

PREFACE

Water Security is emerging as a primary sustainability challenge across the globe in the 21st century, and is conceptualized as the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality of water for sustaining livelihoods, human well-being, and socio-economic development. *Water Security* is a determinant in various societal aspects including food, energy, economy, environment and public health, and thus has a complex political momentum that goes far beyond the traditional water sector.

In this sense, the academia plays an important role in providing new science based knowledge and multidisciplinary approaches in order to deal with water security challenges and its solutions. The collaboration among researchers, stakeholders, governments, non-governmental organizations, and the communities in a systemic way are necessary, as this complex issue requires to be addressed long-term.

Like many other *Developing Regions* worldwide, the *Metropolitan Region of São Paulo, Brazil*, one of largest conurbation and human agglomeration in the world, shows many problems regarding the distribution and availability of fresh and drinking waters, water scarcity, quality and pollution aspects of water, water governance, transboundary water, and other related issues in the context of the climate change. In summary, it faces a cyclic water problem: water comes often too little, sometimes too much, and in general too dirty.

This book presents a contribution to the advancement of knowledge as part of the results of the work performed by the participants of the workshop “*Linking Water Security to the Sustainable Development Goals*” held at the Institute of Advanced Studies of the University of Sao Paulo, Brazil in August, 2018. The workshop aimed to develop a creative co-learning among different experts, and knowledge exchange through experiences from different parts of the world, contributing to produce and to disseminate knowledge regarding water and sanitation.

We are grateful for the financial sponsorship given by Exceed-Swindon and the local support provided by the Institute of Advanced Studies and School of Arts, Sciences and Humanities, University of São Paulo. The International Workshop allowed the attendees a unique opportunity to acquire and to share important know-ledge regarding Water Security considering the global and regional aspects of water governance and manage-ment, emerging technological innovation, and nature-based solutions for water conservation to achieve the Sustainable Development Goals proposed by the Agenda 2030 of the United Nations in their regions.

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A TREATISE OF APPRECIATION OF THE RELATIONSHIP BETWEEN THE WATER SECURITY INDEX (WSI) AND THE SUSTAINABLE DEVELOPMENT GOALS (SDG) IN TROPICAL AFRICA

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Abstract

The combined effects of population growth, increasing demands for water to enhance activities, security, development and the challenges of climate change give rise to an urgent need to carefully monitor and to assess trends and variations in aquatic resources. Over 1.7 billion people are currently living in river basins, where water use exceeds recharge, leading to the desiccation of rivers, depletion of groundwater, and the degradation of ecosystems and the services they provide. As countries develop and populations grow, global water demand (in terms of withdrawals) is projected to increase by 55% till 2050. Already by 2025, two thirds of the world's population could be living in water-stressed countries, if current consumption patterns continue. The economic loss from the inadequate delivery of water and sanitation was estimated to amount to 1.5% of gross domestic product (GDP) of the countries included in a WHO study on meeting the millennium development goals (MDGs). Water is only renewable, if well managed. Water can pose a serious challenge to sustainable development, but managed efficiently and equitably, water can play a key enabling role in strengthening the resilience of social, economic and environmental systems in the light of rapid and unpredictable changes. Water security and the sustainable development goals (SDGs) are key ingredients of *"Our Common Future"*, which is defined as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* This is the overture of our expression on the relationship between the water security index (WSI) and the Sustainable Development Goals in Tropical Africa.

1 Introduction

Water security is the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being and socio-economic development for ensuring protection against water-borne pollution and water-related

disasters. It is to for preserving ecosystems in a climate of peace and political stability (UNEP, 2010). Discussions on the sustainable green development to protect environment health enhance earnings, and poor eradication had been conducted. The concept of water security index (WSI) had been proposed to monitor the water status, which links to the socio-economic development of the country. The index comprises the securities of rural water, urban water, water for development, water quality in the basin, and disaster, and can be used to measure the overall development and to project implementation together with socio-economic planning of the country. This paper proposes the water security definition and assesses the water security in central Africa by reviewing water use status correlated with population data and gross domestic product (GDP) in various countries of the world while achieving their development goals. CEMAC countries (Central African Economic and Monetary Community) can help to understand the competitiveness and the strength, weakness and potential of water development of Central Africa.

