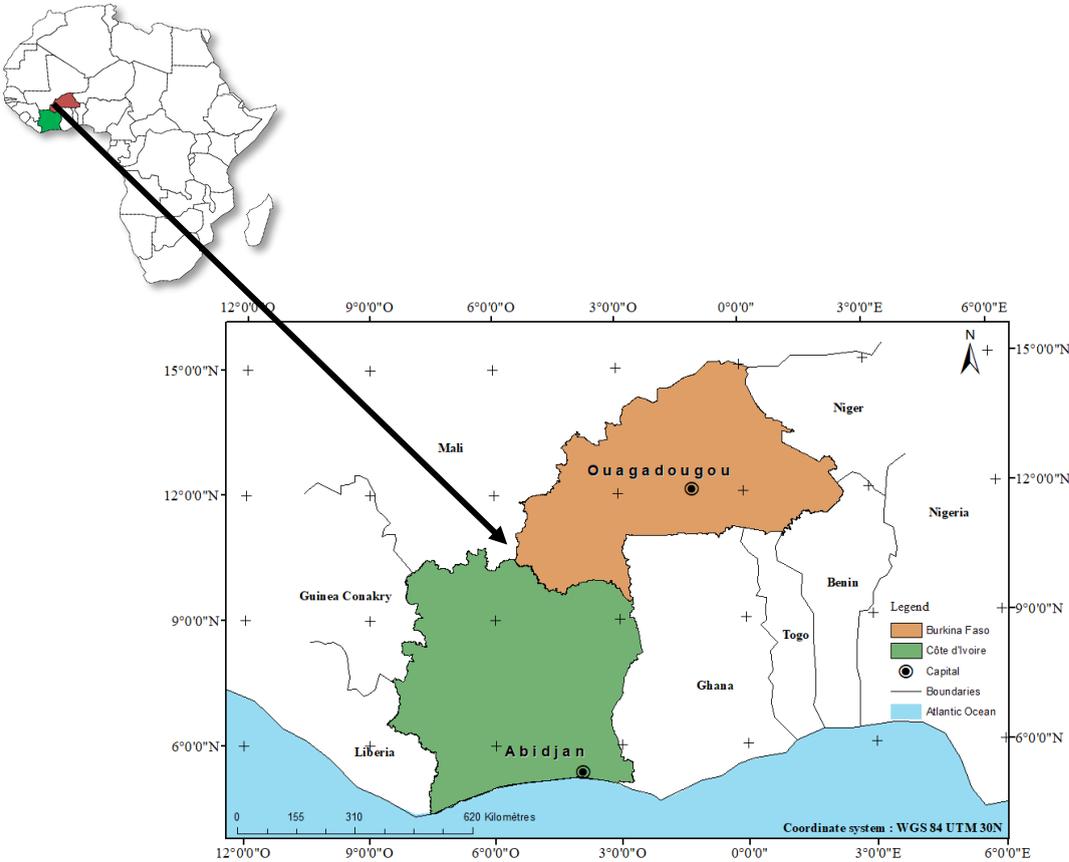


Figure 3.1: Map of Cote d'Ivoire and Burkina Faso in West Africa

3.1.1 Location, Topography and Administrative summary (Cote d'Ivoire)

The first research was conducted in Cote d'Ivoire which is a country in West Africa. It is located in the northern hemisphere, between the Tropic of Cancer and the Equator at 8 00°N, 5 00°W. The country is bordered to the south by the Atlantic Ocean, at the level of the Gulf of Guinea. It shares land borders with Liberia and Guinea to the west, Mali and Burkina Faso to the north, and then Ghana to the east. Cote d'Ivoire has the shape of an irregular square of more than 550 km of side. Its total area is 322,462 km² (land and inland waters). The administrative capital, Yamoussoukro, is located in the center of the country. The economic capital, Abidjan, is to the south, on the coast.

Relief

The Ivory Coast presents on the whole a slightly broken relief, made up of plains and plateaus, with the exception of the west of the country, which is more mountainous. In the south of the country, along the Gulf of Guinea, the coast consists of cliffs in its western part, and a strip of sand and lagoons in its eastern part. North of this coastal strip is a vast plain, then a region of low plateaus (located at altitudes below 350 m). Going further north, the country rises towards the middle plateaus. The highest region of the country is in the west, where the altitudes of these plateaus can reach 900 m. This is where the highest point of Côte d'Ivoire is located, Mount Nimba (1,752 m), the meeting point of the borders of Côte d'Ivoire, Guinea and Liberia.

The climate

Côte d'Ivoire is the transition zone between the humid equatorial climate and the dry tropical climate. Thus, the country can be divided into two main areas: the south and the north. Generally, temperatures are high (around 30 ° C). The difference between the two zones is above all in the level of hygrometry (humidity) of the air, which can be around 100% in the south and go down to 20% in the north in Harmattan weather (dry wind from Sahara).

In the south, that is to say below a horizontal line passing through Yamoussoukro, the climate is equatorial, therefore very humid. The temperature is relatively constant, between 29 and 32°C. There are four main seasons:

- April to mid-July: great rainy season, with frequent precipitation and numerous thunderstorms,
- mid-July to September: short dry season, the sky may remain overcast,
- September to November: small rainy season, with some small precipitation,
- December to March: great dry season, marked by the northern trade winds (harmattan).

In the northern part, the climate is tropical and drier, and the seasons are less marked. The temperature generally evolves between 28°C and 37°C. There are two main seasons:

- June to September: great rainy season, due to the humid trade winds,
- October to May: great dry season.

The vegetation

Due to the two north-south climatic zones, Côte d'Ivoire is separated into two vegetation zones: the forest in the south, the savannah in the northern part. The limit is a line that starts from Man in the west, descends in the region of Yamoussoukro and goes back to the surroundings of Bondoukou in the east. The northern part is covered with savannas, characterized by large areas of grassland and sparse trees, especially when approaching the Sahel to the north. Only areas close to watercourses have dense forests and rich vegetation. The main plantations are fields of millet, millet, sorghum, rice and cotton, and to the south, tomato and vegetable growers. In the center, vast coffee and cocoa plantations have largely taken the place of the forest. The forest extends over the entire southern part of the country. Its surface area has declined sharply in recent decades, in part due to excessive exploitation. Primary forest has practically disappeared, apart from certain protected areas, such as the national parks of Tai in the southwest and Banco in the vicinity of Abidjan. Pineapple, bananas, rubber, cocoa and coffee are grown in the south, as well as coconut palms.

The rivers

The Ivory Coast is crossed by four main rivers, with many tributaries. These rivers flow in a north-south direction, their course ending in the Gulf of Guinea:

- the Cavally (600 km), in the far west, has its source in Guinea and forms the natural border with Liberia,
- the Sassandra (650 km), to the west, also has its source in Guinea,
- the Bandama (950 km), in the center, is the only river with its entire basin in Côte d'Ivoire,
- the Comoé (900 km), to the east, has its source in Burkina Faso.

These rivers are hardly navigable, in particular because of the rapids and waterfalls, or because of the lack of flow in the dry season.

Table 3.1 Summary of the Cote d'Ivoire

Country name	Republic of Cote d'Ivoire
Head of State	Alassane Ouattara
Capital City	Yamoussoukro
Official language	French
Monetary currency	Franc CFA
Population	25,808,000 (2019)
Area km ²	322,463
Human development Indicator HDI	0.492 (2017)
Population projection (2030)	33,168,000

Encyclopedia Universalis, 2020

3.1.2 Location, Topography and administrative Summary (Burkina Faso)

Located under the loop of the Niger, Burkina Faso is a continental country of 274,000 km² without an outlet to the sea. It is limited to the North and West by Mali, to the North-East by Niger, to the South-East by Benin and in the South by Togo, Ghana and Côte d'Ivoire in the South-West. The low slope of the relief hinders the flow of water from the three rivers: Mouhoun, Nazinon, Nakambé (old black, white and red voltas) which drain the country. The closest point to the Atlantic is 450 km away. The average altitude of the plateaus is 450 m. The highest point, the Tenakourou rises to 747 m and is located in the west of the country. A landlocked country in the Sahel, Burkina is still very rural, it is "the Africa of villages".

The Climate

The climate is tropical with mild, dry winters and hot, rainy summers. There are two types of natural environment: the Sahel in the north and the savannah in the south. Burkina Faso has few natural resources. It is a poor and arid country. There are a few deposits of manganese, gold, phosphate, etc. The vast majority of the population is agricultural and cultivates sorghum and millet, groundnuts, sesame, etc. for their own needs. Cotton is one of the main export products.

Table 3.2: Summary of Burkina Faso

Country name	Burkina Faso
Head of State	Roch Marc Christian Kabore
Capital City	Ouagadougou
Official language	French
Monetary currency	Franc CFA
Population	20,875,000 (2019)
Area(km ²)	274,000
GDP	15.65 % (2019)
Population projection 2030	27,969,000

Encyclopedia Universalis, 2020.

3.2 Research design

The study used a comparative approaches of 2 water utilities. Data were collected in Cote d'Ivoire and Burkina Faso. Structured questionnaire were used to collect primary data. Moreover, secondary data were collected from existing documents, books, journals and reports.

