'Enhancing investment decisions aimed at addressing integrated water-related-challenges in sub-Saharan Africa'

KWR

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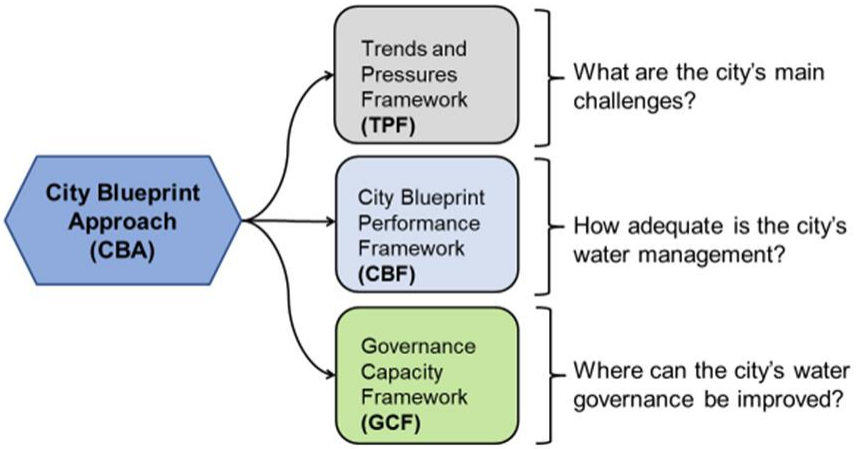
Executive Summary

Water is a global challenge, however, there is a consensus that social and ecological impacts of water-related issues are disproportionately higher in sub-Saharan Africa (SSA). The world water crisis is increasingly seen as a crisis of governance rather than scarcity, echoing the importance of governance for sound water management. Recent development literature has focussed a great deal on Capacity Development (CD) and Joint Knowledge Production (JKP), even linking these to water governance. However, developing and evaluating governance capacities and JKP in practice is challenging, let alone identifying where to prioritise investments aimed at improving such intangible concepts. Considering that USD 22,5 trillion of investments in the water sector will be required until 2050, it is of absolute importance to guide investment decisions, especially those aimed at improving governance.

Therefore, the main aim of this research is to provide additional insight into how integrated urban water governance capacity assessments can be used to inform local investment priorities and decisions of multilateral development banks in the SSA context. In order to do this, the (following) City Blueprint Approach frameworks were employed to assess integrated urban water management and governance. It will also be tested whether they can do this in a systematic, holistic and reproducible fashion and inform investment decisions.



Through the application of both the Trends and Pressures and City Blueprint Framework (CBF) in Abuja (Nigeria), Bangui (Central African Republic), Harare (Zimbabwe), Libreville (Gabon) and Yaoundé (Cameroon), the key challenges of SSA cities have been identified. The main water challenges include wastewater and solid waste treatment, access to drinking water and sanitation, leakages as well as the separation of storm and sewage water. The TPF showed that such challenges were aggravated by unplanned rapid urbanisation, poverty and political instability.

Next, the capacity to govern water pollution in Libreville, Gabon, was evaluated using the Governance Capacity Framework (GCF). Through the application of this framework the key limiting conditions impeding 'good' governance in the city have been identified. The essential limiting conditions include a lack of information, data or a monitoring system on water pollution, the inability to secure the financial continuation of water-related projects and the lack of specific pollution control laws. Insufficient policies also hamper the clear division of responsibilities as to who must do what regarding the mitigation of water pollution, which in turn impairs other governance conditions. Most of the governance limiting points in Libreville coincided with wider urban water governance issues across SSA. Furthermore, it has been demonstrated that this water governance assessment may evaluate CD

and JKP by measuring stakeholder knowledge production and sharing (indicators 2.3/3.3), public participation (indicators 4.1/4.2) and institutional capacities (7.2/7.3), amongst others.

Dimensions	Condition	Indicators
Knowing	1 Awareness	1.1 Community knowledge 1.2 Local sense of urgency 1.3 Behavioral internalization
	2 Useful knowledge	2.1 Information availability 2.2 Information transparency 2.3 Knowledge cohesion
	3 Continuous learning	3.1 Smart monitoring 3.2 Evaluation 3.3 Cross-stakeholder learning
Wanting	4 Stakeholder engagement process	4.1 Stakeholder inclusiveness 4.2 Protection of core values 4.3 Progress and variety of options
	5 Management ambition	5.1 Ambitious and realistic management 5.2 Discourse embedding 5.3 Management cohesion
	6 Agents of change	6.1 Entrepreneurial agents 6.2 Collaborative agents 6.3 Visionary agents
Enabling	7 Multi-level network potential	7.1 Room to manoeuver 7.2 Clear division of responsibilities 7.3 Authority
	8 Financial viability	8.1 Affordability 8.2 Consumer willingness-to-pay 8.3 Financial continuation
	9 Implementing capacity	9.1 Policy instruments 9.2 Statutory compliance 9.3 Preparedness

Ultimately, to understand the value of the CBF an GCF for supporting investment decisions, a literature review has been conducted to identify the key conditions needed to make investments in developing countries. The key conditions needed to make investment decisions such as political stability and security, market size and conditions, labour force and skills as well as the quality of national statistics and data, could all be evaluated by the three City Blueprint Approach frameworks. Moreover, through interviews with young professionals from UNESCO, whom applied the frameworks in the five cities, it was observed how these may be adjusted to the local SSA context. To facilitate the use of these assessments in SSA;

- Certain indicators should be omitted which are deemed less relevant by the user/investor, such as the condition 6 *visionary agents* in the GCF. Certain indicators deemed more salient in the investment context may be added, as for example in the TPF, the ratio of people living in informal settlements to the total urban population.
- Certain indicators of the CBF may be merged in to one, such as all four indicators in category IV Wastewater treatment (indicators; 10 nutrient recovery; 11 energy recovery; 12 sewage sludge recycling and 13 WWT energy efficiency) or may be either omitted completely or renamed as one indicator: recovery of wastewater products.
- Field research should be emphasised over literature study, as online data is scarce in SSA and the key stakeholders usually possess relevant literature, policy documents and reports.
- Researchers should visit the institutions/organisations representing the key stakeholders in person, as they may be difficult to establish contact with through email. As some stakeholders may also be reluctant to share information, this way, key documents could be requested directly.

List of acronyms

AfDB – African Development Banks

CBA - City Blueprint Approach

CBF – City Blueprint Framework

CD – Capacity Development

CNAP – Centre National Anti-Pollution

DGEPN – Directorate General of the Environment for the Protection of Nature

GCF – Governance Capacity Framework

GDP – Gross Domestic Product

KCD – Knowledge Capacity Development

JKP – Joint Knowledge Production

IWRM – Integrated Water Resources Management

MDG – Millennium Development Goal

SSA – Sub-Saharan Africa

OECD – Organisation for Economic Co-Development

TPFF – Trends and Pressures Framework

UN – United Nations

UNDP – United Nations Development Programme

UNESCO – United Nations Educations Scientific Culture Organisation

WWT – Wastewater Treatment Plant

Table of Contents

1. Introduction

1.1 Key water-related challenges in sub-Sahara Africa

The climate is changing more rapidly than ever before, whilst at the same time global populations have increased substantially. Countries of Sub-Saharan Africa (SSA) are particularly vulnerable to climate change due to their low levels of income, technological and institutional capacity which hampers adaptation to rapid environmental changes (Abu-Zeid, 2003; Ashton, 2002; Schulze, 2011; Bonnassieux & Gangneron, 2011; Spoon, 2014). In addition, SSA strongly exploits and relies on climate-sensitive renewable natural resources such as water, fish and timber, leading to declining soil fertility and water storage, erosion and desertification (Conway, 2009). On top of these environmental challenges, the prevalence of AIDS and vector-borne diseases, inadequate governance and rapid population growth amplify the vulnerabilities to climate change (Mustapha et al, 2012). Particularly, water-related issues such as water scarcity, pollution and floods already have a profound impact on the region. These combined challenges lead to large scale rural-urban migration. In fact, this rural-urban migration accounts to about half of the unprecedented 140% urbanisation rate between the 1960s and the 1990s. Compared to the OECD countries, urbanisation in SSA is ten times as fast (Barrios et al., 2006). In fact, 8 of the 10 countries with the highest urbanization rates in the world are located in SSA and urban growth is projected to triple from 346 million to 1.1 billion in the next three decades (Dos Santos et al, 2018; UN, 2015). These environmental and social challenges emphasize the need for urban adaptation strategies, particularly in the context of highly interconnected urban challenges of too little (water scarcity), too much (flooding) and too polluted water.

McDonald et al. (2011) estimate that the total number of people living in urban areas with water shortage will increase from 24 million in 2000 to 162 million by 2050. Cities like Bamako (Mali), Niamey (Niger) and Ouagadougou (Burkina Faso) are already located in countries at high risk of water shortages which is exacerbated by poverty and rapid urban growth (Reig et al., 2013; Dos Santos et al., 2018). The urban growth largely takes place in informal/unplanned settlements or slums, which accommodate an estimated 47% of the urban population in SSA (UN Habitat, 2010; Mberu et al, 2017). Such informal settlements, or slums, are particularly vulnerable to water-related issues, such as access to safe drinking water (Douglas et al., 2008, Dos Santos et al., 2018). Especially in such areas, water is often being supplied at inflated prices by informal water vendors or taken from polluted surface water (Dos Santos et al., 2018; Tusting et al., 2019). Although access to drinking water has steadily increased globally over the last 15 years, it is estimated that half of the urban dwellers in SSA lack access to safe drinking water (World Bank, 2017). In addition, monitoring data is often missing which may lead to even a larger percentage of urban dwellers lacking access to safe potable water. Accordingly, an estimated 1.1 billion people depend on unreliable drinking water sources resulting in the death of 5 million people per year (UNICEF & World Health Organization, 2005).

Despite significant worldwide progress in achieving the Millennium Development Goals (MDG) with respect to access to safe drinking water, SSA fell short of this MDG. As of 2015, access to drinking water fell short by 68% coverage (Dos Santos et al., 2018). Many urban dwellers rely on surface water, however, these sources are generally subject to high pollution due to poor wastewater treatment. Less than 30% is treated in sewage treatment plants, while the remainder is discharging into surface water and groundwater. These untreated waters are likely to become a major source of infectious diseases and oxygen depletion due to eutrophication (Nyenje et al., 2010). Flooding of urban areas can be especially harmful due to bacterial spread and direct contact with humans. In order to overcome the interconnected urban challenges of too little, too much and too polluted water, it is widely recognised that institutions are key in ensuring sustainable, equitable and inclusive water services (OECD 2015). Particularly in SSA, the capacity of the state to provide basic water

infrastructure is severely constrained due to insufficient human and financial resources as well as corruption (Mukheibir, 2007). Although hard engineering solutions are important, many development efforts have gone much further towards socially and contextually driven strategies, such as improving the adaptive capacity of water systems and users through education, changes in culture and lifestyle and institutional capacity to support these changes (Armah et al., 2013; Brooks & Wolfe, 2007). In other words, in order to overcome water-related problems in SSA, a wider array of strategies may be needed, some of which falling within the concept of water governance, which will be explained in more detail in the theory section below.

Adequate governance is widely regarded as the key factor for improving many social, environmental and financial issues (OECD, 2015). In fact, the OECD even labels the global water crisis as a crisis of governance, that is, institutional fragmented and insufficient cooperation, collaboration and coordination between multi-levels of governance both within and outside the water sector (Tortajada, 2010; OECD, 2015). This plethora of challenges can be categorised into systemic challenges, socio-environmental challenges and research-policy divides as illustrated in the figure 1 below (Olagunju et al., 2019). Systemic challenges consist of inadequate capacities and cross-sectoral coordination. Socio-environmental challenges, such as the colonial legacy resulting in discrimination against small scale users as one may see in contemporary post-apartheid South Africa (Olagunju et al., 2019). Regarding the research-policy divides, the most important one is the lack of monitoring data that reflects local realities. This lack of monitoring data and inadequacy of institutional capacities, are argued to be the main setbacks impeding good water governance across SSA (Olagunju et al., 2019). It is important to consider these different challenges as they are deeply rooted issues in many societies of SSA countries and which need to be considered if one seeks to improve water governance efforts across the continent in order to attempt to tackle water-related issues. One such governance challenge depicted below, that of capacity, is a major issue that international development programmes have sought to address by building and enhancing institutional capacities in developing countries (van Lindert, 2016).

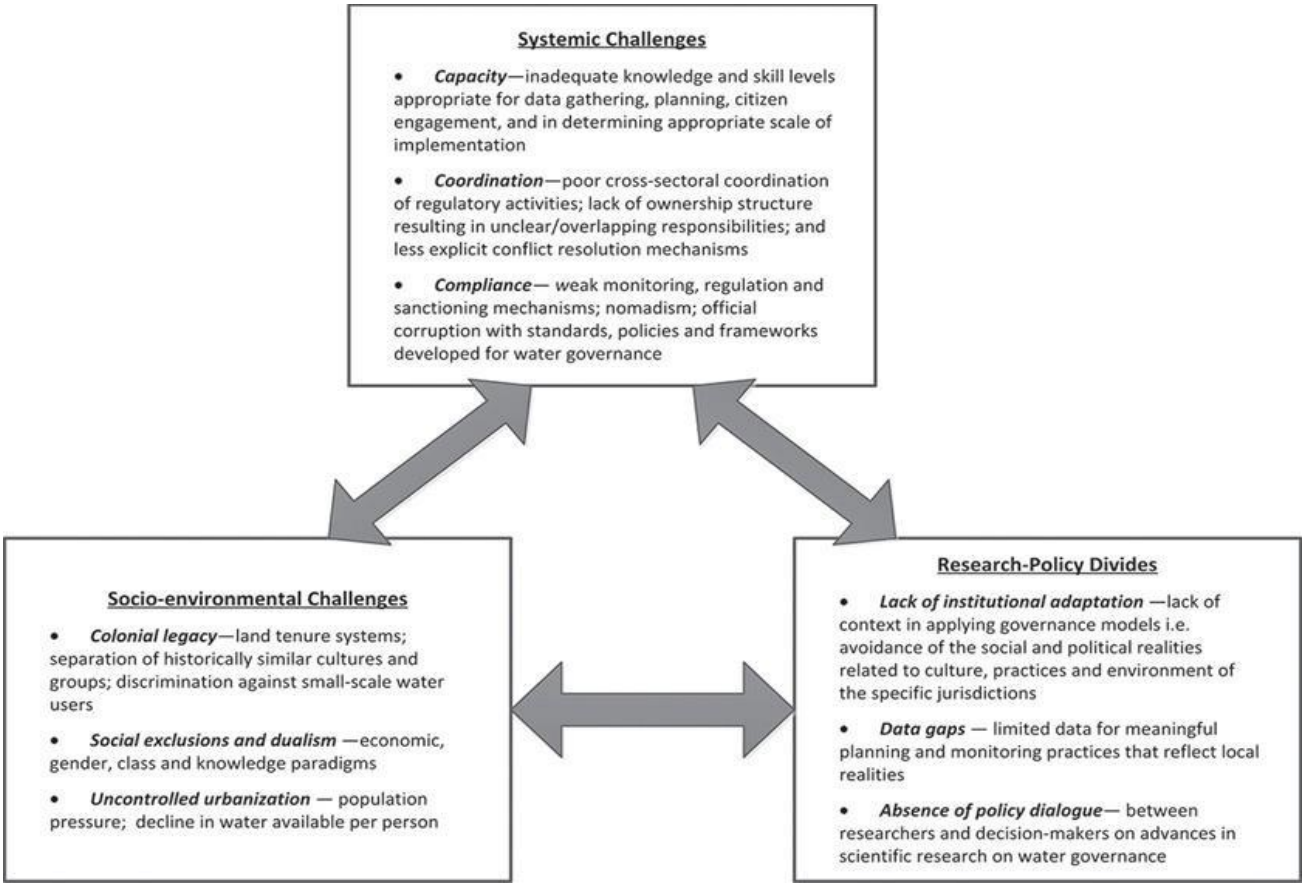


Figure 1: Crosscutting challenges identified in water governance research in Sub-Saharan Africa (Olagunju et al., 2019)

1.2 *International development programmes*

It was only in the 1990s and 2000s that local governance and capacity building became established in development thinking (Van Lindert, 2016). The concept of capacity building gained great focus in international development and is seen as the missing element in development strategies (Peltenburg et al., 2000). This is because inadequate human and organisational capacities, as well as unfavourable institutional environments, are seen to be major factors leading to the failure of many countries to develop themselves (Peltenburg et al., 2000; OECD 2015). It is not surprising, therefore, that many policy documents, e.g., WB, UNDP, and bilateral donor agencies, all agree on the critical importance of capacity building for institutional development in relation to overall development (UNDP, 1996; Constantinou, 2007).

In the African context, a great deal of international development banks and (related) programmes, have sought to improve institutional capacities, and broader water management capacities (AfDB, 2020; World Bank, 2020a). One such example is the African Development Bank funded project PAIEPAL in Gabon which seeks to improve the drinking water supply and sanitation network in the capital, Libreville. The project seeks to improve the water supply infrastructure and to some extent governance capacity (AfDB, 2019). However, with such projects it is not always clear as to which capacities need to be developed first, where funding needs to be prioritised and how the implementation may be evaluated (Vallejo and When, 2016; Mvulirwenande et al., 2017).

Considering the pronounced water related challenges in SSA stated above and the

importance of governance in enabling the efficient use of water infrastructure and technology (Tropp, 2007), it is of utmost importance to guide investment decisions seeking to develop water governance capacities. Since good water governance is key to addressing integrated water issues, especially in the urban SSA context (OECD, 2015) an increased amount of institutional capacities and knowledge sharing across various levels is necessary (Lautze, 2011). Especially considering that 'good' water governance is mainly hampered by a lack of institutional adaptation and absence of verifiable data in SSA (Olagunju et al., 2019). Such gaps in data make it challenging for planners and decision makers to assess use, demand, quantity, quality and distribution of water (de Lange et al, 2010). Data is also required for international development banks and programmes to make considerate investment decisions aimed at tackling water related issues and improving capacity development (World Bank, 2020). Globally, it is estimated that up to USD 22,5 trillion of investments in the water sector will be required until 2050 (OECD, 2015b), thus is imperative to guide the efficient use of resources, especially in areas where these will be scarce. If multilateral development banks or organisations seek to improve local water (governance) capacities in the data meagre environment of SSA, they will need to know which capacities need the most improvement, to thus, prioritise investments efficiently (Moglia et al., 2008).

1.3 *Scientific problem*

Despite these important international capacity-development efforts, it is not specified how capacity development is operationalised, measured and evaluated (Alaerts and Kaspersma, 2009; Mvulirwenande et al., 2017; Blockland et al., 2019). For example, the UNDP has a rather broad definition of capacity building as ways through which individuals, groups, organizations, institutions, and societies increase their abilities to: (i) perform core functions, solve problems, define and achieve objectives; and (ii) understand and deal with their development needs in a broad context and in a sustainable manner (UNDP, 1996). However, many different definitions exist, resulting in conceptual ambiguity. Next to this, capacity building implicitly implies that capacity is lacking and hence needs to be 'built' from scratch (Ife, 2010). However, often some capacity is in place and building an entirely new structure results in substantial transactional costs, disempowerment and re-organisation (Ife, 2010). Alternatively, capacity development implies that it is complementary to already existing capacities. According to this rationale, this study will endorse the concept of 'capacity development' instead of 'capacity building'. The evaluation of Capacity Development is a difficult task, as the intangible effects (i.e., social and individual transformations) are not easily grasped by commonly adopted evaluation methods (Preskill and Boyle, 2007; Vallejo and Wehn, 2016).

Especially knowledge and capacity development (KCD) is increasingly acknowledged as vital for development, however, evaluating KCD in practice can be challenging (Mvulirwenande et al., 2017). KCD in the water sector is increasingly viewed as a complex learning process that involves not only the transfer of knowledge and capacity from one social system to another (e.g., knowledge transfer via partnerships between well-performing water utilities in developed countries and water utilities in developing countries), but also deliberate efforts by a particular system (such as a water utility or a water ministry) to create, strengthen and maintain its overall capacity over time (Mvulirwenande et al., 2017). The literature identifies various KCD programme evaluation models that are usually separated into two broad categories, goal based and system-based models (Philips, 1991). Goal based evaluation models examine the extent to which programmes are meeting predefined targets, such as Kirkpatrick's (1998) four-level model, commonly employed in human resource development. On the other hand, system-based models, such as Worthen and Sanders' (1987) Context, Input, Process, Product model, focus on the general context and situation of the programme under evaluation. Nevertheless, in practice, evaluating such KCD programmes in the water sector remains challenging due to various issues.

As KCD is usually executed as part of larger water programmes it is challenging to track its impact separately (Kasperma, 2013), or to accredit improvement in capacity to one particular intervention (Whyte, 2004). Next to this, it seems to be difficult to plan and monitor the development of capacity due to its long-term and complex nature (Alaerts & Kaspersma, 2009; Wehn de Montalvo & Alaerts, 2013). Then, one must also take into account the challenges of defining capacity operationally and thus measure it through specific indicators. Which is why KCD practitioners often use performance indicators as a proxy measure to assess the impact of their interventions (Alaerts & Kaspersma, 2009; Morgan, 1997; Zinke, 2006). Upon reviewing the literature, it seems that KCD evaluations may be applied to the water sector, however, such evaluations are restricted to programme scales (Mvulirwenande et al., 2017) and to date have not evaluated more specific integrated water governance and management capacities at the local urban scale in SSA. Broader water governance assessment are emerging, such as the Governance Capacity Framework (Koop et al, 2017), the 10 Building Blocks for Water Governance (van Rijkswick et al., 2014) and OECD principles for good governance (OECD, 2015), however, have seldom provided insight into capacity-development priorities of SSA cities and their link with KCD or the production of joint knowledge.

Scarcely any of the KCD impact evaluation indicators focus exclusively on Joint Knowledge Production (JKP). However, frameworks specifically analysing JKP could arguably be beneficial at evaluating whether the targets of integrated water governance and KCD efforts have been met. The concept of Water Governance will be described in more depth further on in this research, yet, according to Lautze et al. (2011) it consists of the processes and institutions by which decisions that affect water are made. Additionally, its qualities lie in openness, transparency and broad participation amongst others (Lautze et al., 2011). Thus, because JKP implies that scientists, policymakers and sometimes other societal actors cooperate in the exchange, production and application of knowledge (Cash et al., 2003; Van den Hove, 2007; Edelenbos et al., 2011), it may be considered as part of and a condition for good water governance, as well as KCD. The former concept is however, once again, difficult to measure in practice.

Edelenbos et al. (2011) and Hegger et al. (2012) established conceptual frameworks[1] for the retrospective analysis of regional joint knowledge production in regional climate change mitigation projects. Their framework can identify success conditions for JKP between scientists, policymakers and other actors engaging in regional climate change mitigation (Edelenbos et al., 2011; Hegger et al., 2012). Such frameworks are important as they enable scholars, research funders or any other actors to assess whether the targets of the programmes have been met or not (Folke et al., 2005). However, such frameworks or methods of assessing JKP have predominantly taken place in the Dutch context about regional climate change in general (Edelenbos et al., 2011, Hegger et al., 2012; 2014; Hegger and Dieperink, 2014) and are lacking in the form of localised assessments in a developmental context. Practice oriented guidelines of 'how to do' joint knowledge production, between different stakeholders and levels, are lacking (Hegger et al., 2012). JKP is also important for investment decisions, as investors, policy makers and scientists will have to together agree on what the investment priorities are. However, first, these investment priorities, or key challenges, need to determined and only then can the solutions be implemented and evaluated. There is, nevertheless, a lack of research on how empirical assessment tools can guide investment decisions aimed at improving integrated water governance capacities (Tropp, 2007; Moglia et al., 2008; Wehn and Vallejo, 2016). In sum, two main related gaps in knowledge have been identified.

[1] See in figure 2 Theory section below

1. Due to the suggestion that water governance capacity assessments may evaluate JKP, there is a lack of research on how to operationalise both of such frameworks in a more localised, developmental context (Hegger et al., 2012; Koop et al., 2017; Pahl-Wostl et al., 2020).

2. There is a gap in knowledge regarding cross-organisational capacity development to address water-related challenges in cities, in order to ensure more informed investment decisions and prioritise investments in SSA (Tropp, 2007; Pascual Sanz et al., 2013; Vallejo and Wehn, 2016, Blockland et al., 2019).

Bearing in mind the previously mentioned water-related challenges in urban SSA, threatened by climate change and population growth, there is a dire need for improving local water governance capacities. However, due to the lack of data and methods evaluating water governance capacity development, it is challenging to guide investment decisions aimed at improving such capacities. Thus, the following research aim and questions arise.

1.4 *Research Aim and Questions*

Main Research Aim

To provide additional insight into how integrated urban water governance capacity assessments can be used to inform local investment priorities and decisions of multilateral investment banks in the SSA context.

Main question

To what extent can empirical assessments for prioritising water-related challenges and capacity development be practically deployed to inform investment decisions and what methodological adjustments would be necessary to fit the context of sub-Saharan African cities?

Sub-questions

This main question is operationalized into three sub-questions:

1. *What are the key water-related challenges in sub-Saharan African cities that require most attention?*

First and foremost, to know where investments need to be directed towards, one needs to know what the main water-related challenges are. In order to find out what the main water-related challenges in sub-Saharan cities are, the findings of six City Blueprint assessments applied in the region, will be scrutinised to identify the key challenges.

2. *What are the strengths and weaknesses of the Governance Capacity Framework for addressing the challenge of urban water pollution in Libreville, Gabon?*

In order to gain a general picture of the urban water governance capacity of SSA the case study of Libreville will be examined in depth, especially in relation to how the issue of water pollution is governed. Thus, the Governance Capacity Framework will be applied and in-depth interviews with stakeholders and professionals in the field, as well as a literature study will be conducted to answer this sub question.

3. *How can the City Blueprint Approach be practically deployed to support investment decisions in the sub-Saharan African context?*

First, a literature review will identify the key conditions needed for investors to make investment decisions in a developmental context. Then the identified conditions will be compared to the indicators the CBA assessments, to verify whether the CBA can support investment decisions. Ultimately, to determine how the CBA could be more practically deployed in the SSA context, interviews with the fellow young professionals whom applied the frameworks will be held, which will provide the basis for the recommendations.

2. Theory

2.1 *Integrated Water Resources Management (IWRM), Water Governance and Governance Capacity*

During the turn of the 20th to the 21st century, a general shift in water management took place, from a focus from technocratic and reactive solutions to anticipative and adaptive measures, as well as from sectoral and hierarchal water policy to integral and participatory policies (Biswas, 2004; Segrave et al., 2016). These broad shifts in water management, as well as more interrelated water issues arising, provided an ideal space for the proliferation of Integrated Water Resources Management (IWRM) (Bouwer, 2003; Biswas, 2004; Pahl-Whostl et al., 2008; Segrave et al., 2016). Water management is increasingly seen as integrated and interdisciplinary by leading organisation such as the OECD, the UN or the UNEP (Jeffrey and Geary, 2006; OECD, 2015; UN, 2017). Thus, the mitigation of water (related) issues are deemed to require integrated solutions, covering multiple disciplines (Biswas, 2004; Rahaman and Varis, 2005; Tropp, 2007). A widely used definition of IWRM put forth by the Global Water Partnership (2000), defined it as; '*a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*'. One of the reasons this paradigm shift from single sector and technological specific methods to IWRM is so attractive, is because it is comprehensive and holistic (Gupta and Agyenim, 2012). This is mainly because it considers multiple sectors, various types of water and different resources in one area at the same time and 'reinforces an ecological approach to land use and planning' (Pahl-Wostl, 2007: p. 49; Gupta and Agyenim, 2012).

However, although the concept has gained popularity in recent decades, many authors argue that IWRM is a rather ambiguous concept, framed by many different definitions and difficult to apply in practice (Biswas, 2004; Jeffrey and Geary, 2006; Grigg, 2008; Gupta and Agyenim, 2012). The overarching goal, namely IWRM, is to operationalise a coherent set of specific targets, that can be applied in various sectors, to together manage water in an efficient, equitable and sustainable fashion. However, in practice it is unclear what needs to be measured or integrated for a water system to be fully integrated (Biswas, 2004). Jensen (2013) has demonstrated that the implementation of IWRM in developing countries often lacks reflection of the local political and social realities on the ground. Jeffrey and Gearey (2006) have even argued that there is no clear evidence that IWRM has actually worked. This is in part due to the "nirvana" nature of the concept (Molle, 2008), the complexity of bridging knowledge and policies across sectors, (Adeel, 2004, Pahl-Wostl, 2009) and grafting the concept on existing institutions does not, in itself, lead to more integrated policies (Agyenim, 2011). Considering the flaws of IWRM stated above, some even arguing the concept has become an end in itself, masking more pragmatic solutions (Giordano and Shah, 2013), the underlying premise of the concept is not unfounded. Despite the definitional, conceptual and practical difficulties of IWRM, it is, nevertheless, of vital importance to view water issues as inherently integrated and requiring multidisciplinary solutions. Bearing in mind wider socio-economic issues plaguing a great deal of SSA cities, one must keep in mind that water-related issues are intertwined with, or even sometimes the result of, wider socio-economic issues (Swyngedouw et al., 2002). For example, in the case of Libreville, Gabon, urban pluvial flooding is often a result of poor urban planning and waste management, as not enough drainage channels are constructed in areas that have experienced recent population growth and solid waste clogs up existing drainage channels, which may have adverse health impacts through the spread of malaria or diarrhoea (Mombo and Edou, 2007). Thus, in such contexts, water management should go hand in hand with land, solid waste and perhaps even public health management, just to name one of many examples how water is related to different areas.

Giordano and Shah (2013) argue that the crux for integrated water management is adopting case specific, pragmatic and integrated solutions to water problems. First, however, one needs to identify the main water-related issues at hand, to better understand where what kind of solutions are most effective. The one would have to work together with local policy makers, institutions, scientists and investors to overcome implementation challenges (Anderson et al., 2008; Jensen, 2013). That is why producing knowledge in a joint manner between these actors is important for the operationalisation of IWRM. To first determine the key water-related challenges, holistic and coherent, preferably indicator-based, methods assessing IWRM, are necessary. However, little such well-defined methods assessing IWRM exist (Moglia et al., 2008; Wolff et al., 2012). This is where the City Blueprint Approach (CBA) tools come in.

One of the three CBA assessment tools, the City Blueprint performance Framework (CBF), is one of the first attempts of performing a basic assessment of IWRM, as it examines multiple factors relating, but not confined to, urban water issues (Koop and van Leeuwen, 2015). It consists of 24 indicators spanning over seven broad categories, ranging from access to drinking water and sanitation, to wastewater and solid waste treatment, all the way to climate change adaptation (Koop and Van Leeuwen, 2020b). In this way, a holistic assessment of IWRM in cities is provided. By consistently measuring 24 different indicators across multiple areas, the CBF is not limited by the definitional issues plaguing IWRM (Agyenim and Gupta, 2012), nor is it an end in itself masking other solutions. This is because the CBF does not instruct how to do IWRM, yet is more about measuring the capacity of IWRM through predefined indicators and identifying key challenges within this. Whether it can do this and inform investment priorities will be scrutinised in this research (main research question and sub-question 1). Hence, this research builds on certain flaws inherent in IWRM. Considering that it is challenging to measure IWRM and thus difficult to know where to invest in IWRM (Moglia et al., 2008; Wolff et al., 2012), measuring water-related areas not only through the CBF but also linking these to the wider socio-economic and political issues identified by the Trends and Pressures Framework is important. By linking water-related issues to wider socio-economic and political trends, the true integrated nature of such issues may come to the surface (Swyngedouw, 2002). Both frameworks will be described in the following methods section. By identifying the key water-related challenges in SSA through these frameworks, local policymakers, scientists or investors can proceed to find the adequate, pragmatic and case specific solutions. In order to answer the third sub question, of how the CBA assessments can support investment conditions in the SSA context, a literature review, identifying the key conditions necessary for investment decisions, will be conducted in section 4.3, further linking investment decisions to IWRM. Through all of this, practical efforts from investors (and policymakers) aimed at improving IWRM in SSA could be guided, a feat traditionally characterised by operational challenges (Gupta and Agyenim, 2012; Jensen, 2013).

The CBF (and TPF), may, however, not be enough to identify and prioritise water-related challenges, as they do not cover the full political or detailed governance side of water management, which also is a flaw that has been attributed to the concept of IWRM (Jensen, 2013). Perhaps also therefore, there has been a shift away from IWRM and towards water governance, in recent water management research (Tropp, 2007; Lautze et al., 2011, Hofstra, 2013).

Although water governance has been lauded in the literature, it is quite theoretical and ambiguous, with many different definitions trying to frame the term (Tortajada, 2010; Lautze et al., 2011). There is no universally accepted definition on water governance, with the concept being used in various manners according to contextual factors. Hooper (2006) argues that water governance is the set of political, social, economic, and administrative systems that make IWRM possible. UNDP (2004) considers water governance to include political, economic and social processes and institutions through which governments, private sector and civil society make decisions about how best to use,

allocate, develop and manage water resources. A widely used definition by the OECD defines water governance as: '*the range of political, institutional and administrative rules, practices and processes (formal and informal), through which decisions are taken and implemented, stakeholders can articulate their interests and have their concerns considered, and decision makers are held accountable for water management*' (OECD, 2015). Water governance is so significant because it ensures the effective application of resources, technology and sound functioning of infrastructure (Tropp, 2007). The water sector has traditionally been- and still is- driven by investments in technological innovations and infrastructure (Tropp, 2007; Vallejo and When, 2015). However, there have also been many instances where infrastructure did not operate in an effective manner, or where the benefits of appropriate technology were not fully realised (Tropp, 2007). According to Tropp (2007) that is why more questions in the development sphere have asked; Who is making decisions about who gets what water, when and how? What voices are heard in influencing decision-making? And on what political and scientific basis are decisions made? One of main challenges in governance, however, is to make public, private and societal actors participate actively and directly at solving issues and creating opportunities (Tortajada, 2010). No single actor has enough power or knowledge to by itself dominate decision making and put forth the right solutions (Kooiman, 2003). The complex interrelationships between actors and institutions, have rendered the application and operationalisation of governance strategies challenging in practice (Tiihonen, 2004). Joint Knowledge Production (JKP) may be vital here, as it by nature links bureaucrats, private actors, scientists and other stakeholders (Hegger et al., 2012; 2014), thus can facilitate the operationalisation of governance, and IWRM strategies, as well as inter-organisational capacity development (Hegger et al., 2012; 2014). The way in which such knowledge may be co-produced is scrutinised in the below analytical framework (4,5,6, Figure 2) established by (Edelenbos et al., 2011). Moreover, the extent to which the three knowledge groups contribute to the process of decision-making is studied (Edelenbos et al., 2011).