2 Material and Methods

2.1 Localization of study area

The study was carried out in Central Africa in the CEMAC countries, which is one of the oldest regional arrangements in Africa, consisting of Cameroon, Central African Republic, Chad, the Republic of Congo, Equatorial Guinea, and Gabon (Falkenmark, 1990). In 1994, the member countries established a full-fledged economic and monetary union (treaty was ratified in 1999), strengthening the existing customs and monetary union, which originated in the colonial era. Linked partly by geography and partly by history, the economies of the CEMAC zone share a number of distinctive characteristics. They are not populous (a combined total population of 32 million), have experienced low historical growth in per capita incomes, made limited strides in poverty reduction over the last several decades, and are highly dependent on oil and other natural resources' exports. The economies also share common challenges, both internal and external, such as volatility resulting from reliance on commodity exports, conflicts of interest between richer coastal and poorer landlocked countries, very limited intra-regional linkages, and political instability within CEMAC and neighboring countries. Regional integration can be a vehicle for overcoming these challenges and a force for improved economic prospects. It may lock countries into policy reform, achieve economies of scale, and provide a unified forum for international negotiations. Success in this endeavor will depend critically on strengthening the institutional capacity, gaining political consensus, building effective infrastructure as well as developing stronger ties within the region and with the neighbors. Figure 1 shows the CEMAC Zone.

2.2 Water security index concept

Up to now, water resources development process started with project development, implementation, monitoring and system improvement, which aimed to facilitate basic needs to people and society. The other portion of water was used for economic development. In recent years, environmental issues were raised and had to be simultaneously considered during water resources planning, too. The index described sufficiency and risk, and was later developed to water security. The index helped to monitor the development of water management clearer and determined under various aspects, e.g., water sufficiency of both quantitative and qualitative

aspects for health, life, ecology preservation, production, disaster relief (UNICEF, 2010), or the accessibility to clean and safe water with sufficient amount and payable cost for hygiene and good quality life with environment protection.

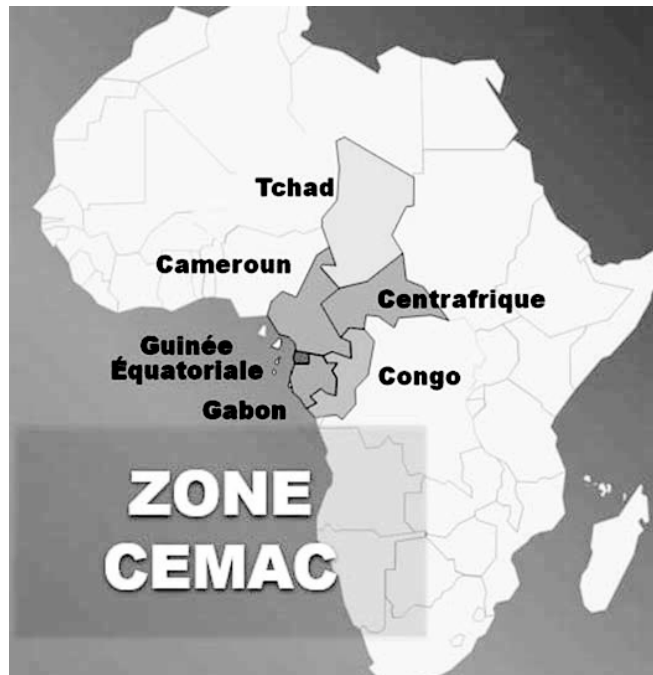


Figure 1: Map of the CEMAC zone in Africa

The planning of each country normally concerned with the development of economics, society and environment. However, the important element for sustainable development is still engaged with water resources. The concept of water security was developed to investigate the actual situations of these basic water developments with socio-economic and environmental development. The security dimensions comprised of water security of household, economics, urban, river health and resilience to disaster. This study determined the water security status from five dimensions: (i) basic water (renewable, supply, sanitation); (ii) sufficient water (water supply, consumption, agricultural water); (iii) development water (irrigation area, industrial water use, water for energy, water for aquaculture); (iv) water disaster (loss from floods and drought), and (v) water for future (population growth, urban population growth, water footprint). The index status' analyzed were correlated with water productivity of the five countries classified by their first capital town. Based on the available data from various sources of the world (Sullivan, 2002; Asheesh, 2003), the index of each country was determined comparatively by weighting equally from each dimensions and marking equally (1-5 points) of each element with ranking from the average (1 = very poor, 2 = poor; 3 = average; 4 = good and 5 = excellent) and standard deviation values.