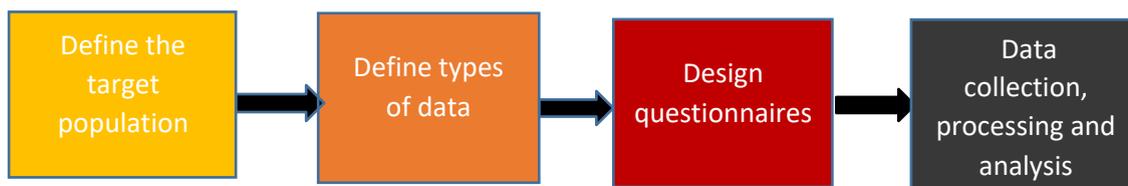


Figure 3.3: Illustration of Research design

3.3 Defining the target population

Although there are numerous approaches grouped succinctly into probability or non-probability techniques (Ley, 2019). Purposive sampling (non-probability) method was used to choose respondents from the selected institutions in charge of water sector. For Cote d'Ivoire, the Ministry of Hydraulics, ONEP, ONAD, and SODECI for interview. As for Burkina Faso, ONEA and MEA are the ones selected to fill out the questionnaires.

Table 3.3: The major category of respondents in Ivory Coast

No	Category	Number of target respondents
1	Ministry of Hydraulics	1
2	ONEP	1
3	SODECI	1
4	ONAD	1
Total	Total	4

Table 3.4: The major category of respondents in Burkina Faso

No	Category	Number of target respondents
1	Ministry of Water and Sanitation (MEA)	1
2	ONEA	1
Total	Total	2

3.4 Types and Sources of Data

The study used both primary and secondary data. Primary data were obtained directly from the field and secondary data were obtained from reports, journal articles, official websites, newsletters and other relevant documents.

3.4.1. Primary data

Primary data were obtained from respondents directly in the study area of the 2 countries. Through African Water Association which the two countries water utilities hold membership, data were collected, whereby Ministry of Hydraulics, ONEP, ONAD, and SODECI were the major respondents in Cote d'Ivoire while ONEA and MEA responded from Burkina Faso. Tools used in this group of respondents were filling questionnaires. Questionnaires are attached as Appendix 1, 2, 3, 4, 5, 6.

3.4.2 Secondary data

Secondary data were obtained from different sources both published and unpublished documents and relevant literatures such as reports, journals, pamphlets, newspapers, publications and internet sources. These documents were obtained from libraries, different institutions and offices.

3.5. Design questionnaires

Data were collected using questionnaires which were addressed to each of the 4 institutions in Cote d'Ivoire (Ministry of Hydraulics, SODECI, ONEP, and ONAD) and 2 institutions in Burkina Faso (ONEA and MEA); with specific questions regarding Non-Revenue water management, Impact of Non-Revenue Water to the Technical, Financial, Customer and Institutional performance. Questionnaires also were designed in a way to give answers for the SWOT analysis of both SODECI and ONEA. (See Appendix 1, 2, 3, 4, 5, 6)

3.6. Data collection, processing and Analysis

The collected data were translated, coded and tabulated to review and compare both water utilities. Then data were processed by the SWOT analysis Model to understand the effective management of Non-revenue Water for both utilities.

3.7 Ethical considerations

This study observed confidentiality when handling the information given on questionnaires. The respondents' information was not passed to any third party. The Respondents consent was sought before administering or conducting interviews.

3.8 Limitations of the study

Due to the pandemic of COVID-19, the face-to-face interviews could not be conducted which reduced the quality of data that were expected. Some respondents delayed to fill the questionnaires which slowed down the process of data collection and analysis. However, the issue was resolved by adopting online communication with most respondents.

CHAPTER FOUR: RESULTS ANALYSIS AND INTERPRETATION

4.0 Introduction to data analysis

This chapter describes the findings of the study. The study used a comparative approach to analyze the effects of Non-Revenue Water as well as NRW management within water utilities in Burkina Faso and Cote d'Ivoire. The approach was undertaken to compare data obtained from 2 countries taking into consideration the Technical, Financial, Customer and Institutional performance indicators directly linked to NRW management. The results are based on research objectives and hypothesis which were used to guide the investigation.

4.1 Analysis and Discussion of major findings

This study analyzed data in three consecutive categories based on the specific questions set in the introduction. Firstly, the study reviewed the level of Non- Revenue Water management in both countries; secondly, the study examined the Technical, Financial, Customer, and Institutional performances of both countries' water utilities on NRW. Lastly, the study analyzed the Strength, Weakness, Opportunities and Threats through SWOT analysis tables and proposed a conceptual model for effective NRW management alongside the Best Practices of both countries' water utilities in dealing with their NRW.

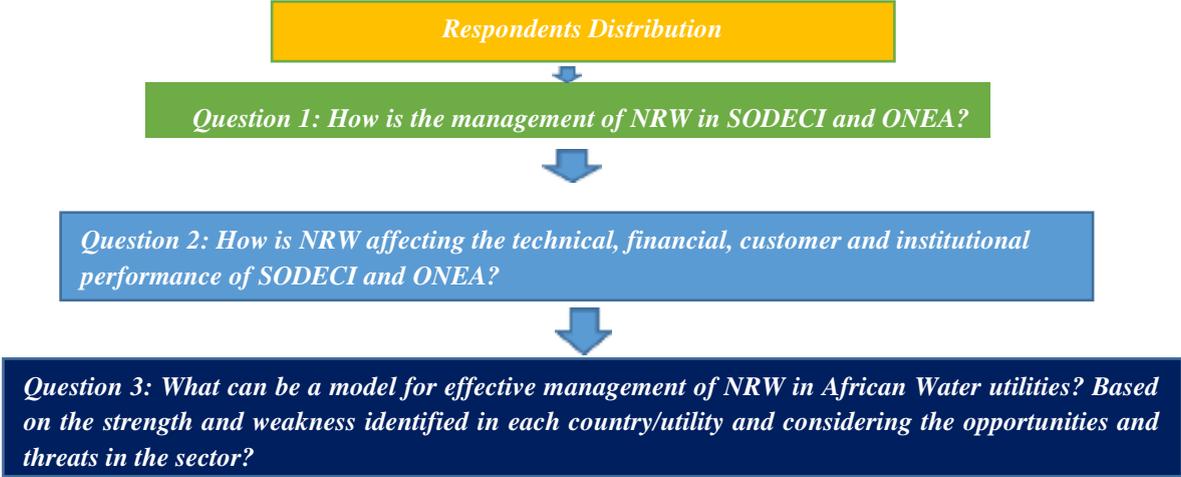


Figure 4.1: Illustration of results analysis

4.1.1 Respondents Distribution

Questionnaires that were sent to ONEA and MEA in Burkina Faso; were responded at 100%. Questionnaires that were sent to SODECI, ONEP, ONAD and MoH; were answered by ONEP, ONAD and MoH to the exception of SODECI, hence making it 75% of the data collected in Cote d'Ivoire.

Table 4.1: The major category of respondents in Ivory Coast

No	Category	Number of respondents
1	Ministry of Hydraulics	1
2	ONEP	1
3	SODECI	No response
4	ONAD	1
Total	Total	3

Note that for SODECI, in order to be able to analyze and compare it with ONEA, data from ONEP, ONAD and the Ministry of Hydraulics as well as secondary data were used to fill the gaps.

Table 4.2: The major category of respondents in Burkina Faso

No	Category	Number of respondents
1	Ministry of Water and Sanitation (MEA)	1
2	ONEA	9
Total	Total	10

Note that for ONEA 9 respondents filled out the questionnaires according to which department of their organizational structure, the questions were addressed.

4.1.2 Question 1: How is the management of NRW in SODECI and ONEA?

In attempt to answer this question, the study reviewed the level of NRW for SODECI and ONEA within the past 7 years and the current level of NRW.

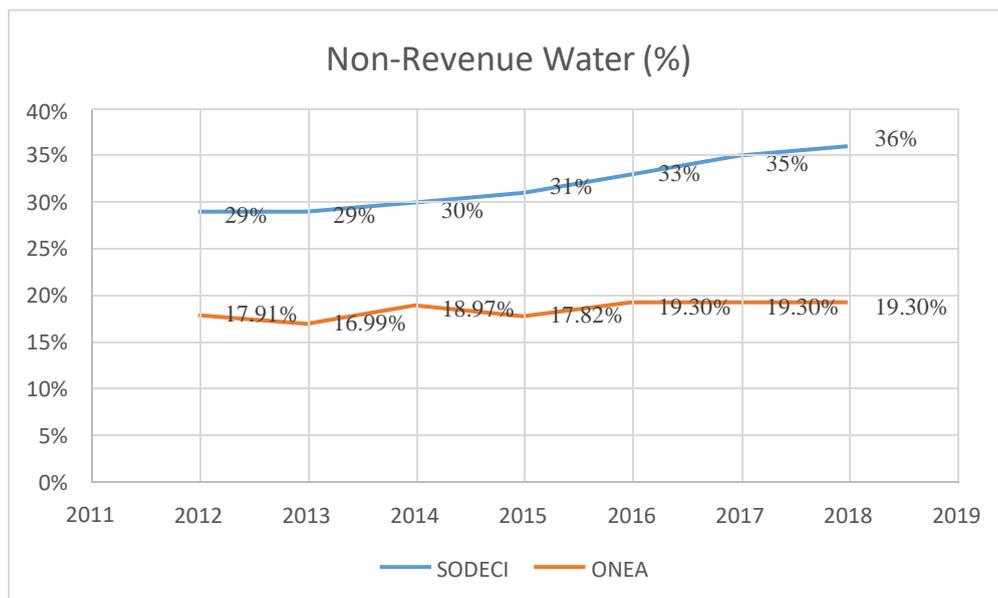


Figure 4.2: Comparison between levels of NRW in ONEA (Burkina Faso) and SODECI (Cote d'Ivoire)

Sources: [IB-net 2017](#) and [World Bank, 2019](#)

(Figure 4.2) shows the different levels of NRW for both countries within 7 years (2012-2018). Comparison used data from two different sources because for (IB-net, 2017), data for NRW in SODECI reaches up to 2014 while the one of ONEA go up to 2016. The use of data from the (World Bank, 2019) was helpful to fill the gap from (IB-net, 2017).