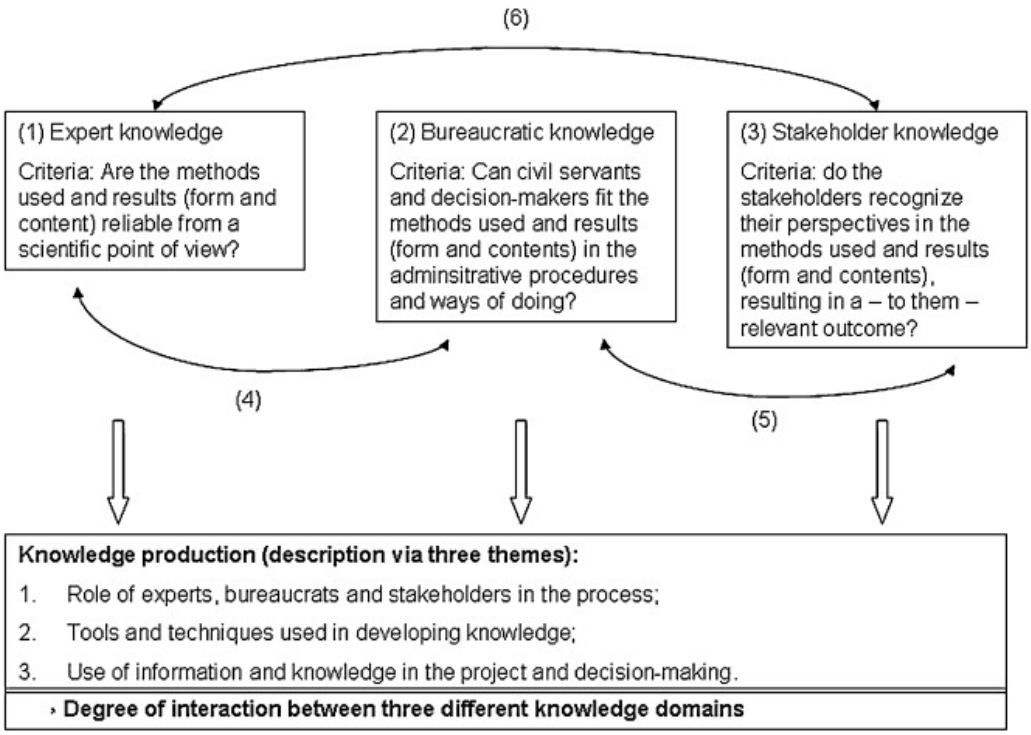


Figure 2: Analytical Framework of Knowledge Co-Production (Edelenbos et al., 2011)

To measure the interaction and knowledge a three-point scale is used, assessing the level of interaction according to the following qualitative criteria; (1) major interaction/two-way communication, (2) medium interaction/one-way communication, (3) minor or absent interaction (Edelenbos et al., 2011). JKP, as exemplified here, may build on the operational issues of IWRM, water governance and inter-organisational governance capacity development, as it can assess the level of communication and knowledge sharing between relevant stakeholders (Edelenbos et al., 2011; Hegger et al., 2012; 2014), which is vital for good governance implementation (OECD, 2015). However, this framework is difficult to apply in practice and has seldom been applied in the developing world (Hegger et al., 2012). Thus, this research will examine whether the Governance Capacity Framework (GCF) can assess local JKP in a developmental context and vice versa, and how it may be relevant to making more effective investment decisions towards developing such capacities.

One must keep in mind, however, that governance capacity is different to governance, as capacity refers to whether actors or a system can 'get things done' by enabling the rules of the game, connect and interlink discourses and provide necessary resources (Dang et al., 2016). There exist many different conceptualisations and components of governance capacity, one of which is institutional capacity. This scrutinises how institutional setting, rules, and regulations enable actors to collaborate and address shared issues (UNDP 2008; Dang et al. 2016). However, governance capacity is broader, also encompassing financial resources, knowledge and the function of discourses (Pahl-Wostl, 2009; Engle and Lemos 2010). Definitions vary frequently with some emphasising integration (Emerson et al. 2012), others cooperation (Dang et al. 2016), yet others focus on flexibility (Termeer et al. 2015). This research, however, will use the definition by Koop et al. (2017) defining governance capacity as; '*the key set of governance conditions that should be developed to enable change that will be effective in finding dynamic solutions for governance challenges of water, waste, and climate change in cities*'.

Measuring specific governance capacities remains challenging, let alone knowing where to invest in order to improve governance capacities. As capacity development is now a widespread ethos of Multilateral Development Banks (Constantinou, 2007), and governance capacity refers to the conditions enabling change for (water) governance challenges (Koop et al., 2017), it is imperative to know which specific capacities need to be invested in. However, because governance capacity inherently deals with enabling change in people, organisations and/or their enabling environment, the concept relies more on non-planned changes than on the pre-defined indicators (Wehn and Vallejo, 2016). In contrast, investors traditionally entrust quantitative indicators, to secure the highest rate of return with the least amount of risk (World Bank, 2020). This may create friction when attempting to secure investments in projects aiming at improving more intangible, difficult to measure, concepts like water governance capacity (Tropp, 2007). Therefore, the Governance Capacity Framework (GCF), may be a suitable assessment tool at measuring specific governance conditions and thus informing investment decisions aimed at improving such capacities. This is because the GCF can consistently assess and rank nine different governance conditions, through a total of 27 pre-defined indicators (Koop et al., 2017). The GCF will be described with more scrutiny in the following methods section. To illustrate the link between success conditions for JKP, the GCF and the conditions required to make investment decisions as identified in the following literature review (section 4.3.1), the table 1 is provided below.

Table 1: Potential links between JKP, the GFC and Investment Decisions (Author's own)

JKP success conditions[2]	**Certain relevant indicators of the GCF**[3]	**Conditions needed to make investment decisions**[4]
Broadest possible actor coalition is present	3.3 Cross-stakeholder learning	
Recognition of differences in actor perspectives takes place	2.3 Knowledge cohesion	Security
Organized reflection on division of tasks by participating actors takes place	7.2 Clear division of responsibilities	Political stability
Role of researchers and their knowledge is clear	2.1 Information availability 3.1 Smart monitoring	Quality of national statistics and data
Innovations in reward structures are present	3.2 Evaluation	Sound legal/regulatory environment
Specific resources such as boundary objects, facilities, organizational forms, and competencies are present	8.3 Financial continuation	Macroeconomic conditions

In the context of this research, the GCF will be applied in Libreville, Gabon, to determine the limiting and encouraging water governance conditions of the city and thus answer sub question 2. Moreover, it will be tested whether this assessment tool can support investment decisions aimed at improving water governance capacities, thus answering the main research question.

[2] Hegger et al., 2012
[3] Koop and van Leeuwen, 2020c
[4] World Bank, 2020

3. Methods

In order to answer the main research question, the results of the City Blueprint Approach (CBA) frameworks were aggregated. The CBA is an assessment tool composed of three complementary frameworks. The main socio-economic, governance and environmental challenges of cities are assessed with (1) the *Trends and Pressures Framework* (TPF) (Koop and van Leeuwen, 2020a). How cities manage their water is measured with (2) the *City Blueprint Framework* (CBF) (Koop and van Leeuwen, 2020b). Where cities can improve their water governance capacities is done with (3) the *Governance Capacity Framework* (GCF) (Koop and van Leeuwen, 2020c).

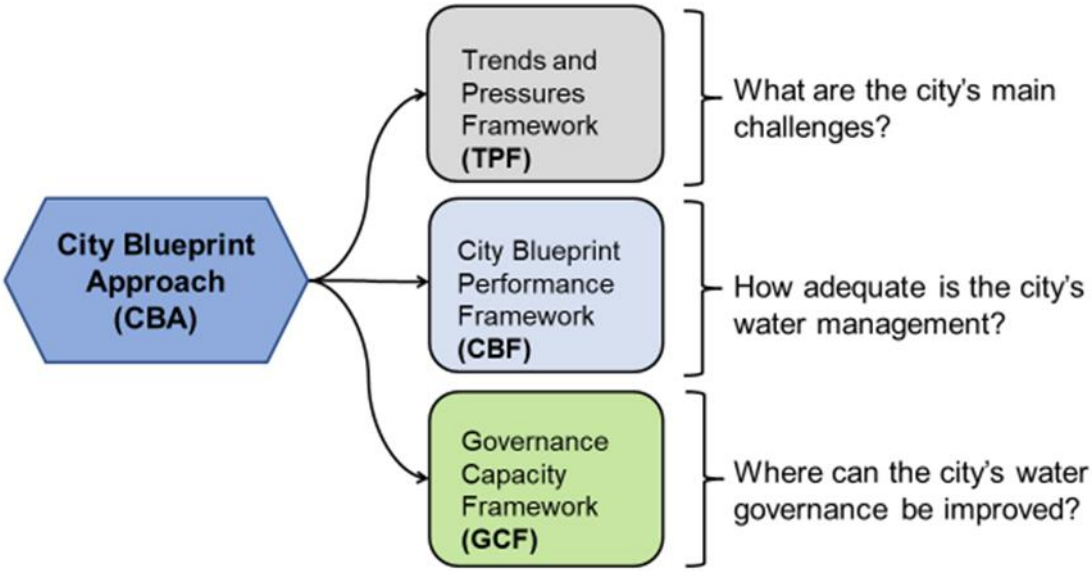


Figure 3: City Blueprint Approach (Koop and van Leeuwen, 2020a)

3.1 Methodology to address sub-question 1: What are the key water-related challenges in sub-Saharan African cities that require most attention?

In order to answer the first sub-question, to identify the key water related challenges, the results of the City Blueprint Framework (CBF) and Trends and Pressures Framework (TPF) were used. The CBF is designed to assess the water management capacity of a city by measuring 24 different indicators spanning across seven main categories (I Basic water services, II water quality, III wastewater treatment, IV Water infrastructure, V Solid waste, VI Climate robustness and VII Plans and actions), as seen in figure 4 below.

Category	Indicator	Score
I Basic water services	1 Access to drinking water	
	2 Access to sanitation	
	3 Drinking water quality	
II Water Quality	4 Secondary WWT	
	5 Tertiary WWT	
	6 Groundwater quality	
III Wastewater treatment	7 Nutrient recovery	
	8 Energy recovery	
	9 Sewage sludge recycling	
	10 WWT energy efficiency	
IV Water infrastructure	11 Stormwater separation	
	12 Average age sewer	
	13 Water system leakages	
	14 Operation cost recovery	
V Solid waste	15 MSW collected	
	16 MSW recycled	
	17 MSW energy recovered	
VI Climate adaptation	18 Green space	
	19 Climate adaptation	
	20 Climate-robust buildings	
VII Plans and actions	21 Management & action plans	
	22 Water efficiency measures	
	23 Drinking water consumption	
	24 Attractiveness	

Figure 4: City Blueprint Framework (Koop and van Leeuwen, 2020b)

The 24 City Blueprint indicators are standardized to a scale of 0-10 in which 10 points implies an excellent score and 0 points a poor score. This is done by comparing the values from an international range, using natural boundaries of 0 and 100% or by using ordinal classes. Often the min-max method is applied:

$$\frac{value - minimum\ value}{maximum\ value - minimum\ value}\ X\ 10 \quad = \text{Indicator score}$$

According to Koop and van Leeuwen (2020b) there are seven steps to be followed in this process;

1. Municipalities and regions are contacted to participate or they contact KWR Water Research Institute (KWR).

2. If a decision has been taken, the city appoints a coordinator for the information collection. This coordinator contacts the stakeholders in the municipality/region to provide the necessary information for the municipality or region.

3. The coordinator completes the City Blueprint Framework (CBF) questionnaire for 24 indicators. This will take a few days. The questionnaire (or an identical word file) is then used to collect the information, step by step (indicator by indicator).

4. For each indicator scoring information is gathered. The information, the sources (websites, documents or publications, and if necessary, the page number(s) are provided and included in the CBF questionnaire word file (copy paste).

5. For each indicator, the scores are calculated as explained in Section 4 of this document.

6. After the completion of this questionnaire a radar chart of all 24 indicators (the City Blueprint) and the Blue City Index (BCI) can be provided. These indicators and the BCI vary from 0 (concern) to 10 (no concern). The City Blueprint spider diagram and the calculation of the BCI can be obtained by introducing the scores for the 24 indicators in the excel file for the calculation of the BCI.

7. KWR will review the information and check the calculation and contact you again to discuss this. After mutual agreement the information can be used to make reports and/or can be added to the City Blueprint Database at KWR Water Research Institute. KWR will then also provide the results of the TPF indicators.

In the context of this research, the CBF has been applied in five cities across SSA by six young professionals from UNESCO. The Trends and Pressures scores were calculated by KWR. The scores for both frameworks, applied to all five cities, are aggregated in a report by Grison and Koop (2020).

The CBF has been used in this research as it seems to be a suitable tool to assess urban IWRM capacity, as well as comparing different cities and seeing which water-related challenges may require most attention (Koop and van Leeuwen, 2015; Rahmasary et al., 2019). Moreover, the assessment tool can classify municipalities and regions in to five thresholds; (1) cities lacking basic water services, (2) wasteful cities, (3) water efficient cities, (4) resource efficient and adaptive cities, and (5) water wise cities (Koop and van Leeuwen, 2015). This will shed light on the main water-related challenges of the region and give a clearer idea of where future investments may be directed towards. Furthermore, applying these assessments may give us a more accurate picture whether water resources are truly managed in an integrated fashion.

Next to the CBF, the results of the Trends and Pressures Framework (TPF) will be used in this research to link the challenges of this framework to those identified by the CBF. Keeping the above figure 3 in mind, the TPF examines a city' wider socio-economic, political and environmental challenges. The TPF (figure 5) is composed of 24 indicators (and sub-indicators), divided over the ensuing four categories; social, environmental and financial pressures and include a 4th category, i.e. the World Bank governance indicators (Koop and van Leeuwen, 2020a).

Category	Indicators		Indicator number	Score
I SOCIAL	Urbanization rate		1	
	Burden of disease		2	
	Education rate		3	
	Female participation		4	
II ENVIRONMENTAL	Flood risk	Urban drainage flood	5	
		Sea level rise	6	
		River peak discharges	7	
		Land subsidence	8	
	Water scarcity	Freshwater scarcity	9	
		Groundwater scarcity	10	
		Sea water intrusion	11	
	Water quality	Biodiversity	12	
	Heat risk	Heat island	13	
	Air Quality	PM2.5/10	14	
III FINANCIAL	Economic pressure		15	
	Unemployment rate		16	
	Poverty rate		17	
	Investment freedom		18	
IV GOVERNANCE	Voice and accountability		19	
	Political Stability		20	
	Government effectiveness		21	
	Regulatory quality		22	
	Rule of law		23	
	Control of corruption		24	

Figure 5: Trends and Pressures Framework (Koop and van Leeuwen, 2020a)

The 24 Trends and Pressures indicators are standardized to a scale of 0-10 and divided in ordinal classes expressed as a 'degree of concern', as shown in the below figure 6 (Koop and van Leeuwen, 2020a).

TPF indicator score	Degree of concern
0 – 2	no concern
2 – 4	little concern
4 – 6	medium concern
6 – 8	concern
8 – 10	great concern

Figure 6: TPF score thresholds (Koop and van Leeuwen, 2020a)

In conjunction with the CBF, the TPF was applied to the five SSA cities of Abuja, Bangui, Harare, Libreville and Yaoundé and the results are synthesised in the report by Koop and Grison (2020). The reasons for employing the TPF in this research are two-fold. First, its findings may add to those of the formerly described CBF and help answer the first sub question of identifying the key water-related challenges in urban SSA. As water challenges are intersectoral and compounded, or even created by, wider socio-economic and political factors (Swyngedouw et al., 2002), it is imperative to measure these. Thus, wider socio-economic, political and environmental issues need to be linked to the challenges identified by the CBF, to fully capture their integrated nature. Second, the TPF needs to be included in this research, in order to determine whether all three of the CBA assessment tools can inform investment decisions and thus answer the third sub question.

3.2 Methodology to address sub-question 2: *What are the strengths and weaknesses of the Governance Capacity Framework for addressing the challenge of urban water pollution in Libreville, Gabon?*

In order to gain a general picture of the urban water governance capacity of SSA the case study of Libreville will be examined in depth, especially in relation to how the issue of water pollution is governed. The Governance Capacity Framework (GCF) will be applied, as it can rank governance conditions according to certain predefined qualitative thresholds. Thus, the Governance Capacity Framework will be applied and in-depth interviews with different stakeholders from various levels and professionals in the field of water management will be conducted, as well as literature study. Interviews are a suitable method as they may provide in depth knowledge into certain issues.

In essence, the GCF focuses on five different areas, namely on water scarcity, flooding, waste collection, wastewater treatment and urban heat islands. For each of these areas, nine conditions that are deemed necessary for good governance, composed of three indicators each, are tested, as seen in the below figure 7. Subsequently all 27 sub indicators made of pre-defined questions will be scored according to the 5-point Likert type scale method from very encouraging (++) to very limiting (- -) (Koop and van Leeuwen, 2020c). This indicator scoring process, is exemplified in the appendix 1.

Dimensions	Condition	Indicators
Knowing	1 Awareness	1.1 Community knowledge 1.2 Local sense of urgency 1.3 Behavioral internalization
	2 Useful knowledge	2.1 Information availability 2.2 Information transparency 2.3 Knowledge cohesion
	3 Continuous learning	3.1 Smart monitoring 3.2 Evaluation 3.3 Cross-stakeholder learning
Wanting	4 Stakeholder engagement process	4.1 Stakeholder inclusiveness 4.2 Protection of core values 4.3 Progress and variety of options
	5 Management ambition	5.1 Ambitious and realistic management 5.2 Discourse embedding 5.3 Management cohesion
	6 Agents of change	6.1 Entrepreneurial agents 6.2 Collaborative agents 6.3 Visionary agents
Enabling	7 Multi-level network potential	7.1 Room to manoeuver 7.2 Clear division of responsibilities 7.3 Authority
	8 Financial viability	8.1 Affordability 8.2 Consumer willingness-to-pay 8.3 Financial continuation
	9 Implementing capacity	9.1 Policy instruments 9.2 Statutory compliance 9.3 Preparedness

Figure 7: Governance Capacity Framework (Koop and van Leeuwen, 2020c)

By substantiating the scores of each indicator, the findings are validated in a standardised and reproducible fashion (Steflova et al., 2018). This method entails three main steps:

1. A desk study of scientific literature, official government sources, policy documents and grey literature resulting in a report of the substantiated preliminary Likert score of each indicator (Steflova et al., 2018).
2. The construction of a standardized importance/influence matrix to identify stakeholders, categorize them, and specify their roles and responsibilities (Steflova et al., 2018). Importance refers to the urgency a stakeholder has vis-à-vis (the mitigation of) the water challenge. Influence refers to the power a stakeholder has in dealing with the water issue. The importance/influence matrix consists of four classes: (1) crowd (low importance and low influence); (2) context (low importance and high influence); (3) subjects (high importance and low influence); and (4) key players (high importance and high influence) (Steflova et al., 2018). For each class, at least one stakeholder representing the government, the market and civil society were selected as suggested by Lange et al. (2013). In order to retain anonymity the interviewees were referred to as (interviewee 1, interviewee 2,…) an so forth. The semi-structured, face to face interviews usually lasted one hour.
3. The interviewees were asked to give feedback on the scores and support this with concrete examples, reports or policy documents. Once the feedback was included, the final indicators scores were substantiated.

Regarding the application of the GCF in Libreville , Gabon, in total 10 key experts representing the following stakeholders were selected; Ministry of the Environment, the Ministry of Water Resources and Energy, the Institution for Sanitation and Public Hygiene (IHPA), the National Centre for Anti-Pollution (CNAP), the municipality of Libreville, the National Centre for Scientific Research (CENAREST), the Omar Bongo University and the NGOs *Generation Eau Claire* and *H20 Gabon*.

Originally it was planned to assess the governance capacity of three different water related issues, namely water pollution, water scarcity and flooding, however, the premature forced ending of the fieldwork after two weeks due to the Covid-19 outbreak made this impossible and hence only one challenge, that of water pollution, has been assessed in depth. The remaining interviews to fulfil the assessment of this challenge have been done online through Skype or WhatsApp calls.

3.3 Methodology to address sub-question 3*: How can the City Blueprint Approach be deployed to support investment decisions in the sub-Sahara African context?*

In order to answer this question, first and foremost the conditions needed to make investment decisions had to be determined. To know whether the CBA can be used to support investment decisions one must know what conditions need to be satisfied for investors before they can decide to invest in a project or programme. Thus, first, a literature review will be conducted to determine these conditions. Secondly, the three CBA frameworks will be reflected upon to better align with the purpose of facilitating investment decisions in SSA cities. Through interviews with the fellow young professionals whom applied the CBF the five cities (GCF applied in one city), it will be sought to reveal what methodological adjustments and practical recommendations can be made to facilitate the use of these frameworks in the local SSA context. The interview questions with the young professionals can be found in the appendix 2. Based on the information gathered in the literature review, the

interviews with the young professionals and the author's own experience at employing the GCF in Libreville, some recommendations will be made how the CBA tools can support investment decisions for water-related projects.

For the field research of this thesis, the author conducted another internship with UNESCO and worked in their regional office in Libreville, Gabon. That internship lasted for a total of six months and during that time the author helped UNESCO organise the *World Water Day* in Gabon, in cooperation with the Ministry of Water Resources, as well as write a roadmap for the water sector of Libreville. The researcher co-authored this roadmap and the recommendations made in this report were based on the results of the CBF and GCF of Libreville. The author then presented the recommendations for the water sector in Libreville in an online workshop with the key water stakeholders of the city. In the appendix 3, the description of the workshop summary can be found. In this workshop, it was concluded that the key priority was to divide responsibilities clearly as to who has to do what in regard to wastewater treatment and sanitation, which was a main finding in the GCF analysis. Thus, an attempt to bridge science and practice was made by the researcher.

The interrelationships between the above mentioned scientific and societal problems, research questions, theory and methods are depicted in the research framework below.

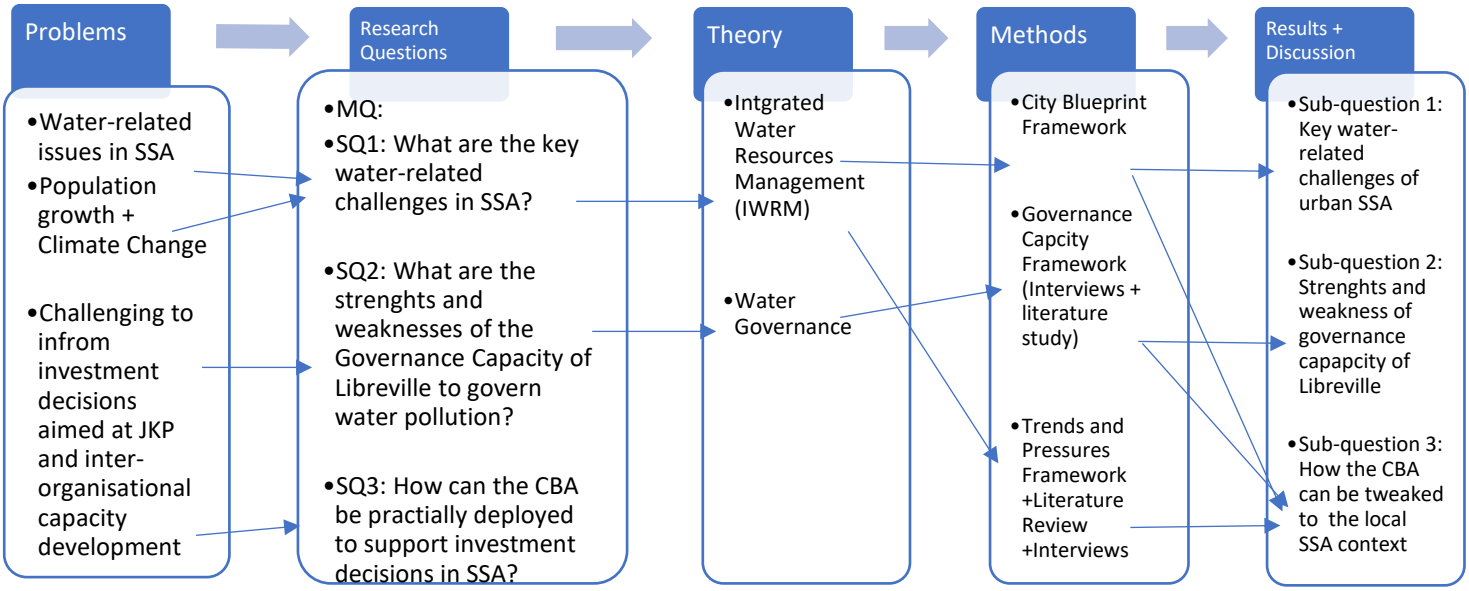


Figure 8: Research Framework (Author' own)

4. Results

4.1 *What are the key urban water related challenges in SSA*

In order to identify the key water-related challenges in sub-Saharan African cities the results of five City Blueprint, as well as the Trends and Pressures assessments will be presented below. First the city of Abuja, Nigeria will be presented, followed by Bangui, Central African Republic. Next, the results for Harare, Zimbabwe will be illustrated, before those of Libreville, Gabon and Yaoundé, Cameroon.

Abuja

Regarding the TPF illustrated in red in the figure 9 below, Abuja, the capital of Nigeria, has an alarmingly high; urbanisation rate, burden of disease, economic pressure and inflation rate, as well as deplorable air quality and political instability (Koop and Grison, 2020).

According to the CBF, illustrated below in figure 10, Abuja scored high on access to sanitation and drinking water quality, as well as consumption. The city also separates its stormwater and wastewater effectively. On the other hand, all wastewater treatment indicators, except for sewage sludge recycling scored very low. Water system leakages, solid waste recycling and energy recovered as well as climate robust buildings and adaptation scored low (Koop and Grison, 2020).

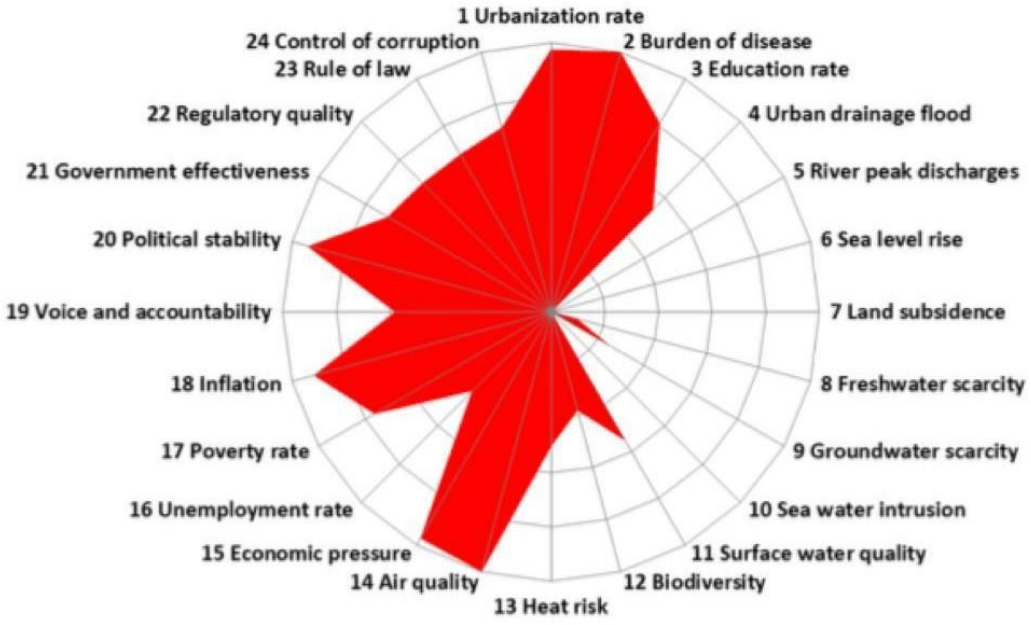


Figure 8: TPF results Abuja (Koop and Grison, 2020)

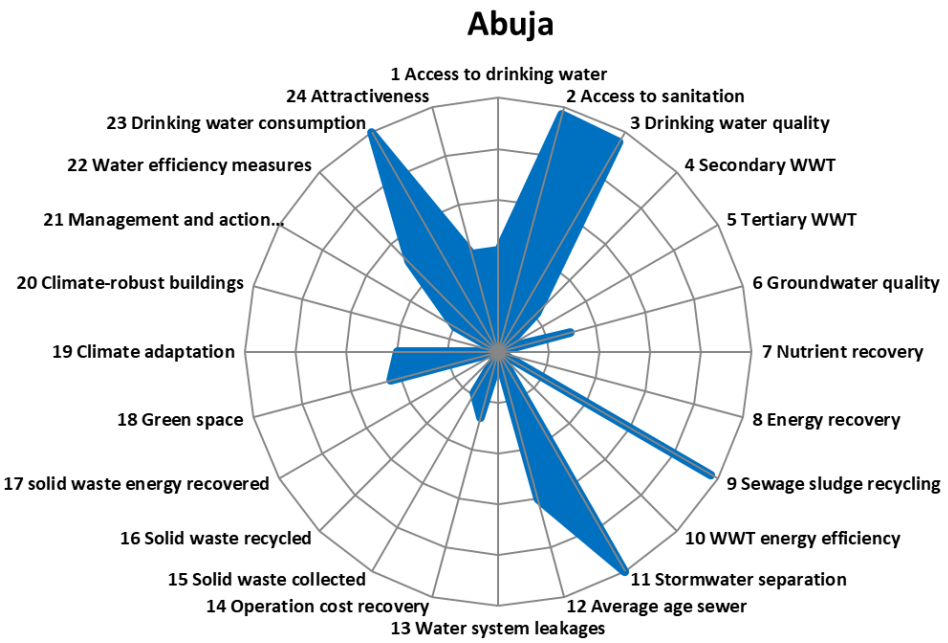


Figure 9: CBF results Abuja (Koop and Grison, 2020)

Table 1: Score chart of CBF results Abuja (Koop and Grison, 2020)

Indicators	Score	Indicator	Score
1.Access to drinking water	4.0	13.Water system leakages	0.3
2.Access to sanitation	9.7	14.Operation cost recovery	2.7
3.Drinking water quality	9.5	15.Solid waste collected	1.9
4.Secondary WWT	2.1	16.Solid waste recycled	0.0
5.Tertiary WWT	0.3	17.Solid waste energy recovered	0.0
6.Groundwater quality	3.0	18.Green space	4.4
7.Nutrient recovery	0.0	19.Climate adaptation	4.0
8.Energy recovery	0.0	20.Climate robust buildings	0.0
9.Sewage sludge recycling	9.7	21.Management and action plans	2.0
10.WWT energy efficiency	0.0	22.Water efficiency measures	5.0
11.Stormwater separation	10.0	23.Drinking water consumption	10.0
12.Age of sewers	6.0	24.Attractiveness	4.0

Bangui

According to the TPF depicted in the figure 11 below, Bangui, the capital of the African Central Republic, has a cause for concern regarding; its high burden of disease, its low education rate, inefficient urban drainage, fresh- and ground -water scarcity, air quality, economic pressures and inflation rate, as well as political stability (Koop and Grison, 2020).

The CBF score for Bangui, illustrated in figure 12 below, was found to score well on drinking water quality and consumption, next to having a new sewer system in place. In contrast, except for secondary WWT, all other WTT indicators score very low, as well as solid waste recycling and energy recovery. Solid waste collection on the whole achieved a high score (Koop and Grison, 2020).