2.3 Situations in CEMAC Countries

In Gabon, water outages have reached critical levels in the capital Brazzaville. Several neighborhoods, including Mfilou and Moungali, have no access to potable water due to ongoing issues at the National Water Supply Company. The *Water-For-All* program, which has cost some USD 333 million, has yet to reach its goals of significantly increasing potable water access in the country, particularly in parts of rural Congo, where less than 15% of the population has readily available drinking water. Individuals are advised to stock up on bottled water and to collect water in large vessels, when running water is available, and to make sure the water is completely clear before collecting it by running taps for few minutes to flush pipes.

Strict food and water precautions are advised, such as boiling, filtering, and/or chemically treating water before consumption. Water quality in Gabon is abundant, but unevenly distributed and strained by high rates of urbanization. Gabon has one of the highest levels of water availability in the world about 127,825 m³ per capita and year. 87% of Gabon's 1.8 million people live in urban areas, such as Libreville and Port-Gentil. As the urban population increases, so does the demand for a fixed water supply. Gabon's low capacity for drinking water production and lack of storage and maintenance facilities leads to frequent water shortages in Libreville and other urban areas. Water quality in Gabon is different in urban and rural areas. In 2015, 92% of urban areas and 59% of rural areas had access to improved water resources. 'Improved' drinking sources include piped water on property and other improved sources of drinking water, according to the World Health Organization. Despite its status as an upper middle-income country, 34% of the population lives in poverty. Rural, poverty stricken areas suffer deprivation from drinking water resources in Gabon, and 58% of the population does not have access to improved sanitation facilities. In 2015, sanitation rates in urban and rural areas were 43% and 32%, respectively. Access to sanitation facilities is very low in Gabon. Inadequate wastewater and rainwater networks and deficient solid waste management explain the disparity. Inadequate sewage and waste management led to negative health outcomes. Insufficient sanitation and lack of access to improved water sources are associated with the increased risk of neglected tropical diseases (NTDs), a class of infectious bacterial and parasitic diseases. In Gabon, a large proportion of the population is at risk of infection from soil-transmitted helminthiasis, lymphatic filariasis and schistosomiasis.

RCA The town of Birao, with 10,000 residents, is suffering from its remote location in the north of the Central African Republic and receives little aid. In addition to experiencing long gaps in the provision of public services, residents face an influx of people displaced by the conflict. Birao, over a thousand kilometers from Bangui, is hard to reach by road and almost completely cut off during the rainy season. *"It's a real challenge for those few aid organizations that attempt to reach these people,"* said Marius Cocoa, an official of the International Committee of the Red Cross (ICRC) based in the region. *"Although they have not been directly affected by the fighting, those living here are suffering from a shortage of health services, drinking water and food."*

In BANGUI, Central African Republic (CAR) just ahead of the onset of the rainy season, which increases the risk of water-borne diseases like cholera, UNICEF and its partners have restored safe

and chlorinated drinking water for more than 183,000 displaced people across the Central African Republic (CAR). *“Access to safe drinking water remains out of reach to many people who have been displaced by the violence,”* said UNICEF CAR Representative Souleymane Diabaté. *“As the first heavy rains have already begun, standing water and flooding increase the risk of a cholera outbreak.”*

In Baney, the sight of children fetching water at the nearest river with buckets on their heads is a common scene, a small town situated in the outskirts of Malabo, the capital of Equatorial Guinea. Running water is scarce in homes. That is, why families must mobilize and organize their daily pilgrimage to a river named Ehola, which means *‘the protective spirit of the people’*. *“God has not endowed our people with water,”* said the director of the Papa Bacabo National School in Baney, referring to the river, which is completely dry most of the time. Adding to concerns over its quantity, the water is not of good quality, and the nearest source is far from having the minimal hygienic conditions for use without risks in terms of water quality and children survival. This dramatic situation is prevalent in almost all of Equatorial Guinea; a country, where less than half of the population has access to safe water, and one that has not yet developed a large-scale sanitation program. Around 2 children out of 10 here die before the age of five, often from diarrhea, cholera or other diseases linked to poor water quality. Water is the source of life and must be protected. This leitmotiv is gaining momentum on the world’s development agenda. It is of particular interest this date in 2008, which had been declared by the United Nations as the International Year of Sanitation.