The level of NRW in Burkina Faso has not been high since 2012 but rather kept increasing. However, ONEA has managed to keep a constant low level of NRW of 19.30 % since 2016. On the other hand, data shows that NRW level in Cote d'Ivoire keeps increasing since 2012 when it was just 29%, and increased to 36% in 2018. According to the standard set by Water Operators Partnership Africa (WSP-Africa, 2009), a well performing utility should keep NRW level at 25% and below. This takes us to the next question.

4.1.3 Question 2: How is NRW affecting the technical, financial, customer and institutional performance of SODECI and ONEA?

This part sought to review and compare the four performance sectors (Technical, Financial, Customer, and Institutional) with some of the selected indicators directly linked to the impacts of NRW; with the purpose of analyzing what could be the different challenges affecting the performance of those four sectors in solving the problems of Non-Revenue Water. Most results were given by respondents in questionnaires, however some data were retrieved from different sources to fill the gaps.

4.1.3.1 Technical Performance

For technical management of NRW, six performance indicators were chosen because of the direct impact they have on the technical efficiency of water utilities. Those indicators include Water supply coverage, Non-Revenue Water level, Metering efficiency, the number of Bursts/leaks and thefts and water quality monitoring.

Table 4.3: Comparison of the Technical Performance of SODECI and ONEA

(I)Technical Performance	Performance Indicators	Definition	SODECI	ONEA
	1. Water Supply Coverage (%)	Households connected	71%	*92.44%
	2. Nonrevenue water (%)	Difference between water supplied and water sold (i.e. volume of water “lost”)	36%	19.3% 5m ³ / km/Day
	3. Metering (%)	Nbr of connections with operating meters	98.44%	100%
	4. Bursts and leaks Thefts	Nbr of pipe breaks and leaks in pipelines, Number of Theft	1.5 break/km/yr ----- -	2.95 break/ km/ yr 9000 leaks/month Unknown frauds/yr
	5. Water quality and water quality monitoring	Physico-chemical Bacteriological test	**96%	**100%(2018)

Discussion on the Technical performance

Results show that ONEA's water supply coverage has increased from 91.15 % in 2016 to 92.44 % in 2020. This arguably, shows the large efforts explained by the way the utility managed to maintain constant the amount of water loss (19.3%) during the whole 3 years period despite the challenges of increased number of leaks each month as well as the yet unknown number of water thefts made by customers as it has only records of 24 thefts in 2019 alone. In addition, the water utility managed to increase the number of connections with operating meters at 100%, hence the ability to record the water supplied and consumed which is at 84% as of 2017. The issue of NRW also makes the utility pay close attention to the quality of water supplied as well as its monitoring and this has been done at 100%. Finally, the whole ideal vision is to reduce commercial losses first (billing and metering errors) before dealing with the technical water losses as the later requires a massive amount of investment (WSP-Africa, 2009).

Water supply in Cote d'Ivoire has shown a tremendous increase from 2014 where it was just at 68.5 % to attain 71 % (ICEA-Espelia, 2018) with 98.44 % of connections that have operating meters. This implies a lot of efforts to expand the network especially in urban areas due to increasing population (World Bank, 2019), previous studies conducted within four regional districts in Abidjan found 43.6% of good operating meters, 33.3% of failing meters, 13.2% of the non-functioning meters and 9.9% frauds which accounts for 1092 . However, Non-Revenue water is still as high as 36 % and this is encountered mostly in the urban areas where records show 1.8 pipe break per kilometer each year. If 98.44 % of the connections have operating meters, then what could be the reason for a 36% NRW level? NRW is most felt by technical department of SODECI where 70 million usd are invested each year for technical loss reduction whereas 1 million usd is invested for commercial losses reduction. Cote d'Ivoire has managed however to conduct the physical-chemical and bacteriological test to maintain the quality of water supplied at 96%.

4.1.3.2 Financial performance

For the financial performance, other six selected indicators include Collection efficiency, Operating cost coverage ratio, Unit cost of production, unit revenue, subsidized water, and service to the poor. The Overall Efficiency Indicator would be also added as it helps to predict how long it will take for a utility to recover the cost of Non-Revenue water reduction expenses from the bills $OEI = (1 - NRW) * \text{Collection efficiency}(\%)$. However, (WSP-Africa, 2009) stated that this indicator does not give a clear amount of cost for production and the revenue.

Table 4.4: Comparison of the Financial Performance of SODECI and ONEA

(II) Financial Performance	Performance Indicators	Definition	SODECI	ONEA
	1.Collection efficiency	% of bills paid	**97.4%	**98%
	2.Operating cost coverage ratio	Annual Operational Expenses Cost of NRW reduction	*1.06 (2014) 1 M usd/year for commercial losses 70 M usd for technical losses	*1.23 (2017) 200,000 usd for NRW monthly (technical and commercial)
	3.Unit cost of production	Annual expenses of water produced	*0.94 usd/ m ³ sold	*0.73 usd/m ³ sold
	4.Unit revenue	Annual amount of water sold	-----	**0.90 usd/m ³
	5.Water tariffs Subsidized water	Water pricing structure Government or The wealthiest subsidize for the poor	**401f/m ³ Average tariff -----	IBT pricing **504f/m ³ average tariff 0-8 m ³ at 188f/m ³ for standpipes
	6.Service to the poor	Number of connections expanded for the poor	-----	*11 connections (2017)

Discussion on the Financial Performance

Despite the challenges of investing in reduction of water losses, the efficient metering discussed above helps ONEA to increase the number of bills paid for water at 98% within an 89 days period (ICEA-Espelia, 2018).

ONEA invests 200,000 usd for NRW reduction each year. the pricing that ONEA uses and the unit cost of production being 0.73 usd/m³, it is able to accumulate the net profit which is estimated to be 0.17 usd/ m³; that is the reason behind enforcing the pricing policy to strengthen drinking water supply and sanitation systems (validated every 5 years 2014-2018) (ONEA official website); the IBT pricing structure makes it possible for the government or the wealthiest to subsidize to the poor. For customers with standpipes, stand-alone water stations, raw water; these are individual customers (households) who do not have a water connection for various reasons (unplanned area, plot more than 50 m from the network, cost of connection not being carried) and who supply directly to standpipes and autonomous water stations using buckets, basins and kegs. The sale price of water to the standpipe manager is 188 f/ m³ without ceiling limitation and 10 f/ m³ of sanitation fee without ceiling limitation. The sale price of water to the manager of the stand-alone water station is 95 f / m³ and 10 f / m³ of sanitation fees without ceiling limitation. For raw water customers: These are large house or industrial customers with a raw water connection (untreated water) used mainly by industries. The sale price of raw water is 504 f / m³ (ICEA-Espelia, 2018) and a sanitation fee of 52 f / m³ without ceiling limitation. Hence, with the increased revenue, ONEA was able to subsidize water and expand 11 water services connections for the poor.

Results also show that SODECI's efficiency to collect bills is 97.4% as per data from report of (SODECI-RDD, 2017) and the ratio of annual operational expenses is 1.06. For NRW, SODECI in partnership with the Ministry of Hydraulics and ONEP, spends 1 million US dollar annually for commercial losses reduction while it spends 70 million US dollar annually for technical or physical losses reduction. The unit cost of production is 0.94 usd per m³ of water sold annually while the average tariff of water is 401f/m³ (ICEA-Espelia, 2018).

4.1.3.3 Customer Performance

For customer performance, the selected indicators include continuity of water supply, customer complaints, community participation and customer satisfaction rate.

Table 4.5: Comparison of the Customer Performance of SODECI and ONEA

(III)	Performance Indicators	Definition	SODECI	ONEA
	1. Continuity of water supply	Average hours of water supply per day	**20 hours/day	**23 hours/day
	2. Customer complains	Rate of complains handling	***8959 repair interventions 98% of complains handling	*0.6% complains (2016) *96% complains handling within 3 days (2016)
	3. Community participation	Communication NRW awareness	Call center Hotline: 175	24/7 call center Hotline: 11-11
	4. Customer satisfaction rate		-----	*90% (2017)

Discussion on Customer Performance

Results show that ONEA's customers get water 23 hours throughout the day. The rate of complaints being 0.6 % since 2016, ONEA manages to handle these complaints at 96% within 3 days. Customer performance shows that the utility maintains a good collaboration with the customers. More so, the communication established between the utility and the customer through the call center that operates 24/7, helps the utility get quick feedback on the kind of services they provide. In addition, the call center helps the utility get alerts for possible leaks, bursts and error in water meter within households. ONEA established a hotline 11-11 which is easy to remember for customers to call anytime they encounter a problem related to NRW (USAID/WBI, 2010). Therefore, customer satisfaction rate was 90 % since 2017. For SODECI, the continuity of water supply is 20 hours per day. SODECI fixed the Customer Relationship call center (175) for any possible concern related to water services.

To this, a study made by (Ta, 2016) show that a total of 8959 interventions to repair leaks has been recorded in 2016 with a 98% of complains handling in 2017 (. Among SODECI’s useful advices that were put on the website on how collect, consume and conserve drinking water, there is one that prohibits frauds on meters despite that there is no clear charge related to those frauds. So far, there is no record on the customer satisfaction rate.