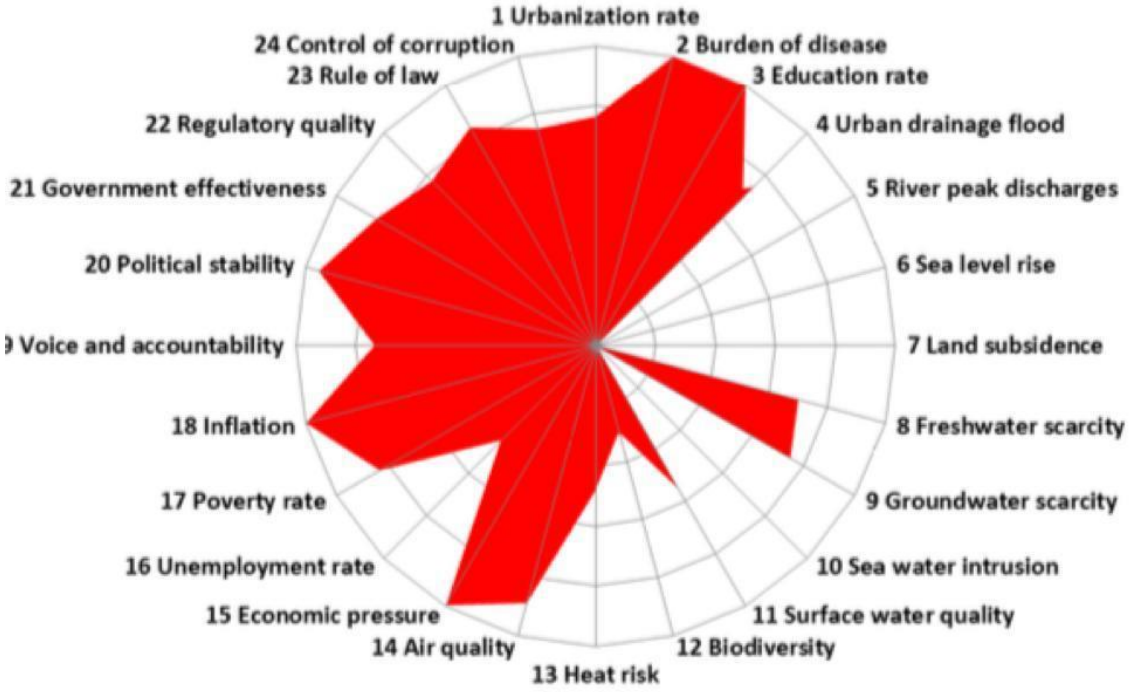


Figure 10: TPF results Bangui (Koop and Grison, 2020)

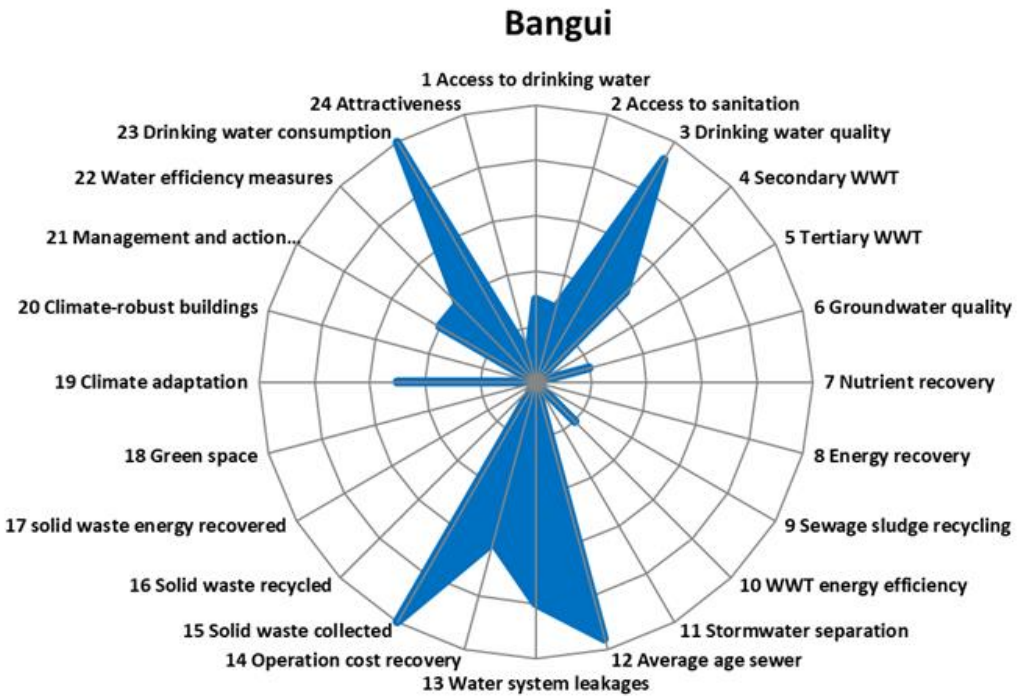


Figure 11: CBF results Bangui (Koop and Grison, 2020)

Table 2: Score chart CBF results Bangui (Koop and Grison, 2020)

Indicators	Score	Indicator	Score
1.Access to drinking water	3.0	13.Water system leakages	8.0
2.Access to sanitation	2.8	14.Operation cost recovery	6.0
3.Drinking water quality	9.3	15.Solid waste collected	10.0
4.Secondary WWT	4.6	16.Solid waste recycled	0.0
5.Tertiary WWT	0.0	17.Solid waste energy recovered	0.0
6.Groundwater quality	2.0	18.Green space	0.0
7.Nutrient recovery	0.0	19.Climate adaptation	5.0
8.Energy recovery	0.0	20.Climate robust buildings	0.0
9.Sewage sludge recycling	0.0	21.Management and action plans	4.0
10.WWT energy efficiency	2.0	22.Water efficiency measures	4.0
11.Stormwater separation	0.0	23.Drinking water consumption	10.0
12.Age of sewers	9.6	24.Attractiveness	1.0

Harare

The TPF demonstrated, in the following figure 12, that Harare, Zimbabwe, has; a high burden of disease, significantly high economic pressures, substantial room for improvement regarding voice and accountability, political stability, government effectiveness and regulatory quality (Koop and Grison, 2020).

Harare, presented in the below figure 13, scored high on the CBF regarding drinking water quality, stormwater separation, age of sewers, green spaces and water efficiency measures. The city achieved a relatively high score on secondary and tertiary WWT compared to the other cities, yet at the same time also received low scores on the other WWT related indicators. Solid waste recycling and energy recovery also scored low (Koop and Grison, 2020).

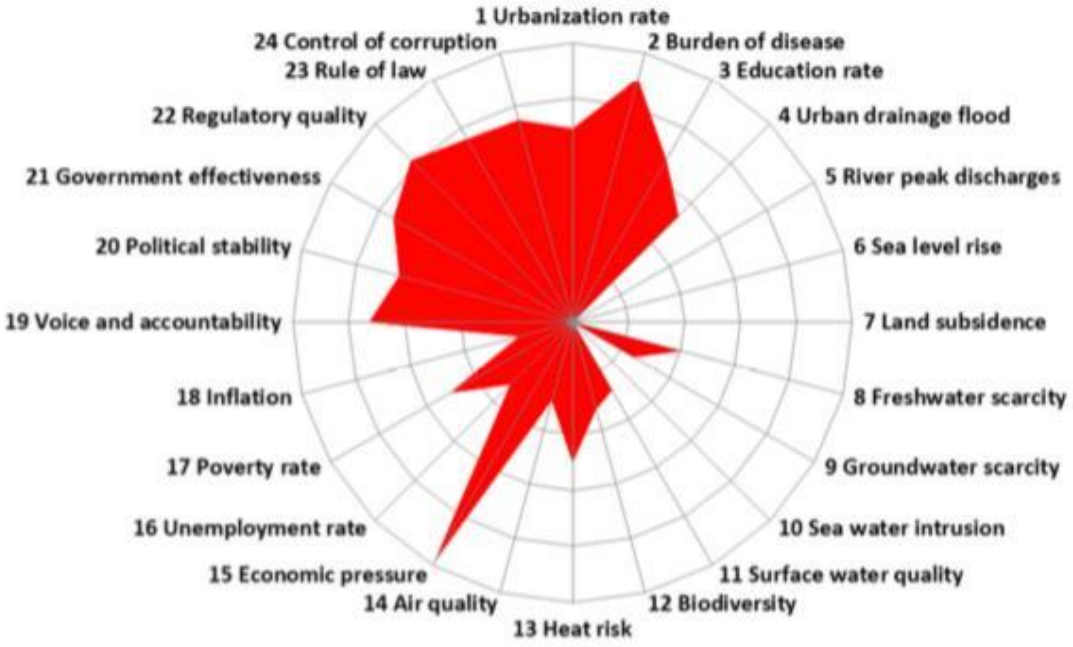


Figure 12: TPF results Harare (Koop and Grison, 2020)

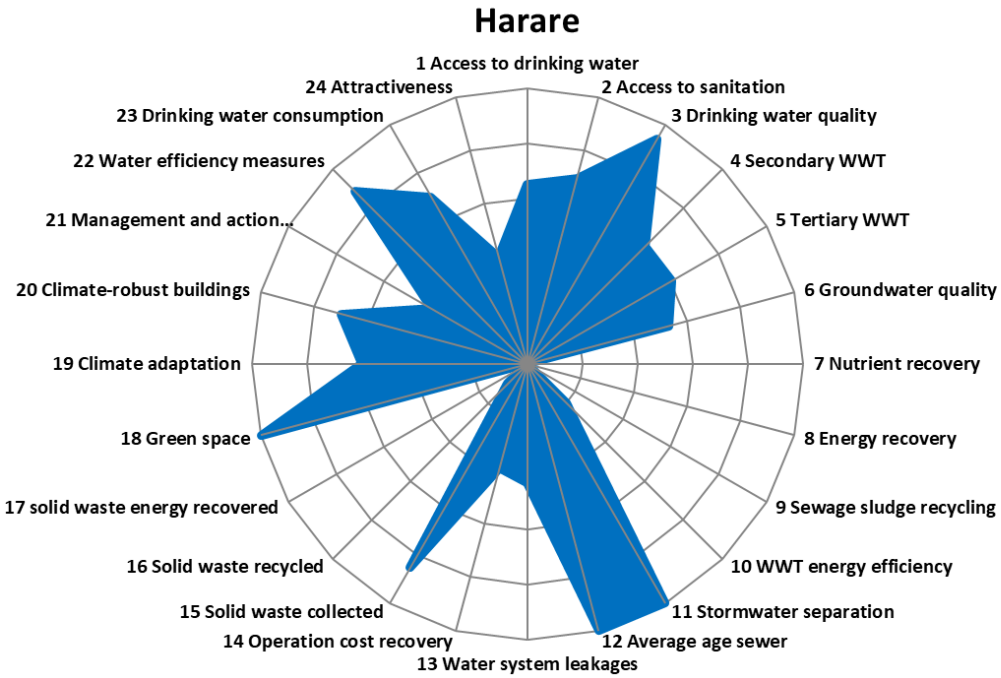


Figure 13: CBF results Harare (Koop and Grison, 2020)

Table 3: Score chart CBF results Harare (Koop and Grison, 2020)

Indicators	Score	Indicators	Score
1.Access to drinking water	6,5	13.Water system leakages	4.3
2.Access to sanitation	7.0	14.Operation cost recovery	3.9
3.Drinking water quality	9.4	15.Solid waste collected	8.5
4.Secondary WWT	6.0	16.Solid waste recycled	1.0
5.Tertiary WWT	6.0	17.Solid waste energy recovered	0.0
6.Groundwater quality	5.3	18.Green space	10.0
7.Nutrient recovery	0.0	19.Climate adaptation	6.0
8.Energy recovery	0.0	20.Climate robust buildings	7.0
9.Sewage sludge recycling	0.0	21.Management and action plans	4.0
10.WWT energy efficiency	2.0	22.Water efficiency measures	8.9
11.Stormwater separation	10.0	23.Drinking water consumption	7.0
12.Age of sewers	10.0	24.Attractiveness	4.0

Libreville

In the TPF (figure 15) Libreville, Gabon, was found to exhibit significant pressures in; it's poor education rate, urban flooding, surface water quality and unemployment rate (Koop and Grison, 2020). The political related indicators (19, 20, 21, 22, 23 and 24) were all found to pose moderate pressures (Koop and Grison, 2020).

The CBF results for Libreville illustrated below in figure 16, scored well on drinking water quality and consumption as well as green spaces and climate adaptation. At the same time however, the city scored a zero on all WTT related indicators and scored close to zero on stormwater separation and water system leakages, as well as solid waste recycling and energy recovery (Koop and Grison, 2020).

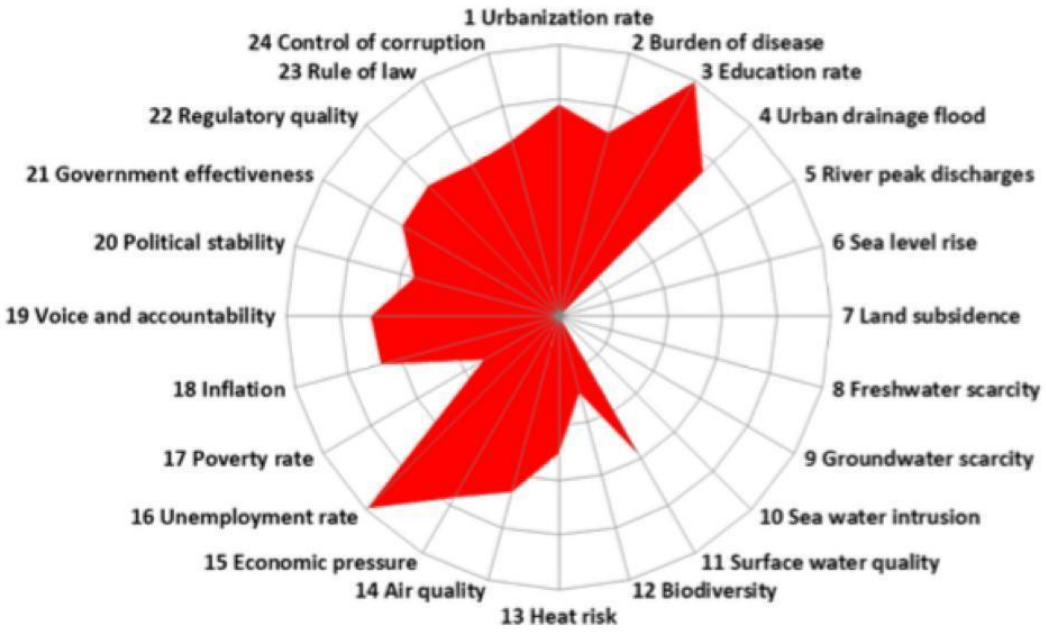


Figure 14: TPF results Libreville (Koop and Grison, 2020)

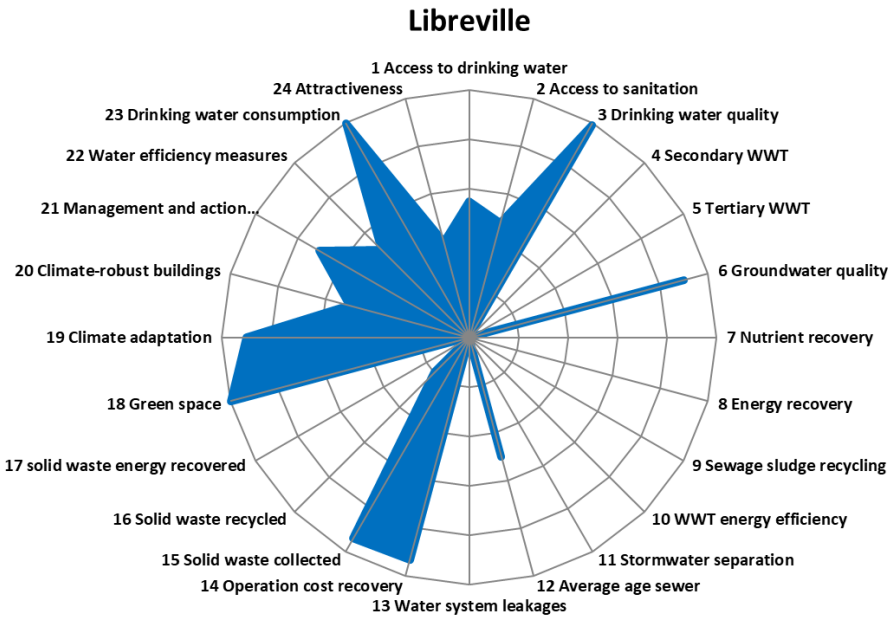


Figure 15: CBF results Libreville (Koop and Grison, 2020)

Table 4: Score chart CBF results Libreville (Koop and Grison, 2020)

Indicators	Score	Indicators	Score
1.Access to drinking water	5.5	13.Water system leakages	0.1
2.Access to sanitation	4.8	14.Operation cost recovery	9.3
3.Drinking water quality	9.9	15.Solid waste collected	9.4
4.Secondary WWT	0.0	16.Solid waste recycled	2.0
5.Tertiary WWT	0.0	17.Solid waste energy recovered	0.0
6.Groundwater quality	9.0	18.Green space	10.0
7.Nutrient recovery	0.0	19.Climate adaptation	9.0
8.Energy recovery	0.0	20.Climate robust buildings	5.0
9.Sewage sludge recycling	0.0	21.Management and action plans	7.0
10.WWT energy efficiency	0.0	22.Water efficiency measures	5.0
11.Stormwater separation	0.0	23.Drinking water consumption	10.0
12.Age of sewers	5.0	24.Attractiveness	4.0

Yaoundé

In the TPF illustrated in the following figure 17, Yaoundé, Cameroon, was found to experience high pressures in its education rate, its urban drainage, its river peak discharges, its surface water and air quality, its economy, as well as political stability and government effectiveness (Koop and Grison, 2020).

Yaoundé scored high in the CBF (figure 18) in access to sanitation, water system leakages and drinking water consumption. On the other hand, the city received low scores for all WWT related indicators, stormwater separation, operation cost recovery, green spaces and solid water recycling and energy recovery (Koop and Grison, 2020).

Figure 16: TPF results Yaoundé (Koop and Grison, 2020)

Yaoundé

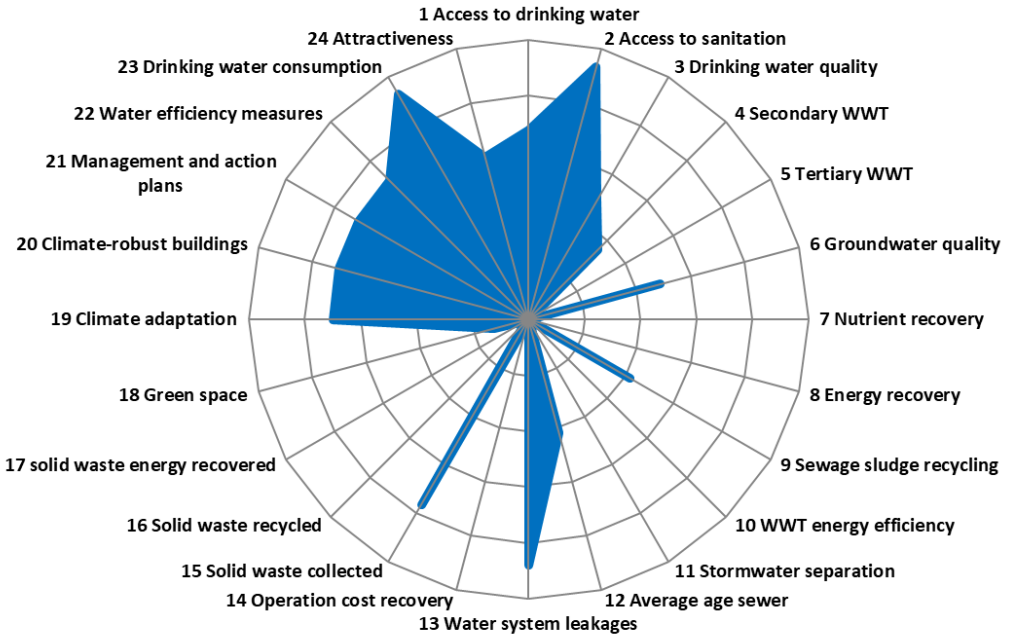


Figure 17: CBF results Yaoundé (Koop and Grison, 2020)

Table 5: Score chart CBF results Yaoundé (Koop and Grison, 2020)

Indicators	Score	Indicator	Score
1.Access to drinking water	6.8	13.Water system leakages	8.8
2.Access to sanitation	9.3	14.Operation cost recovery	0.0
3.Drinking water quality	4.9	15.Solid waste collected	7.7
4.Secondary WWT	3.5	16.Solid waste recycled	0.2
5.Tertiary WWT	0.0	17.Solid waste energy recovered	0.1
6.Groundwater quality	4.9	18.Green space	1.3
7.Nutrient recovery	0.0	19.Climate adaptation	7.0
8.Energy recovery	0.0	20.Climate robust buildings	7.0
9.Sewage sludge recycling	4.2	21.Management and action plans	7.0
10.WWT energy efficiency	0.0	22.Water efficiency measures	7.0
11.Stormwater separation	0.1	23.Drinking water consumption	9.3
12.Age of sewers	4.2	24.Attractiveness	6.0

The table 6 below illustrates the common water-related challenges, or limiting results of the CBF of the five cities, highlighted in red.

Table 6: Common limiting water related scores of CBF analyses (Author's own)

CBF indicators	Abuja	Bangui	Harare	Libreville	Yaoundé
1.Access to DW	4.0	3.0	6.5	5.5	6.78
2.Access to sanitation	9.7	2.76	7	4.8	9.34
4. Secondary WWT	2.14	4.6	6.04	0.0	3.5
5.Tertiary WWT	0.31	0.0	6.04	0.0	0.0
7./8.WWT Nutrient/Energy recovery	0.0/ 0.0	0.0/ 0.0	0.0/ 0.0	0.0/ 0.0	0.0/ 0.0
10.WWT efficiency	0.0	2.0	2.0	0.0	0.0
11. Stormwater separation	10	0.0	10	0.0	0.0
13.Leakage	0.34	8.0	4.3	0.06	8.8
16./17. Solid Waste recycled/energy recovered	0.0/ 0.0	0.0/ 0.0	1.0/ 0.0	2.0/ 0.0	1.0/ 1.0

4.1.3 Common key water-related challenges

Indicator 1: Access to drinking water and Indicator 13: Leakages

Regarding leakages in the water system most of the five cities scored poorly except for Bangui and Yaoundé, scoring an 8 and an 8.8 respectively in the CBF. For the city of Harare, Zimbabwe, leakage, or the percentage of water lost in the distribution system due to leaks, was estimated at 28.5% (Koop and Grison, 2020). It is worth mentioning that for this indicator in the CBF, leakage of more than 50% receives a score of 0.

In the city of Abuja, Nigeria, it was estimated through the CBF that 48.3% of water in the distribution network was lost. Libreville, Gabon, scored close to a zero, meaning that it lost 49.7% of water due to leakage in the distribution system, which means that half of the drinking water supplied to the city was lost due to leakage.

This is especially problematic if one considers that access to drinking water scored relatively low for most of the cities, with only slightly more than 50% of the population having access for Libreville, 65% for Harare and close to 70% for Yaoundé. Abuja and Bangui received very low scores for this indicator, meaning that in the former city 40% of the urban population has access to potable drinking water and only 30% has access in the latter (Koop and Grison, 2020).

To summarise, for Bangui and Yaoundé, leakage does not pose a substantial issue, whereas in Harare, Abuja and Libreville it is a major problem, thus representing a key challenge for most of SSA

cities. The problem of leakage exacerbates the issue of access to drinking water, which is, to varying degrees, a major problem in all the five assessed cities.

Indicator 11: Stormwater separation

Regarding the separation of storm and sewage water, the CBF attributed contrasting scores to the five cities. Abuja and Harare, received a 10, meaning that all storm water sewers and all sanitary or household wastewater sewers are completely separated (Koop and Grison, 2020). However, on the other hand, Bangui and Libreville scored a 0, meaning that all sewage and storm water were combined. No data on this indicator was found for Yaoundé, effectively meaning that also here no storm and sewage water is separated. Although this indicator measures the length of sanitary and storm sewers, it may not be clear how much of the urban area is covered by these, which may be an issue considering recent rapid urbanisation rates (Koop and Grison, 2020). The inadequate separation of storm and sewage water, as well as the urban coverage of sewers may also adversely impact the issue of urban pluvial flooding (Karley, 2009). Thus, in most of the assessed SSA cities stormwater separation is a key challenge.

Indicators 17 & 17: Solid waste recycling and energy recovery

Solid waste recycling and energy recovery is a key challenge in all assessed SSA cities. In Harare, Libreville and Yaoundé a small fraction (10%, 10% and 20% respectively) of solid waste is composted, whereas none is in Abuja or Bangui. In none of the five cities any solid waste is incinerated with energy recovery. This may have detrimental impacts on the wider water cycle, as for example all of this non-recycled waste is simply being dumped on landfills, in which polluted water may leach down into the aquifers or surface water bodies, especially following heavy rains (Mor et al., 2006). Next to ecological impacts, human health may also be affected by this, as many informal waste collectors may be exposed to all kinds of toxic materials (Mor et al., 2006). The extent to which solid waste collection services cover the whole city has not been examined by the CBF, however, in cities as Libreville, it is known that informal settlements are usually not covered by the municipal waste collection services (Mombo and Edou, 2007). Thus, the lack of recycling of solid waste, as well as the dearth of waste incineration with energy recovery, is an indirect key water challenge for SSA cities.

Indicators 4 & 5; 7 & 8 and 10: Wastewater treatment

There is a severe lack of wastewater treatment (WWT) in SSA cities, with Harare the only city scoring above a five, namely a 6.00 for both secondary and tertiary treatment. This implies that 60% of Harare's population is connected to the WWT plant which employs secondary and tertiary treatment (Koop and Grison, 2020). In Abuja, Bangui and Yaoundé, only about 21%, 46% and 35% of the total urban population respectively, are connected to a WWT plant employing secondary treatment. From these, apart from Abuja serving 3% of its population with tertiary treatment, none are equipped with tertiary treatment (Koop and Grison, 2020). Libreville received a score of 0 for all WWT related indicators, as the city has no formal WWT plant serving its wider population. Apart from Bangui and Harare, whom both scored a 2 for WWT energy efficiency (indicator 10), all other three cities scored a 0 (no data available for Yaoundé). None of the WWT plants of the five SSA cities recover any energy or nutrients (indicators 7 & 8). That apart from Harare, in most SSA cities, household and other wastewater is discharged without treatment back into the environment, is a major water challenge.

Common results for Trends and Pressures Framework

The Trends and Pressures Framework revealed that there is a high burden of disease in the five assessed cities, except for Yaoundé, where this is less pronounced. The education rate was found to be quite low for all the five cities, meaning that in Harare the completion rate for children of primary school age was at 88%, one of the highest numbers of the five cities (Koop and Grison, 2020). The

urbanisation rate is high for all the five cities, especially for Abuja (Koop and Grison, 2020). Urban drainage flooding, translating to the percentage of urban soil sealing coverage, was found to be high in Bangui, Libreville and Yaoundé, with 60%, 60% and 70% of soil sealing coverage respectively (Koop and Grison, 2020). According to the TPF, surface water quality is only a slight issue in Abuja, Bangui and Harare, yet a significant issue in Libreville and Yaoundé, in which both were found to have a national surface water quality index score of 42% and 11% respectively (Koop and Grison, 2020). Economic pressures were significant in all five cities, meaning they all have a low GDP per capita (Koop and Grison, 2020). The poverty rate was most significant in Abuja and Bangui, where 50% and 60% respectively of the national population, lives on less than 1.9 USD a day (Koop and Grison, 2020). In Zimbabwe it was at 20% and in Gabon and Cameroon at 3% and 5% respectively (Koop and Grison, 2020). The political related indicators (19, 20, 21, 22, 23 and 24) were found to pose the most significant pressure for Bangui, somewhat significant pressure for Abuja and Harare and moderate pressure for Libreville and Yaoundé, except for voice and accountability (indicator 19) political stability (indicator 20) and government effectiveness (indicator 21), which were problematic for the latter city (Koop and Grison, 2020).

4.2 *The enabling and limiting conditions of the Governance Capacity Framework for addressing urban water pollution in Libreville, Gabon*

To address the question about the strengths and weaknesses of urban water governance in Gabon, each of the eight governance conditions are provided. The results of this conditions are depicted in figure 19 below. The introduction of the study area and detailed score substantiations of each indicator, are included in appendix 1.

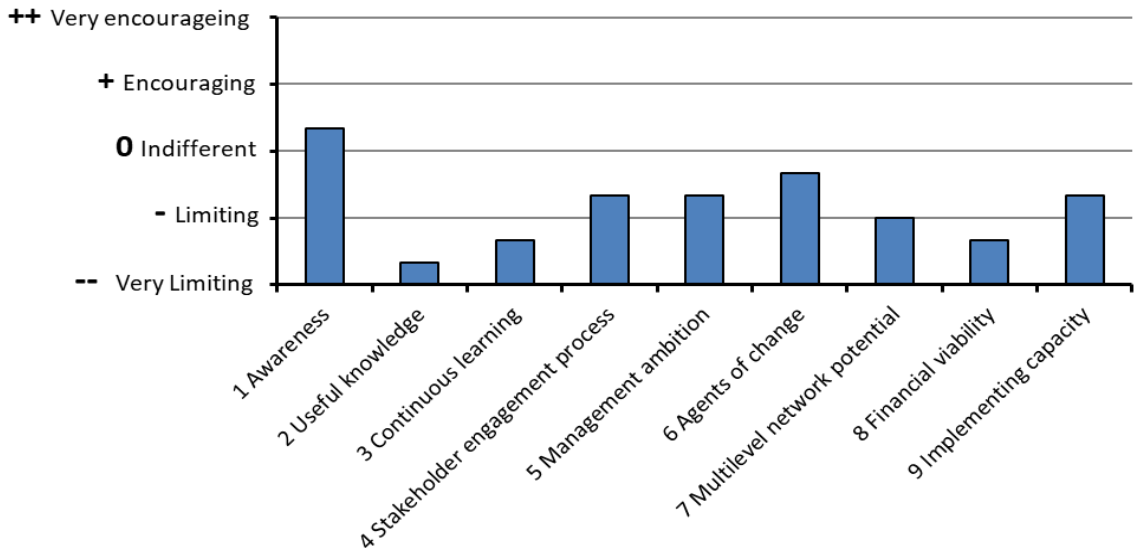


Figure 18: Bar chart of nine GFC conditions

Condition 1: Awareness

Knowledge regarding the current and future risks surrounding the issues of water pollution are generally underestimated by the communities and stakeholders in Libreville (indicator 1.1: neutral (**0**) contribution to the capacity to govern water pollution). Most people within the general population seem to know the basic health-related risks of consuming improper water (interviewee 5). However, the wider, more specific risks of water pollution to the environment are not known or considered, let alone the future risks such as environmental degradation and its indirect consequences on the economy, such as fishing. Although polluted surface waters in the city can be clearly perceived through olfactory as well as visionary senses, the general sense of urgency to address such problems seems relatively small (indicator 1.2: encouraging (**+**) contribution). It seems that although the general population does not voluntarily throw their waste into the environment, it often does not have any other choice of behaviour as rubbish bins are scarce and overflowing (interviewee 1). Thus, it is quite common for households and small businesses to discharge solid or liquid waste into juxtaposed water bodies interviewee 1, 5 and 8). This is a main source of water, soil and food contamination. Most stakeholders are aware of this, however, there are only small changes in actions and behaviour in response (indicator 1.3: exploration (**0**)).

Condition 2: Useful knowledge

There is a severe lack of data available on water pollution and its causes and related issues (indicator 2.1: very limiting (**--**) contribution to the capacity to govern water pollution; Binga, ND; Interviewee 4). The little information that is readily accessible online on the topics of water pollution is extremely difficult to access by the wider public and may to a lesser extent be challenging to comprehend for non-experts (indicator 2.2: very limiting (**--**) contribution), as it is usually in the form of scientific papers, reports or grey literature (Mombo and Edou, 2007; Republique Gabonaise, 2015). Acquiring information about sanitation and wastewater treatment provides substantial barriers. First of all, transparency about which information is available is not readily available through public communication challenges. Second, most reports are only available on request and may take a long time to arrive. Information found on such matters is usually sector specific and very rarely shared between ministries (indicator 2.3: limiting (**-**) contribution). As such, different methods of producing information are rarely shared, as for example the ministry of mines who is equipped with analysis laboratories, seldom lends their equipment or laboratories to other ministries or academics which the latter do not possess (interviewee 4).

Condition 3: Continuous learning

There are no measures in place which systematically gather data on surface or groundwater bodies, as well as domestic and industrial wastewater throughout the city, except for drinking water supply quality management in the supply station (interviewee 6 and 7). A smart monitoring system in which real time measurements are taken at multiple locations in the city is missing (indicator 3.1: very limiting (--) contribution to the capacity to govern water pollution). For example, the city of Bristol in the UK, has multiple measuring station across the city and all of the data are automatically relayed to a central data base through the internet, making it possible to see daily changes in surface water quality (Chen & Wan, 2018).

With such a smart monitoring system in place, especially underlying trends such as groundwater acidification and contamination of heavy metals (Ondo, 2011) from garages, food or chemical companies and hospitals in Libreville may be identified. Accordingly, eutrophication and algal blooms and its environmental impacts on water pollution are relatively unknown (interviewee 8). Without a consistent monitoring system in place throughout the city it is quite challenging to evaluate whether policies aiming at reducing water pollution work or not and how they can be made more effective (indicator 3.2: limiting (**-**) contribution). Hence, without a monitoring system in place it is

difficult to consistently evaluate the effectiveness of policies and regulations that aim to reduce water pollution (interviewee 4 and 6). With respect to addressing water pollution in Libreville, there is little collaboration between different relevant stakeholders, such as between the municipality and the ministry of water and energy or that of the environment (indicator 3.3: limiting (-) contribution). In fact, top-down the government legislation and priorities do not always align with local water pollution challenges that municipalities and communities face (interviewee, 7; Allogho, 2006).

Condition 4: Stakeholder Engagement Process

Some stakeholders, such as NGOs or affected communities, are consulted before new water pollution or sanitation related projects are initiated. However, various local experts (interviewee 4, 5 and 7) representing different interests all indicate that there are no clear procedures for stakeholder participation and stakeholders usually have low influence on the outcomes of the decisions made and if they are included, they get involved at a late stage in the decision-making process (indicator 4.1: limiting (-) contribution to the capacity to govern water pollution). As a result, many projects are developed without active engagement or efforts to align with local stakeholders, which can impede effective project implementation (UNDP 2008; Glucker et al. 2013; OECD, 2015; interviewee 9). Thus, it seems that stakeholders' core values, such as livelihoods or key business interests are not optimally protected throughout the stakeholder engagement process (indicator 4.2: neutral (0) contribution). Key reason cannot be attributed to a lack of goodwill, yet is rather a result of weakly defined engagement procedures that are not consistently applied (Allogho, 2006; interviewee 1 and 4). In addition to community-based engagement, private actors like Veolia or Averda have had disputes with the government about payments (Takoleu, 2019). No clear examples of transparent and realistic exit procedures in the stakeholder consultation processes are found. Accordingly, no clear examples have been observed that indicate that a variety of alternatives are co-created with stakeholders to address water pollution related projects (indicator 4.3: limiting (-) contribution).

Condition 5: Management ambition

In Gabon there are rather ambitious goals concerning the mitigation of water pollution, sanitation and to a lesser extent wastewater treatment (indicator 5.1: limiting (-) contribution to the capacity to govern water pollution). However, these overarching objectives are not consistently supported by short-term targets. For example, one long-term vision in the Strategic Plan for an Emerging Gabon seeks to provide access to improved sanitation for everyone by 2025 (Republique Gabonaise, 2011). 'Action 13' and Objective 19 in the Strategic Plan for an Emerging Gabon (Republique Gabonaise, 2011) draw on 'the fight against pollution and nuisances' and mention that water should be addressed in anti-pollution efforts, yet it is not specified how this will be done in practice (Republique Gabonaise, 2012).

However, it is hardly specified how that can be achieved in relation to the fact that only about half of the city's population has access to improved sanitation, especially in the poorer informal settlements of the city where archaic pit latrines are still commonly used (Mombo & Edou, 2007; Chaignaud, 2008). Short-term targets, such as providing improved sanitation facilities and solid as well as liquid waste collection services to all informal settlements of Libreville by 2025 could be implemented. Policies aimed at reducing water pollution do not formally address the informal settlements of Libreville in more case tailored efforts, (indicator 5.2: limiting (-) contribution) taking the socio-economic and cultural characteristics of these areas into account (interviewee 4 and 7). Such informal settlements like the *bas-fonds* are often located in drainage basins and inhabited by mostly poorer people or recent immigrants from rural areas (Mboumba, 2007). These neighbourhoods experience especially severe water pollution as most domestic solid and all liquid waste ends in the adjacent watersheds which poses a major health threat due to flooding during the rainy season (Mombo and Edou, 2007). Because these policies are not coherent across geographic boundaries and

as there often is a dysfunction between technicians who depend on the central administrations and the local policies of municipalities (interviewee 8 and 9), policies are also insufficiently aligned according to different governmental levels (indicator 5.3: neutral (**0**) contribution).