In N’djamena, the capital of Chad, bakes in the midday heat, Aisha Adoum uses the harsh sun to dry tomatoes, ochre and berries for the market. It is the dry season there, with dust coating everything. Children find relief playing in the low and polluted lakes and rivers, alongside carpet washers. Clean water is in high demand, but poor neighborhoods, called quartiers, on N’Djamena’s outskirts do not benefit from the city’s utilities grid. Instead, they rely on shallow wells or, if they can afford it, water vendors. Even then, there is no guarantee that the water is clean. In 2016, over 17,000 people contracted cholera in Chad, with thousands of cases in the capital alone. In the same year, UNICEF started building clean water delivery systems in the poor communities around N’djamena in partnership with the “Secours Islamique France”. The wells are 60 meters deep – far deeper and, thus, far cleaner than the open or hand-pumped wells commonly used here. Solar panels fuel the pumps, which suck up and deliver the water to an elevated tank, which in turn feeds two water points.

3 Results and Discussion

The UN analytical brief present a summary of core elements needed to achieve and to maintain water security, synthetized from a broad range of sources access to safe and sufficient drinking water as affordable cost in order to meet basic needs, including sanitation and hygiene, safeguard health and level of well-being. In spite of the importance and the apparent abundance of water, most of Sub-Saharan Africa faces a serious water scarcity problem. Countries of the CEMAC zone are not margin of the situation. These five countries face water crises. Cameroon is crisscrossed by

many rivers that run from the countries mountainous north to the south. It is believed to have one of the world's largest reserves of fresh water. But for more than three months, millions in the Cameroon capital have gone without it. The ministry of water and the water utilities corporation, Camwater, says a drop in the water level at major catchments has caused the problem. But it is also clear that over the years, new infrastructure was not built to match the city's rapidly growing population. The unplanned expansion of the sprawling city has left entire neighborhood unconnected to the city's water network. Cameroon plans to increase Yaounde's water supply to 500,000 m³ in two years by tapping into the Sanaga, one of the country's largest rivers. The move should increase potable water supply from more than 30% to 60% of the population.

3.1 Protection of livelihoods and human rights

This means to reduce inequality within and among countries. One cannot live in a truly developed world without equal opportunities for both countries and their citizens. Equality is at the core of all sustainable development goals. Together, one can empower and promote the social, economic and political inclusion of all people irrespective of age, sex, disability, race, ethnicity, origin, and religion, economic or other status. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. One can only look forward to a more equal and sustainable world, if one has more peaceful and inclusive societies. That means one needs to reduce crime, violence, and exploitation. The illegal arms and drug trade will have to stop. Public institutions that one relies on will have to be effective, transparent and accountable. The protection values receive a mark of 3.5/5, which is an average mark for the five countries in CEMAC zone as resumed in Table 1.

3.2 Water for environmental development

Urgent actions must be taken to combat climate change and its impacts. The world's industrialized nations have changed the balance of the earth's carbon cycle over the last 150 years by burning large amounts of fossil fuels. Climate change has the potential to derail other efforts toward sustainable development by altering weather patterns that threaten the food production and increasing sea levels, which will displace coastal communities. One needs to increase awareness and convey urgency to world leaders, so one can begin combating climate change before it is too late. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. Pressures from the growing global population, urbanization and climate change are causing biodiversity to decline. Most developing countries rely on meat from wild animals for food. Let's work to restore and to protect our planet's biodiversity in order to prevent land degradation, ecosystem imbalance, and food insecurity. The water supplies for socio-economics and environmental development in the CEMAC area receive a mark of 2.5/5.

3.3 Wastewater treatment/sanitation

Ensure availability and sustainable management of water and sanitation for all. More than half of households worldwide have access to clean water in their homes; however, the number of people without adequate sanitation (a safe toilet) is increasing as people move into more crowded cities. Diseases caused by contaminated water kill more people every year than all forms of violence, including war. By prioritizing clean water, one can improve the health and livelihoods of millions of people. Water is essential to life. As populations grow and economies expand, access to clean and safe water is imperative. Isotopic techniques shed light on the age and quality of water. Some countries use this to implement integrated water resource management plans to sustainably use resources and to protect water and water-related ecosystems. For this point, the mark is 3/5.