4.1.4.4 Institutional Performance

For the institutional performance, three major indicators which include staff productivity, capacity building, and institutional and regulatory framework were identified.

Table 4.6: Comparison of the Institutional Performance of SODECI and ONEA

(IV)Institutional Performance	Performance Indicators	Definition	SODECI	ONEA
	1. Staff productivity	Total Nbr of staff/1000 Connections	**2 staff/ 1000 connections	**2.7 staff/ 1000 connections
	2. Capacity building	Annual Staff training	-----	100% Annual training done
	3. Water Governance	Institutional Framework and Organizational structure	Private Company Clear and detailed No chief in charge of NRW	Public company Clear and details with a chief in charge of NRW

Discussion on Institutional Performance

ONEA managed to keep the average number of 2.7 staff/ 1000 connections. This makes it possible to ensure 100% capacity building through an annual staff training organized by ONEA, MEA as well as external partners such as AfWA. If the capacity building is done at high level, the level of tracking water losses, either technical or economical, is high.

The report of (WSP- Africa, 2009) states that normally the international accepted benchmark for water utilities is less than 6 staff per 1,000 connections. More staff members in the utility means less productivity and hence poor management especially of NRW. ONEA being the public institution, it has a clear and detailed institutional and regulatory framework showing different departments and their respective responsibilities.

ONEA was established in 1985 by a signed decree n ° 85/387 / CNR / PRES / EAU of July 28, 1985 in the form of a public State establishment with character industrial and commercial. The institution is divided into departments with detailed duties and responsibilities for each. Results from questionnaires also mentioned that ONEA has the chief of services specifically in charge of water losses reduction. Being a public company, ONEA signs objective-based Plan Contracts with MEA with specific targets for service quality, which are evaluated every six months to ensure compliance with obligations (<http://oneabf.com/>).

Institutional Performance of SODECI

Despite the increased number of water losses, SODECI uses 2 staff members per 1000 connections. This complies with the international standard of less than 6 staff/ 1000 connections.

In addition, SODECI has partnership with the National Water Fund (FNE), hosted by the National Investment Bank which ensures the repayment of loans contracted for the benefit of the sector. The Development Fund finances the social connections, the works of renewal of the installations, the works of reinforcement and extension of the network, the investments in works. It is to note that SODECI signed a two concessional agreements with the State of Cote d'Ivoire including the one of the urban public drinking water distribution service in Côte d'Ivoire and the leasing agreement for the maintenance and operation of the sanitation and drainage networks and works of the city of Abidjan. The ERANOVE group also takes part in the water supply and distribution where SODECI holds 46% of the capital from it. The capital from the State of Cote d'Ivoire is 3.25 %; SIDIP holds 4.81%; FCP SODECI holds 6.72% and finally other various Ivoirians invested 39.15%. In addition, in the form of subsidiaries, SODECI holds 85% stake in LOGIVOIRE for the construction of housing for officers. It also holds 33% of the capital of the Groupement de Services Eau et Electricite G2EE Management company for water and electricity agencies. SODECI also has a strong partnership with ONEP where the later ensures monitoring and control of water supply activities under the performance based contract; the Ministry of Hydraulics as well as African Water Association (AfWA) which is hosted in SODECI and which enhances capacity building through staff training, benchmarking and sharing of best practices with African countries' water utilities. Finally, SODECI work with the customers or beneficiaries under the contract for subscription for connection, or renewal, or mutation. SODECI ensures the management of payment. Furthermore, results show that the organization lack a department that deals with Non-Revenue Water and the chief responsible for reduction of water losses.

4.1.4 Question 3: What can be a model for effective management of NRW in African Water utilities? Based on the strength and weakness identified in each country/utility and considering the opportunities and threats in the sector?

To answer this question, a SWOT analysis was used to compare and understand to what extent two very different water utility management models one public (ONEA) and other private (SODECI) could have a similar or divergent impact on solving the challenges of NRW. According to (Abay et al., 2016) studying the current situation by using SWOT analysis helps to tackle issues that hinder the performance of the utilities. In this study the SWOT tables analyzed the strength and weakness of both utilities and compared the opportunities and threats they have in the sector; while also looking at the best practices adopted by each utility. In order to be able to do SWOT analysis for SODECI, since the utility did not respond to questionnaires, a SWOT analysis for ONEP, ONAD and Ministry of Hydraulics (See appendix 7&8&9) were done before with the purpose of retrieving important information related SODECI.

Table 4.7: SWOT analysis for NRW Management in SODECI

STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
<p>Technical Performance</p> <ul style="list-style-type: none"> • 71% access to drinking water in urban areas • Expanding water supply networks 	<p>Technical Performance</p> <ul style="list-style-type: none"> • Leaks: aging pipes • 36% NRW • Unimproved operating performance • Few/No updated data on the websites (IBNet) 	<p>Technical Performance</p> <ul style="list-style-type: none"> • Available water resources • Donors finance new technologies 	<p>Technical Performance</p> <ul style="list-style-type: none"> • Military-political situation • Climate change
<p>Financial Performance</p> <ul style="list-style-type: none"> • 1 million usd/year for commercial losses • 70 million usd for technical losses 	<p>Financial Performance</p> <ul style="list-style-type: none"> • Mobilization of funding necessary to achieve the water for all 	<p>Financial Performance</p> <ul style="list-style-type: none"> • PPP with State of Cote d'Ivoire, donors and multilateral organizations 	<p>Financial Performance</p> <ul style="list-style-type: none"> • Control of the production costs • The water tariff • Lack of investment
<p>Customer Performance</p> <ul style="list-style-type: none"> • Call line (175) for alerts • Online subscription and payment of water bill 	<p>Customer Performance</p> <ul style="list-style-type: none"> • Guarantee of the quality of service provided to customers 	<p>Customer Performance</p> <ul style="list-style-type: none"> • Projects to expand connections in Abidjan and sub-districts. 	<p>Customer Performance</p> <ul style="list-style-type: none"> • Continuity of drinking water service for the populations served
<p>Institutional performance</p> <ul style="list-style-type: none"> • Institutional framework • Organizational Structure 	<p>Institutional Performance</p> <p>Organization structure: No department is in charge of water losses reduction</p>	<p>Institutional Performance</p> <ul style="list-style-type: none"> • Capacity building: every year • AfWA: good practices and benchmarking 	<p>Institutional Performance</p> <ul style="list-style-type: none"> • Climate change and population growth

Table 4.8: SWOT analysis for NRW Management in ONEA

STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
<p>Technical</p> <ul style="list-style-type: none"> • 92.44 %: drinking water in urban areas • M&E every 6 months • Water balance 	<p>Technical</p> <ul style="list-style-type: none"> • 9000 leaks/month • Number of frauds are completely unknown 	<p>Technical</p> <ul style="list-style-type: none"> • Technical & financial partners • National Public Health Laboratory & AfWA 	<p>Technical</p> <ul style="list-style-type: none"> • Scarcity of water resources • Climate change
<p>Financial</p> <ul style="list-style-type: none"> • Efficient bill collection • Prioritize maintenance charge • 200,000 Usd/year for NRW reduction 	<p>Financial</p> <ul style="list-style-type: none"> • Economic loss of around 200,000 USD/month • Rare economic assessments of losses 	<p>Financial</p> <ul style="list-style-type: none"> • Strong support from TFPs (Technical & financial partners) • Financing contract with the State 	<p>Financial</p> <ul style="list-style-type: none"> • The instability of the state budget lines • The increasing investment cost
<p>Customer</p> <ul style="list-style-type: none"> • Easy call line 11-11 • Installed devices to ease connections 	<p>Customer</p> <ul style="list-style-type: none"> • Insufficient Knowledge transfer to all stakeholders 	<p>Customer</p> <ul style="list-style-type: none"> • Training of staff about customer service 	<p>Customer</p> <ul style="list-style-type: none"> • Increased water demand • Spontaneous housing
<p>Institutional</p> <ul style="list-style-type: none"> • Legal and Institutional Framework • A department in charge of NRW 	<p>Institutional</p> <ul style="list-style-type: none"> • Need for skills transfer to municipalities, which are not yet able to assume it 	<p>Institutional</p> <ul style="list-style-type: none"> • National water policy defined by the MEA • Decentralization • Government and donors 	<p>Institutional</p> <ul style="list-style-type: none"> • Increasing population • Climate change • The state budget

4.1.5 Develop a Model for effective NRW management

As stated by (Wegelin, 2013), after a SWOT analysis, the next step is to identify strategies or best practices to increase the strength and opportunities while minimizing weaknesses and threats in water utilities.

Below is a proposed conceptual model that water utilities should adopt for effective NRW management:



Figure 4.3: A conceptual model for effective NRW management

This conceptual model illustrates the three main management factors to be adopted for any case study in order to establish short-term and long-term strategies for effective Non-Revenue Water management within a utility. It is an integral and inclusive tool showing the main operational activities, the overarching factors as well as the enabling environment.

Main Operational activities

This part shows the core management activities within a water utility. As we have seen above NRW has great impact on the technical, financial, customer and institutional performance of the utility. Therefore it is good to identify all the activities done as well as the strength, the weakness, the opportunities and threats within the four sectors. Note that technical and financial management can include all aspects of asset management mostly when the water utility is in charge of that asset management. It can range from infrastructure repair or replacement to investment mobilization for the later actions. For institutional management, the organizational structure or human resources management as well as the institutional framework are further taken into consideration within the enabling environment.