Condition 6: Agents of Change

Through community representatives, it may be possible for communities to somewhat influence decision-making (indicator 6.1: neutral (**0**) contribution to the capacity to govern water pollution) Entrepreneurial individuals may seek opportunities with NGOs and in some cases with officials from the mayor's office, local political leaders or even the media, who may then transmit messages further to the 'top' (interviewee 1 and 10). Next to such collaborations, there are also novel collaborations between young people who volunteer and assemble to improve sanitation efforts (Provost, 2009; indicator 6.2: neutral (**0**) contribution). There are some visionary agents of change (indicator 6.3: neutral (**0**) contribution) such as the mayor of the Libreville, the general directorate of the technical services to the environment and urban amenities, or the minister of water and energy and even the prime minister, who put forth long-term visions on sanitation.

Condition 7: Multi-level network potential

In theory, actors within the civil society are not allowed to just take the decision in their own hands of managing their wastewater (interviewee 9). In practice, however, there are community sanitation initiatives, who work with NGOS who listen to and help the former (interviewee 10), as well as private beverage companies and some hotels and hospitals, who have autonomously built their own onsite wastewater treatment facilities, which is tolerated by the government (indicator 7.1: limiting (**-**) contribution to the capacity to govern water pollution). A major impediment for effectively addressing water pollution issues in Libreville, is the unclear division of responsibilities as to who must do what regarding water pollution (indicator 7.2: very limiting (**--**) contribution). A great deal of informants stressed that responsibilities are unclear and competences between various ministries often overlap (interviewee 4, 6, 7, 8 and 9). For example within the ministry of the environment, both the General Directorate for the Environment and the Protection of Nature (DGEPN) and the ministry of health's institute for Public Hygiene and Sanitation (IHPA) carry out controls of surface water quality and deal with complaints (Interviewee 9, 2020; Gabonese Republic, 2005). This also hampers the authority to ensure the implementation and compliance (indicator 7.3: neutral (0) contribution) of adequate anti-pollution control measures in practice. Because the planned water code is not yet in place, it is not clear who may ensure compliance, or what penalties may be applied in case of infractions (interviewee 6 and 9). On the other hand, it is not known whether private actors as the beverage company Sobraga received subsidies from the state for constructing their own on-site waste-water treatment facilities.

Condition 8: Financial viability

There is limited affordability and availability of sanitation services (indicator 8.1: limiting (-) contribution to the capacity to govern water pollution), as the informal neighbourhoods of Libreville rely on shared pit latrines and septic tanks, because standard toilets are often unaffordable and unavailable (interviewee 6). Wastewater treatment services on the other hand are simply inexistent. Most communities are willing to pay for the sanitation of the environment (indicator 8.2: limiting (**-**) contribution). However, they may not always have access or the financial resources to afford such services (interviewee 8 and 10). Overall, there is a severe lack of financial arrangements to secure long-term anti water pollution policy implementation and risk reduction (indicator 8.3: very limiting (**--**) contribution), since the state budget is struggling to address the water quality goals (interviewee 6 and 8). Numerous public-private-partnerships between state utilities and private companies have collapsed due to termination of funding from the Gabonese state, such as the rupture between the SEEG and Veolia contract (interviewee 4; Reuters, 2018).

Condition 9: Implementing capacity

Implementing capacity is considerably lacking in Libreville as for example policy instruments such as the polluter pays principle are seldom used in practice (indicator 9.1: limiting (-) contribution to the capacity to govern water pollution). The polluter pays principle does exist, however, whether it is applied in practice remains questionable (interviewee 9). Due to unclear division of responsibilities, as well as incomplete legislation regarding water quality control, statutory compliance of wastewater discharge from industries is insufficient (interviewee 3 and 9). Thus, there is only moderate compliance to existing legislation in the capital (indicator 9.2: limiting (-) contribution) which leads to much uncontrolled and unknown water pollution. There are laws in place for industries to have their own action plans (indicator 9.3: neutral (**0**) contribution) to prevent polluting accidents (interviewee 2). However, there are no action plans to target gradual diffuse pollution, as this is mostly a symptom of uncontrolled urban development.

Synthesis

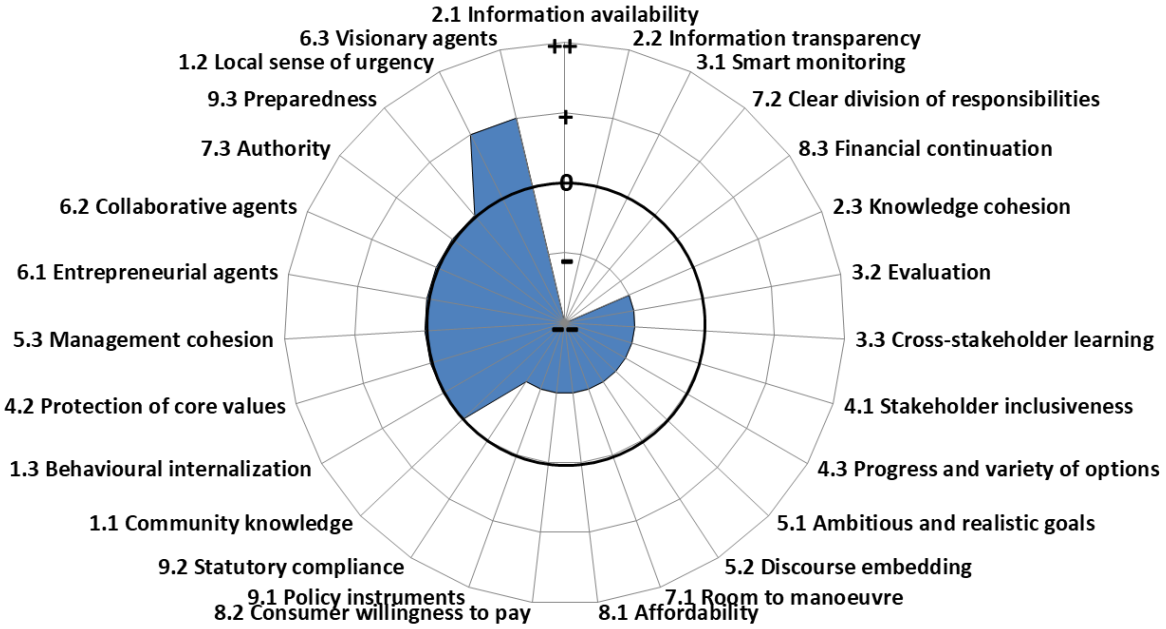


Figure 19: Spider diagram of GFC results of all indicators

In the context of climate change and urban growth, water pollution issues are likely to play a more decisive role in Libreville's near future social and economic development. The issues hampering the capacity of stakeholders and authorities to together govern water pollution challenges are highly inter-related.

Without a consistent water quality monitoring system (indicator 3.1) in place throughout the city, it is challenging to know what is going on the system, to determine where most pollution sources originate and test what can be done to stem these. Because there is a lack of data and information on water pollution (indicator 2.1) as well as no monitoring system in place (indicator 3.1), it is also difficult for the relevant institutions to know which policies have to implemented where (condition 5), which policy instruments have to be applied (indicator 9.1), and how to evaluate if they work or not (indicator 3.2). Moreover, it is challenging to prepare action plans for sudden pollution incidents or gradual increases in water pollution (indicator 9.3) or determine who complies or does not (indicator 9.2), without a comprehensive monitoring system in place. Hence, insufficient monitoring of water

pollution, both domestic and industrial, directly inhibits statutory compliance (indicator 9.2) and evaluation and improvement of policies (indicator 3.2) and existing policy instruments (indicator 9.1). A lack of financial arrangements (indicator 8.3) and human capacities are also a major barrier to mitigating water pollution in the city. Not only could further financial arrangements help secure an efficient smart water quality monitoring system (indicator 3.1), but help with the construction of a separate sewage network and wastewater treatment facilities. The continuation of financial arrangements (8.3) might also help secure the completion of projects aiming at reducing water pollution. In addition to this, the fragmented policies (indicator 5.1) on wastewater treatment, sanitation and water pollution, hamper a clear division of responsibilities (indicator 7.2), as to who must do what in practice regarding the mitigation of these issues. The ministry of water and energy, the ministry of the environment, the ministry of health and the ministry of public works all work on the issues of water pollution, more explicitly sanitation, yet some seem to have similar functions as others. For example, both the ministry of the environment and the ministry of public health check water quality and may sanction. However, the ministry of water and energy, which also may control water quality and is involved in sanitation efforts, cannot ensure compliance with pollution regulation. Thus, an unclear division of responsibilities also makes sanctioning (indicator 7.3) more difficult and facilities statutory incompliance (indicator 9.2).

A water code, in which competencies as well as the concepts of sanitation and wastewater treatment would be clearly defined, could help resolve issues of overlapping function and unclear division of responsibilities (indicator 7.2), as well as clarify authority to sanction (indicator 7.3). Next to this, an independent regulatory organisation could check the work of these institutions and organise regular meetings between officials of these institutions, or create a communication platform between them. In this way, information between the relevant institutions could be shared improving cross-stakeholder capacity building (indicator 3.3) and make information accessible to the public enhancing information availability (indicator 2.1). However, in order to address water pollution issues in Libreville, the most beneficial step for the long term is the implementation of a smart water quality monitoring system (indicator 3.1). Consequently, a monitoring system and a larger amount of available information (indicator 2.1) on water quality would make foreign investment into addressing these issues more attractive as a return on investments would be secure. Hence, this would strengthen financial continuation (indicator 8.3) for projects aiming at addressing water quality and investment in hard infrastructure as well as the education of professionals in the field. Secondly, a water code with new laws and short-term policy goals would be beneficial at guiding the work of institutions in charge of addressing water pollution by clearly identifying their responsibilities (indicator 7.2) and authority (indicator 7.3). Dividing (institutional/organisational) responsibilities clearly, would be the most beneficial step in the short term, so tasks can be clearly defined and prioritised without overlapping each other. Third, a regulatory organisation could help improve communication between ministries and evaluate their efforts as well as new policies in place. Fourth, regular meetings organised between this regulatory body, the relevant institutions, municipalities, NGOs and the private sector may serve to improve stakeholder inclusiveness and protection of core values (indicator 4.1; 4.3), as well as even alter the behaviour of stakeholders (indicator 1.3).

4.3 Why the CBA can be practically deployed to support investment decisions and how it may be tweaked to the local SSA context?

In order to determine how the CBA frameworks may be tailored to help development organisations invest in local water related projects in urban SSA, first the conditions needed to make investment decisions have to be identified. Thus, a brief literature review is conducted identifying the key conditions necessary for making investment decisions, particularly in the case of development banks investing in developing countries. The case of the African Development Bank is subsequently illustrated as an example, before it is elucidated how the CBA frameworks may be used to make considerate investment decisions. Once the value of these frameworks should have become clear, various propositions based on the interviews with fellow UNESCO young professionals from SSA who applied these, are made to adjust the methodologies and make them easier to deploy in practice in the wider region.

4.3.1 Key conditions to make investment decisions

The most significant body of knowledge on investment decisions comes from finance which looks at how capital markets and financial analysis influences investment decisions (Stewart et al., 2009; Pike et al., 2006). Alkaraan and Northcott (2006) go on to mention that decision-making usually follows a 'rational' model-based analysis. However, within the literature on organizational decision-making, it follows that major investment decisions are messy, iterative and only part 'rational' (Alkaraan and Northcott, 2006). What most authors and theories agree on is that such choices are based on data and deal with the analysis of uncertainty and risk (Alkaraan and Northcott, 2006; Pike et al., 2006). In the case of investment projects, gathering enough data and information are essential criteria needing to be satisfied before investments can be made (Pike et al., 2006; Samorodov et al., 2014; Huang and Pearce, 2015). This makes sense, if one considers the main goal of making the highest return on investments. In order to judge investment project efficiency, a first stage usually consists of formulating the business idea and then evaluating the feasibility of the project's implementation within the targeted financial, marketing, juridical and social context (Samorodov et al., 2014). Naturally there are many tools, indicators or frameworks to evaluate a project's efficiency, such as a simple cost-benefit analysis, however, these usually weigh the financial expenses against gains, yet do not tell us much about which key conditions are needed to take investment decision in the first place.

The Global Investment Competitiveness report by the World Bank (2020) is a good start to investigate the key conditions needed for investment decisions in developing countries. Based on a survey interviewing 754 executives of multinational corporations investing in developing countries, it found out what matters to investors investing in developing countries. The main conclusions are that political stability, security, macroeconomic conditions and a sound business, legal and regulatory environment are key drivers of investment decisions (World Bank, 2020). Specifically, decisions are shaped by Risk-Return calculations where investors consider a broad range of factors in their decisions such as domestic market size and stability, exchange rate, labour force and skills, as well as physical infrastructure (World Bank, 2020). These results, as well as the ways in which such necessary conditions may be measured are illustrated in the table 7 below.

Table 7: Key investment conditions (authors own)

Conditions needed	How this is measured
Political stability	Worldwide Governance Indicators
Security	Worldwide Governance Indicators
Macroeconomic conditions	GDP/GNP
Market size/stability	Market Potential Index
Sound legal/regulatory environment	Worldwide Governance Indicators
Labour force and skills	Unemployment rate/Labour Force Participation rate/Education rate
Quality of national statistics and data	Government reports, academic literature, etc.

The survey found that especially political stability and environments without strict regulation on foreign business activity in the host country or investment freedom, are most important to investors' decision-making (World Bank, 2020). On the other hand, macroeconomic, political, and regulatory risks—whether actual or perceived—deter investors (World Bank, 2020). These findings complement existing literature stating that stable political and regulatory friendly environments are necessary to mitigate risk (English and Mule, 1996; Gatti, 2012). According to the survey results, the most significant political risks consisted of; lack of transparency and predictability in dealing with public agencies, sudden change in the laws and regulations with a negative impact on the company, delays in obtaining necessary government permits and approvals to start or operate a business, restrictions in the ability to transfer and convert currency, breach of contract by the government (World Bank, 2020).

On the contrary, 'pull' factors to lure in investments entailed; transparency and predictability in the conduct of public agencies, investment protection guarantees provided in the countries laws, ease of obtaining government approvals to start business and to own all equity in the company and investment incentives such as tax free days and predictability and efficiency in the laws and regulations (World Bank, 2020). These results echo the literature discussing attractive investment conditions (Echandi et al., 2015). However, at the same time, the survey has not mentioned whether 'gut feeling' or intuition plays a role, which is an important factor that investors consider when data is lacking (Huang and Pearce, 2015). In the context of development banks or organisations, however, what else is necessary to the formulation of investment choices?

4.3.2 Loan process of the African Development Bank

As previously mentioned, the reduction of risk when making an investment is paramount (Grundy and Johnson, 1993, Klos et al., 2004), which also holds for development banks (Mostofi-Zadeh and Niknam, 2011; World Bank, 2020). Development banks differ from traditional banks in the sense that financial profitability is not always their main motive and that development is (English and Mule 1996; Mostofi-Zadeh and Niknam, 2011; World Bank, 2018). This implies that such banks use different criteria transcending standard financial measures. Some of these non-financial criteria may include 'patient capital' or 'venture philantropy', the former implying not to take a full return on investment and the latter aiming to build the core capacities of the funded organisations (Kingston and Bolton, 2004). An example of such a development bank may be considered by scrutinising the loan process of the African Development Bank (AfDB). Before the AfDB chooses to finance a project, it reviews a country's economy, particularly its national and sector development programmes and then forecasts whether the project is in line with the sustainable development goals of the AfDB, and whether it has a positive

impact on the host society, economy or ecosystem (AfDB, 2006). When the AfDB chooses projects to invest in, these projects have to pursue clearly defined objectives that are in line with the AfDB' strategic goals such as sustainable economic goals; execution based on the least cost technical solution; time-bound delivery of benefits; and in the case of project loans - financial viability (AfDB, 2006). According to the AfDB (2006) financial viability is defined by the ability of a project to replicate itself, to finance day-to-day operations and maintenance, and to service its debt. The AfDB chooses investment projects with financial analysts to receive detailed knowledge of the institutions that will be used during implementation and for the future operations (AfDB, 2006). Broadly, the AfDB conducts financial appraisals of Executing Agency's and Implementing Agencies to determine whether such institutions are technically, managerially and financially capable of efficiently and effectively implementing proposed projects (AfDB, 2006). Then risk assessments of the projects are held, in which institutional and organizational aspects, funds flow, and audit arrangements are looked at (AfDB, 2006). Before a project may be prepared, the AfDB must satisfy itself as to (i) the project's technical, financial and economic viability against the background of national, sectoral and local needs for the investment; (ii) the economic and financial justification for the proposed output(s); (iii) project and/or entity sustainability; (iv) the extent of its contribution to human and technological advancement; and (v) governance aspects of the project (AfDB, 2006).

According to the book *Politics and the African Development Bank* (Mingst, 2014), projects financed by the AfDB come into life following a specific procedure in most cases. The AfDB is presented a proposal illustrating the nature of the project and its, technical, financial and economic viability. However, this is a simplistic view, as often projects are even mutually negotiated between host governments, the World Bank and AfDB officials (Mingst, 2014). Countries requesting a loan need to complete a pre-investment survey when applying. Based on the country's economic priorities and the AfDB' sectoral lending programme the Bank develops a project pipeline for the following three to four years and a feasibility study is conducted (Mingst, 2014). The pipeline is a list of projects, prioritised by the governments that the Bank is considering to fund. Around 40% of the projects are eventually dropped by the government due to changes in priorities or being taken up by other development agencies (Mingst, 2014).

In the subsequent phase, the Bank recommends the project for appraisal. An appraisal team of several AfDB officials (economic and technical) travel to the country to visit government officials and gather data for the appraisal report. In such an appraisal report the technical, financial and economic viability is tested, using indicators such as the economic rate of return calculating expenses versus profits. However, sometimes no economic rates of return are calculated because the project was aimed at improving a whole sector (Mingst, 2014). In some cases, the statistical information may be of such poor quality that even 'guess-estimates' of an economic rate of return are impossible to make, leading to some officials questioning such indicators as they need a certain degree of technical competence not always possible if statistical information is lacking (Mingst, 2014).

If the appraisal report is positive, meaning that if the technical, economic, and financial viability standards have been met, then a working group is established in preparation for the meeting with the loan committee (MIngst, 2014). The loan committee determines which political conditions are necessary for a project's success before it may be approved. Once approved, the Bank invites the borrower to participate in negotiations for the loan (Mingst, 2014). In order to receive funds, the borrowers must provide sufficient documentation to assure the bank that they will be able to meet loan conditions (AfDb, 2009; Mingst, 2014). Once an agreement has been reached, the appraisal report is submitted to the executive board for final approval (Mingst, 2014). Prior to disbursing the funds specific conditions must be met, such as provision of necessary documentation and a stable political environment (Mingst, 2014, World Bank, 2020). In the case of water-related projects in SSA,

this process could be sped up by using the CBA assessment tools to acquire relevant data on whether such loan conditions are met and where investments need to be prioritised.

4.3.3 How the City Blueprint Approach can inform water investment decisions

The City Blueprint Approach can be used as a valuable tool to assist project appraisal by development banks through numerous ways bearing in mind the key conditions necessary for such investment decisions as outlined in table 7 above (Feingold et al., 2018; Rahmasarya, 2019). Regarding political stability, the Trends and Pressures Framework may be especially useful by using its indicator 4 measuring political stability. Macroeconomic conditions may be evaluated though the TPF's indicators 9 on economic pressure, 11 poverty rate and 12 on inflation rate (Koop and van Leeuwen, 2020a). Labour force and social conditions are assessed through this framework by looking at the first three indicators of urbanisation rate, burden of disease and education rate as well as indicator 10 on unemployment rate. Additionally, one may also rapidly be able to determine whether a project is affected by water scarcity (indicator 5) or is vulnerable to flood risk (indicator 6) (Koop and van Leeuwen, 2020a).

Regarding the financing of water projects not only the TPF, but also the City Blueprint and Governance Capacity Frameworks can be used to facilitate investment decisions. For example, when assessing physical infrastructure, the City Blueprint may be beneficial as it analyses whether a city is equipped with wastewater treatment facilities (indicators 4 and 5), if access and quality of drinking water standards that a water utility has to comply with are met (indicators 1 and 3) and whether the city is adapted to climate change through its indicators 18 on green spaces, 19 on climate adaptation and 21 on climate-robust buildings (Koop and van Leeuwen, 2020b). The CBF can also determine the state of water infrastructures such as by measuring the efficiency of wastewater treatment plants (category IV) and more specifically the indicators 11, 12, 14 and 18 on stormwater separation, average age of sewers, water system leakages and operation cost recovery (Koop and van Leeuwen, 2020b). Through applying this analysis, a relatively rapid assessment of a city's Integrated Water Management capacity can be done, clearly showing which areas need improvement or require investments. In order to assess the feasibility of a water project aiming at enhancing IWRM in a certain city, the CBF can also provide examples of other cities which have successfully tackled a certain water issue and can be used as source of inspiration. If a project seeks to improve access to drinking water in a city, it may examine the results of other CBFs in the region and see which city(s) does this successfully and why, thus informing their own project goals. Both the CBF and the TPF, do not require a great deal of technical competencies, which may address the issue of certain development bank officials whom criticised the use of indicators technically complex indicators (Mingst, 2014).

Regarding, the Governance Capacity Framework (GCF), it can be used to support investment decisions by analysing institutional capacities (indicator 7.2), regulatory environment (indicators 7.3 and 9.2), legal frameworks (indicator 5.1), policies and policy instruments (indicators 5.2; 5.3 and 9.1) all of which are areas examined prior to making an investment (World Bank, 2020). Because a key condition deterring a potential investment is political risk and institutional inadequacies (World Bank, 2018), the GCF is particularly suitable as it evaluates cooperation and division of responsibilities between different institutions (indicator 3.3), as well the policy instruments implemented (indicator 9.1) and the degree to which laws are complied to (indicator 9.1). Considering the economic and financial justification for the proposed project output(s) of the AfDB mentioned above, such as the extent of its contribution to human and technological advancement, as well as governance aspects of the project (AfDB, 2006), the GFC may adequately measure these non-financial aspects development banks often seek to improve. Evaluating water governance and human capacities is challenging (Vallejo and Wehn, 2016; Koop et al., 2017), however, the GFC may do this by evaluating the public

level of knowledge and behaviour vis-à-vis a certain water related issue (indicators 1.1; 1.2 and 1.3), as well as the community participation (condition 4) and information availability and transparency (indicators 2.1 and 2.2). In order to satisfy good governance conditions (Lautze et al., 2011) and long-term implementation of the project, the participation of all stakeholders and reliable financial continuation are necessary for project implementation (Reed, 2008). The GCF is a reliable tool for measuring the implementation in practice of a project, as it assesses stakeholder inclusion, cooperation, protection of core values (indicators 4.1; 4.2 and 4.3).

4.3.4 Methodological alterations for the deployment of the CBA in the SSA context

However, in the GCF some indicators may be less useful than others for aiding investment decisions in a SSA context. Thus, indicators that do not coincide with the areas potential investors want to assess, could simply be omitted. The whole framework comprises 27 indicators, even by removing just three the scoring process is less time consuming. To facilitate the implementation of these frameworks in practice, some methodological revisions have been made based on the interviews with the young professionals whom applied these in the SSA cities.

Regarding the CBF, it seemed that all indicators should be kept as they were unanimously deemed as salient (interviewees 1,2,3,4 and & 6). However, although all indicators are important, some additional indicators may be added when applying this framework to the developmental context. The percentage of green spaces (CBF indicator 18) is valuable to know in regard to alleviating the heat island effect and dampening runoff of floods (Krellenberg et al., 2013), yet at the same time the portion of informal settlements compared to the total urban area may be more relevant to know in a SSA context. This ratio can be easily determined using the UN-Habitat data made available by the World Bank (World Bank, 2018). In the developing world, it is important to determine the urban ratio of informal settlements, as in these areas access to drinking water and sanitation, as well as coverage of wastewater and solid waste treatment services are low (Douglas et al., 2008). Next to this the urban areas covered by formal sanitation and waste collection services could also be indirectly measured, as in these areas such services, are often lacking (Douglas et al., 2008; Arimah and Branch, 2011; Dos Santos et al., 2018). By doing this, one could not only determine the total percentage of the population without access to sanitation, drinking or solid wate collection, but also where these areas are located and thus knowing the specific geographical areas where to invest in.

Some interviewees (interviewees 1 and 2) stated that certain indicators of the CBF may be merged in to one, such as all four indicators in category IV Wastewater treatment (indicators; 10 nutrient recovery; 11 energy recovery; 12 sewage sludge recycling and 13 WWT energy efficiency) may be either omitted completely or renamed as one indicator: recovery of wastewater products (interviewee 2). As these WWT related indicators scored very low for all five cities it makes sense to merge them in to one in order to save time.

Regarding the GCF, as mentioned above a great deal of indicators can inform investment decisions, however, some indicators have not matched the conditions needed for investment decisions outlined above. Although assessing whether there are individuals being able to support visions striving to improve water challenges (condition 6) is highly important for measuring leadership, knowing this, however, may be less relevant for development banks seeking to improve water capacities as none of the conditions identified above seek to evaluate leadership per se. The point here is not to take out indicators such as '*visionary agents'* or '*green spaces*' from the frameworks, but to clarify that certain indicators may be comparatively less relevant in the context of a specific investment project and thus can be omitted to save time and effort. Next to revising the methodology of the assessment frameworks, some practical recommendations can be made to facilitate the deployment of these for the SSA context.

4.3.5 Practical recommendations for the deployment of the CBA in the SSA context

Following the interviews with fellow UNESCO students whom applied the City Blueprint Approach frameworks (mostly the CBF and to some the TPF and GCF) in cities of sub-Saharan Africa, some common practical difficulties arose. What stood out was the difficulty in finding reliable, up to date and relevant data to score the indicators which was a difficulty that all students expressed (interviewee 11, 12, 13, 14, 15 &,16). Many indicators had to be scored using outdated data as nothing else was available. Half of the respondents mentioned that information had to be requested from officials in the relevant organisations/institutions as it was not publicly available on the internet (interviewees 12, 13 and & 15). Multiple interviewees shared the opinion that in order to adapt the City Blueprint to the SSA context and overcome such issues of insufficient data, it is recommendable to put less emphasis on the preliminary literature study in order to allocate more time to undertaking interviews with relevant officials (interviewee 12, 14 & 16). These interviewees (12, 14 & 16), stressed the fact that because so little data was available online, as well as most of the relevant data in the hands of certain officials, the emphasis should be directed toward interviewing these individuals. This finding coincides with the results of the previous literature review in which it was found that officials of the AfDB or private consultants, need to conduct onsite evaluations in the countries applying for a loan (Mingst, 2014). In addition to emphasising interviews over literature study, the stakeholders selected for interviewing could be asked to provide relevant documents prior to the interviews. As the stakeholders have more information on the water challenge, they will also possess key reports, papers or data on the matters. Several students (interviewees 11, 13 & 16), however, shared the opinion that certain stakeholders were reluctant to share documents or reply to emails. Thus, especially for the SSA context, individuals seeking to contact relevant stakeholders for the analyses may need to visit the institutions or organisations in person. Documents may also be requested during the interviews by asking for examples substantiating certain answers. This has two valuable implications. On the one hand, additional literature is provided which may also help to score other indicators. On the other hand, concrete evidence is delivered, enhancing the validity of certain answers.

Simplified questionnaires to the respondents, especially regarding the GCF, is also a key recommendation some students made to simplify such assessments (11 & 12). Specifically, that simplified questions tailored to the interviewees background and expertise may be posed. For example, regarding the GFC, indicator 2.3 '*Knowledge cohesion*' asks the predefined question; **'***To what extent is information cohesive in terms of using, producing and sharing different kinds of information, usage of different methods and integration of short-term targets and long-term goals amongst different policy fields and stakeholders in order to deal with the water challenge?*'. This question may be simplified as; '*to what extent is information on the water related issue shared between various stakeholders?*'. Apart from the interview questions being simplified, so may the indicator score substantiations, especially for the GCF. This is because qualitative governance indicators are by definition complex (Lautze et al., 2013), thus need to be simplified by future users in order to be understood in layman's terms.

Thus, in order to simplify the predefined questionnaire, the young professionals assigned with conducting the CBF or GCF should be given a week to conduct a pre-draft to score the indicators based on the literature study, and then have an online meeting with an employee of KWR, the organization which created these assessment tools, in which the current student will propose his or her adjusted predefined questions. Then another week should be given to finish the literature study before the interviews may commence. This way, valuable time doing desk research could be limited and more time may also be allocated to the field research, as well as any queries regarding the indicators may be resolved. Moreover, by conducting a brief online meeting between a researcher at KWR and an

individual employing one of these frameworks, questions regarding the other recommendations such as, merging or omitting indicators, seeking data for certain indicators when it is unavailable or any other practical issues, may be asked. This way, the coherence in the application of the frameworks is ensured.

For more data to be provided on the indicators measured by the CBA, these frameworks should be made accessible to local universities across SSA. This way local students can provide further data by applying these in their host cities and publicise the data online with the help of KWR. This way anyone, including officials from development banks, may use that data synthesized on an online to inform their own investment decisions.

5. Discussion

5.1 Key water related challenges in SSA

One may see through the table 4 in the above results section 5.1 that most cities score relatively low on access to drinking water and to a lesser extent sanitation, as well as water system leakage and stormwater separation. What is especially striking is that all WWT related indicators score very low for all assessed cities, especially nutrient and energy recovery. WWT is a ubiquitous problem for most SSA countries and cities, with for example in Addis Ababa, the capital of Ethiopia, the municipal WWT plant only serving about 13.000 people of its 2.7 million inhabitants (Wan et al., 2013). Additionally, it was found that in Burkina Faso, Ghana and Senegal, less than 5L per person per day of wastewater is being treated by WWT plants, compared to a ratio of 63L per day per person in Tunisia (Nikiema et al., 2011). One may see a stark difference in WWT between North Africa and SSA, for example that in Tunisia and Algeria more than 80% of the population is connected by the sewer network (Nikiema et al., 2011). All the assessed cities scored a 0 on WWT nutrient and energy recovery, making advancements in Circular Economy difficult, something that has also been demonstrated for Kenya (Ddiba et al. 2020). Thus, it is demonstrated that issues of WWT are not limited to the five assessed cities but are widespread in the whole of SSA. Why this is the case is due to several factors, one of which is the deteriorated sewage infrastructure, lacking technical and financial resources, not being able to cope with rapid and uncontrolled urban growth (Wan et al., 2013).

Such water issues are clearly interrelated, as one can see through the results depicted in the table 4 above. For example, when looking at the city of Harare, in Zimbabwe, it scores the highest out of the 5 cities in terms of secondary and tertiary WWT, by covering 60% of its population with secondary and tertiary treatment. Yet at the same time the city also scores a 10 out of 10 on stormwater separation, and it is of no coincidence that the city also scores a 10 in indicator 12, age of sewers. In contrast, Libreville, the capital of Gabon, does not have a formal WWTP connecting the city, and at the same time scores a 0 on stormwater separation and has a relatively old sewage network in place (indicator 12 score = 5), dating from the colonial era. Untreated wastewater released back into the environment, can have devastating impacts not only on the environment (Capps et al., 2014), but also on human health (De Man et al., 2014) and even the economy (Robbins, 2013).

Although drinking water quality generally scored quite high in most cities, access to this potable resource on the other hand fared less well. Even though countries like Nigeria, Cameroon and Gabon have abundant water resources (Oumar and Tewari, 2013), it was found that in most assessed cities less than 60% of the population has access to safe and reliable drinking water. There are numerous reasons for this, such as sporadic precipitations or droughts, rapid urbanisation and population explosion, as well as poor management of available resources (Oumar and Tewari, 2013). Abuja, for example grew from 832.000 in 2000 to 3.2 million today in 2020 (Worldpopulationreview, 2020). The Trends and Pressures Framework (TPF), also demonstrated that Abuja is concerned with a high urbanisation rate, as well as, to a lesser extent, Bangui and Libreville (Koop and Grison, 2020). Interestingly, the City Blueprint Framework (CBF) showed that in these cities, access to sanitation and drinking water is very low, showing us that there is a correlation between a high urbanisation rate and a low access to these services. As is the case with a lot of SSA cities, population growth mainly takes place in slums (Mberu et al, 2017), which in turn are characterised by a lack of access to drinking water or sanitation (Arimah and Branch, 2011; Dos Santos et al., 2018). Usually, cities in SSA, in which access to drinking water is low, access to sanitation is also low (Dagdeviren & Robertson, 2011; Oumar and Tewari, 2013). Regarding most assessed cities by the CBF, there also seems to be a correlation between these two indicators. When comparing the findings of the CBF and the TPF, it was also found that a high urbanisation rate may have detrimental impacts on storm water and wastewater separation. Except for Abuja, which is a relatively recent and planned city, all the other assessed cities

having a high urbanisation rate (Abuja, Bangui, Libreville and Harare) also have a low stormwater separation (Koop and Grison, 2020). Considering that in SSA most urban growth takes place in slums, characterised by deplorable living conditions (Mberu et al, 2017), it makes sense that storm- and waste-water separation is lagging behind in such unplanned and informal settlements and that it may be linked to high urbanisation rates.

Access to sanitation and drinking water are particularly challenging in Abuja and Bangui, where wider socio-economic pressures and political instability were also found to be high (Koop and Grison, 2020). In Bangui, the CBF, scored lowest in terms of access to sanitation and drinking water, which is especially problematic as it also experiences fresh- and groundwater scarcity, which may have especially devastating future impacts on the society (Koop and Grison, 2020). This proves that water challenges are often rooted in-, and co-determined by, wider environmental and socio-economic, as well as political issues (Swyngedouw et al., 2002) and hence also why they require integrated and multidisciplinary solutions (Biswas, 2004). Considering this, assessments such as those of the CBA will be of vital importance to prepare for erratic climatic changes and unplanned urban growth. This is because the CBA can specifically identify which water, as well as wider factors, are problematic and why this is the case. Thus, it may prioritise key water related challenges.