3.4 Water for economic development

Isotopic techniques provide accurate assessments of soil erosion and help to identify erosion hot spots, providing an important tool to reverse land degradation and restore soils. The IAEA's support in this area helps many countries to gather information using these techniques to shape agricultural practices for more sustainable use of land and, ultimately, to increase incomes, while also improving conservation methods and protection of resources, ecosystems and biodiversity. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Economic recession has taken a toll on both the quantity and quality of jobs around the world. For the 190 million unemployed, job availability is the key not only to economic growth, but also to more equal wealth distribution. Economic prosperity and opportunities for gainful employment are critical for safe, stable societies. This enables the building of an organizational capacity, the bargaining power of inhabitant's people, and achieving sustainable improvements in the prospects for income generating activities of women and young people. The World Bank and other international agencies assist in promoting good governance in public enterprises. The good governance receives a mark of 3/5.

Table 1: Water Security Index WSI of CEMAC Countries

Countries	Cameroon	CAR	Chad	Congo	Guinea Eq.	Gabon	Average
<i>Protection of livelihoods and human rights</i>	4	4	3	3.5	3.5	3	3.5
<i>Water for environmental development</i>	3	2	2	2.5	2.5	3	2.5
<i>Wastewater treatment/sanitation</i>	2.5	3	3	3	3	3.5	3
<i>Water for economic development</i>	3	2.5	3	3	3	3.5	3
<i>Water security index (WSI)</i>	3.3	2.7	3	3	3	3	3

The Water security index (WSI) for CEMAC Countries is $3.3 + 2.7 + 3 + 3 + 3 + 3 = 18/6 = 3$, which is above the average of all African countries.

Ensuring access to water is increasingly becoming a challenge in the world in general and in Central Africa in particular. Countries are facing significant threats of water scarcity and increasing

volatility of supply, attributable to factors such as climate, geography and demographics (Kalbermatten et al., 1982; Rijsberman, 2006). Limited access to water can “*jeopardize economic growth and social wellbeing*”. The acquisition of modern infrastructures for potable water and wastewater treatment, transmission could improve on the water security index of our community.

4 Conclusions

The objective of this study was to evaluate the water security index in five countries in Central Africa (CEMAC). Water security has recently received attention, but it has been an issue in several regions for decades. Particularly in many urban centers in Sub-Saharan Africa, poor sewage infrastructure and limited access to piped or improved water sources have been a persistent and chronic issue. In such situation, perception of what is normal water access, might be distorted, hence, continuing to use environmental indicators such as common water sources, per capita water use and excreta disposal facilities might provide a clear indicator of water related issues. However, a valid scale to measure water insecurity at the household level is needed, especially to capture anxiety, changes in water intake behaviors and food access issues those families due to water shortage. Also, a scale will be useful to capture opportunity cost and risk of food insecurity due to limited water access.

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SOCIAL FOOTPRINT OF WATER AND SANITATION IMPROVEMENTS IN LOW HDI COUNTRIES

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Abstract

Investment in water and sanitation is needed to achieve the Sustainable Development Goals (SDG). Improving access to safe water and sanitation facilities has substantial effects on health. This paper aims to assess social impacts of intervention scenarios regarding water and sanitation improvement in five low Human Development Index (HDI) countries. These improvements should result in establishing a better public health and a higher environmental quality, which in turn should result in lower public healthcare expenses, liberating resources for other areas like education and security. Social impacts were assessed combining impacts on productivity and impacts on human well-being according to the social footprint impact assessment, considering characteristics of each country studied. In different levels between the analyzed countries, economic benefits of providing access to safe drinking water and wastewater treatment services to the population would vary from US\$ 186,000 to more than US\$ 150,000,000 annually, considering just the reduction of diarrheal disease incidence. In this way, sanitation improvements will not be only economically feasible, but also socially affordable from a sustainability perspective according to the SDG.

1 Introduction

With the deadline for the Millennium Development Goals expired in 2015, there has been a call for renewed development targets in the context of the Sustainable Development Goals. These goals include universal access to improved water and sanitation for all by 2030, which still remains a challenge mainly for developing countries, since the ability of governments to expand access is constrained by limited financial resources (Evans, 2005; Whittington et al., 2007; Ndikumana & Pickbourn, 2016; Fuller et al., 2016).