Overarching Factors

These are the most pressing factors influencing the core management activities of water utilities. They include: leadership, governance, culture, as well as the existing management strategies. These overarching factors may influence a good or bad performance of the water utilities. Therefore, when establishing the short-term or long-term NRW management strategies there is need to include the four factors most especially for best practices exchange among utilities.

Enabling Environment

The last aspect should be an enabling internal and external environment. More specifically identifying the opportunities and threats in the sector; and establishing the best practices to attract or increase those opportunities while also developing strategies to deal with the possible threat a utility may encounter. The enabling environment includes sector policy, regulation, legislation and institutional arrangement.

NB: While this is a generalized model for any case study to effectively manage NRW, when conducting a comparative study between or among utilities, there is need to take into consideration only the possible best practices that might work for all those utilities. The first question could be <what can this utility learn from the other ones?> and the next question could be <Are these best practices feasible? Can they be adopted by this utility based on the SWOT analysis done?> If YES, a model of best practices exchange can then be adopted for those specific practices.

CASE STUDIES: Exchange of Best Practices between SODECI and ONEA

Below is an example of exchange of best practices between SODECI and ONEA



Figure 4.4: Best practices exchange between SODECI and ONEA

4.1.6 Discussion on SWOT analysis and best practices exchange

4.1.6.1 Comparison of ONEA (Burkina Faso) and (SODECI) Cote d'Ivoire

Strength in NRW Management

Both countries have a clear and detailed National Water Policy coupled with a strong Institutional and regulatory framework. For ONEA, the National Water Policy is defined by MEA while SODECI signs a lease contract with ONEP and the State represented by MOH for investment funds of water projects, each year, where 1 million usd is invested in reducing commercial losses and 70 million usd for technical losses. ONEA managed to keep constant the level of NRW and conducts monitoring and evaluation of water projects after 6 month in a year. This allows ONEA to provide 92.44% water supply coverage while SODECI's water supply coverage went from 68.5% to 71%.

Best Practices to increase the strength in NRW Management

For ONEA a strong team of experts organize a weekly meeting at different unit levels to evaluate the performance of their services. To this a good internal communication is assured. Apart from that, ONEA kept the IBT structure which according to different utilities, shows weakness in considering the poor customers (WSP-Africa, 2009) but reduced the price for the low income households to 188 cfa/ m³ while the average price is 504 cfa/m³ (ICEA-Espelia, 2018). The average water tariffs for Cote d'Ivoire is 401 cfa/m³.

Weakness in NRW Management

For ONEA, The non-operationalization of national programs and a strong centralization of the missions of the project implementation units result into insufficient dissemination for good knowledge by all stakeholders, hence Need for skills transfer to municipalities, which are not yet able to assume it. In addition, the number of frauds are completely unknown due to the rare assessment of economic loss from water loss. For SODECI, too much cases of leaks due to obsolescence of the pipes and the utility faces the problem of repairs, maintenance of structures and supervision of rural populations. With this, it is not easy to guaranteeing the quality and quantity of drinking water as well as other service provided to customers. There is need for mobilization of funding necessary to achieve the water for all objective of the SDG6 and improvement of SODECI operating performance against NRW.

Best Practices to reduce weakness in NRW Management

A good action plan drawn with strategy of reducing water losses, an audit of unbilled water, alert call, Search for and repair of leaks, changing defective meters together with continuous capacity building are great tools to deal with NRW for ONEA. As for SODECI, good practices such as deploying people to install strong pumps, continuous performance monitoring through annual contract reporting and operational control, the arbitration of disputes between operators or between operators and users, and managing complaints of the users are also maintained.

Opportunities in NRW Management

The results show that Cote d'Ivoire has made a success story with Private Public Partnership for water and sanitation (World Bank, 2019). This arguably indicates that dealing with Non-Revenue Water requires a combination of all stakeholders ranging from donors, internal and external partners alongside best practices to be adopted for future projects (AWWA, 2019). The private Company, SODECI ensures all the technical responsibilities under a contract of affermage signed with the State of Cote d'Ivoire. To this, ONEP, comes up with the strategy to address NRW in Abidjan metropolitan and works with SODECI under the signed contract. SODECI also works with other private NGOs through which investments for 1 million usd each year for reduction of commercial losses and 70 million usd for the technical losses are made. This also includes the works of expanding the network as well as asset management. On the other hand, the Government is responsible of supplying water to village centers (Philip et al., 2009). ONEA, as a public institution works under the contract of the state of Burkina Faso but also has strong support from external technical and financial partners such as Bill and Melinda Gates Foundation as well as other donors. AFWA plays an important role for both utilities in ensuring sharing knowledge and best practices through benchmarking, the capacity building and their visibility.

Best Practices to increase opportunities in NRW Management

ONEA does continuous monitoring of the quality of the water produced, both internally and by the National Public Health Laboratory while SODECI conducts more researches on NRW. Training conducted by AFWA to increase the visibility and capacity building of both ONEA and SODECI staff members. SODECI maintains a good relation with donors while ONEA is also decentralizing the authority to municipalities' water and establishing a policy of outsourcing certain functions (water professions) to partner companies, with permanent control and quality requirements for services.

Threats in NRW Management

Both utilities present the threat of climate change and population growth. While climate change poses a big problem on water resources of both countries, the issue of population growth makes it more difficult to cover the number of supplied households with potable water and ensure the continuity of drinking water supply. Utilities are unable to provide service to the poor especially in urban areas where people live in congested and illegal settlements (WSP-Africa, 2009); the possibility for water theft is higher as well. The extreme rainfall in Cote d'Ivoire as stated by (ECHO newsletter of June 2020) results into flooding and damages the obsolescent water distribution pipes and pumps hence increasing the investment cost of repair and replacement.

Best practices to deal with threats in NRW Management

ONEA explores new technologies to deal with threats. Among them there is an establishment of a device to make connections on time, the large project of Ziga II which aims at increasing water access to different parts of Burkina Faso and establishing a water balance. Meanwhile, SODECI and ONEP, with the help of the Ministry of Hydraulics and other internal and external donors introduced projects to increase water supply. For instance APTF projects to supply drinking water to 155 sub-districts in Abidjan. Still, good negotiation with donors, technical and financial partners is the key to dealing with those threats.

4.1.7 Policy implications on NRW management

The results from this study call upon policy implication for policy makers and others stakeholders to act toward ensuring NRW Management in Burkina Faso and Cote d'Ivoire and hence contribute to improving water utilities sustainability.

Below are policy implications with some evidences on where they are needed the most:

- i) Incorporating ICT tools for data acquisition and public engagement in NRW reduction

The use of information technology tools is an essential strategy to achieve water security within all sectors of operation and hence improve the sustainability of water supply and management (Gorbesville, 2018). During the period of pandemic of Covid-19, where lockdowns was mandatory to be able to contain the pandemic, utilities faced difficulties to collect and update data on Non-Revenue Water. Hence the need to incorporate tools for data acquisition, monitoring and controlling the level of NRW and transmission of information to the stakeholders (Lai, 2017). Results from the study exemplify the need for SODECI and ONEA to keep track of data about NRW. To this, (USAID/AfWA, 2015) report suggested the use of available technologies such as network modeling and GIS to support their decision making. In addition, data need to be presented in a clear and understandable way. This will help to increase more investment and improve public awareness on NRW as well as its management.

- ii) Improve water revenues for cost recovery

To ensure their sustainability, utilities must recover the cost of water services through generated revenues (Banerjee et al., 2010). This explains the need for improvement of water tariffs, increase water supply coverage to meet the cost recovery (Banerjee et al., 2010). The less the cost recovery, the failure to expand services to the poor. For instance, SODECI has been given the responsibility to operate, on its own risk, the whole water supply and maintenance system in urban Cote d'Ivoire with the condition of recovering the full cost of services from its generated revenue (SODECI website). Despite that SODECI is a private company, one of the challenges faced is the tariffs set by different stakeholders. This explains the need to review the average tariffs in order to ensure the cost recovery of services as well as expand more connections especially those that need subsidies.

ii) Enforce capacity building for technical and commercial losses management

Capacity building has proven to be one of the key aspect for ensuring good operational efficiency of water utilities. For instance, in Cambodia the level of NRW reduced from 72% to 6% within a period of 15 years and this was achieved due to a good sharing of knowledge as well as capacity building through in-house training centers (Hani, 2011). AfWA helps improving capacity building in African water utilities by providing a platform for sharing best practices through training and benchmarking for comparison purpose (USAID/WBI, 2010). Some of African utilities have benefited from these training and Burkina Faso is still ranking among the best performing utilities. In addition, as ICT is being seen as a crucial tool in water management, there is need for training to the staff members about different technologies involved in water loss reduction especially those in charge of operation and maintenance.

iv) Institutionalization of NRW management within water utilities

One of the key issues of NRW management is that NRW is not given a priority within the institutional planning despite high NRW level recorded (State of Green, 2016). SODECI for example needs to establish a department in charge of NRW just like ONEA did. This will help to monitor the monthly and annually water losses and hence be able to reduce them.

v) Establish annual SWOT analysis to measure utilities' progress in NRW management

(Wegelin, 2013) explained the need to do SWOT analysis for water utilities, in the following quote “Before a strategy and business plan can be developed, it is important to have a proper understanding of the status quo. To obtain a proper understanding of the status quo, it is recommended to perform a 'strengths, weaknesses, opportunities and threats' (SWOT) analysis of the institutional, technical, financial, legal and social components of the municipal water business. The SWOT analysis should be combined with an analysis of key performance indicators such as non-revenue water, water losses and unit consumption”. For instance, during the diagnostic visit organized by AfWA and GWOPA in 2019, the SWOT analysis helped the utility to establish short and medium strategic plans for different thematic areas including NRW (WOP/GWOPA/AfWA, 2019).