By applying the CBA in urban SSA, a fresh view on the region' IWRM capacity is portrayed. Up to date no studies in the urban SSA context have been done which have scrutinised so many different areas related to IWRM at once, as the City Blueprint and Trends and Pressures Frameworks have. Most papers have solely examined a handful of challenges in isolation of each other, such as access to sanitation and drinking water (Oumar and Tewari,2013), wastewater treatment (Wang et al., 2014) or flooding (Salami et al., 2017). Moreover, a great deal of methods evaluating IWRM have seldom used such reproducible indicators by using complex modelling tools (Jakeman and Letcher, 2003; Letcher et al., 2013; Karthe et al., 2013). Therefore, a need for holistic, coherent and reproducible measurement tools assessing IWRM arise (Anderson et al., 2019). This research, has demonstrated that by evaluating 24 single indicators, spanning across multiple areas, the key IWRM challenges and capacity of a city was evaluated rapidly in a holistic, coherent and reproducible manner. This has important implications for increasing city-to city learning and capacity building seeking to improve IWRM in urban SSA, as this systematic approach can be easily applied in other cities, using and contributing to knowledge on IWRM on a joint fashion, in the data scarce environment of SSA. Because IWRM has proven to be difficult to operationalise in developing countries (Gupta and Agyenim, 2012, Jensen, 2013), the CBF may not solely inform context-specific IWRM capacities, yet also connect those using it, i.e. young professionals, or investors, with local stakeholders, policy makers or scientists, thus rendering key practitioners aware of the IWRM issues they are faced with. By creating such knowledge in a joint way, as well as informing and connecting key stakeholders with independent researchers or investors, pragmatic, efficient and case specific solutions may be created. Something that is vital, yet that has been challenging for the effective implementation of IWRM (Gupta and Agyenim 2012; Giordano and Shah, 2013). However, Grigg (2016), argued that good governance is necessary to implement IWRM principles into practice. That is where the third tool of the CBA comes in, the Governance Capacity Framework.

5.2 The strengths and weaknesses of the Governance Capacity Framework for addressing the challenge of urban water pollution in Libreville, Gabon

The in-depth case study of the governance capacity of Libreville (Gabon) revealed some interesting findings on how the issue of water pollution, encompassing wastewater treatment and sanitation, is governed in a city of SSA. The GCF showed that information regarding water pollution in Libreville was not readily available to the public (indicator 2.1), nor transparent (indicator 2.2) or regularly shared between stakeholders (indicator 2.3). Next to this, there was no comprehensive water quality monitoring system in place across the city (indicator 3.1), all of which resulted in stakeholders in charge with addressing water pollution not knowing what needs to be done where, nor how the system may respond to certain projects or policies (indicator 3.2). In addition to this, an absence of policy documents defining the goals (indicator 5.1) and responsibilities (indicator 7.2) regarding the mitigation of sanitation and wastewater treatment issues was missing. Numerous respondents of the study, also representing key stakeholders, shared the opinion that an unclear division of responsibilities as to who has to do what, was a major barrier to 'good' governance of water pollution (interviewees 2, 4, 5, 8 & 9). In addition to this, other barriers to 'good' governance in Libreville were lack of information and smart monitoring, insufficient community participation (indicator 4.1) and a deficiency of financial resources (indicator 8.3).

The GCF was applied in Cape Town, South Africa, in which it was shown that smart monitoring, community knowledge and experimentation with alternative water management technologies are paramount when seeking to effectively govern urban water related challenges (Madonsela et al., 2019). The water governance issues identified in the GFC for Libreville match those illustrated in figure 1 by Olagunju et al. (2019) shown in the introduction. As is illustrated in figure 1 of the introduction, Libreville also experiences socio-environmental challenges such as social exclusion by poorer populations of the informal settlements in the decision-making process. The city also experiences certain of these systemic challenges, such as inadequate capacities for data gathering, citizen engagement, unclear/overlapping responsibilities and weak monitoring, regulation and sanctioning mechanisms. Similar research policy divides also apply for the capital of Gabon such as, data gaps and an absence of policy dialogues. Thus, it may be assumed, that what holds for the governance capacity of Libreville, is also valid for cities across SSA, except for Cape Town which is one of the wealthiest cities in Africa according to GDP per capita (Madonsela et al., 2019). The very limiting score of the condition 2 seen in figure 18 in the section 4.2, '*useful knowledge'*, is certainly valid for other cities across the sub-continent. As earlier mentioned in the scientific problem section 1.4, a dearth of reliable and up to date data on water issues is prevalent across SSA (Olagunju et al., 2019). The CBF has demonstrated this, by most of the indicators having to be scored using information gathered from interviews as opposed to literature study, and some indicators receiving a zero due to no information being available.

The worth of the GCF goes beyond validating such regional governance issues, by providing an in-depth evaluation of the governance capacity regarding a specific water-related challenge and explaining why certain conditions are limiting or encouraging through its detailed score substantiations which can be found in appendix 1. Evaluating water governance is challenging and holistic methods assessing this concept are lacking (Wiek and Larsson, 2012). Some frameworks have sought to scrutinise water governance in a holistic and integrated fashion (Pahl-Wostl et al. 2010; Parkes et al. 2010; van Rijkswick et al., 2014; van Montfort et al., 2014), however, none of these are indicator based, can gather data locally through interviews or seek feedback from interviewed stakeholders in the scoring process. Water governance has seldom been assessed in the SSA context, with most studies conducted in South Africa (Madonsela et al., 2019), or others solely looking at public

participation (Hegga et al., 2020) or examining river basins (Pahl-Wostl et al., 2012). The frameworks referred to above are also not able to score a multitude of indicators in a systematic way, by evaluating a certain governance capacity from very limiting (--) to very encouraging (++) according to certain thresholds, making the tool reproducible and consistent. Illustrating the scores in a clear manner as demonstrated in the synthesis graph (figure 18) above in the results section 4.2, permits cities to compare their scores easily and permits investors to rapidly gain an overview of the limiting governance conditions needing improvement. In addition to this, the CBA tools can produce and measure the Joint Production of Knowledge (JKP), as well as the GCF can evaluate specific governance capacities.

The GCF may not only measure JKP, yet also contribute to producing knowledge in a joint manner. By conducting semi-open interviews with the relevant stakeholders, the method inherently collects knowledge, background information and even literature from the governance actors. This was a continuous process, as once the preliminary scores were attributed, feedback and additional evidence was sought from the interviewed stakeholders themselves. The research also provided an external perspective, as it was conducted by a foreign researcher. All of this makes the CBA, a useful tool for collecting and disseminating the voices of various stakeholders (Aartsen et al., 2018). In addition to this, it may be argued that by interviewing the local young professionals whom applied the CBF in the different SSA cities, and together determining how this tool may be adjusted to the local context, knowledge was jointly produced. Considering the Joint Knowledge Production conceptual framework outlined in the figure 2, and the table 1, in the above theory section, the GCF may also evaluate certain success conditions for JKP. Some of these JKP success conditions consist of; the broadest possible actor coalition, the recognition of differences in actor perspectives, organised reflection on the divisions of tasks by participating actors, role of researcher and knowledge is clear, and specific resources such as boundary objects, facilities, organizational forms, and competencies are present (Hegger et al., 2012). The GCF may evaluate these by measuring whether stakeholders share knowledge between them (indicator 2.3) and whether they are open to learn and cooperate with each other (indicator 3.3). The GCF also demonstrated that the division of responsibilities was unclear between the relevant institutions (indicators 7.2), as the stakeholders seldom communicate with each other. It may also measure actor coalition through its indictors 4.1; 4.2 and 4.3, measuring the stakeholder engagement process. Regarding the assessment of resources, the GCF can, to a certain extent, measure organisational competences, by scrutinising their authority to sanction (indicators 7.3 and 9.2), as well as financial competences (indicator 8.3). Consequently, one may argue that JKP somewhat achieved, if these indicators receive positive (+ and ++), if they score negatively (- or --) it is not achieved. Thus, the hypothesis made that the GCF can be used as a tool to evaluate JKD in practice holds. However, the GCF may only assess few aspects of JKP, making it far less comprehensive at doing so than the JKP frameworks by Edelenbos et al. (2011) and that of Hegger et al. (2012; 2014). Thus, new avenues of research are needed to marry JKP with governance capacity frameworks and how to operationalise them in practice.

5.3 CBA frameworks tailored to the local SSA context, to inform investment decisions and enhance JKP and CD evaluations in practice.

In the 4.3 it was elucidated that the CBA assessment frameworks may be used to inform investment decisions through certain indicators in the Trends and Pressures, City Blueprint and Governance Capacity Framework, matching the identified investment conditions. It was also established that these frameworks are especially useful to inform water-related investment decisions by providing rare combined information on the wider political, socio-economic and environmental climate of a country

(TPF), the IWRM capacity of a city (CBF), as well as the capacity of a city to govern a certain water challenge. However, to be truly beneficial in practice some methodological and practical revisions were suggested, such as omitting less relevant conditions such as '*visionary agents'*, facilitating predefined indicator questions and substantiations in the GCF, as well as allocating more time to field research over literature study for both the GCF and CBF. The purpose of this is to facilitate the use of such assessments for development banks or organisations, young professionals, academics and even students. It is of great importance to give practical advice of how to adapt these assessment tools in the local African context, so they are made more reproducible in layman's terms. This way anyone may employ them, making the tools more attractive for potential investors and permitting non-experts like bureaucrats or private actors to employ them and identify investment priorities. Producing more knowledge on these topics, will also attract investors, as one of the key conditions they need to make investments is reliable data and information (World Bank 2020). During an interview with a key expert in the Gabonian Ministry of Water Resources, the informant stated that often financial resources were lacking to secure the long term functioning of certain initiatives, yet that external investors were reluctant to invest, as local studies and data were lacking and thus return on investment could not be secured (interviewee 6). Therefore, making such assessments like the CBA more reproducible and accessible, not only for investors, but for the wider public in general, is so important. Hence, more local data can be provided, increasing the willingness of investors to invest as less risk will be involved (World Bank, 2020), creating a virtuous cycle. Considering the multitude water related challenges characterising urban SSA, with deep reaching socio-economic and political roots, it is imperative to create such virtuous cycles all over the region to adapt to an uncertain future. Thus, more local research is needed to attract investments and inform local policy makers across the continent. However, even if the CBA assessments manage to inform investment decision and an increasing number of water-related projects are funded by MDBs in SSA, the long-term implementation of these is not yet secured. The CBA may only point out the issues, on which the solutions may be built upon, yet it cannot operationalise the solutions into practice. That is why encouraging the production of joint knowledge, as outlined in the previous section is so important, so local key stakeholders can regularly communicate and establish action priorities. When the author conducted the online workshop with the key water stakeholders in Libreville, the unclear division of responsibilities regarding wastewater treatment and sanitation was the central point in the discussion. It was thus agreed upon that stakeholders must regularly communicate and share information to address water pollution. A challenge here, however, is how to incorporate private investors or development bank officials into this JKP process, so that everyone together can establish the most efficient ways to develop local water governance capacities. More research is needed on how to incorporate such investors into the local JKP processes.

5.4 *Limitations*

The CBA can merely inform stakeholders, yet not secure the long-term cooperation between stakeholders. Certain policy recommendations will be made at the end of this paper to enhance long term stakeholder communication and hence, operationalisation of cross-organisational governance capacity development. Moreover, this research provides knowledge on how to inform investment decisions, yet not on more forward-looking investment decisions. In a context of climate change and rapid urbanisation, making investment decisions more forward looking is especially important (Pot, 2020). Including this dimension was considered by the author, however, in the context of this research scope, examining such forward looking decisions would have required too many additional methods and concepts.

Regarding JKP a similar case is made. This research indeed provides the joint production of knowledge, however, does not secure this on the long term. To address this limitation, it has been recommended in the results section 5.3 and policy recommendations, that partnerships should be created with KWR and universities across SSA and regular meetings between UNESCO and local stakeholders be held. More information on this is provided in the policy recommendations following the conclusions.

This research employs indicator-based methods, by gathering data through mostly interviews for the CBF and GCF, posing the risk that knowledge of individuals may be biased or flawed (Moglia et al., 2008). For example, regarding the score of indicator 2, access to sanitation, in the CBF for Abuja, it received a score of 9.7, meaning that 97% of the population allegedly has access to sanitation. This score was substantiated based on one interview with an official in the Nigerian national bureau of environmental statistics. It is, however, not clear what is meant by access to 'proper' sanitation and it seems unlikely that 97% has access to improved sanitation. In a study by Hopewell and Graham (2014), it was estimated that access to improved sanitation in Abuja is between 25 and 50% of the city's population. Thus, findings seeming unrealistic like these, were double checked against existing literature on the matter. To avoid any further of such setbacks during the data gathering process, the predefined questions in the GCF were posed to multiple stakeholders and one indicator score was never based on one informants' response alone. In addition to this, empirical examples and literature were often requested during the interview process to validate claims. This in turn also reinforced the validity of the results for the GCF, as rare documents and reports were supplied from the stakeholders directly.

This research also focuses exclusively on the CBA and on the surface may be considered somewhat myopic. Other indicator-based methods assessing IWRM or broader water governance frameworks exist, such as for example the Water Needs Index (Moglia et al., 2008) or the 10 Building Blocks method (van Rijkswick et al., 2014). Through analysing the literature, the CBA assessments were compared to such frameworks and linked to the relevant theory. All three frameworks seemed suitable to answer the research questions and contribute to the knowledge gaps. By focusing on solely CBA is was implied to critically discuss one method, and to provide practical recommendations on the use of just one method, to keep the research scope specific and thorough.

During this research SSA is often referred to as a whole, and although links have been made with the results of the five cities and other urbans areas not assessed in this research, challenges for SSA are homogenous. Compared to been West and Central African cities, urban areas of East Africa have received far less attention. To overcome this, results of the GCF have been compared with those of the same method in Naisha, Kenya (Ddiba et al., 2020). Conclusions on SSA as a whole have been made with care during this research. The author also considered his position as an 'outside' white researcher in a continent different from his own. The author coped with this situation by always listening intently to the views and opinions of the interviewed stakeholder and young professionals, critically yet without judgement, aware of his own predetermined beliefs.

6. Conclusions

As sub-Saharan Africa (SSA) is experiencing a great deal of water-related issues and good water governance is seen as the panacea for sound water management, little is known as to how to evaluate water governance capacities in practice (Lautze et al., 2015). Considering that USD 22,5 trillion of investments in the water sector will be required until 2050 (OECD, 2015b), it is of absolute importance to guide investment decisions aimed at improving integrated water governance capacities in SSA. Thus, the main research question asked; *'To what extent can empirical assessments for prioritising water-related challenges and capacity development be practically deployed to inform investment decisions and what methodological adjustments would be necessary to fit the context of sub-Saharan African cities?'*

To answer this, first, the key urban water-related challenges of SSA were determined and measured using the City Blueprint Framework (CBF) and Trends and Pressures Framework (TPF). Through the application of the CBF in Abuja, Bangui, Harare, Libreville and Yaoundé, the key challenges, such as wastewater and solid waste treatment, access to drinking water and sanitation, leakages as well as the separation of storm and sewage water, were identified. The TPF demonstrated that these challenges were exacerbated by unplanned rapid urbanisation, poverty and political instability. Second, the Governance Capacity Framework (GFC) was applied in Libreville, Gabon. The GCF identified and ranked the main limiting conditions hampering the capacity to govern water pollution in Libreville, which coincided with wider water governance issues in SSA (Olagunju et al., 2016). Particularly institutional, technical and financial capacities were the main governance limiting conditions for Libreville. Thus, the GCF proved to be able to assess and rank water governance capacities using local knowledge. Third, it has been established that the City Blueprint Approach (CBA) frameworks can guide investment decisions, as the key conditions needed to take such decisions, such as political stability and security, market size, labour force and skills, physical infrastructure, as well as the quality of national statistics and data are measured by the CBA.

In order to ensure reproducibility of these frameworks in a data poor environment of SSA, a standardized more simplified methodology is required. Through interviews with the young professionals who have deployed the CBF, certain adjustments and practical recommendations were made to fit the SSA context. Due to certain indicators, such as '*visionary agents*' in the GCF, not matching the conditions needed to make investment decisions, potential investors are free to omit indicators not applicable to the local project context. '*Visionary agents*' (GCF condition 6) may be important for measuring leadership, however, may be less relevant for investors, as none of the investment conditions seek to evaluate leadership per se. It was also found that certain indicators may be added, such as measuring the ratio of slum dwellers to total urban population in the TPF, since water related issues are most pronounced in informal settlements.

Furthermore, due to data scarce environments in SSA, field research should be emphasised over literature study, to save time and gather literature directly from the interviewed stakeholders, as they are in possession of the relevant knowledge and documents. Not only would this facilitate the use of such assessments in the SSA context, but knowledge would also be produced jointly by being gathered by the researchers and local water management actors. Thus, the main question was answered, as this research demonstrated that the three CBA assessment tools could, prioritise water related challenges, measure the conditions needed to take investment decisions in developing countries and show how their use could be facilitated in the local SSA context. This is not only relevant for development bank officials, private investors or policy makers, yet also for development organisations, scientists, young professionals and the wider public, as more rare knowledge is provided to inform the governing of integrated water resources in urban SSA.

Policy recommendations

- European universities, such as Utrecht University, may create additional partnerships with other universities across sub-Saharan Africa, to provide scholarships and knowledge, with the guise of developing local integrated water governance capacities and technical skills. The IHE-Delft Institute for Water Education may be used as an appropriate example for this.
- The City Blueprint Approach (CBA) frameworks[5] should be made more accessible to universities across sub-Saharan Africa, for local students to use and gather data. The results of these three CBA frameworks should be then sent to KWR Water Research Institute, who can publish them online.
- UNESCO needs to disseminate the CBA assessments tools, apply them in the local context and then publish the results online independently, as well as through KWR.
- UNESCO may come in as it has regional offices across sub-Saharan Africa, employing many young professionals and working closely with local institutions, private actors and development banks and organisations, as well as NGOs. Moreover, UNESCO's local offices should organise and mediate bimonthly, online meetings between key representatives of each of these.
- Multi-lateral Development Banks such as the World Bank, African Development Bank, or European Bank for Development and Reconstruction, as well as national development organisations, such as the French Agency for Development (AFD), the German Corporation for International Cooperation (GIZ), or the Netherlands Development Cooperation, should be made aware of, empirically based, integrated water management and governance capacity evaluations (such as the CBA). As well as UNESCO, these organisations have local offices all over the globe and may participate in the local meetings organised by UNESCO when seeking to carry out projects.
- In order to bridge science to practice, KWR should inform such development organisations, of the use of the CBA so they may learn about the method and apply it in practice.

CBA composed of: (1) Trends and Pressures Framework (Tool assessing urban socio-economic and political trends); (2) City Blueprint Framework (Tool assessing urban water management); (3) Governance Capacity Framework (Assessment of urban water governance capacities).

7. Bibliography

Aartsen, M., Koop, S., Hegger, D., Goswami, B., Oost, J., & Van Leeuwen, K. (2018). Connecting water science and policy in India: lessons from a systematic water governance assessment in the city of Ahmedabad. *Regional Environmental Change*, *18*, 2445-2457.

Abu-Zeid, M. (2003). Water in Africa and future challenges. *L'eau en Afrique et les défis du futur*. Houille Blanche, 1, 26–30.

Adeel, Z. (2004). Focus on new water issues-perspectives at the end of the International Year of Freshwater. *Global Environmental Change*, 1-4.

African Development Bank (2006). *Guidelines for Financial Management and Financial Analysis of Projects*. Available at: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Procurement/Project-related-Procurement/GFA01_Guidelines%20for%20FG%20%26%20FA%20of%20Proj.pdf [Accessed 2020 Nov. 01].

African Development Bank (2019). Gabon - Programme De Développement Du Secteur De L'Eau Et De L'Assainissement – Premier Sous-Programme Intégré Pour L'Alimentation En Eau Potable Et L'Assainissement De Libreville (PIAEPAL) – Volet Eau Potable - Rapport D'Évaluation.

African Development Bank (2020). Projects and operations. Available at: https://www.afdb.org/en/projects-and-operations/selected-projects [Accessed 2020 Nov. 01].

Alkaraan, F., & Northcott, D. (2006). Strategic capital investment decision-making: A role for emergent analysis tools?: A study of practice in large UK manufacturing companies. *The British Accounting Review*, *38*, 149-173.

Agyenim, J. B. (2011). *Investigating institutional arrangements for integrated water resource management in developing countries: The case of white volta basin, Ghana* (Doctoral dissertation, Vrije Universiteit).

Agyenim, J. B., & Gupta, J. (2012). IWRM and developing countries: Implementation challenges in Ghana. *Physics and Chemistry of the Earth, Parts A/B/C*, *47*, 46-57.

Alaerts, G. J., & Kaspersma, J. (2009). Progress and challenges in knowledge and capacity development. *Capacity development for improved water management*, 3.

Allogho-Nkoghe, F. (2006). *Politique de la ville et logiques d'acteurs. A la recherche d'alternatives d'aménagement pour les quartiers informels de Libreville (Gabon)* (Doctoral dissertation, Montpellier 3).

Anderson, A., Karar, E., & Farolfi, S. (2008). Synthesis: IWRM lessons for implementation. *Water SA*, *34*, 665-669.

Arimah, B. C., & Branch, C. M. (2011). Slums as expressions of social exclusion: Explaining the prevalence of slums in African countries. *UN-Habitat, Nairobi*.

Ashton, P. J. (2002). Avoiding conflicts over Africa's water resources. *AMBIO: A Journal of the Human Environment*, *31*, 236-242.

Bamberger, M. (2000). The Evaluation of International Development Programs: A View from the Front. *American Journal Of Evaluation*, *21*, 95-102.

Barrios, S., Bertinelli, L., & Strobl, E. (2006). Climatic change and rural-urban migration: The case of sub-Saharan Africa. *CORE Discussion Paper No. 2006/46*.

Badham, J., Elsawah, S., Guillaume, J. H., Hamilton, S. H., Hunt, R. J., Jakeman, A. J., ... & Gober, P. (2019). Effective modeling for Integrated Water Resource Management: A guide to contextual practices by phases and steps and future opportunities. *Environmental Modelling & Software*, *116*, 40-56.

Beguy, D. (2016). Poor data affects Africa's ability to make the right policy decisions. *The Conversation, 18*.

Binga, H., (N.D). *La Gestion De L'eau Au Gabon*. Available at: https://www.sifee.org/static/uploaded/Files/ressources/actes-des-colloques/ouagadougou/session-7/3_Binga_communication.pdf [accessed 2020 Feb. 10].

Biswas, A. K. (2004). Integrated water resources management: a reassessment: a water forum contribution. *Water international*, *29*, 248-256.

Blokland, M., Alaerts, G., Kaspersma, J., & Hare, M. (Eds.). (2019). *Capacity development for improved water management*. CRC Press.

Bonnassieux, A., & Gangneron, F. (2011). Des mini-réseaux d'eau potable : entre enjeux politiques et arrangements locaux. Le cas de la commune de Djougou au Bénin. *Mondes en développement*, 77-92.

Brooks, D. B., & Wolfe, S. (2007). Water demand management as governance: lessons from the Middle East and South Africa. *In Water resources in the Middle East* (pp. 311-323). Springer, Berlin, Heidelberg.

Bouwer, H. (2003). Integrated water management for the 21st century: problems and solutions. *Journal of Irrigation and Drainage Engineering, 128*, 193-202.

Cameron, D. B., Mishra, A., & Brown, A. N. (2016). The growth of impact evaluation for international development: how much have we learned*?. Journal of Development Effectiveness, 8*, 1-21.

Capps, K. A., Bentsen, C. N., & Ramírez, A. (2016). Poverty, urbanization, and environmental degradation: urban streams in the developing world. *Freshwater Science*, *35*, 429-435.

Cash, D.W., Clark, W.C., Alcock, F., Dickson, N., Eckley, N., Guston, D., Jaeger, J., Mitchell, R., (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences of the United States of America* 100, 8086–8091.

Chaignaud, C. (2008). Etude sur l'état de l'eau et l'assainissement dans la capitale de Libreville et analyse de l'association. Master 2 Ingénierie des Projets de Coopération. Université des sciences et technologies Lille 1.

Chen, Y., & Han, D. (2018). Water quality monitoring in smart city: A pilot project. *Automation in Construction*, *89*, 307-316.

Constantinou, N. (2007). *Capacity development in the World Bank Group: A review of nonlending approaches*. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/9567/40431%20Nonlending%20approaches%20CDBrief23%20%28PUBLIC%29.pdf?sequence=5&isAllowed=y [accessed 2020 Oct. 03].

Conway, G. (2009). The science of climate change in Africa: impacts and adaptation. *Grantham Institute for Climate Change Discussion Paper*, 24.

Dagdeviren, H., & Robertson, S. A. (2011). Access to water in the slums of sub-Saharan Africa. *Development Policy Review, 29*, 485-505.

De Man, H. H. H. J. L., Van Den Berg, H. H. J. L., Leenen, E. J. T. M., Schijven, J. F., Schets, F. M., Van der Vliet, J. C., ... & de Roda Husman, A. M. (2014). Quantitative assessment of infection risk from exposure to waterborne pathogens in urban floodwater. *Water research*, *48*, 90-99.

De Lange, W. J., Wise, R. M., Forsyth, G. G., & Nahman, A. (2010). Integrating socio-economic and biophysical data to support water allocations within river basins: An example from the Inkomati water management area in South Africa. *Environmental Modelling and* Software*, 25*, 43–50.

Ddiba, D., Andersson, K., Koop, S. H., Ekener, E., Finnveden, G., & Dickin, S. (2020). Governing the circular economy: Assessing the capacity to implement resource-oriented sanitation and waste management systems in low-and middle-income countries. *Earth System Governance*, *4*, 100063.

Devi, A., & Bostoen, K. (2009). Extending the critical aspects of the water access indicator using east Africa as an example. *International Journal of Environmental Health Research*, 19, 329–341.

Dia, M. (1996). *Africa's management in the 1990s and beyond: Reconciling indigenous and transplanted institutions.* The World Bank.

Dos Santos, S., Adams, E. A., Neville, G., Wada, Y., De Sherbinin, A., Bernhardt, E. M., & Adamo, S. B. (2017). Urban growth and water access in sub-Saharan Africa: Progress, challenges, and emerging research directions. *Science of the Total Environment*, *607*, 497508.

Douglas, I., Alam, K., Maghenda, M., Mcdonnell, Y., McLean, L., & Campbell, J. (2008). Unjust waters: climate change, flooding and the urban poor in Africa. *Environment and urbanization*, *20*, 187-205.

Echandi, R., J. Krajcovicova, and C.Z.W. Qiang. (2015). The Impact of Investment Policy in a Changing Global Economy. *Policy Research Working Paper 7437,* 19-90.

Edelenbos, J., Van Buuren, A., Van Schie, N., (2011). Co-producing knowledge: joint knowledge production between experts, bureaucrats and stakeholders in Dutch water management projects. *Environmental Science and Policy* 14, 675–684.

Emerson, K., Nabatchi, T., & Balogh, S. (2012). An integrative framework for collaborative governance. *Journal of public administration research and theory*, *22*, 1-29.

Engle, N. L., & Lemos, M. C. (2010). Unpacking governance: building adaptive capacity to climate change of river basins in Brazil. *Global Environmental Change*, *20*, 4-13.

English, E. P., & Mule, H. M. (1996). *The African Development Bank* (Vol. 1). Lynne Rienner Publishers.

Feingold, D., Koop, S., & van Leeuwen, K. (2018). The city blueprint approach: urban water management and governance in cities in the US. *Environmental management*, *61*, 9-23.

Folke, C., Hahn, T., Olsson, P., Norberg, J., (2005). Adaptive governance of social–ecological systems. *Annual Review of Environment and* Resources 30, 441–473.

Gatti, S. (2012). *Project finance in theory and practice: designing, structuring, and financing private and public projects*. Academic Press.

Giordano, M., & Shah, T. (2014). From IWRM back to integrated water resources management. *International Journal of Water Resources Development*, *30*, 364-376.

Glucker, A. N., Driessen, P. P., Kolhoff, A., & Runhaar, H. A. (2013). Public participation in environmental impact assessment: why, who and how? *Environmental impact assessment review*, *43*, 104-111.

Grigg, N. S. (2008). Integrated water resources management: balancing views and improving practice. *Water International, 33*, 279-292.

Grigg, N. S. (2016). IWRM and Water Governance. *Integrated Water Resource Management* (pp. 99-118). Palgrave Macmillan, London.

GWP (2000). *Integrated Water Resources Management*. Available at: https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/04-integrated-water-resources-management-2000-english.pdf [accessed 2020 Feb. 18].

Hegga, S., Kunamwene, I., & Ziervogel, G. (2020). Local participation in decentralized water governance: insights from north-central Namibia. *Regional Environmental Change*, *20*, 1-12.

Hegger, D., Lamers, M., Van Zeijl-Rozema, A., & Dieperink, C. (2012). Conceptualising joint knowledge production in regional climate change adaptation projects: success conditions and levers for action. *Environmental science & policy*, *18*, 52-65.

Hegger, D., & Dieperink, C. (2014). Toward successful joint knowledge production for climate change adaptation: lessons from six regional projects in the Netherlands. *Ecology and Society*, 2, *19*.

Hofstra, M. (2013). Water governance, a framework for better communication. *Water Governance*, *1*, 9-13.

Hooper, B. P. (2006). Key performance indicators of river basin organizations. *US Army Corps of Engineering/IWR 70,* 143*.*

Hopewell, M. R., & Graham, J. P. (2014). Trends in access to water supply and sanitation in 31 major sub-Saharan African cities: an analysis of DHS data from 2000 to 2012. *BMC public health*, *14*, 208.

Huang, L., & Pearce, J. L. (2015). Managing the unknowable: The effectiveness of early-stage investor gut feel in entrepreneurial investment decisions. *Administrative Science Quarterly*, *60*, 634-670.

Ife, J. (2010). Capacity building and community development. *Challenging capacity building* (pp. 67-84). Palgrave Macmillan, London.

Jakeman, A. J., & Letcher, R. A. (2003). Integrated assessment and modelling: Features, principles and examples for catchment management. Environmental Modelling & Software, 18, 491–501.

Jeffrey, P., & Gearey, M. (2006). Integrated water resources management: lost on the road from ambition to realisation?. *Water science and technology*, *53*, 1-8.

Jensen, K. M. (2013). Viewpoint–Swimming against the current: Questioning development policy and practice. *Water Alternatives*, *6*,276-283.

Karthe, D. A. N. I. E. L., Malsy, M. A. R. C. U. S., Kopp, S., Minderlein, S., & Hülsmann, L. (2013). Assessing water availability and its drivers in the context of an integrated water resources management (IWRM): a case study from the Kharaa River Basin, Mongolia. *GeoÖko*, *34*,5-26.

Kaspersma, J. M. (2013). *Competences in Context: Knowledge and capacity development in public water management in Indonesia and The Netherlands*. IHE Delft Institute for Water Education.

Letcher, R. A., Jakeman, A. J., Barreteau, O., Borsuk, M. E., ElSawah, S., Hamilton, S. H., & … Voinov, A. A. (2013). Selecting among five common modelling approaches for integrated environmental assessment and management*. Environmental Modelling & Software, 47*, 159–181.

Koebele, E. A. (2015). Assessing outputs, outcomes, and barriers in collaborative water governance: A case study. *Journal of Contemporary Water Research & Education*, *155*, 63-72.

Kooiman, J. (2003). *Governing as governance*. Sage.

Karley, N. K. (2009). Flooding and physical planning in urban areas in West Africa: situational analysis of Accra, Ghana. *Theoretical and Empirical Researches in Urban Management*, *4*,25-41.

Kaufmann, D., Kraay, A., & Zoido-Lobatón, P. (1999). Aggregating governance indicators. *World Bank publications*, 2195.

Kingston, J., & Bolton, M. (2004). New approaches to funding not-for-profit organisations. *International Journal of Nonprofit and Voluntary Sector Marketing*, *9*, 112-121.

Kirkpatrick, D. (1998). *Evaluating training programmes: The four levels.* San Francisco: BerrettKoechler.

Koop, S.H.A & Grison, C. (2020). *City Blueprint assessments in five African cities.* Available at: file:///C:/Users/fritz/Downloads/wetransfer-939a12/City%20Blueprint%20assessments%20in%20five%20African%20cities.pdf [accessed 2020 Sept. 09].

Koop, S. H., & van Leeuwen, C. J. (2015). Assessment of the sustainability of water resources management: a critical review of the city blueprint approach. *Water Resources Management, 29*, 5649-5670.

Koop, S. H. A., Koetsier, L., Doornhof, A., Reinstra, O., Van Leeuwen, C. J., Brouwer, S., ... & Driessen, P. P. J. (2017). Assessing the governance capacity of cities to address challenges of water, waste, and climate change. *Water Resources Management*, *31*, 3427-3443.

Koop S.H.A, van Leeuwen CJ. (2020a). Indicators of the Trends and Pressures Framework (TPF). Version August 2020. KWR Water Research Institute, Nieuwegein. Available at: https://library.kwrwater.nl/publication/61396712/[accessed 2020 Aug 28].

Koop S.H.A, van Leeuwen CJ. (2020b). Indicators of the City Blueprint performance Framework (CBF). Version August 2020. KWR Water Research Institute, Nieuwegein. https://library.kwrwater.nl/publication/61397318/ [accessed 2020 Aug 28].

Koop S.H.A, van Leeuwen CJ. (2020c). Indicators of the Governance Capacity Framework (GCF). Version August 2020. KWR Water Research Institute, Nieuwegein https://library.kwrwater.nl/publication/61397218/ [accessed 2020 Aug 28].

Krellenberg, K., Müller, A., Schwarz, A., Höfer, R., & Welz, J. (2013). Flood and heat hazards in the Metropolitan Region of Santiago de Chile and the socio-economics of exposure. *Applied Geography*, *38*, 86-95.

Lautze, J., De Silva, S., Giordano, M., & Sanford, L. (2011). Putting the cart before the horse: Water governance and IWRM. In *Natural Resources Forum 35*, 1-8. Oxford, UK: Blackwell Publishing Ltd.

Lange, P.; Driessen, P.P.J.; Sauer, A.; Bornemann, B.; Burger, P. (2013). Governing towards sustainability conceptualising modes of governance. J. Environ. Policy Plan. 2013, 15, 403–425.

Mboumba, A. (2007). Gestion urbaine et équité socio-spatiale: les inégalités dans les services de base à Libreville (Gabon). *L'Espace geographique*, *36*, 131-140.

McDonald, R. I., Green, P., Balk, D., Fekete, B. M., Revenga, C., Todd, M., & Montgomery, M. (2011). Urban growth, climate change, and freshwater availability. *Proceedings of the National Academy of Sciences, 108*, 6312-6317.

Mingst, K. A. (2014). *Politics and the African development bank*. University Press of Kentucky.

Moglia, M., Alexander, K. S., Cook, S., Sullivan, C., Lane, B., Lipkin, F., ... & Haskard, C. (2008). *Regional and country scale water resource assessment; informing investments in future water supply in the Asia Pacific region—a decision support tool*. Highett, Vic.: CSIRO. Available at: https://publications.csiro.au/rpr/pub?pid=procite:346a759b-0356-4b7a-9cdb-09a128a57629&sb=RECENT&expert=false&q=regional%20and%20country%20scale%20water%20resource%20assessment [accessed 2020 Sept. 21].

Molle, F. (2008). Nirvana concepts, narratives and policy models: Insights from the water sector. *Water alternatives*, *1*, 131-156.

Mombo, J. B., & Edou, M. (2007). Assainissement et explosion urbaine au Gabon. *Villes en Parallèle*, *40*, 196-225.

Mor, S., Ravindra, K., Dahiya, R. P., & Chandra, A. (2006). Leachate characterization and assessment of groundwater pollution near municipal solid waste landfill site. *Environmental monitoring and assessment*, *118*, 435-456.

Mostofi-Zadeh, E., & Niknam, R. (1992). LEBANON DEVELOPMENT BANK: A PROPOSAL FOR ACTION/BANQUE DE DEVELOPPEMENT DU LIBAN: UN PLAN D'ACTION. *Savings and Development*, 287-304.

Mvulirwenande, S., Wehn, U., & Alaerts, G. (2017). Evaluating knowledge and capacity development in the water sector: Challenges and progress. *Water International*, *42*, 372-384.

Mukheibir, P. (2007). Qualitative assessment of municipal water resource management strategies under climate impacts: the case of the Northern Cape, South Africa. *Water Sa, 33*, 575-581.

Nguema, R. M. (2005). Développement de la ville, découpage et appropriation des territoires urbains au Gabon: le cas de Libreville. *Belgeo. Revue belge de géographie,* 481-498.

Nyenje, P. M., Foppen, J. W., Uhlenbrook, S., Kulabako, R., & Muwanga, A. (2010). Eutrophication and nutrient release in urban areas of sub-Saharan Africa—a review. *Science of the total environment*, *408*,447-455.

OECD. (2015). *OECD principles on water governance welcomed by ministers at the OECD ministerial council meeting on 4 June 2015*. Available at: https://www.oecd.org/cfe/regionaldevelopment/OECD-Principles-on-Water-Governance.pdf [accessed 2020 March 03].

OECD. (2015b). Water, growth and finance: policy perspectives. Available at: https://www.oecd.org/environment/resources/Water-Growth-and-Finance-policy-perspectives.pdf [accessed 2020 Jan. 28].

Olagunju, A., Thondhlana, G., Chilima, J. S., Sène-Harper, A., Compaoré, W. N., & Ohiozebau, E. (2019). Water governance research in Africa: progress, challenges and an agenda for research and

action. *Water International, 44*, 382-407.

Ondo, J. A. (2011). *Vulnérabilité des sols maraîchers du Gabon (région de Libreville): acidification et mobilité des éléments métalliques* (Doctoral dissertation, Aix-Marseille 1).

Oumar, S. B., & Tewari, D. D. (2013). The evolution of access to drinking water and sanitation coverage in urban centers of selected African countries. *Mediterranean Journal of Social Sciences*, *4*, 747-747.

Owa, F. D. (2013). Water pollution: sources, effects, control and management. *Mediterranean journal of social sciences*, *4*, 65.

Pahl-Wostl, C. (2009). A conceptual framework for analysing adaptive capacity and multi-level learning processes in resource governance regimes. *Global environmental change*, *19*, 354-365.

Pahl-Wostl, C., Lebel, L., Knieper, C., & Nikitina, E. (2012). From applying panaceas to mastering complexity: toward adaptive water governance in river basins. *Environmental Science & Policy*, *23*, 24-34.

Pahl-Wostl, C., Holtz, G., Kastens, B., & Knieper, C. (2010). Analyzing complex water governance regimes: the management and transition framework. *Environmental science & policy*, *13*, 571-581.

Pahl-Wostl, C., Knieper, C., Lukat, E., Meergans, F., Schoderer, M., Schütze, N., ... & Thiel, A. (2020). Enhancing the capacity of water governance to deal with complex management challenges: A framework of analysis. *Environmental Science & Policy*, *107*, 23-35.

Parkes, M. W., Morrison, K. E., Bunch, M. J., Hallström, L. K., Neudoerffer, R. C., Venema, H. D., & Waltner-Toews, D. (2010). Towards integrated governance for water, health and social–ecological systems: The watershed governance prism. *Global Environmental Change*, *20*, 693-704.

Peltenburg, M., de Wit, J., & Davidson, F. (2000). Capacity building for urban management: learning from recent experiences.

Pike, R., & Neale, B. (2006). *Corporate finance and investment: decisions & strategies*. Pearson Education.

Philips, J. (1991). Handbook of training evaluation and measurement methods (2nd ed.). Houston, TX: Gulf Publishing.

Preskill, H., & Boyle, S. (2007). Evaluation capacity building unplugged. Think tank session at the meeting of the American Evaluation Association, Baltimore.

Provost, T. (2009). *L'eau et l'assainissement à Libreville le cas de deux quartiers sous-intégrés du premier arrondissement proposition d'un projet pilote de participation des habitants.* Master 2 Ingénierie des Projets de Coopération. Université des sciences et technologies Lille 1.

Rahaman, M. M., & Varis, O. (2005). Integrated water resources management: evolution, prospects and future challenges. *Sustainability: science, practice and policy*, *1*, 15-21.

Reed, M. S. (2008). Stakeholder participation for environmental management: a literature review. *Biological conservation*, *141*, 2417-2431.

Reig, P., Shiao, T., & Gassert, F. (2013). Aqueduct water risk framework. WRI Working Paper, Washington DC: *World Resources Institute*, forthcoming.

République Gabonaise (2005). Evaluation Environnemental et Sociale Sectorielle du PSFE. Available at : http://documents1.worldbank.org/curated/pt/898491468251730358/pdf/e1217.pdf [accessed 2020 24 June].

République Gabonaise (2012). Plan Stratégique du Gabon Emergent. Available at : https://www.undp.org/content/dam/cafi/docs/Gabon%20documents/French/Gabon_2015_SM%20A_PlanStrategiqueGabonEmergent.pdf [accessed 2020 19 June].

République Gabonaise (2015). *Cadre de gestion environnementale et sociale*. Available at : http://documents1.worldbank.org/curated/en/235081468031557708/pdf/SFG1264-FRENCH-EA-P151077-PUBLIC-Disclosed-8-11-2015-Box393182B.pdf [accessed 2020 24 June].

Reuters. (2018). *UPDATE 2-Gabon Seizes Veolia's SEEG Water And Power Unit*. Available at: https://www.reuters.com/article/gabon-veolia-environ-idUSL8N1Q65FX [accessed 2020 15 May].

Robbins, D. (2013). Guidance for Improving Sanitation in El Salvador's Tourism Areas Through Decentralized Wastewater Management Systems. *Policy Brief*, 1-4.

Samorodov, B., Maslova, A., & Mysienko, O. (2014). Evaluation of investment projects effectiveness in a bank's activity. *Економічний часопис-XXI*, 9,98-101>

Schulze, R. E. (2011). Approaches towards practical adaptive management options for selected water-related sectors in South Africa in a context of climate change. *Water SA, 37*, 621-646.

Segrave, A., Brouwer, S., Frijns, J., (2016) Understanding anticipatory water governance. *Global Water Forum*.

Spoon, J. (2014). Quantitative, qualitative, and collaborative methods: approaching indigenous ecological knowledge heterogeneity. *Ecology and Society, 19*.

Šteflová, M., Koop, S., Elelman, R., Vinyoles, J., & Van Leeuwen, K. (2018). Governing non-potable water-reuse to alleviate water stress: The case of Sabadell, Spain. *Water*, *10*, 739.

Stewart, S. D., Neumann, J. J., Knittel, C. R., & Heisler, J. (2009). Absence of value: An analysis of investment allocation decisions by institutional plan sponsors. *Financial Analysts Journal*, *65*(6), 34-51.

Swyngedouw, E., Kaika, M., & Castro, E. (2002). Urban water: a political-ecology perspective. *Built Environment (1978-)*, 124-137.

Takouleu, J. M. (2019). *GABON: Averda suspends waste collection in Libreville for outstanding*

arrears. Afrik 21. Availbale at: https://www.afrik21.africa/en/gabon-averda-suspends-waste-collection-in-libreville-for-outstanding-arrears/ [accessed 2020 Apr. 05].

Termeer, C. J., Dewulf, A., Breeman, G., & Stiller, S. J. (2015). Governance capabilities for dealing wisely with wicked problems. *Administration & Society*, *47*, 680-710.

Tiihonen, S. (2004). *From governing to governance*. Tampere University Press.

Tropp, H. (2007). Water governance: trends and needs for new capacity development. *Water Policy*, *9*,19.

Tortajada, C. (2010). Water governance: Some critical issues. *International Journal of Water Resources Development, 26*(2), 297-307.

Tusting, L. S., Bisanzio, D., Alabaster, G., Cameron, E., Cibulskis, R., Davies, M., Okumu, F. O. (2019). Mapping changes in housing in sub-Saharan Africa from 2000 to 2015. *Nature, 568*, 391-394.

UNDP (1996). Capacity development: lessons of experience and guiding principles. UNDP, New York.

UNDP (2008) United Nations Development program: governance principles, institutional capacity and quality. New York, USA.

UN (2015). World urbanization prospects: The 2014 revision. United Nations Department of Economics and Social Affairs, Population Division: New York, NY, USA, 41.

Vallejo, B., & Wehn, U. (2016). Capacity development evaluation: The challenge of the results agenda and measuring return on investment in the global south. *World Development*, *79*, 1-13.

Van der Keur, P., Henriksen, H. J., Refsgaard, J. C., Brugnach, M., Pahl-Wostl, C., Dewulf, A., & Buiteveld, H. (2008). Identification of major sources of uncertainty in current IWRM practice. Illustrated for the Rhine Basin. *Water Resources Management*, *22*, 1677-1708.

Van den Hove, S., (2007). A rationale for science–policy interfaces. *Futures 39*, 807–826.

Van Lindert, P. (2016). Rethinking urban development in Latin America: A review of changing paradigms and policies. *Habitat International, 54*, 253-264.

Van Montfort, C., Michels, A., & Frankowski, A. (2014). *Governance models and partnerships in the urban water sector: A framework for analysis and evaluation*. Available at: https://dspace.library.uu.nl/handle/1874/303566 [accessed 2020 Sept. 26].

Van Niekerk, S., & Weghmann, V. (2019). *Municipal Solid Waste Management Services in Africa.* Available at: http://www.world-psi.org/sites/default/files/documents/research/waste_management_in_africa_2018_final_dc_without_highlights_2019.pdf [accessed 2020 May 18].

Van Rijswick, M., Edelenbos, J., Hellegers, P., Kok, M., & Kuks, S. (2014). Ten building blocks for

sustainable water governance: an integrated method to assess the governance of water. *Water international*, *39*, 725-742.

Wang, H., Wang, T., Zhang, B., Li, F., Toure, B., Omosa, I. B., ... & Pradhan, M. (2014). Water and wastewater treatment in Africa–current practices and challenges. *CLEAN–Soil, Air, Water*, *42*, 1029-1035.

WHO/UNICEF (2005). Joint Water Supply, Sanitation Monitoring Programme, World Health Organization, *WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation*, & UNICEF). Water for life: making it happen. World health organization.

Whyte, A. (2004). *Landscape analysis of donor trends in international development*. New York: The Rockefeller Foundation.

Wiek, A., & Larson, K. L. (2012). Water, people, and sustainability—a systems framework for analyzing and assessing water governance regimes. *Water Resources Management, 26*, 3153-3171.

Wolff, H. P., Wolf, L., Subah, A., Guttman, J., Tamimi, A., Jarrar, A., ... & Karablieh, E. (2012). Methodological challenges in evaluating performance, impact and ranking of IWRM strategies in the Jordan Valley. *Water Science and Technology*, *66*, 1407-1415.

World Bank (2017). *People using safely managed drinking water services, urban (% of urban population)*. Available at: https://data.worldbank.org/indicator/SH.H2O.SMDW.ZS [accessed 2020 Feb. 20].

World Bank (2018). *Population living in slums (% or urban population).* Available at: https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS [accessed 2020 Feb. 24].

World Bank (2020a). *Integrated Water Management and Development Project.* Available at: https://projects.worldbank.org/en/projects-operations/project-detail/P163782. Accessed on 01/11/2020.

World Bank (2020). *Global Investment Competitiveness Report 2019/2020 : Rebuilding Investor Confidence in Times of Uncertainty.* Available at: https://openknowledge.worldbank.org/handle/10986/33808 [accessed 2020 July 12].

Worldpopulationreview (2020). *Abuja population growth*. Available at: https://worldpopulationreview.com/world-cities/abuja-population [accessed Sept. 06].

Worthen, B. R., & Sanders, J. R. (1987). *Educational evaluation*. New York, NY: Longman

Zanetta, C. (2001). The evolution of the World Bank's urban lending in Latin America: from sites and services to municipal reform and beyond. *Habitat international, 25*, 513-533.

Zinke, J. (2006). Monitoring & Evaluation of Capacity and Capacity Development.

8. Appendices

Appendix 1: Governance Capacity Framework score substantiations Libreville, Gabon

Definition of water pollution:

'The collection, treatment and production of wastewater and its effect on human and ecosystem health. This falls under the umbrella terms of 'waste-water treatment' and 'sanitation' which will be used in this analysis when discussing water pollution.'

Sanitation is quite am ambiguous term with many different meanings. For this research the Merriam-Webster definition of sanitation will be employed as;

1: the act or process of making sanitary[1]

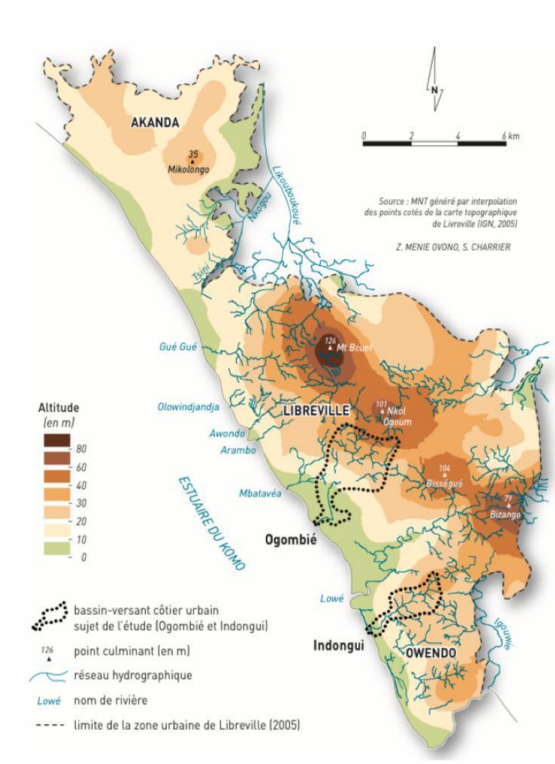
2: the promotion of hygiene and prevention of disease by maintenance of sanitary conditions (as by removal of sewage and trash) —often used attributively

Wastewater treatment is the removal of impurities from wastewater, or sewage, before they reach aquifers or natural bodies of water such as rivers, lakes, estuaries, and oceans (Britannica, 2020). The removal of impurities is usually done in waste wastewater treatment plants with primary, secondary and tertiary treatment, yet standards of what is 'safe' to emit back into the environment vary by country.

1: By 'sanitary' is meant; i) of/or relating to health, ii) of, relating to, or used in the disposal especially of domestic waterborne waste (Meriam-Webster, 2020)

Introduction of Libreville

Concerning sanitation and wastewater treatment in Gabon, with the exception of the cities of Moanda, Mounana and Gamba, which have a reduced semi-collective sanitation network and which concern a few districts, the sanitation system practiced in Gabonese cities (including Libreville) is mostly autonomous sanitation. Access to improved on-site sanitation varies from one city to another. Cities in the provinces of Ngounié (33.30%) and Nyanga (35.60%) have the lowest rates of access to improved sanitation (Mombo and Edou, 2007). Wastewater treatment plants and separate sewage networks are also barely in place in cities of Gabon, apart from some onsite treatment plants in some hospitals or hotels of Libreville. The capital of 920.000 people is located on the littoral of the gulf of Guinea, has two main rivers flowing through it and some parts of the city consisting of drainage basins (Poittier and Ovono, 2019). The geography of Libreville already exposes the city to pluvial flooding and water pollution as a dense network of streams and rivers runs through it as can be seen in the below figure 1.



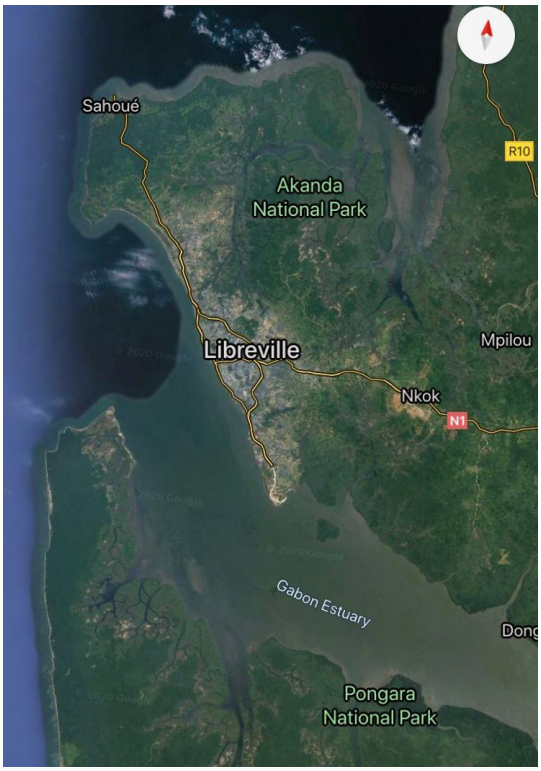


Figure 1: Topographical map of Libreville (Poittier and Ovono, 2019). Figure 2: Map of Libreville (Google Earth, 2020)

Adding to this geographical situation, the socio-economic character of the capital's population enhances water pollution. The city is urbanising rapidly (see %), with a huge influx of rural to urban migrants who in many cases move to informal settlements of city due to coming from poor backgrounds. In fact, nearly 80% of Libreville's inhabitants live in informal settlements, characterised by anarchic sanitary conditions. According to the study conducted during the preparation of the Libreville master plan, 59% of plots are not equipped with household water drainage systems and 39% of households discharge their household water in their plots, which encourages water stagnation and the proliferation of insects (mosquitoes, etc.) (Mombo and Edou, 2007).

All domestic wastewater and effluents from enterprises and industries such as garages, hospitals, food companies amongst others is not treated and runs straight into the surface waters, the sea and even seeps through into the groundwater causing devastating impacts to the environment and human health and the economy (Momba and Edou, 2007). Groundwater contamination of heavy metals, and surface water algal blooms and eutrophication are all impacts of water pollution and may

even be detrimental to the economy by harming the fishing sector (Owa, 2011). Health impacts of consuming or bathing in polluted surface water have cause diarrhoea, dysentery and other contagious viral infections in the Libreville (Mombo and Edou, 2007). Such issues may even be aggravated in a context of climate change and urbanisation.

Thus, it is imperative for Libreville to mitigate water pollution before it causes irreversible damages to the environment and to human health. Good governance of sanitation and wastewater treatment will be necessary to curb water pollution. The government knows this but still has much to do about these issues, as will be demonstrated in this Governance Capacity Analysis.

Prior to discussing the score substantiations of the various indicators, one must know that there are four main institutions responsible for sanitation and wastewater treatment;

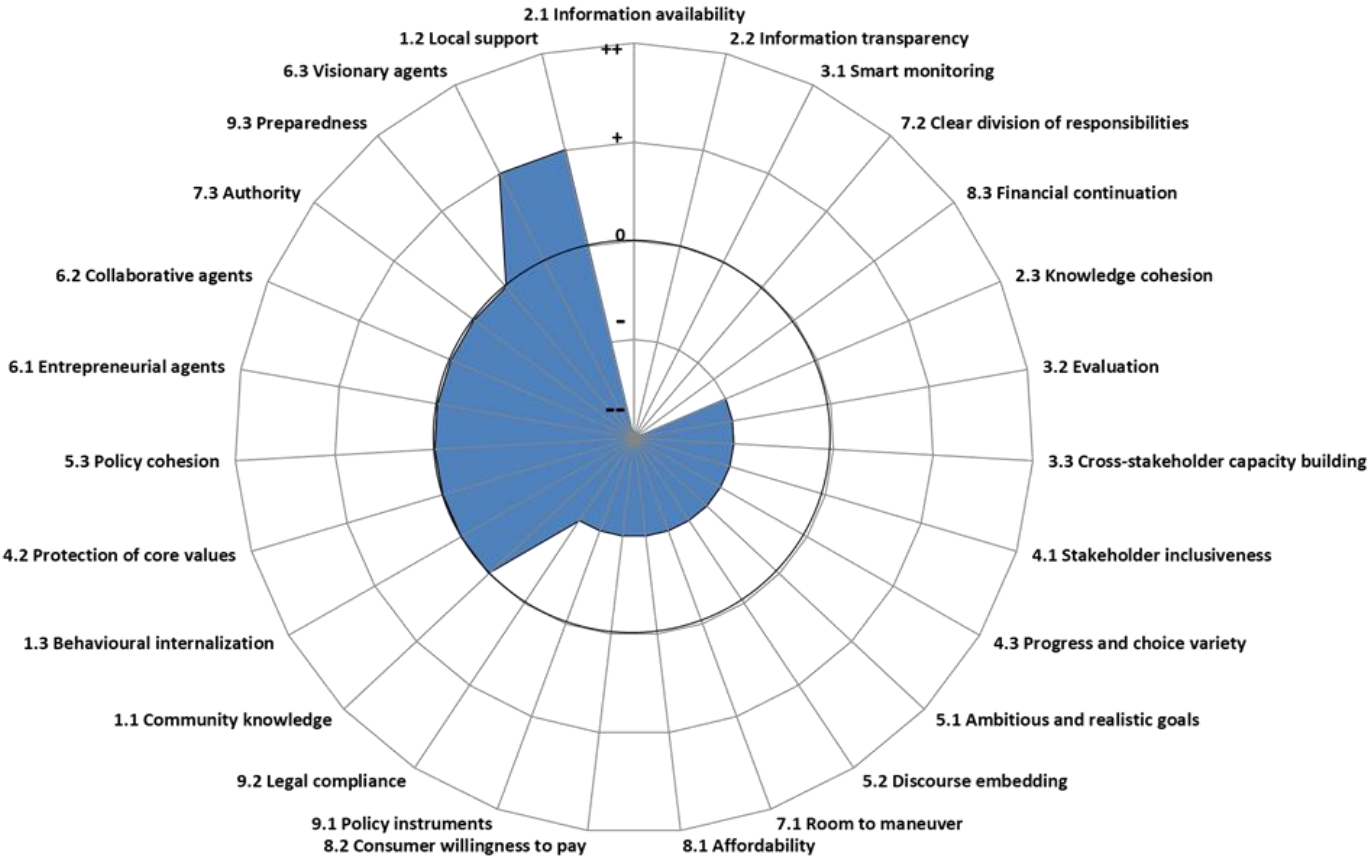
1. The Ministry of Water and Energy which is in charge of sanitation and wastewater collection and treatment,
2. The Ministry of Health which is responsible for household hygiene and sanitation through the Institute of Public Hygiene and Sanitation (IHPA) which deals with all domestic matters and sets standards of septic tanks,
3. The Ministry of Public Works does everything related to stormwater collection,
4. The ministry of Environment deals with water pollution and general pollution.

Within the ministry of environment there are different 'general directorates' such as that for aquatic resources or that of nature protection (DGEPN). In addition to this there are also regulatory bodies associated to the ministry of environment such as the National Centre for Anti-Pollution (CNAP or CENAP) and the High Commission of the environment, however, the former is soon to be dismantled.

Interviewees (key representatives of following organisations):

- Interviewee 1: NGO Génération Eau Claire (Generation Clear Water) 10/03/20
- Interviewee 2: National Centre for Anti-Pollution (CNAP) 13/03/20
- Interviewee 3: General Directorate of Water and Forests, Ministry of the Environment (17/03/20)
- Interviewee 4: Omar Bongo University (12/04/20)
- Interviewee 5: NGO Generation Eau Clair and RECOJAC youth association (06/05/20)
- Interviewee 6: Ministry of Water resources and Energy (07/05/20)
- Interviewee 7: IRSH/CENAREST Research institute (21/05/20)
- Interviewee 8: General Directorate on Aquatic Ecosystems, Ministry of the Environment (10/06/20)
- Interviewee 9: Institute of Public Hygiene and Sanitation (IHPA) (11/06/20)
- Interviewee 10: NGO, H20 Gabon (15/06/20)

Results of Governance Capacity Framework for Water Pollution in Libreville



Condition 1: Awareness

Awareness refers to the understanding of causes, impact, scale and urgency of the water challenge.

Indicator 1.1: Community knowledge

Predefined question: To what extent is knowledge regarding the current and future risks, impacts and uncertainties of the water challenge dispersed throughout the community and local stakeholders which may result in their involvement in decision-making and implementation?

Score substantiation: 0 = Underestimation (of water related risk)

The score of 0 was chosen as knowledge regarding the current and future risks surrounding the issues of water pollution are underestimated by the communities and stakeholders in Libreville. Most people within the general population seem to know the basic health-related risks of consuming improper water (Interviewee 5, 2020). However, the wider, more specific risks of water pollution to the environment are not known, let alone the future risks such as environmental degradation and its indirect consequences on the economy (such as fishing) are not considered (Levesque-Kombila, 2017). Some stakeholders and community organisations voice the issues of water pollution and inadequate sanitation and try to do something about it (Allogho, 2006), as for example some young people volunteering to collect litter (Provost, 2009).

++	**Balanced awareness**	Nearly all members of the community are aware of and understand the actual risks, impacts and uncertainties. The water challenge is addressed the local level. Local communities and stakeholders are familiar with or are involved in the implementation of adaptation measures
+	**Overestimation**	The community is knowledgeable and recognize the many existing uncertainties. Consequently, they often overestimate the impact and probability of incidents or calamities. The water challenge has been raised at the local political level and policy plan may be co-developed together with local communities
0	**Underestimation**	Most communities have a basic understanding of the water challenge. However the current risks, impacts and frequencies are often not fully known and underestimated. Future risks, impacts and frequencies are often unknown. Some awareness has been raised amongst or is created by local stakeholders and communities
-	**Fragmented knowledge**	Only a small part of the community recognizes the risks related to the water challenge. The most relevant stakeholders, have limited understanding of the water challenge. As a result, the issue is hardly or not addressed at the local governmental level
--	**Ignorance**	The community, local stakeholders and decision-makers are unaware or ignore the water challenge. This is demonstrated by the absence of articles on the issue in newspapers, on websites or action groups addressing the issue

Indicator 1.2 Local sense of urgency

Predefined question: To what extent do actors have a sense of urgency, resulting in widely supported awareness, actions, and policies that address the water challenge?

Score substantiation: + = General sense of urgency of long-term sustainability goals

The score of + 'General sense of urgency of long-term sustainability goals' was attributed here instead of 0, as it does seem that the urgency of (surface) water pollution and treating wastewater is experienced by most of the population daily. This is simply due to the fact that there is no formal wastewater treatment system in place in the city (Mombo & Edou, 2007) and people can see and smell the implications of this in the city (waste clogged channels, turbid water, open defecation, etc.). The government knows this too and tries to do things about it as establishing a water code (Law) and through projects such as the Azeng Ayong project. This project consisted of constructing drainage channels in the densely populated drainage basin of the same name. However, the project has been terminated before completion due to insufficient funding (Info 241.com, 2020). Already in 2002 the budget (of Libreville) represented only 1% of the State budget and a share of that went to solid waste collection yet nothing to wastewater treatment showing that this issue is relatively less urgent than others on the central governments agenda (Chaignaud, 2008). There is a sense of urgency among stakeholders regarding water pollution, however, it seldom results in widely supported awareness, actions, and policies (Interviewee 1 and 2; 2020). Issues surrounding water pollution are also mentioned in local elections to gain voters, but little is done subsequently (Provost, 2009).

Actions needed: Education campaigns to general public, especially targeted towards woman and children. (*See next indicator*).

++	**Strong demand for action**	There is a general sense of importance regarding the water challenge. There is continuous, active, public support and demand to undertake action and invest in innovative, ground-breaking solutions. This is evident, since the issue receives much media attention and action plans are implemented
+	**General sense of urgency of long-term sustainability goals**	There is increasing understanding of the causes, impacts, scale and urgency of the water challenge. It leads to general sense of urgency of the need for long-term sustainable approaches. However, measures requiring considerable efforts, budget, or substantial change with sometimes uncertain results are often receiving only temporal support. The water challenge is a main theme in local elections
0	**Moderate willingness for small changes**	There is growing public awareness and increasing worries regarding the water challenge. However, the causes, impact, scale and urgency are not widely known or acknowledged leading to the support for only incremental changes. It is a side topic in local elections
-	**Raising of awareness by small groups**	A marginalized group (e.g. the most vulnerable, environmentalists, NGOs) express their concerns, but these are not widely recognized by the general public. Adaptation measures are not an item on the political agenda during elections

--	**Resistance**	There is generally no sense of urgency and sometimes resistance to spend resources to address the water challenge. It is not an item on the political agenda during elections, as is evident from the lack of (media-) attention

Indicator 1.3 Behavioural internalisation

Predefined question: To what extent do local communities and stakeholders try to understand, react, anticipate and change their behaviour in order to contribute to solutions regarding the water challenge?

Score substantiation: 0 Exploration

Especially in informal settlements, sewage and household (liquid) waste is discharged into community latrines or into the wilderness. It is not clear whether the local communities and stakeholders try to understand and change their behaviour in order to contribute to solutions regarding water pollution. From the communities' perspective the behaviour that one should ideally desire is to not dump solid or liquid waste into the environment or adjacent water bodies. There is no desire from the population to throw their waste into the environment, however, it is the conditions that impose them this behaviour (Interviewee 1, 2020). 'It is an easy gesture (to discharge waste in water bodies) for the households because there is no garbage collection or sewage system, so the easiest thing to do is just to throw the garbage and sewage into the watercourses' (Interviewee 5, 2020). This is the main source of water, soil and food contamination (Provost, 2009).
Such behaviour is known to be detrimental, however, it is very difficult to change. Firstly, due to the controlled, high urbanisation rate of 87.1% (Worldpopulationreview, 2020), many informal settlements *(+- 80% of city*) are located in drainage basins as these used to be uninhabited due to risk of flooding in the city (Mboumba, 2007; Pottier and Ovono, 2019). Such poor neighbourhoods usually only have archaic sanitation measures, with pit latrines and sewage tanks, and are not connected to the wider city sewage network (Mombo and Edou, 2007). In addition to this, because they are difficult to access by more 'formal' waste management companies, most solid and liquid waste ends in the adjacent water bodies.

Secondly, there also is a cultural and sociological aspect. Many Gabonese have moved from the countryside to the capital and have traditionally used more biodegradable materials in the former rural homes, which were mostly disposed in nature (Interviewee 8, 2020). Such behaviours persist today with many, especially the more recently immigrated which mostly move to such under integrated neighbourhoods in the drainage basins.

Regarding the younger generation we have seen some efforts at trying to clean the environment, as for example local beach or rubbish collection clean up schemes (Provost,2009).

++	**Full internalisation**	Because actors are fully aware of the water challenge, their causes, impacts, scale and urgency, it is integrated into long-term and joint strategy, practices and policies. All actors are encouraged to participate. At this point, the water challenge is integrated into everyday practices and policies
+	**Moderate internalisation**	Awareness has evolved to mobilization and action. There are various incentives for actors to change current practices and approaches regarding the water challenge. The water challenge, however, is not yet fully integrated into clear strategy, practices and policies

0	**Exploration**	There is a growing awareness, often as a result of local, exploratory research regarding the causes and solutions of the water challenge. There are only incremental changes in actions, policy and stakeholder's behaviour
-	**Recognized as an external pressure**	The water challenge is partly recognized, mainly due to external pressure instead of intrinsic motivations. There is no support to investigate its origin or to proceed to action or changing practices
--	**Unawareness**	There is unawareness of the water challenge with hardly any understanding of causes and effects or how current practices impact the water challenge, the city or future generations

Condition 2: Useful knowledge

This condition describes the qualities of information with which actors have to engage in decision-making.

Indicator 2.1 Information availability

Score substantiation: - - = Lack of information

There is a severe lack of data available on water pollution, its causes and related issues (Binga, ND; Interviewee 4, 2020). It may be that some relevant ministries or the SEEG are in the possession of information on water quality, however, none of this data is easily publicly accessible and might not be available et al. For an NGO, in order to receive information on water pollution, the procedure is that one has to apply to the institutions and then they give access to the documents (Interviewee 10, 2020).

Information on water pollution in Libreville is hardly accessible on the World Wide Web. There may be some circumstantial information in the hands of the relevant ministries, however, this information is not shared or made public in a systematic way to inform all stakeholders (Interviewee 8 and 1, 2020). Generally, there is a lack in data gathering on water quality in Libreville (Interviewee 4, 2020). Such unreliable and unavailable information on water pollution, makes it extremely difficult to meet current and future demands to reveal information gaps and enhance decision making. A lack of sharing of information also proves detrimental to a general sense of learning on the issues of water pollution as incidents may not be reported and even if they are, may not be heard by the relevant authorities.

++	**Comprehensive information enabling long-term integrated policy**	A comprehensive and integrated documentation of the issue can be found on local websites and policy papers. It is characterized with adequate information, an integrated description of social, ecological and economic processes regarding the water challenge, as well as goals and policies. Furthermore, progress reports on effective implementation can be found
+	**Information enhancing integrated long-term thinking**	Strong effort is put in providing integrated information from various fragmented sources. Information gaps are identified and attempted to be bridged. This may be clear from extensive documentation on the long-term process. Also citizen knowledge may be taken into account

0	**Information fits demand, limited exploratory research**	Information on the water challenge is available. Knowledge on understanding or tackling the water challenge is progressing and is produced in a structural way. Knowledge gaps are hardly identified due to lock-in into existing disciplines and policy. This is apparent from the quantity of factual information, but the causes, risks and impacts of long-term processes are lacking behind
-	**Information scarcity and limited quality**	Limited information is available which does not grasp the full extent of the water challenge. In some cases not all information is of sufficient quality to generate a comprehensive overview
--	**Lack of information**	No information on the water challenge can be found. Or the scarce available information is of poor quality

Indicator 2.2 Information transparency

Predefined question: To what extent is information on the water challenge accessible and understandable for experts and non-experts, including decision-makers?