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the observation and recommendations based on research objectives and the results obtained. This study's main objective was to analyze and identify from a comparative point of view between ONEA and SODECI what could be the different challenges in solving the problems related to NRW, with a view at developing a model for effective NRW management for African water utilities.

5.2 Conclusion

This study used a comparative approach between two very different water utilities, one public for the case of ONEA from Burkina Faso and another one private for the case of SODECI in Cote d'Ivoire. Results showed that despite that Burkina Faso is a waterless country, ONEA managed to keep constant the level of NRW at 19% and this has allowed it to supply water at 94% to the population. On the other hand, SODECI's NRW has been increasing over the past years to reach the level of 36%. This has affected all the sectors of performance especially the one on water supply coverage which is still at 71% despite that Cote d'Ivoire is a water resource country. A SWOT analysis showed that ONEA's weakness lies in not paying attention to the increasing number of frauds while SODECI's main weakness is the lack of department in charge of NRW reduction. Both utilities presented a common threat of climate change and population increase. Based on the results, the study proposed a conceptual tool for effective NRW management with a case study of best practices exchange between SODECI and ONEA.

5.3 Recommendation

1. For SODECI, a dialogue mechanism between SODECI and all stakeholders could be a way forward to solving the issue of NRW especially on setting the water tariffs for operational cost recovery and asset management.
2. A technical diagnostic study for SODECI and ONEA could help to check the progress especially on the water balance, Input metering, pressure monitoring, information technology (maps and GIS), all leaks repair records and repair time as well as the established District Meter Areas (DMA).
3. The use of the innovative model proposed in the framework of this thesis could significantly improve the management of NRW in any water utility in Africa and the world.

5.4 Future work

The future research could be on community awareness and engagement in NRW management; more specifically on finding and fixing leaks, reporting errors in meter as well as frauds.

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APPENDICES

APPENDIX 1

QUESTIONNAIRES FOR SODECI

Références de la personne répondant aux questions :

References of the person answering the questions:

- Nom/Prénom :**
- Name/Surname :**
- Fonction :**
- Position :**
- Contact** (s) (courriel et/ou téléphone) :
- Contact** (s) (email and/or telephone):

A. Performance opérationnelle

1. Existe-t-il une stratégie spécifique pour la SODECI en ce qui concerne l'Eau Non Facturée (ENF)? Si oui, qui est impliqué ? Quel est le coût annuel ? Si non, pourquoi?
Is there any specific strategy for SODECI to address NRW? If so, who is involved? What is the annual cost? If not why?
2. Quel est le nombre de fuites, de connexions illégales et d'erreurs de comptage qui sont signalées par an ? Et de quelle manière la SODECI fait-elle face à la situation ?
How many leaks, illegal connections and counting errors are reported per year? And how is SODECI dealing with the situation?
3. Quelles méthodes la SODECI a-t-elle utilisées pour réduire le niveau de l'ENF ?
What methods has SODECI used to reduce the level of NRW?
4. Quel a été le niveau de l'ENF au cours des 5 dernières années ?
What has the level of NRW been for the past 5 years?
5. Quels sont les plans pour augmenter le niveau de gestion de l'ENF à l'avenir ?
What are the plans to increase the level of NRW management in the future?

B. Performance financière/ Financial performance

1. Quelle est la structure tarifaire de l'eau adoptée par la SODECI ?
What is the water tariff structure adopted by SODECI?
2. Comment les tarifs de l'eau sont-ils liés au revenu par habitant de la population desservie ?
How are water prices related to the per capita income of the population served?
3. Quel est le montant des revenus que la SODECI tire de l'eau fournie ? Est-ce suffisant pour couvrir entièrement les coûts d'exploitation et de maintenance ?
What is the amount of income that SODECI derives from the water supplied? Is this enough to fully cover the operating and maintenance costs?
4. Quelles sont les pertes économiques liées à l'ENF ?
What are the economic losses associated with NRW?
5. Comment l'institution traite-t-elle les pertes économiques ?
What are the economic losses associated with NRW?

C. Performance des clients/ Customer performance

1. Quelle est la couverture des branchements d'eau en milieu urbain et par milieu urbain ?
What is the coverage of water connections in urban areas and by urban area?
2. Quelles méthodes utilisez-vous pour garantir l'efficacité de la fourniture de services d'eau ?
What is the coverage of water connections in urban areas and by urban area?

D. Performance des institutions/ Institutional performance

1. Quelles sont les technologies adoptées par SOCEDI pour fournir des services de qualité à la communauté face au changement climatique et à l'augmentation de la population ?
What technologies has SOCEDI adopted to provide quality services to the community in the face of climate change and population growth?
2. Quels sont les besoins prioritaires de la SODECI pour assurer un service de qualité aux populations ?
What technologies has SOCEDI adopted to provide quality services to the community in the face of climate change and population growth?
3. Quels sont les défis de la collaboration avec les partenaires publics ? Et comment les relever ?
What are the challenges of working with public partners? And how to meet them?

4. Dans quelle mesure le renforcement des capacités est-il fait pour augmenter la productivité du personnel ?
To what extent is capacity building being done to increase staff productivity?
5. Comment l'AAE apporte-t-elle une valeur ajoutée à la SODECI ?
How does the AAE bring added value to SODECI?
6. Comment est assuré le développement des capacités dans le secteur des acteurs ? Quel est le rôle joué par la SODECI dans ce sens ?
How is capacity development ensured in the stakeholder sector? What role does SODECI play in this regard?

APPENDIX 2

QUESTIONNAIRE FOR MINISTRY OF HYDRAULICS

Références de la personne répondant aux questions:

References of the person answering the questions:

- Nom/Prénom :**
- Name/Surname :**
- Fonction :**
- Position :**
- Contact** (s) (courriel et/ou téléphone) :
- Contact** (s) (email and/or telephone):

A. Questions d'introduction :

1. Quelle est la fonction principale du Ministère de l'Hydraulique dans le secteur de l'eau en Côte d'Ivoire ?

What is the main function of the Ministry of Hydraulics in the water sector in Cote d'Ivoire?

2. Comment le Ministère est-il organisé pour assurer sa performance dans le cadre de sa mission/rôle ?

How is the ministry organized to ensure its performance on his mission/role

3. Quels sont les besoins prioritaires du Ministère de l'Hydraulique pour assurer des services d'eau efficaces dans les zones rurales ?

What are the priority needs of the Ministry of Hydraulics to ensure efficient water services in rural areas?

4. Selon vous, quels sont les revers (lacunes) de la politique de l'eau et de l'assainissement en Côte d'Ivoire ?

In your opinion, what are the setbacks (gaps) of the water and sanitation policy in Côte d'Ivoire?

5. Selon vous, quelle est l'efficacité de la mise en œuvre des politiques de l'eau et de l'assainissement ?

In your opinion, how effective is the implementation of water and sanitation policies?

B. Performance institutionnelle

1. Quel est le rôle du Ministère dans le suivi des activités quotidiennes de la SODECI et de l'ONEP dans la fourniture du service de l'eau ?

What is the role of the Ministry in monitoring the daily activities of SODECI and ONEP in the provision of the water service?

2. Quels sont les défis de la collaboration avec des institutions privées comme la SODECI ?

What are the challenges of working with private institutions like SODECI?

3. Comment le ministère est-il prêt à couvrir l'ensemble de la Côte d'Ivoire avec l'approvisionnement en eau au cas où la SODECI ne fonctionnerait plus ?

How is the ministry ready to cover the whole of Côte d'Ivoire with water supply in the event that SODECI no longer functions?

4. Les questions de financement du secteur de l'eau ?

Questions of financing the water sector

5. Comment est assuré le développement des capacités dans le secteur des acteurs ? Quel est le rôle joué par le Ministère dans ce sens ?

How is capacity building of sector stakeholders ensured? What role does the Ministry play in this direction?

APPENDIX 3

QUESTIONNAIRES FOR ONEP

Références de la personne répondant aux questions :

References of the person answering the questions:

- Nom/Prénom :**
- Name/Surname :**
- Fonction :**
- Position :**
- Contact (s) (courriel et/ou téléphone) :**
- Contact (s) (email and/or telephone):**

A. Performance opérationnelle

Operational Performance

1. Existe-t-il une stratégie spécifique de l'ONEP pour traiter le problème de l'Eau Non Facturée (ENF) ? Si oui, qui est impliqué ? Quel est le coût annuel ? Si non, pourquoi ?

Is there a specific ONEP strategy to deal with the problem of Non-Revenue Water (NRW)? If yes, who is involved? What is the annual cost? If not, why ?

2. Quelles mesures ont été prises par l'ONEP pour sensibiliser la communauté à la problématique de l'ENF?

What measures have been taken by ONEP to sensitize the community to the problem of NRW?

3. Quelles sont les principales causes de fuites et comment l'ONEP gère-t-il la question ?

What are the main causes of leaks and how is ONEP handling the issue?

B. Résultats financiers

Financial Performance

1. Quel est le coût de la gestion des ressources en eau (réparation/remplacement des installations de distribution d'eau) ?

What is the cost of water resource management (repair / replacement of water distribution equipments)?

2. Comment l'ONEP maximise-t-il l'investissement dans le renouvellement des canalisations et des joints les plus détériorés ?