Score substantiation**: - = Not transparent and inaccessible knowledge**

Information on water pollution is extremely difficult to access to the wider public and may to a lesser extent be challenging to comprehend for non-experts. The little information that is readily accessible online on the topics of water pollution is usually in the form of scientific papers and reports (e, (Mombo and Edou, 2007, Republique Gabonaise, 2015), nevertheless it is quite outdated and quite scarce. Even in Libreville, a great deal of people also do not have regular access to the internet, which makes the access of such information even more challenging.

Although information sharing is not discouraged, it is not shared enough between the scientific community and the wider public (Interviewee 4, 2020). Information, such as policy documents, are quite difficult to access as it is mostly retained in the hands of the relevant ministries and seldom is it publicly available. The majority of documents and studies cited in this research had to be requested from the respondents themselves and are not publicly available on the internet, making the authors' search for reliable information sources extremely difficult.

++	**Easy access to cohesive knowledge**	Information is easily accessible on open source information platforms. There are multiple ways of accessing and sharing information. Information is often provided by multiple sources and is understandable for non-experts
+	**Sharing of partly cohesive knowledge**	All interested stakeholders can access information. Action has been taken to make knowledge increasingly understandable. Still, it is a time-consuming search through a maze of organizations, protocols and databases to abstract cohesive knowledge and insights
0	**Sharing of very technical knowledge**	There are protocols for accessing information; however, it is not readily available. Although information is openly available, it is difficult to access and comprehend because it is very technical. The water challenge is reported on local websites and reports

-	**Low sharing of fragmentized knowledge**	Information is sometimes shared with other stakeholders. However, information is inaccessible for most stakeholders. Furthermore, knowledge is often technical and difficult to understand for non-experts. The water challenge may be addressed on local websites
--	**Not transparent and inaccessible knowledge**	Information is limitedly available and shared. Sharing may be discouraged. The information that is available is difficult to understand. The water challenge is not addressed on local websites

Indicator 2.3 Knowledge cohesion

Predefined question: To what extent is information cohesive in terms of using, producing and sharing different kinds of information, usage of different methods and integration of short-term targets and long-term goals amongst different policy fields and stakeholders in order to deal with the water challenge?

Score substantiation: - = Low-cohesive knowledge within sectors

To the authors knowledge no examples have been seen of different sectors sharing knowledge with each other to mitigate a water pollution related challenge. Information found on such matter is usually sector specific and very rarely shared between ministries (Gabonreview, 2012; Interviewee 4, 2020). Different methods of producing information are also rarely shared, as for example the ministry of mines who is equipped with analysis laboratories, seldom lends their equipment or laboratories to other ministries or academics which the latter do not possess (Interviewee 4, 2020). Such little sharing of information as well as conflicting views on a specific issue hampers the integration of short- and long-term goals. For example, although there is common goal of improving sanitation measures (Environmental Code, 2011), the term sanitation is defined differently by various ministries. Sanitation by the Ministry of Public Works, sanitation consists in making works, cleaning the gutters and removing the solid waste. For the Ministry of Hydraulic Resources, it is the treatment of wastewater and rainwater (Interviewee 8, 2020).

++	**Implementation of cohesive knowledge**	Stakeholders are engaged in long-term and integrated strategies. Information can be found that is co-created knowledge and will contain multiple sources of information, multiple and mixed methods taking into account the socio-, ecological and economic aspects of the water challenge
+	**Substantial cohesive knowledge**	Sectors cooperate in a multidisciplinary way, resulting in complete information regarding the water challenge. Besides multiple actors, multiple methods are involved to support information. Too many stakeholders are involved, sometimes in an unbalanced way. Knowledge about effective implementation is often limited
0	**Insufficient cohesion between sectors**	Data collection within sectors is consistent and is sustained in multiple projects for about two to three election periods. Knowledge on the water challenge, however, is still fragmented. This becomes clear from different foci of the stakeholders as stated in their organisation's strategies and goal setting
-	**Low-cohesive knowledge within sectors**	Information that is found is sector specific and information is inconsistent within and between sectors

--	**Non-cohesive and contradicting knowledge**	A lack of data strongly limits the cohesion between sectors. Information that is found can even be contradictory

Condition 3: Continuous learning

Continuous learning and social learning is essential to make water governance more effective. The level of learning differs from refining current management, critical investigation of fundamental beliefs or questioning underlying norms and values.

Indicator 3.1: Smart monitoring

Predefined question: To what extent is the monitoring of process, progress, and policies able to improve the level of learning (i.e., to enable rapid recognition of alarming situations, identification or clarification of underlying trends)? Or can it even have predictive value?

Score substantiation: - - = Irregular, poor quality or absent

There is no water quality monitoring system in place throughout the city, except for drinking water supply quality management, in the supply station (and network) (Interviewee 7, 2020). This, however, is monopolised by the drinking water supply and electricity company (SEEG) and it is hard to verify their data (Interviewee 2, 2020). The data remains in their hands and in order to verify it one would have to first request it and/or carry out one's own tests.

Notwithstanding the presence of a drinking water quality system, there are no measures in place which systematically gather data on surface or groundwater bodies, as well as domestic and industrial wastewater (Interviewee 6, 2020).

Consquently, as there is no motoring system in place it is extremely difficult to recognise alarming situations such as the adverse health impacts following floods when sewage water ends up in the streets or a greater amount of solid and liquid waste gets washed into the sea and poses a threat to bathers and the ecosystem. Especially underlying trends such as groundwater acidification and contamination of heavy metals (Ondo, 2011), eutrophication and algal blooms are environmental impacts of water pollution that are relatively unknown. For example, untreated sewage water discharged into water bodies will severely reduce dissolved oxygen (O2) in these as bacteria will work hard to break down suspended solids in the sewage. The flora and fauna in rivers will thus be harmed and reduced by suffocating due to less available oxygen (Owa, 2013).

Water pollution can also have numerous detrimental health impacts, as for example in Gabon in 1995 50% of urban diseases were water related such as diarrhoea, dysentrie and other contagious viral infections which are caused by drinking or washing in polluted water (Mombo and Edou, 2007).

In order to predict future trends and reduce devastating repercussions on the city's water bodies like these, one must constantly gather data on surface and even groundwater quality to see how these change over time and to model future scenarios. Without a monitoring system in place and only sporadic water quality monitoring, it is difficult to improve the level of learning on surface, let alone ground -water quality and diffuse pollution and so better prepare for threats against human or environmental health. Especially in the context of urban population growth and climate change, water pollution and floods are likely to become more problematic for human and ecosystem health if left unaddressed.

++	**Useful to predict future developments**	Monitoring system is adequate in recognizing alarming situations, identifying underlying processes and provides useful information for identifying future developments. Reports of monitoring will display discrepancies between fundamental beliefs and practices. The monitoring is changed in order to act

		upon these findings by altering the fundamental beliefs. Often regulatory frameworks are changed, new actors are introduced, new risk management approach are used
+	**Useful to recognize underlying processes**	The abundant monitoring provides sufficient base for recognizing underlying trends, processes and relationships. Reports of monitoring will display discrepancies between assumptions and real process dynamics. Acting upon these findings by altering the underlying assumptions characterizes this level of smart monitoring. Often also system boundaries are re-defined, new analysis approach introduced, priorities are adjusted and new aspects are being examined
0	**Quick recognition of alarming situations**	Monitoring system covers most relevant aspects. Alarming situations are identified and reported. This leads to improvement of current practices regarding the technical measures. There is only minor notification of societal and ecological effects
-	**Reliable data but limited coverage**	Monitoring occurs, however the monitoring system does not cover all facets of the water challenge, with sometimes incomplete description of the progress and processes of technical and policy measures. Monitoring is limited to singular effectiveness or efficiency criteria and cannot identify alarming situations
--	**Irregular, poor quality or absent**	There is no system to monitor the water challenge or monitoring is irregular

Indicator 3.2: Evaluation

Predefined Question: To what extent are current policy and implementation continuously assessed and improved, based on the quality of evaluation methods, the frequency of their application, and the level of learning

Score substantiation: - = Non-directional evaluation

It seems like there are only sporadic policy evaluation mechanisms in place like environmental impact assessments or normal studies which vary according to ministry (Interviewee 6, 2020). The Ministry of water resources for example conducts a report every year evaluating the projects of the past year in order to assess what has been done (Interviewee 6, 2020). However, due to absence of specific policies on water pollution (only broad laws from the environmental code), as well as no consistent monitoring system in place, it is impossible to evaluate policies that do not exist. Without monitoring on surface and groundwater quality it is extremely challenging to evaluate whether policies or projects against water pollution work in practice. For example, if a new law specifically aiming to reduce direct wastewater discharge into surface waters in the upcoming water code is passed, one needs consistent gathering of data before, during and way after the creation of the policy to know if it has had any effect.

There do exist annual performance reports of various ministries which evaluate sporadic measures of dealing with water pollution related issues (interviewee 6, 2020). However, these are no policies transcending all ministries and so cannot be evaluated in a consistent and comprehensive manner.

In conclusion, there do not seem to be consistent evaluation criteria on water pollution polices in practice or coherent data gathering, which makes them hard to improve. However, there is a new

water code being established, which may suggest that the government has recognised the lack of policies on specific urban water pollution and seeks to improve them.

++	**Exploring the fitness of the paradigm**	Frequent and high quality evaluation procedures fully recognize long-term processes. Assumptions are continuously tested by research and monitoring. Evidence for this is found in sources (primarily online documents) that report on the learning process and progress. Uncertainties are explicitly communicated. Also, the current dominant perspective on governance and its guiding principles are questioned
+	**Changing assumptions**	There is continuous evaluation, hence continuous improvements of technical and policy measures and implementation. Innovative evaluation criteria are used. This is evidenced by reports containing recommendations to review assumptions or explicitly indicating the innovative character of the approach
0	**Improving routines**	The identified problems and solutions are evaluated based on conventional (technical) criteria. Current practices are improved. This becomes clear from information of the used and existing criteria, the small changes recommended in reports and short-term character
-	**Non-directional evaluation**	Evaluation is limited regarding both frequency and quality. Evaluation occurs sometimes, using inconsistent and even ad-hoc criteria. Also the evaluation is not systematic. There is no policy on the performance of evaluations, only the evaluation(s) itself are reported
--	**Insufficient evaluation**	There is no evaluation of technical or policy measures regarding the water challenge. Otherwise it is not documented

Indicator 3.3: Cross stakeholder learning

Predefined Question: To what extent **are stakeholders open to and have the opportunity to interact with other stakeholders** and deliberately choose to learn from each other?

Score substantiation: - = Small coalitions of stakeholders with shared interest

The score of minus 'Small coalitions of stakeholders with shared interest' was attributed here, as although stakeholders are open for interaction, it seldom takes place in practice. Regarding sanitation, the ministry of Health states that there has been insufficient collaboration between different departments and sectors (Ministry of Health, 2012). Especially in the field of water pollution there is not much collaboration between different relevant stakeholders, particularly at the top down level with the government not always agreeing with the municipalities and communities (Interviewee, 7, 2020; Allogho, 2006). Thus, there are not many opportunities for stakeholders to interact and deliberately come together to collaboratively deal with a specific water pollution issue and learn from each other. However, some small coalitions exist, as between NGOs and communities, with the former being able to empower the latter.

++	**Putting cross-stakeholder learning into practice**	There is recognition that the water challenge is complex and that cross-stakeholder learning is a precondition for adequate solutions and smooth implementation. This is evidenced by broad support for policy measures and implementation. Moreover, continuous cross-stakeholder learning programs are in place or may be institutionalized
+	**Open for cross-stakeholder learning**	Stakeholder interaction is considered valuable and useful for improving policy and implementation. Various initiatives for cross-stakeholder learning have been deployed, yet the translation into practice appears difficult. The programs may not be structural and the learning experience may not be registered and shared
0	**Open for stakeholder interaction**	Stakeholders are open to interaction, though not much learning is going on due to the informative character of the interaction. Often, a number of stakeholders, that do not necessarily share interests or opinions, are involved in the decision-making process
-	**Small coalitions of stakeholders with shared interest**	Interaction occurs in small coalitions based on common interests. Opinions of those outside the coalition are generally withheld. Only information for the shared point of view is sought. This is evidenced by the finding of only one perspective regarding the water challenge or few perspectives that are supported by means of circle-referencing
--	**Closed attitude towards cross-stakeholder learning**	There is no contact with other parties, contact may even be discouraged. This is apparent from limited sharing of experience, knowledge and skills. No information is shared outside organisation and sector, nor is external information used

Condition 4

Indicator 4.1 Stakeholder inclusiveness

Predefined question: To what extent are stakeholders interact in the decision-making process interaction (i.e., are merely informed, are consulted or are actively involved)? Are their engagement processes clear and transparent? Are stakeholders able to speak on behalf of a group and decide on that group's behalf

Score substantiation: 0 = Untimely consultation and low influence

Some stakeholders, such as NGOs or affected communities, are consulted before new water pollution or sanitation related projects are taking place, however, various local experts representing different interests all indicate that there are no clear procedures for stakeholder participation and stakeholders usually have low influence on the outcomes of the decisions made and are included quite late in this process (Interviewee 5; 7, 2020). Thus, it appears that stakeholders from the civil society are merely consulted rather than actively involved and that engagement processes are not clear nor transparent. Nevertheless, some stakeholders like the NGOs appear to be able to speak on behalf of the communities and advise these, by for example doing awareness campaigns (Interviewee 5, 2020). This also makes room for different collaborations, as for example the Catholic organisations or NGOs being able to support communities in certain efforts to improve sanitation (Provost, 2009).

++	**Transparent involvement of committed partners**	All relevant stakeholders are actively involved. The decision-making process and the opportunities for stakeholder engagement are clear. It is characterised by local initiatives specifically focussing on water such as local water associations, contractual arrangements, regular meetings, workshops, focus groups, citizen committees, surveys
+	**Timely, over-inclusive and active involvement**	Stakeholders are actively involved. It is still unclear how decisions are made and who should be involved at each stage of the process. Often too many stakeholders are involved. Some attendants do not have the mandate to make arrangements. Stakeholder engagement is abundantly done for often overlapping issues
0	**Untimely consultation and low influence**	Stakeholders are mostly consulted or informed. Decisions are largely made before engaging stakeholders. Frequency and time-period of stakeholder engagement is limited. Engagements are mainly ad hoc consultations where stakeholders have low influence on the end-result
-	**Non-inclusive involvement**	Not all relevant stakeholders are informed and only sometimes consulted. Procedures for stakeholder participation are unclear. If involved, stakeholders have but little influence
--	**Limited supply of information**	No stakeholders are included, or their engagement is discouraged. Information cannot be found on the extant decision-making process.

Indicator 4.2 Protection of core values

Predefined question: To what extent 1) is commitment focused on the process instead of on early end-results? 2) do stakeholders have the opportunity to be actively involved? 3) are the exit procedures clear and transparent? (All three ensure that stakeholders feel confident that their core values will not be harmed.)

Score substantiation: 0 = Suboptimal protection of core values

It is not clear whether commitment is focused on the process instead of on early end results, however, although some stakeholders can be involved, the exit procedures are not clear nor transparent. In the rare cases that stakeholders are actively engaged, alternatives are insufficiently considered (see next indicator) and influence on decision making seems to generally be quite low (see previous indicator). The communities as a whole do not have much influence on decisions making, only some people within them may have more say. Although the government may consult the populations it usually does not really take their needs into account and imposes projects on them (Interviewee 9, 2020). Thus, it seems that generally socio-cultural values of the communities is seldom explicitly taken into account (Allogho, 2006; Interviewee 1; 4, 2020). However, at the same time NGOs speak on behalf of affected communities and in some sort can give them a 'voice' and empower these by advising and supporting them (Interviewee 5, 2020). Next to these stakeholders, private actors like Veolia or Averda have had disputes with the government, as the latter withheld due payments to the former companies (Takoleu, 2019).

++	**Maximal protection of core values**	Stakeholders are actively involved and have large influence on the end-result. There are clear exit possibilities and leading to more stakeholders more committed to the process. The participation opportunities and procedure of implementation are clear.
+	**Requisite for early commitment to output**	Stakeholders are actively involved and expected to commit themselves to early outcomes in the process. Hence relevant stakeholders may be missing in contractual arrangements as they do not want to commit themselves to decisions to which they have not yet contributed. At this point involved stakeholders have influence on the end-result and therefore the output serves multiple interests
0	**Suboptimal protection of core values**	As stakeholders are consulted or actively engaged for only short periods, alternatives are insufficiently considered. Influence on end-result is limited. Decisions comply with the interests of the initiating party primarily. There are no clear exits in the engagement process
-	**Non-inclusive and low influence on results**	The majority of stakeholders is engaged, but the level of engagement is low (informative or sometimes consultative). There is a low influence on the result which invokes resistance, for example on internet platforms and newspapers
--	**Insufficient protection of core values**	Because stakeholders are hardly engaged or informed, core values are being harmed. Implementation and actions may be contested in the form of boycotts, legal implementation obstructions and the invoking of anti-decision support. There may be distrust and an absence of participation

Indicator 4.3 Progress and variety of options

Predefined question: To what extent are procedures clear and realistic, are a variety of alternatives co- created an thereafter selected from , and are decisions made at the end of the process in order to secure continued prospect of gain and thereby cooperative behavior and progress in the engagement process?

Score substantiation: - Rigid procedures limit the scope

It is not known whether exit procedures are clear and realistic, or if a variety of alternatives are co-created and whether decisions regarding water pollution related projects are being made at the end of the process. Based on the little information that has been found on this indicator, a preliminary score of – 'Rigid procedures limit the scope' is attributed here. Communities are consulted on some occasions, however, the outcomes are not always clear (interviewee, 8). One interviewee stated that there was a project of the watershed project for the rectification of the main riverbeds to reduce flooding. For the project people had to be relocated. The State had to relocate the identified populations, but they did not do it. Another interviewee did argue that there was a project in the drainage basins of Libreville, where some populations had to be relocated and that the government did compensate these rightfully (Interviewee 9, 2020). However, upon request both interviewees did not provide any hard evidence to support such claims and no information could be found on the internet to disprove or prove either of these.

++	**Active engagement with choice selection at the end of the cooperation**	There is active engagement of all relevant stakeholders and clarity of participation procedure and realistic deadlines. The range of alternatives is fully explored and selection of the best alternatives occurs at the end of the process. Reviews of stakeholder meetings provide the alternatives addressed. Stakeholders are engaged throughout the whole process as specified in contractual agreements
+	**Active involvement with abundant choice variety**	Stakeholders are actively involved and there is sufficient room for elaborating alternatives. Procedures, deadlines and agreements are unclear. There is no or few specification on deadlines in terms of dates. Due to inexperience with active stakeholder engagement, decisions are taken too early in the process leading to the exclusion of argument and solutions. Hence, decisions may not be fully supported
0	**Consultation or short active involvement**	There is a clear procedure for consultation or short active involvement of stakeholders, but the opportunities to consider all relevant alternatives is insufficient. Decisions are therefore still largely unilateral and solutions suboptimal. The suboptimal character of a solution can be observed from evaluations or difference in opinions
-	**Rigid procedures limit the scope**	Informative and consultative approaches are applied, according rigid procedures with low flexibility. The period of decision-making is short with a low level of stakeholder engagement. These unilateral decision-making processes may lead to slow and ineffective implementation. The latter can be observed from critique via public channels
--	**Lack of procedures limit engagement and progress**	The lack of clear procedures hinder stakeholder engagement. This unilateral decision-making limits progress and effectiveness of both decision-making and implementation. It might result in conflicting situations. Often, much resistance can be found online and implementation may be obstruct

Condition 5: Policy ambitions

Management Ambitions Policy ambitions assesses if current policy is ambitious, feasible, well-embedded in local context and if it forms a cohesive set of long-term and short-term goals within and across sectors.

Indicator 5.1 Ambitious and realistic management

Predefined question: To what extent are goals ambitious(i.,e identification of challenges, period of action considered, and comprehensiveness of strategy) and yet realistic(i.e. cohesion of long term goals and supporting flexible intermittent targets, and the inclusion of uncertainty in policy)?

Score substantiation: - = Short-term goals

Generally, goals concerning the mitigation of water pollution, sanitation and to a lesser extent wastewater treatment, are quite ambitious. The challenges, except the latter, are identified in the Strategic Plan for an Emerging Gabon (PSGE) and the environmental code. There are overarching

policy goals against pollution like the 'Action 13' and Objective 19 in the Strategic Plan for an Emerging Gabon (PSGE) drawing on 'the fight against pollution and nuisances', mentions that water should be addressed in anti-pollution efforts, yet it is not specified how this will be done in practice (Gabonese Republic, 2012). There are more long-term goals, as for example to give everyone access to sanitation by 2025 (AfDB, 2016). However, in reality only about half of the city's population has access to improved sanitation, especially in the poorer informal settlements of the city where archaic pit latrines are still commonly used (Mombo & Edou, 2007; Chaignaud, 2008).
The level of ambition is not supported with intermittent goals and targets that applied, monitored and indicate the progress that is being made In the PSGE and the environment code, to the author's knowledge, although pollution is defined, sanitation and water pollution are defined making the terms open for interpretation. The issue of household and domestic wastewater treatment is not mentioned, let alone the goals of creating a wastewater treatment system covering the whole of greater Libreville. This is also a paradox for other articles in the code. For example, ambitions are formulated in the environmental code such as; Article 36 ,- Waste of any kind of origin industrial, agro-pastoral, artisanal, mining, commercial, urban or otherwise, must be collected, picked up, treated to eliminate or reduce their harmful effects on health, natural resources and the environment (Environmental code, 2014). However, without defining wate pollution and identifying its causes or without a comprehensive wastewater treatment system in place, this article cannot be applied in practice.

The underlying scheme of operational targets and measures regarding wastewater treatment and pollution control, which are necessary to achieve these overall water quality ambitions, require substantial specification and elaboration. The authorities seem to focus more on solid waste treatment and pluvial flooding rather than wastewater treatment (Mombo and Edou, 2007). For example, the treating of household cooking oils and liquid waste from garages or other small industries in the city are not mentioned in the National Anti Pollution Plan. Thus, long term goals are not supported by flexible intermittent targets, nor is uncertainty included in policies.

++	**Realistic and ambitious strategy**	Policy is based on modern and innovative assessment tools and policy objectives are ambitious. Support is provided by a comprehensive set of intermittent targets, which provide clear and flexible pathways. Assessment tools and scenarios analyses identify tipping points that may be found in policy documents
+	**Long-term ambitious goals**	There is a long-term vision that incorporates uncertainty. However, it is not supported by a comprehensive set of short-term targets. Hence, achievements and realistic targets are difficult to measure or estimate. Visions are often found online as an organisation's strategy. They often entail a description of t he water challenge and need for action
0	**Confined realistic goals**	There is a confined vision of the water challenge. Ambition are mostly focused on improving the current situation where unchanging conditions are assumed and risk and scenarios analyses are lacking
-	**Short-term goals**	Actions and goals mention sustainability objectives. Actions and goals are "quick fixes" mainly, not adhering to a long-term vision or sustainable solutions. Uncertainties and risks are largely unknown

--	**Short-term, conflicting goals**	Goals consider only contemporary water challenges, are short-sighted and lack sustainability objectives. Goals are arbitrary and sometimes conflicting and the character of policy is predominantly reactive

Indicator 5.2 Discourse embedding

Predefined Question: To what extent is sustainable policy interwoven in historical, cultural, normative and political context?

Score substantiation: - = Persistent reluctance and poor embedding

The score of minus was given here largely due to the mismatch of policy adapted to the local context. Libreville is growing rapidly, with most of this growth taking place in such aforementioned 'under integrated neighborhoods' which are characterized by a relatively poor population living in an environment vulnerable to water contamination, especially in the '*bassins versants'* (drainage basin). In these *bassins versants* water pollution is severe as most domestic solid and all liquid waste ends in the adjacent watersheds which poses a severe health threat due to flooding during the rainy season. Policies do not address such under integrated neighborhoods in more case tailored efforts, taking the socio-economic and cultural characteristics of these areas into account (Interviewee 4 and 7, 2020). As previously mentioned, the behavior of discharging liquid or solid waste into the environment is in part due to cultural factors and in part due to contextual urban factors which do not leave many communities with a different choice than to pollute. It does not seem that environmental policies seek to address cultural factors of those recent rural to urban migrants, nor seek to improve waste collection measures in such under integrated neighborhoods. There is an urgent need, however, to take all segments of society into account, especially since local communities voice their discontent of water pollution issues (Interviewee 5, 2020). In addition to all of this, one must consider that because sanitary conditions are so deplorable in such deprived neighborhoods, human psychology will thus influence people's behavior to contribute to such deplorable sanitary practices, i.e. to throw rubbish into nature and liquid waste into streams (Keizer et al., 2008).

++	**Embedding of sustainable implementations**	Local context is used smartly to accelerate policy implementation. Innovations are subdivided into suitable phases which are more acceptable and effectively enables sustainable practices. Effective policy implementation is enabled by a general consensus that long-term integrated policy is needed to address the water challenge
+	**Consensus for sustainable actions**	There is a consensus that adaptation is required, but substantial effort is necessary as there is little experience in addressing the water challenge in a long-term integrated approach. Furthermore, the decision-making periods are long as trust relations with new unconventional partners need to be built
0	**Low sense of urgency embedded in policy**	Current policy fits the local context. The water challenge is increasingly identified, framed and interwoven into local discourse, but the disregard of uncertainty prevents a sense of urgency that is necessary to adopt adequate adaptation measures. Decision making often results in very compromised small short-term policy changes
-	**Persistent reluctance and poor embedding**	Actors feel reluctant to execute current policy as it conflicts with their norms and values. Policy hardly takes the local context and existing discourses into account. And the policy does not correspond with societal demands. This

		may lead to distrust between actors, inefficient use of resources and ineffective overall implementation
--	**Policy mismatch**	Cultural, historical and political context is largely ignored, leading to arduous policy implementation. Actors may not understand the scope, moral or to whom it applies or how to implement it (total confusion)

Indicator 5.3 Management cohesion

Predefined Question: To what extent is policy relevant for the water challenger, and coherent regarding 1)geographic and administrative boundaries, and 2) alignment across sectors, government levels, and technical and financial possibilities?

Score substantiation: 0 Fragmented policies

The laws in place against water pollution in the environment code could be more relevant and coherent regarding geographic boundaries and more aligned across different sectors and levels. The policies do not fully take into account the geographic differences within Libreville, particularly, that certain densely inhabited, 'under-integrated' neighborhoods not disposing of sanitation measures and inaccessible to solid waste collection services, are prime sources of ground and surface water pollution (Interviewee 7, 2020; Environment code 2011). Article 15 of the environmental code states: 'It is forbidden to deposit, throw away, dump or scatter solid, liquid or solid waste or residues, or gas, or any other substance likely to pollute the soil in places other than those exclusively provided for this purpose by the texts in force.' (Republique Gabonaise, 2011). However, if in such 'under-integrated' neighborhoods no formal sanitation and no solid or liquid waste collection services exist, this law cannot be respected even if the populations know about it and want to respect it.

In addition to this, policies are not aligned according to different governmental levels, as there are departments that make strategies without consulting the municipalities and there may be a dysfunction between technicians who depend on the central administrations and the local policies of municipalities (Interviewee 8 and 9, 2020).

++	**Cohesive synergetic policies**	Policies are coherent and comprehensive within and between sectors. There is an overarching vision resulting in smooth cooperation. Goals are jointly formulated, evaluated and revised to adapt to new challenges. This is evidenced by thematic instead of sectoral approaches. Many inter-sectoral meetings, interdisciplinary reports and cohesiveness in goals and strategies are formulated
+	**Overlapping comprehensive policies**	There is cross-boundary coordination between policy fields to address the water challenge. Policies are cohesive, but have not yet resulted in broad multi-sectoral actions. Efforts to harmonize different sectors are evident by employee functions or assignments and protocols
0	**Fragmented policies**	Policy is fragmented and based on sector's specific scope and opportunities for co-benefits are hardly explored. However, effort may be made to balance the resource allocation between sectors
-	**Opposing sectoral policies**	Overall water and climate adaptation policy is characterised by fragmentation and imbalance between sectors. The majority of resources

		is spent on the dominant policy field and overlap between sectors lead to inefficient use of resources
--	**Incompatible policies**	Policies between and within sectors are strongly fragmented and conflicting. This is evidenced by contradicting objectives and the squandering use of resources

Condition 6: Agents of change

In order to drive change, agents of change are required to show direction, motivate others to follow and mobilize the resources required.

Indicator 6.1 Entrepreneurial agents

Predefined question: To what extent are the entrepreneurial agents of change enabled to gain access to resources, seek and seize opportunities, and have influence on decision-making ?

Score substantiation: 0

Some community leaders or elected representatives, who represent certain communities may not have access to resources, nevertheless may have influence on decision-making. When communities have concerns, they contact an elected representative who speaks on their behalf and defends them (Provost, 2009; Interviewee 10, 2020). Such community representatives may seek opportunities and have influence on decision-making, as they speak with the government when sanitation related projects are organized, however, if their views are respected in the end remains questionable (Interviewee 10, 2020). Some argue that local populations are never asked about their opinions on decisions made and are only really considered if they need to vacate land that is needed or illegally inhabited (Backouyanga, 2014). Through such community representatives, it may be possible for communities to seek opportunities with NGOs and in some cases to officials from mayor's office or local political leaders or even the media , who may then transmit messages further to the 'top' (Interviewee 1, 2020).

++	**Long-term support for entrepreneurship**	There is recognition of the need for continuous innovation, hence applied research is enabled that explores future risk management and supports strategy formulation. The experiments yield increased benefits and new insights. This is recognized by other actors, thereby providing access to new resources. Continuous experimentation is secured by long-term and reliable resource allocation
+	**Tentative experimental entrepreneurship**	There is a growing understanding of the water challenge's uncertainty, complexity and need for innovative approaches that entail a certain level of risk. Tentative experimental projects set in but are paid by conventional resources. Projects are small-scale pilots
0	**Conventional and risk-averse entrepreneurship**	Entrepreneurial agents of change are better able to seize low-risk opportunities. Therefore opportunities for innovative approaches and synergies are hardly pursued. Small changes can be observed

-	**Room for short-sighted entrepreneurship**	Agents of change struggle to gain access to resources to address imminent water challenges. Windows of opportunity to identify and to act upon perceived risks are limited. Opportunities to address stakeholders with potential access to resources are rarely seized
--	**Insufficient entrepreneurship**	Ignorance for risk and threats leads to ineffective rigid governance and lack of opportunity for entrepreneurial agents to enable improvements. Moreover, distrust by other actors and potential investors, further decrease access to resources

Indicator 6.2 Collaborative agents

Predefined question: To what extent are actors enabled to engage, build trust-collaboration, and connect business, government and sectors, in order to address the water challenge in an unconventional and incomprehensive way

Score substantiation: 0 = Agent are enabled to enhance conventional collaboration

It does not seem that actors are enabled to engage and connect business and government sectors in order address water pollution (Interviewee 4, 20). However, some agents can enhance traditional collaborations. Traditional coalitions with trusted relationships exist within communities themselves, with sometimes certain kind of 'community leaders' taking the initiative of organizing communal efforts (Provost, 2009; Interviewee 10, 2020). Next to this, there are also novel collaborations between young people who volunteer and assemble to improve sanitation efforts (Provost, 2009). Community representatives, along with NGOs, may also facilitate collaborations between the civil society and the government. There was a case of water pollution from the Ntoum Cement plant (38km) outside of the capital, where the plant caused a lot of pollution and the NGO H20 Gabon, along with the local community representatives managed to have enough influence to shut down the plant (Interviewee 10, 2020). More such examples have to the authors knowledge, have not taken place within Libreville.

++	**Agents of change enhances wide-spread synergetic collaboration**	There is on-going build-up of productive and synergetic collaborations. Facilitators may even be administered to coordinate this through mediation and authority. There is a conception of the ideal collaboration composition
+	**Agents of change can push for collaboration between new stakeholders**	There is an understanding that water challenges requires long-term and integrated solutions. Hence, wide-spread collaborations between a variety of stakeholders and sectors are being established. New collaborations with unconventional actors, result, more and more, in valuable new insights and effective networks
0	**Agent are enabled to enhance conventional collaboration**	Traditional coalitions are preserved to maintain status quo. There is trust within these coalitions. There is limited space to create new collaborations. If new collaboration occurs solutions are still mostly sectoral and short- to mid-term

-	**Insufficient opportunities for collaborative agents**	There is insufficient opportunity for agents of change to go beyond conventional collaboration. The current collaborations are deemed sufficient to deal with the water challenge whereas the vision is limited to ad hoc command and control approaches
--	**Lack of collaborative agents**	Collaboration is discouraged, because of a strong hierarchical structure. There is distrust between stakeholders and the willingness and thereby opportunities for collaborative agents are largely lacking

Indicator 6.3 Visionary agents

Predefined question: To what extent **are actors in the network able to manage and effectively push long term and integrated strategies** which are adequately supported by interim targets?

Score substantiation: preliminary score + Long-term vision with flawed communication

There are some visionary agents such the mayor of the Libreville or the minister of water and energy and even the prime minister, who put forth long-term visions on sanitation (Gabon review, 2018). However, these agents are not always quite clear in their formulations on water pollution and how this problem may be addressed (interviewee 10, 2020). The general director of the general directorate of the technical services to the environment and urban amenities vowed in a press conference in February of this year to dedicate all his efforts on improving sanitation in the city and working closely with the mayors office (Gabonnews, 2020)

On a smaller scale there are local political leaders and the mayor who do communicate their visions on securing better sanitation for all and ameliorate wastewater and sewage networks in the city (Interviewee 10, 2020). The mayor of Librveille, Leandre Nzue, has proclaimed that he will compose and guide a team dedicated to making the environments of Libreville cleaner with sanitation at the heart of this project (Mikomba, 2019).

++	**Long-term vision supported by short-term targets**	Visionary agents of change in different positions and with different backgrounds actively and successfully promote a sustainable and tong-term vision regarding the water challenge, that is communicated clearly. Short-term targets fit the long-term visions. There is interest and employment in trend analysis.
+	**Long-term vision with flawed communication**	There is a clear long-term, integrated and sustainable-oriented vision. There is still some discrepancy between short-term targets and implementation strategies and the long-term vision from visionary agents of change. This means that agents are not always clear in their formulation regarding the effect and impact of envisioned strategies
0	**Defense of status quo**	The visions of the existing agents of change are limited to promoting the business as usual. They do not oppose nor promote long-term, integrative thinking. Interest or employment in trend analysis is limited
-	**Unilateral and short-term vision**	There is a unilateral vision regarding the water challenge, which considers a limited groups of actors. The vision often has a short-term focus, with a maximum of 3 to 4 years

--	**Deficient sustainability vision and short-term focus**	There is a lack of visionary agents that promote change towards a long-term, sustainable vision regarding the water challenge. Diverging expectations and objectives of stakeholders are the result. This may be evidenced by indecisiveness or even conflicts. Long-term and integrative initiatives may also be blocked

Condition 7: Multi-level network potential

Urban water governance involves a plethora of actors and interests from all levels of government, organizations and (private) stakeholders. For sustainable solutions, working in networks is an essential determinant for effective solutions.

Indicator 7.1: Room to maneuver

Predefined question: To what extent do the actors have the freedom and opportunity to develop a variety of alternatives and approaches (This includes as hoc, fit for purpose partnerships that can adequately address existing or emerging issues regarding the water challenge)?

Score substantiation: 0 = Limited room for innovation and collaboration

In theory actors in the civil society are not allowed to just take the decision in their own hands of managing their wastewater (Interviewee 9 , 2020). The institute of public hygiene and sanitation is obliged to guide the population according to the predefined standards and possibilities. In practice, there are community sanitation initiatives, who work with NGOS who listen to and help the former (Interviewee 10, 2020). For example there are community initiatives in which some communities choose representatives to talk to NGO's like Brainforest who may speak on behalf of the communities to the government or private actors (Interviewee 10, 2020).

Private actors, like the beverage company Sobraga, as well as some hotels and hospitals, have autonomously built their own onsite wastewater treatment facilities.

++	**Freedom to develop innovative solutions**	There is a common and accepted long-term vision for dealing sustainably with the water challenge. Within the boundaries of this vision, actors are given the freedom to develop novel and diverse approaches and partnerships, resulting in continuous improvements and exploration. These partnerships are most likely institutionalized
+	**Redundancy to address uncertainty**	There is recognition that a high degree of freedom is necessary to deal with complex situations in the form of experiments and looking for new unconventional collaborations. There is a dynamic mix of cooperative partnerships and a redundant set of diverging alternative solutions. A clear overall vision to steer research is however lacking
0	**Limited room for innovation and collaboration**	Actors are given the means to perform predefined tasks for dealing with problems that are framed with a narrow, short-term and technical-oriented scope. There is limited room to deviate. Solutions are sought in own sectoral field and expertise
-	**Limited autonomy**	Only a few actors receive some degree of freedom, there are limited opportunities to develop alternatives, and there is hardly any opportunity to form partnerships with unconventional actors

--	**Strictly imposed obligations**	The actions of stakeholders are strictly controlled and there are rigid short-term targets. Freedom to form new partnerships is strongly limited as actor network composition is fixed and small. There are no resources made available for exploring alternatives that might be more effective or efficient whereas many actors that are affected by the water challenge do not have a voice

Indicator 7.2 Clear division of responsibilities

Predefined question: To what extent are responsibilities clearly formulated and allocated, in order to effectively address the water challenge?

Score substitution: - = Barriers for effective cooperation

The unclear division of responsibilities is a major impediment for 'good governance' on water pollution related issues in Libreville. Before diving in to the score substantiation one must understand the context, that there are 4 main institutions in charge to deal with water pollution related issues;
1. The Ministry of Water and Energy which is in charge of sanitation and wastewater collection and treatment,

2. the Ministry of Health which is responsible for household hygiene and sanitation through the Institute of Public Hygiene and Sanitation (IHPA) which deals with all domestic matters and sets standards of septic tanks

3. The Ministry of Public Works does everything related to stormwater collection.

4. Ministry of Environment deals with water pollution and general pollution. (Interviewee 6, 2020) Within the ministry of environment there are different 'general directorates' such as that for aquatic resources or that of nature protection (DGEPN). In addition to this there are also regulatory bodies associated to the ministry of environment such as the National Centre for Anti Pollution (CNAP or CENAP) and the High Commission of the environment, however, the former is soon to be dismantled.

In practice however, regarding the mitigation of water pollution related issues, responsibilities are not clear and often overlap. For example, the responsibilities of the DGEPN overlap with many other Directorates and ministries such as that of public health. Both the DGEPN and the ministry of health's institute for public hygiene and sanitation (IHPA) carry out controls of surface water quality and deal with complaints (Interviewee 9, 2020; Republique Gabonaise, 2005). In addition to this the competences of these institutional bodies are not clearly defined resulting in overlapping activities and no clear structure as to who must do what exactly in practice (Chaignaud, 2008). In the environmental code there is no mention of other institutions, other than the ministry of the environment, and the role they play in sanitation and wastewater treatment and so hence also against water pollution (Republique Gabonaise, 2014). Furthermore, in this code, sanitation or wastewater treatment is not defined, which may give room to interpretation in responsibilities as to which institutions has to do what in improving these two issues. Many interviewees have stressed that responsibilities as to who has to do what in practice against wastewater treatment or sanitation are not clearly defined and that there exist many overlappings between assigned functions (Interviewees 6, 7 and 9, 2020). All of this also results in these top government institutions not coordinating well with the bottom actors in the municipality and NGOs' ,as the implementation of policies on a practical level does not work well (Interviewee 7, 2020).

++	**Dynamic, fit-for-purpose cooperations**	There are many synergetic cooperations within the urban water network that can provide solutions for the water challenge. The roles and responsibilities are clearly divided amongst actors. These cooperations are dynamic and result in fit-for-purpose problem solving necessary to solve complex, multi-level and unknown challenges
+	**Innovative cooperative strategies**	Actors recognize that knowledge and experience are scattered within the local network. Therefore, extra effort is made to bundle the scattered expertise and to reach fit-for-purpose division of clear roles and responsibilities. New cooperation compositions are explored
0	**Inflexible division of responsibilities**	Responsibilities are divided over a limited set of conventional actors. Opportunities for new cooperation and more effective division of responsibilities are not seized or even recognized. Sometimes conventional actors get more tasks to deal with new water challenges
-	**Barriers for effective cooperation**	Authorities are fragmentized or they lack interest. Moreover, miscommunication and lack of trust are causes that block effective water governance
--	**Unclear division of responsibilities**	There is an unclear division of responsibilities and often the relationships are over-hierarchical. Everybody expects someone else to make required effort and trust is hardly found

Indicator 7.3 Authority

Predefined question: To what **extent are legitimate forms of power and authority present that enable long term, integrated and sustainable solutions** for the water challenge?

Score substantiation: 0 = Restricted authority

The institutions responsible in various ways in dealing with water pollution related issues do in theory seem to have the authority to deal with such issues, however, in practice this power is not exercised to its full extent. The environmental code states that the ministry of the environment elaborates and puts in practice the measures destined to prevent and mitigate water pollution (Republique Gabonaise, 2014). Yet it also states in the article 69 that some of these measures consist of maintaining water collection facilities and putting in place a water data monitoring system, however, in practice no comprehensive monitoring system exists and National Anti-Pollution Center (CNAP) has been dissolved. Although it is not stated in the environmental code, other institutions like the Institute for Public Hygiene and Health as well as to some extent the ministry of Water and Energy should in theory be in charge of sanitation and the latter as well as the ministry for public works should be responsible for wastewater treatment and sewage both issues covering water pollution (Interviewee 6 and 9, 2020) In addition to this, it appears that only the ministry of the environment and the Institute for Public Hygiene can sanction in practice (Interviewee 2; 9, 2020).

The new water law (code) being developed is not yet fully functional in practice and not all ministries may therefore sanction (Interviewee 6). Why the water code is not yet operational is unknown, yet it is in the process of being established. Neither is it clear who has and does not have the authority to sanction, as for example informants from the ministry of environment stated that the CNAP has the authority to sanction yet informants within the CNAP expressed the contrary, that they may not sanction (interviewee 2, 2020). This could in part be due to the unclear division of responsibilities and the many institutions which should in theory be in charge of addressing sanitation or wastewater treatment.

++	**Strong well-embedded authority**	Long-term, integrated approaches regarding the water challenge are well embedded in policy and regulatory authorities. Authoritative figures receive much support both politically and by society. Their opinions and statements also receive much media attention
+	**Stirring authority**	There is recognition of the need for long-term and integrated approaches by both the public and the political arena. Sustainability approaches regarding the water challenge are now implemented as declarations of intent and sustainability principles in policy and regulation. Legitimate authorities are assigned to coordinate long-term integrated policy and implementation
0	**Restricted authority**	The water challenge is addressed as long as the status quo is not questioned. Long-term policy visions are limited and new policy mainly needs to fit into existing fragmentized structure. This means small (technical) changes are occurring
-	**Unfruitful attempts**	The water challenge is put forward by individuals or a groups of actors, but there is only little interest which is also fragile due to poor embedding of sustainability principles in current policy mechanisms, interests, and budget allocation. The challenge may have been mentioned in reviews or reports but left unaddressed
--	**Powerlessness**	The addressing of the water challenge is regularly overruled with contradicting and competing interests and so it is hardly included in policy, regulation or administrative principles

Condition 8: Financial viability

Sufficient financial resources are crucial for good water governance. Willingness to pay for water challenge adaptation services is important to gain access to reliable funding for long-term programs. At the same time, water and climate adaptation services need to be affordable for everyone including poor people or people being disproportionally affected.

Indicator 8.1 Affordability

Predefined question: To what extent are water services and climate adaptation measures available and affordable to all citizens, including the poorest?

Score substantiation: - = Limited affordability of basic water services

There is limited affordability and availability of sanitation services as the under integrated neighborhoods of Libreville rely on shared pit latrines and septic tanks, as standard toilets and such are unaffordable (Interviewee 6, 2020). However, in reality it is more of a question of availability, as informal household waste collection services are in most cases affordable, yet the wastewater drainage system is not formally connected to such under-integrated neighborhoods and waste collection services do not have access to such neighborhoods due to topographical constraints (Interviewee 5, 2020). In the absence of formal wastewater drainage channels in under integrated neighborhoods and waste being discharged into the environment, water pollution mitigation measures are not available to all citizens of Libreville.

The *Plan Strategique du Gabon Emergent* (PSGE) has the objective of securing sanitation to all and reducing environmental pollution, however, it is not specified in this text, nor in the environmental code of how to reach all segments of society in practice, especially the poorest in the *bassins versants,* as the different conditions in such neighborhoods do not seem to be addressed

formally (PSGE; Envrionemnetal code, 2014) . There are studies and projects that have been attempted (Interviewee 6, 2020) such as in Nzeng Ayong, however, whether they truly have reached those populations in the long term remains questionable as not enough examples of this may be found.

++	**Climate adaptation affordable for all**	Programs and policies ensure climate adaptation for everyone. This includes public infrastructure and private property protection. The solidarity principle is clearly percolated in policy and regulation
+	**Limited affordability of climate adaptation services**	Serious efforts are made to support climate adaptation for everyone, including vulnerable groups. There is often recognition that poor and marginalized groups are disproportionately affected by the water challenge. This is increasingly addressed in policy and regulation
0	**Unaffordable climate adaptation**	Basic water services are affordable for the vast majority of the populations, however poor people and marginalized communities have much difficulty to afford climate adaptation measures to protect themselves against impacts such as extreme heat, flooding or water scarcity.
-	**Limited affordability of basic water services**	A share of the population has serious difficulty to pay for basic water services such as neighbourhoods with low-income or marginalized groups. There is hardly any social safety net regarding water services, let alone for climate adaptation measures
--	**Unaffordable basic water services**	Basic water services are not affordable or even available for a substantial part of the population. This may be due to inefficient or obsolete infrastructure, mismanagement or extreme poverty

Indicator 8.2 Consumer willingness-to-pay

Predefined question: How is expenditure regarding the water challenge perceived by all relevant stakeholders (i.e is there trust that the money is well spent?)

Score substantiation: - fragmented willingness to pay

It seems that there is a fragmented inability to pay by stakeholders for improving wastewater treatment and sanitation in the goal of mitigating water pollution. Most communities are willing to pay for the sanitation of the environment, however, they may not always have access or the financial resources to afford such services (Interviewee 8; 10 2020). It is not known whether the civil society deems that its money is well spent on wastewater treatment and sanitation efforts.

Also hotels, hospitals and some beverage companies like Sobraga are willing to pay for onsite wastewater treatment facilities, which can be exemplified by the latter company building a large water treatment facility on its mina site in Libreville (Bdpmodwoam.org, 2012). One thing to note however, is that Sobraga is the largest beverage producing company of the country and a large part of the plastic bottles ending in the sea and water bodies are from this company.

++	**Willingness to pay for present and future risk reductions**	The water challenge is fully comprehended by decision-makers. There is political and public support to allocate substantial financial resources. Also expenditure for non-economic benefits is perceived as important. There is clear agreement on the use of financial principles, such as polluter-pays- and user-pays- or solidarity principle
+	**Willingness to pay for provisional adaptation**	Due to growing worries about the water challenge, there are windows of opportunity to increase funding. However, the perception of risk does not necessarily coincide with actual risk. Financial principles, such as polluter-pays principle, may be introduced. Due to inexperience, implementation is often flawed. Focus groups decide on priority aspects regarding the water challenge, but there is confusion regarding the extent and magnitude of the water challenge
0	**Willingness to pay for business as usual**	There is support for the allocation of resources for conventional tasks. There is limited awareness or worries regarding the water challenge. Most actors are unwilling to financially support novel policies beyond the status quo. Generally, there is sufficient trust in local authorities
-	**Fragmented willingness to pay**	Willingness to pay for measures addressing the water challenges are fragmented and insufficient. The importance and risks are perceived differently by each stakeholder. Generally, their estimates of the cost are substantially lower than the actual costs
--	**Mistrust and resistance to financial decisions**	There is a high level of mistrust in decision making of resource allocation. At this level financial decisions are based on prestige projects, projects that benefit small groups or specific interests. As expenditures often do not address the actual water challenges, there is a high degree of resistance regarding resource allocation

Indicator 8.3 Financial continuation

Predefined question: To what extent do financial arrangements secure long-term, robust policy implementation, continuation, and risk reduction?

Score substantiation: -- = lack of financial resources

The severe lack of financial arrangements to secure long-term anti water pollution policy implementation and risk reduction comes up regularly in the interviews and literature.
The state budget is struggling to meet the water quality goals of the country (Interviewee 6, 2020). This makes sense, as already in 2002 the budget (of Libreville) represented only 1% of the State budget. Around 29% of this budget was allocated to garbage collection while nothing was invested in wastewater treatment (Chaingnaud, 2008). The sanitation and drainage project of Nzeng Ayong which started in 2015 has been halted due to inability to settle the debts to the construction company Conduril from the government, with 85% of the project already being completed (Info 241, 2020,).Talks between the co-funder, the European Union, the Ministry of Public Works and Conduril are supposed to have resumed in February 2020 after having been paused for 2 years (Infos 241, 2020)

In addition to this, numerous public private partnerships between state utilities and private

companies have collapsed due to termination of funding from the Gabonian state, such as the rupture between the SEEG and Veolia contract (Interviewee 4, 2020; Reuters, 2018).

There also exists financing and loan schemes from international institutions (WB, AFD, AfDB, etc.) such as the PAIEPAL project for water supply and sanitation in the capital (Interviewee 6, 07/05/20). However, more data and studies are needed on water pollution in order for such institutions to make more investments in such issues (Interviewee 6, 2020).

++	**Long-term financial continuation**	There is secured continuous financial support for long-term policy, measures and research regarding the water challenge. These costs are included into baseline funding. Generally, both economic and non-economic benefits are considered and explicitly mentioned
+	**Abundant financial support with limited continuation**	Abundant financial resources are made available for project based endeavours that are often exploring new solutions but lack long-term resource allocation or institutionalized financial continuation. Hence, long-term implementation is uncertain
0	**Financial continuation for basic services**	Financial resources are available for singular projects regarding basic services of the water challenge. The allocation of financial resources is based on past trends, current costs of maintenance and incremental path-dependent developments. Costs to deal with future water challenges are often not incorporated. Limited resources are assigned for unforeseen situations or calculated risks
-	**Inequitable financial resource allocation**	There are potential resources available to perform basic management tasks regarding the water challenge, but they are difficult to access, are distributed rather randomly and lack continuity. No clear criteria can be found on the resource allocation. Resources allocation is ad hoc and considers only short-time horizons
--	**Lack of financial resources**	There are insufficient financial resources available to perform basic tasks regarding the water challenge. Financing is irregular and unpredictable leading to poor policy continuation

Condition 9: Implementing capacity

Implementing capacity is about the effectiveness of policy instruments with respect to the water challenge. Part of the effectiveness is also due to the level of compliance to policy and regulation and the familiarity with (calamity) action plans.

Indicator 9.1 Policy instruments

Predefined question: To what extent are policy instruments effectively used (and evaluated), in order to stimulate desired behavior and discourage undesired activities and choices?

Score substantiation: - Unknown impacts of policy instruments

Policy instruments such as the polluter pays principle are seldom used in Libreville. The polluter pays principle does exist, however, whether they are applied in practice remains questionable (Interviewee 9, 2020). Libreville has traditionally not been an industrial hub, so it seems that specific policies

discouraging industrial water pollution in the city are not that present as the petrol and mining sector operate outside the capital (interviewee 7, 2020) However, there are still numerous hospitals and food/beverage companies operating within the city who may be polluting, yet do not seem to be specifically addressed in policy documents. Some policy instruments exist such as the prohibition of dumping waste into the environment or building your house within 20 meters of a water body (examples). However, there is an issue of monitoring which makes it hard to evaluate the impacts such policy instruments may or may not have.

A lot of incoming rural migrants to the city locate in zones *non-aedificandi*, situated in the *bas fonds* at the bottom of drainage basins in swamps or flood prone areas with no sanitation and not connected to the sewage network. This is largely due to uncontrolled urbanization and lack of social housing. There are no planning policy instruments in place which specifically aim to control urbanization (Mombo and Edou, 2007). It is important to move people away from these areas as they are significant sources of water pollution and the communities themselves vulnerable to all sorts of health impacts and floods (Mombo and Edou, 2007).

++	**Effective instruments enhance sustainable transformations**	There is much experience with the use of policy instruments. Monitoring results show that the current use of instruments proves to be effective in achieving sustainable behaviour. Continuous evaluation ensures flexibility, adaptive capacity and fit-for-purpose use of policy instruments
+	**Profound exploration of sustainability instruments**	Instruments to implement principles such as full cost-recovery and polluter-pays principle, serve as an incentive to internalize sustainable behaviour. The use of various instruments is explorative and therefore not yet optimized and efficient. The use of instruments is dynamic. There are a lot of simultaneous or successive changes and insights
0	**Fragmented instrumental use**	Policy fields or sectors often have similar goals, but instruments are not coherent and may even contradict. Overall instrumental effectiveness is low and temporary. There is sufficient monitoring and evaluation leading to knowledge and insights in how instruments work and actors are getting a more open attitude towards improvements
-	**Unknown impacts of policy instruments**	Instruments are being used without knowing or properly investigating their impacts on forehand. The set of instruments actually leads to imbalanced development and inefficiencies that are hardly addressed
--	**Instruments enhance unsustainable behavior**	Policy instruments may enhance unwanted or even damaging behaviour that opposes sustainability principles, e.g., discount for higher water use stimulates spilling and inefficiency. There is hardly any monitoring that can be used to evaluate the counterproductive effects of these policy instruments

Indicator 9.2 Statutory compliance

Predefined question: To what extent is legislation and compliance, well-coordinated, clear and transparent and do stakeholders respects agreements, objectives, and legislation?

Score substantiation: - = Moderate compliance to incomplete legislation

There is only moderate compliance to incomplete legislation and many stakeholders are not able to respect objectives and legislation. There are many small scale construction, food and beverage companies as well as garages and other small and medium enterprises in Libreville. However, it

remains questionable how and where their waste is disposed of with a significant amount likely ending in nearby surface or ground water bodies. Due to unclear division of responsibilities and sanctioning, as well as incomplete legislation regarding water quality control, industries are pretty much free to discharge whatever they want in their wastewater channels or into the environment. An informant within the ministry of water resources and energy stated; 'the laws and policies are not fully respected, there must be a monitoring control on the whole city, but there is a cost behind it, we don't have the means, we don't know what is going on, we can't know if everyone is respecting the rules, we do 2 or 3 controls per year on the sanitation level. We can't be sure if the companies respect the rules' (Interviewee 3, 2020). There must be a general sanitation plan (plan directeur d'assainissement) and water code in force in the city, otherwise it is difficult to know whether industries or companies are complying to specific laws in place aiming to reduce water pollution. However, in practice, these often fail due to organisational, financial or other issues as the water code which is still not operational despite having been conceived in 2016 (Interviewee 8, 2020).

++	**Good compliance to effective sustainable legislation**	Legislation is ambitious and its compliance is effective as there is much experience with developing and implementing sustainable policy. Short-term targets and long-term goals are well integrated. There is a good relationship among local authorities and stakeholders based on dialogues.
+	**Flexible compliance to ambitious explorations**	New ambitious policies, agreements and legislations are being explored in a "learning-by-doing" fashion. Most actors are willing to comply. Some targets may be unrealistic and requires flexibility
0	**Strict compliance to fragmentized legislation**	Legal regulations regarding the water challenge are fragmented. However, there is strictly compliance to well-defined fragmentized policies, regulations and agreements. Flexibility, innovations and realization of ambitious goals are limited. Activity may be penalized multiple times by different regulations due to poor overall coordination
-	**Moderate compliance to incomplete legislation**	The division of responsibilities of executive and controlling tasks is unclear. Legislation is incomplete meaning that certain gaps can be misused. There is little trust in local authorities due to inconsistent enforcement typically signalled by unions or NGO's
--	**Poor compliance due to unclear legislation**	Legislation and responsibilities are unclear, incomplete or inaccessible leading to poor legal compliance by most actors. If legislation is present it enjoys poor legitimacy. Actors operate independently in small groups. Fraudulent activities may take place

Indicator 9.3 Preparedness

Predefined question: To what extent is the city prepared (i.e there is clear allocation of responsibilities, and clear policies and action plans) for both gradual and sudden uncertain changes and events?

Score substantiation: 0 low awareness of preparation strategies

As there is little industrial activity in Libreville that may bring about sudden changes and events in water pollution the city does not need to prepare too much against industrial accidents. However, there are no action plans to target gradual diffuse pollution, as this is mostly a symptom of uncontrolled urban development. There are laws in place for industries to have their own action plans to prevent polluting accidents but further research needed to conform this (Interviewee 2, 2020). The environmental code does to some extent cover industrial pollution, yet in contrast does little against

domestic household pollution (interviewee 6, 2020.) However, without a formal water quality monitoring system in place across the city, preparing for gradual changes as they are hard to perceive without continues measurements.

++	**Comprehensive preparedness**	Long-term plans and policies are flexible and bundle different risks, impacts and worst case scenarios. They are clearly communicated, co-created and regularly rehearsed by all relevant stakeholders. The required materials and staff are available on short-term notice in order to be able to respond adequately. Evaluations on the rehearsals or reviews on dealing with calamities are available
+	**Fragmented preparedness**	A wide range of threats is considered in action plans and policies. Sometimes over-abundantly as plans are proactive and follow the precautionary principle. Awareness of risks is high, but measures are scattered and non-cohesive. They may be independent or made independently by various actors. Allocation of resources, staff and training may therefore be ambiguous
0	**Low awareness of preparation strategies**	Based on past experiences, there are action plans and policies addressing the water challenge. Actions and policies are clear but actual risks are often underestimated and the division of tasks is unclear. They are not sufficient to deal with all imminent calamities or gradually increasing pressures. Damage is almost always greater than is expected or prepared for
-	**Limited preparedness**	Action plans are responsive to recent calamities and ad hoc. Actual probabilities and impacts of risks are not well understood and incorporated into actions or policies. Reports can be found on how the water sector deals with recent calamities
--	**Poor preparedness**	There are hardly any action plans or policies for dealing with (future) calamities, uncertainties and existing risks. The city is highly vulnerable

Bibliography:

Allogho-Nkoghe, F. (2006). *Politique de la ville et logiques d'acteurs. A la recherche d'alternatives d'aménagement pour les quartiers informels de Libreville (Gabon)* (Doctoral dissertation, Montpellier 3).

Backouyanga, D. (2014). *Les enjeux de la gestion du risque environnemental dans.* Dunkerque: Université du Littoral Côte d'Opale

Banque africaine de développement (2019). *Gabon - Programme De Développement Du Secteur De L'Eau Et De L'Assainissement – Premier Sous-Programme Intégré Pour L'Alimentation En Eau Potable Et L'Assainissement De Libreville (PIAEPAL) – Volet Eau Potable - Rapport D'Évaluation*. Available at: https://www.afdb.org/fr/documents/document/gabon-water-and-sanitation-sector-development-programme-first-libreville-integrated-drinking-water-supply-and-sanitation-programme-piaepal-drinking-water-component-appraisal-report-107894 [Accessed 17 June 2020].

Bdpmodwoam, (2012). *Sobraga, pionnière du traitement des eaux usées au Gabon*. Available at : http://www.bdpmodwoam.org/articles/2012/06/16/a-linitiative-de-lassociation-du-systeme-panafricain-de-certification-forestiere-pafc-gabon-libreville-abritera-a-partir-du-20-juin-prochain-un-atelier-sur-la-certification-fore/ [accessed 19 May 2020]

Binga, H., (N.D). *La Gestion De L'eau Au Gabon*. Available at: https://www.sifee.org/static/uploaded/Files/ressources/actes-des-colloques/ouagadougou/session-7/3_Binga_communication.pdf [accessed 2020 Feb. 10].

Chaignaud, C. (2008). Etude sur l'état de l'eau et l'assainissement dans la capitale de Libreville et analyse de l'association. Master 2 Ingénierie des Projets de Coopération. Université des sciences et technologies Lille 1.

Gabonreview.net. (2012). *PIAEPAL : Julien Nkoghe Bekale Donne Le Top – Gabonreview.Net | Actualité Du Gabon |*. [online] Available at: <https://www.gabonreview.net/piaepal-julien-nkoghe-bekale-donne-le-top/> [Accessed 17 June 2020].

Gaboneco. (2020). *PNUG : S'Approprier Le Plan D'Urgence - Gaboneco*. [online] Available at: <http://gaboneco.com/pnug-s-approprier-le-plan-d-urgence.html> [Accessed 17 June 2020].

Info241.com. (.2020). *Bassin Versant De Nzeng-Ayong : Le Gabon Doit Encore Près D'un Milliard À Conduril*. [online] Available at: https://info241.com/bassin-versant-de-nzeng-ayong-le-gabon-doit-encore-pres-d-un,4913 [Accessed 17 June 2020].

Levesque-Kombila, A. (2017). Perceptions de l'environnement et des pratiques de gestion des déchets: une recherche-action pour la construction de perceptions" pro-environnementales" chez les élèves librevillois (es).*UQAM | Bibliotheques | Depot Institutionnel*. [online] Archipel.uqam.ca. Available at: <http://archipel.uqam.ca/11364/> [Accessed 18 June 2020].

Mikomba (2019). *Installation de la nouvelle équipe de la mairie de Libreville désormais dirigée par Léandre Nzué.* Gaboninitiatives. Available at : https://www.gaboninitiatives.com/installation-nouvelle-equipe-mairie-libreville-dirigee-leandre-nzue/ [accessed 13 March 2020].

Ministere de la Sante, des Affaires Sociales et de la Solidarite et de la Famille. (2012). *Plan National De Developpment Sanitaire 2011-2015*. [online] Libreville. Available at: https://extranet.who.int/countryplanningcycles/sites/default/files/country_docs/Gabon/pnds_2011_2015.pdf [Accessed 17 June 2020].

Mboumba, A. (2007). Gestion urbaine et équité socio-spatiale: les inégalités dans les services de base à Libreville (Gabon). *L'Espace geographique*, *36*, 131-140.

Mombo, J. B., & Edou, M. (2007). Assainissement et explosion urbaine au Gabon. *Villes en parallèle*, *40*(1), 196-225. Available at: https://www.persee.fr/docAsPDF/vilpa_0242-2794_2007_num_40_1_1443.pdf [Accessed 17 June]

Provost, T. (2009). *L'eau et l'assainissement à Libreville le cas de deux quartiers sous-intégrés du premier arrondissement proposition d'un projet pilote de participation des habitants.. Master 2 Ingénierie des Projets de Coopération*. Université des sciences et technologies Lille 1. Available at : https://lillocat.univ-lille.fr/permalink/33UDLILLE_INST/1g918av/alma990003848430205601 [Accessed 17 June]

République Gabonaise (2005). Evaluation Environnemental et Sociale Sectorielle du PSFE. Available at : http://documents1.worldbank.org/curated/pt/898491468251730358/pdf/e1217.pdf [accessed 2020 24 June].

République Gabonaise (2012). Plan Stratégique du Gabon Emergent. Available at : https://www.undp.org/content/dam/cafi/docs/Gabon%20documents/French/Gabon_2015_SM%20A_PlanStrategiqueGabonEmergent.pdf [accessed 2020 19 June].

République Gabonaise (2015). *Cadre de gestion environnementale et sociale*. Available at : http://documents1.worldbank.org/curated/en/235081468031557708/pdf/SFG1264-FRENCH-EA-P151077-PUBLIC-Disclosed-8-11-2015-Box393182B.pdf [accessed 2020 24 June].

Reuters. (2018). *UPDATE 2-Gabon Seizes Veolia's SEEG Water And Power Unit*. Available at: https://www.reuters.com/article/gabon-veolia-environ-idUSL8N1Q65FX [accessed 2020 15 May].

Takouleu, J. M. (2019). *GABON: Averda suspends waste collection in Libreville for outstanding arrears*. Afrik 21. Availbale at: https://www.afrik21.africa/en/gabon-averda-suspends-waste-collection-in-libreville-for-outstanding-arrears/ [accessed 2020 Apr. 05].

Pottier, P. & Allogho, FM., Koumba, JP., Ntsame, N. (2017). L'urbanisation à l'assaut du littoral du Gabon. *Research Gate*.

Ondo, J. A. (2011). *Vulnérabilité des sols maraîchers du Gabon (région de Libreville): acidification et mobilité des éléments métalliques* (Doctoral dissertation, Aix-Marseille 1).

Owa, F. D. (2013). Water pollution: sources, effects, control and management. *Mediterranean journal of social sciences*, *4*(8), 65.

Worldpopulationreview, (2020) *Libreville population 2020*. Available at: https://worldpopulationreview.com/world-cities/libreville [accessed 17 March 2020].

Appendix 2: Interview questions with fellow young professionals whom applied the CBA frameworks in the five SSA cities

Data gathering process

1. *Was it easy or challenging for you to find relevant, reliable and up to date data to score your indicators? Can you name the key obstacles? (1 – 5 obstacles)*
2. *Which indicators were the most challenging to score?*
3. *Why were they difficult to measure for you and how did you overcome these challenges?*
4. *How would you recommend future colleagues using the framework(s) to overcome these issues?*
5. *In parallel to the report, can you tell me which indicators would require adjustment in the context of sub-Saharan Africa (SSA) and why (can be because of data gathering process, political considerations, investment opportunities, etc…)?*
6. *How would you change/adjust the CBA analysis frameworks to the SSA context to make them easier to use for your future colleagues?*

Scoring of indicators

7. *Which were the easiest indicators to score and why?*
8. *Which results did not match your previous expectations?*
9. *Which indicators/areas do you think were the most important to be measured in the (CBF/TPF) and why?*
10. *Which were the least important and why?*
11. *Do you think these indicators were not necessary or irrelevant?*
12. *If yes, do you think they could have been left out of the analysis framework and why?*
13. *Are there any new indicators/ areas that could be worth measuring which are not in the CBA?*

Interviewees (6 Young professionals of UNESCO):

- Interviewee 11 (02/08/2020)
- Interviewee 12 (03/08/2020)
- Interviewee 13 (03/08/2020)
- Interviewee 14 (04/08/2020)
- Interviewee 15 (10/08/2020)
- Interviewee 16 (11/08/2020)

Appendix 3: Workshop with key water stakeholders in Libreville + recommendations made

Libreville' UNESCO office organised an online workshop on the 9th of September with some of the key stakeholders of the capital' water sector. The main purpose of this workshop was to present the results of the City Blueprint and Governance Capacity analysis frameworks applied in Libreville, along with a road map (*feuille de route*) outlining the key recommendations for improving the water sector of the city and discussing these with the participants. The main outcome of the workshop was that communication between the relevant stakeholders, especially the institutions in charge of dealing with water related issues, needed to improve and that this is to be done through organising meetings on a monthly basis between the relevant stakeholders.

The workshop began with an opening speech by M. Enzo Fazzino, Libreville' UNESCO chief representative, followed by a brief introduction of the City Blueprint Approach by Maud Berthelot, from the division of water sciences of the UNESCO headquarters in Paris. Subsequently, the consultant Glawdis Ovenga presented her findings of the Trends and Pressures, as well as City Blueprint framework for Libreville, before KWR' intern Fritz Jaax presented the results of the Governance Capacity Framework for water pollution in Libreville. Finally, Fritz, also presented the main recommendations of the road map which preceded a discussion between the participating stakeholders on these recommendations for improving Libreville's water sector.

Around 60 people were invited, 45 of which connected themselves or left at various point and around 32 participated from start to finish (9am – 12.45 LBV time).
The workshop was attended by representatives of; the Ministry of Energy and Water Resources, the Ministry of Water Forestry Sea and the Environment, UNESCO, FAO, the African Development Bank (ADB), the French Development Agency (AFD), the National Commission for UNESCO, the National Agency for National Parks (ANPN), the Gabon IHP Committee, the Energy and Water Company of Gabon (SEEG), the NGO Génération Eau Claire, RECOJAC youth association Gabon, the Institute of Public Hygiene and Sanitation, the National Centre for Scientific and Technological Research (CENAREST), Omar Bongo University, the Institute for Research in Tropical Ecology (IRET), the National School of Water and Forestry (ENEF) and PAYNCOP Gabon and Durable TV.

The main key recommendations for the short term were following;

- The implementation of an intelligent water quality monitoring system;
- the creation of water code incorporating policy objectives that consider urban realities and clearly identify the responsibilities of institutions dealing with water issues;
- creating an IWRM office in the ministry of Water Resources serving as a platform for interdisciplinary communication and evaluation between the water related institutions;
- holding regular meetings between this regulatory IWRM office, relevant institutions, municipalities, NGOs and the private sector.

For the longer term it was deemed necessary to;

- Separate pluvial drainage channels and wastewater;
- Construct a wastewater treatment plant and connect it to the wider sewer system;
- Implement a smart water monitoring system;
- Improve and create community sanitation in the informal settlements;
- Insert topics of Climate Change and water related issues into primary and secondary school curriculum;
- Adapt the city to climate change.