How is ONEP maximizing investment in the renewal of the most deteriorated pipes and joints?

C. Performance des institutions

Institutional Performance

1. Quelles sont les stratégies mises en place pour suivre la performance de la SODECI dans la fourniture d'eau aux populations ?

What strategies have been put in place to monitor SODECI's performance in providing water to populations?

2. Quelles sont les stratégies mises en place pour maintenir la relation avec les donateurs ou bailleurs de fonds ?

What strategies have been put in place to maintain the relationship with donors or financial partners?

3. Comment l'ONEP alloue-t-il et suit-il le budget pour répondre au mieux aux besoins de la SODECI?

How does ONEP allocate and monitor the budget to best meet SODECI's needs?

4. Quelle est la fenêtre d'opportunité dont dispose l'ONEP pour adopter les nouvelles technologies en matière d'investissement dans l'eau ?

What is the window of opportunity available to ONEP for adopting new technologies in terms of investment in water?

5. Quels sont les défis auxquels l'ONEP doit faire face ?

What are the challenges ONEP has to face?

6. Comment l'ONEP aborde-t-il les défis rencontrés ?

How does ONEP approach the challenges encountered?

7. Comment l'AAE apporte-t-elle une valeur ajoutée à l'ONEP ?

How does AfWA add value to ONEP?

8. Comment est assuré le développement des capacités dans le secteur des acteurs ? Quel est le rôle joué par l'ONEP dans ce sens ?

How is the capacity building of sector's stakeholders ensured? What role does ONEP play in this?

APPENDIX 4

QUESTIONNAIRES FOR ONAD

Références de la personne répondant aux questions :

References of the person answering the questions:

- Nom/Prénom :**
- Name/Surname :**
- Fonction :**
- Position :**
- Contact** (s) (courriel et/ou téléphone) :
- Contact** (s) (email and/or telephone):

A. Performance opérationnelle

1. Comment l'ONAD assure-t-il le fonctionnement à long terme des services d'assainissement ?

How does ONAD ensure the long-term operation of sanitation services?

2. Quelle est la couverture des services d'assainissement dans les zones urbaines ?

What is the coverage of sanitation services in urban areas?

B. Performance financière

1. Quelles mesures ont été prises par l'ONAD pour maximiser les fonds destinés aux projets/activités d'assainissement ?

What measures have been taken by ONAD to maximize funds for sanitation projects / activities?

2. Comment la tarification est-elle structurée pour assurer la couverture des coûts d'exploitation et de maintenance des services d'assainissement ?

How is the pricing structured to cover the operating and maintenance costs of sanitation services?

C. Performance des clients

1. Comment l'ONAD collabore-t-il avec la communauté pour s'assurer que la sensibilisation et les pratiques d'assainissement sont bien mises en œuvre ?

How does ONAD collaborate with the community to ensure that awareness-raising and sanitation practices are well implemented?

D. Performance institutionnelle

1. Comment l'ONAD travaille-t-il avec ses partenaires pour assurer des services d'assainissement adéquats à la communauté ?

How does ONAD work with its partners to provide adequate sanitation services to the community?

2. Quelles sont les méthodes appliquées par ONAD pour le suivi des services d'assainissement au quotidien ?

What are the methods applied by ONAD for monitoring daily sanitation services?

3. Quelles stratégies utilisent-ils pour maximiser la gestion des actifs face aux divers défis tels que le changement climatique et l'augmentation de la population ?

What strategies do they use to maximize assets management in the face of various challenges such as climate change and population growth?

4. Quels sont les principaux défis auxquels l'ONAD est confronté ? Et comment y répondent-ils ?

What are the main challenges facing ONAD? And how do they respond to it?

5. Quelle est l'efficacité de la politique d'assainissement pour contribuer aux objectifs de l'ONAD ?

How effective is the sanitation policy in contributing to the objectives of ONAD?

6. Comment l'AAE apporte-t-elle une valeur ajoutée à l'ONAD ?

How does AfWA add value to ONAD?

7. Quelles stratégies l'ONAD utilise-t-il pour assurer la réalisation des objectifs de l'ONAD ?

What strategies does ONAD use to ensure the achievement of ONAD's objectives?

8. Comment est assuré le développement des capacités dans le secteur des acteurs ? Quel est le rôle joué par l'ONAD dans ce sens ?

How is capacity building of sector stakeholders sector ensured? What role does ONAD play in this?

APPENDIX 5

QUESTIONNAIRES FOR THE NATIONAL OFFICE OF WATER AND SANITATION

Références de la personne répondant aux questions :

References of the person answering the questions:

- Nom/Prénom :**
- Name/Surname :**
- Fonction :**
- Position :**
- Contact (s) (courriel et/ou téléphone) :**
- Contact (s) (email and/or telephone):**

A. Performance opérationnelle

1. Existe-t-il une stratégie spécifique pour l'ONEA en ce qui concerne l'Eau Non Facturée (ENF)? Si oui, qui est impliqué ? Quel est le coût annuel ? Si non, pourquoi ? **Is there a specific strategy for ONEA with regard to Non-Billed Water (ENF)? If yes, who is involved? What is the annual cost? If not why ?**
2. Quel est le nombre de fuites, de connexions illégales et d'erreurs de comptage qui sont signalées par an ? Et de quelle manière l'ONEA fait-elle face à la situation ? **How many leaks, illegal connections and counting errors are reported per year? And how is ONEA coping with the situation?**
3. Quelles méthodes l'ONEA a-t-elle utilisées pour réduire le niveau de l'ENF ? **What methods has ONEA used to reduce the level of NRW?**
4. Quel a été le niveau de l'ENF au cours des 5 dernières années ? **What has been the level of NFE in the past 5 years?**
5. Quels sont les plans pour augmenter le niveau de gestion de l'ENF à l'avenir ? **What are the plans to increase the level of management of NFE in the future?**

B. Performance financière

1. Quelle est la structure tarifaire de l'eau adoptée par l'ONEA ? **What is the pricing structure for water adopted by ONEA?**

2. Comment les tarifs de l'eau sont-ils liés au revenu par habitant de la population desservie ?

How are water prices linked to the per capita income of the population served?

3. Quel est le montant des revenus que l'ONEA tire de l'eau fournie ? Est-ce suffisant pour couvrir entièrement les coûts d'exploitation et de maintenance ?

How much income does ONEA get from the water supplied? Is it enough to fully cover the operating and maintenance costs?

4. Quelles sont les pertes économiques liées à l'ENF ?

What are the economic losses linked to NFE?

5. Comment l'institution traite-t-elle les pertes économiques ?

How does the institution deal with economic losses?

C. Performance des clients

1. Quelle est la couverture des branchements d'eau en milieu urbain et par milieu urbain ?

What is the coverage of water connections in urban areas and by urban area?

2. Quelles méthodes utilisez-vous pour garantir l'efficacité de la fourniture de services d'eau ?

What methods do you use to ensure the efficiency of the provision of water services?

D. Performance des institutions

1. Quelles sont les technologies adoptées par l'ONEA pour fournir des services de qualité à la communauté face au changement climatique et à l'augmentation de la population ?

What technologies have ONEA adopted to provide quality services to the community in the face of climate change and population growth?

2. Quels sont les besoins prioritaires de l'ONEA pour assurer un service de qualité aux populations ?

What are the priority needs of ONEA to provide quality service to populations?

3. Quels sont les défis de la collaboration avec les partenaires publics, et comment les relever?

What are the challenges of working with public partners, and how can we meet them?

4. Dans quelle mesure le renforcement des capacités est-il fait pour augmenter la productivité du personnel ?

To what extent is capacity building done to increase staff productivity?

5. Comment l'AAE apporte-t-elle une valeur ajoutée à l'ONEA ?

How does the AAE add value to ONEA?

6. Comment est assuré le développement des capacités dans le secteur des acteurs ? Quel est le rôle joué par l'ONEA dans ce sens ?

How is capacity development in the stakeholder sector ensured? What role does ONEA play in this?

APPENDIX 6

QUESTIONNAIRES : MINISTÈRE DE L'EAU ET DE L'ASSAINISSEMENT

Références de la personne répondant aux questions :

References of the person answering the questions:

- Nom/Prénom :**
- Name/Surname :**
- Fonction :**
- Position :**
- Contact (s) (courriel et/ou téléphone) :**
- Contact (s) (email and/or telephone):**

Questions d'introduction :

1. Quelle est la fonction principale du Ministère de l'Eau et de l'Assainissement dans le secteur de l'Eau et de l'Assainissement au Burkina Faso ?
What is the main function of the Ministry of Water and Sanitation in the Water and Sanitation sector in Burkina Faso?
2. Comment le Ministère est-il organisé pour assurer sa performance dans le cadre de sa mission/rôle ?
How is the Ministry organized to ensure its performance within the framework of its mission / role?
3. Quels sont les besoins prioritaires du Ministère de l'Eau et de l'Assainissement pour assurer des services d'eau efficaces dans les zones rurales
What are the priority needs of the Ministry of Water and Sanitation to provide efficient water services in rural areas?
4. Selon vous, quels sont les revers (lacunes) de la politique de l'eau et de l'assainissement au Burkina Faso ?
In your opinion, what are the setbacks (gaps) of the water and sanitation policy in Burkina Faso?

5. Selon vous, quelle est l'efficacité de la mise en œuvre des politiques de l'eau et de l'assainissement ?

In your opinion, how effective is the implementation of water and sanitation policies?

6. Quel est le rôle du Ministère dans le suivi des activités quotidiennes de l'ONEA dans la fourniture du service de l'eau ?

What is the role of the Ministry in monitoring ONEA's daily activities in providing the water service?

7. Quels sont les défis de la collaboration avec des structures comme l'ONEA ?

What are the challenges of collaborating with structures like ONEA?

8. Comment le ministère est-il prêt à couvrir l'ensemble du Burkina Faso en approvisionnement en eau au cas où l'ONEA ne fonctionnerait plus ?

How is the Ministry ready to cover the whole of Burkina Faso with water supply in the event that ONEA no longer functions?

9. Comment est assuré le financement du secteur de l'eau et quels sont les principaux défis ?

How the water sector funded and what is are the main challenges?

10. Comment est assuré le développement des capacités dans le secteur des acteurs ? Quel est le rôle joué par le Ministère dans ce sens ?

How is capacity development of the sector's stakeholders ensured? What role does the Ministry play in this direction?

APPENDIX 7

SWOT ANALYSIS FOR MINISTRY OF HYDRAULICS	
STRENGTH	<ul style="list-style-type: none"> -participate in the monitoring and protection of water resources; -management of drinking water infrastructure; -development of drinking water supply infrastructure in urban and rural areas; -development and monitoring of regulations in terms of studies, construction and operation of human hydraulic works. - an institutional and regulatory framework which ensures its governance and its performance -deploying people to install strong pumps -Contracting and technical supervision of ONEP -the effectiveness of the implementation of water and sanitation policies in Côte d'Ivoire lies in the institutional and regulatory framework. The lease contract, conventions and contracts between the State and private entities and the various funds set up to accelerate the performance of the sector are an illustration of this <p>Capacity building:</p> <ul style="list-style-type: none"> - Human Resources Department (HRD) which plans standard trainings every year to allow executives and operating agents to improve their knowledge and performance. -Training to executives, agents of ONEP and SODECI for specific aspects
WEAKNESS	<ul style="list-style-type: none"> -The problem of repairs, maintenance of structures and supervision of rural populations -Guaranteeing the quality and quantity of drinking water -Guarantee of the quality of service provided to customers -Control of factor costs; -Negotiation of the water tariff
OPPORTUNITY	<p>A strong partnership with</p> <ul style="list-style-type: none"> - The Ministry of Economy and Finance and the Ministry to the Prime Minister in charge of the Budget/financial supervision; - (ONEP), which is the delegated company for the provision of drinking water - (SODECI), through the control and monitoring of the lease contract for the public distribution of drinking water throughout the territory. -local authorities to contract for hydraulic infrastructures in rural sub-sector -ONAD for sanitation -Sectoral drinking water policy -rural hydraulic system with ONEP to ensure the supply of water in rural areas -Funds for drinking water: Water Development Fund (FDE) and the National Water Fund (FNE), donors and multilateral organizations
THREAT	<ul style="list-style-type: none"> -The problem of repairs, maintenance of structures and supervision of rural populations -Guaranteeing the quality and quantity of drinking water -Guarantee of the quality of service provided to customers -Control of factor costs; -Negotiation of the water tariff

APPENDIX 8

SWOT ANALYSIS FOR ONEP (COTE D'IVOIRE)	
STRENGTH	<ul style="list-style-type: none"> - Reduction of commercial losses by supporting the farmer by deploying a brigade on the network (Annual cost of 1 million US Dollars) - Reduction of technical losses through a vast investment program planned with donors. A vast investment program of \$ 70 million - Integration of a NRW component in drinking water projects - ONEP maximizes renewal investments by check-ups and performance monitoring - SODECI's performance is monitored through operational control and contractual reporting - Conducting regular Studies and Researches to deal with challenges - Negotiation with donors and technical and financial partners
WEAKNESS	<ul style="list-style-type: none"> - Leaks due to obsolescence of pipes - Mobilizing funds necessary to achieve the water for all objective - Improving SODECI's operating performance
OPPORTUNITY	<ul style="list-style-type: none"> - Relations with donors are maintained through funding requests and various fora - The budgets allocated to SODECI are discussed during the preparation of the annual work plan financed from the development fund (FDE) - The adoption of new technologies is made during the implementation of projects and investments financed by donors or sector funds - Value added by AFWA: sharing of good practices and benchmarking - Capacity building of WASH actors is ensured through trainings initiated by ONEP in collaboration with suppliers, academics and various partners - Partners: SODECI, World Bank, Action Faim, Unicef, bneta, AfDB, BADEA, Ministry of Hydraulics, AFWA
THREAT	<ul style="list-style-type: none"> - Over increasing population - Climate change

APPENDIX 9

SWOT ANALYSIS FOR THE MINISTRY OF WATER AND SANITATION IN BURKINA FASO	
STRENGTH	<ul style="list-style-type: none"> -Defining, developing, coordinating the implementation of the national policy for the sector, developing partnerships, and seeking funding -Strong national water policy with a clear organization, and maintains a permanent consultation of all the actors. - Monitoring and evaluation of projects, done every 6 months -Capacity building through trainings and equipment, interstate and international technical cooperation, and research
WEAKNESS	<ul style="list-style-type: none"> Insufficient dissemination for good knowledge by all stakeholders A skills transfer to municipalities, which are not yet able to assume it The non-operationalization of national programs The strong centralization of the missions of the project implementation units
OPPORTUNITY	<ul style="list-style-type: none"> Substantial funding for the implementation of operational programs (targets are set on the SDGs) - Efficient decentralized structures - Good collaboration with decentralized structures - Strong support from TFPs (Technical & financial partners) - ONEA signs objective-based Plan Contracts with specific targets for service quality - In Case ONEA stops functioning, water works will continue through the central departments in relation to: Development projects, deconcentrated and decentralized structures (Regional Councils and municipalities) and technical and financial partners - Financing sources: the state budget, state and non-governmental partners, the populations concerned, large commercial enterprises
THREAT	<ul style="list-style-type: none"> The instability of the state budget lines



THE AFRICAN WATER ASSOCIATION (AfWA)

The African Water Association (AfWA) is an International NON-PROFIT ORGANIZATION which aims to cover all facets of the water cycle. The Institution's mission is to serve as a continental network for Sanitation and Water professionals and to share best practices for sustainable management. Advisory Member with Consultative Status of the United Nations' Economic and Social Commission since 2004, AfWA is a professional Association of Organizations, Utilities and Operators working in the Water, Sanitation and Environment related sector in Africa.

AfWA has more than 100 - Member Utilities in over 40 countries in Africa, and is headquartered in Abidjan, CÔTE D'IVOIRE – West Africa (AfWA, 2016).

Background history of AfWA

AfWA started off as UAWS, which was created in the late 1970's after many negotiations. The motivation and objective for creation was due to decreased rainfall and population growth, sanitation and different problems facing water sector. The preparatory meeting was in Abidjan in February 1979. Several president across Africa have led the fate UAWS hence giving the union a continental call.

The union came to reality after the first congress held in Abidjan in February 1980, eighteen (18) new members joined, new agreements on various issues and appointment of important positions in the union.

In March 1988 the unions headquarters was set to be in Abidjan, Côte d'Ivoire and the functions and administrative secretary was to be taken care by the Société de Distribution d'Eau de la Côte-d'Ivoire (SODECI) (water supply utility of Côte d'Ivoire).

Until to date many congresses have been held about twelve, seminars and workshops have been organized on various topics dealing with water, sanitation and environment. The congresses are international involving experts from all over the world.

In early 2000's new lines of actions of the union were set. UAWS changed its name to the Association Africaine de l'Eau (AAE) in French and African Water Association (AfWA) in English on 25th April 2003. Individual members such as professionals, scholars, researchers and everyone who worked on water, sanitation and environment sector joined the union.

Water Utility Partnership (WUP) programme was launched in 1996 on the reforming of water sector in Africa International conference. It is an African regional capacity building programme with a focus on urban and peri-urban water utilities. The programme was initiated by the African Water Association (AfWA), the Regional center for Low Cost water and Sanitation (CREPA), the Training, Research and Networking for Development (TREND) and the World Bank.

For more than 30 years, a currently known as the African Water Association (AfWA) wants to win the challenge for sustainable access to portable water and sanitation services for African populations (AfWA, 2016).

Mission and objectives of AfWA

- Coordinate the search for knowledge and latest development in the technical, legal, administrative and economic fields for Drinking water production, supply and of sanitation,
- Promote the exchange of information on methods, processes and procedures of drinking water production and supply and sanitation,
- Initiate, encourage and promote any action of cooperation and exchange in professional training.

How it works

AfWA is now the unique lead-representation of the professional organizations in the water and sanitation sector in Africa. The Association contributes to the sector agenda-setting, policy development, needs identification, promote innovation and new approaches. By so doing, AfWA seeks to be at the upfront in implementing the African Head of State Sharm El-Sheikh 2008 Declaration aiming at enhancing coverage on water and sanitation in Africa to achieve the MDGs target and the now SDGs.

Over years AfWA has sought to facilitate capacity development of utilities and influence sector policy by providing sound professional outlook on emerging issues and engage other actors (AfWA, 2016).

The African Water Association aims to:

- Provide its members with the results of studies, research and surveys in all branches of activity in the drinking water, sanitation and environment sector;
- Encourage measures of general interest that will help upgrade professional skills;
- Maintain close relations with all regional, continental and international organs devoted to issues relating to the objectives of the Association;
- Organize congress, symposia, seminars, workshops and technical sessions;
- Institute awards and distinctions to promote and stimulate members' performances.

Organizational chart of AfWA

