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Managing Transboundary Water Resources: A Comparative Study of the Great Lakes of North America and the Great Lakes of Africa

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ABSTRACT

Water is essential to life. This essential resource is not equitably distributed throughout the world. Therefore, countries that are fortunate enough to have water resources within their jurisdiction should take prudent measures to maximize the benefits that water resources bring to the people and the many lives they support. However, when a water resource is shared by two or more countries, its management becomes very difficult. It takes cooperation between the countries to effectively manage shared water resources.

The United States and Canada have proven that cooperation is all that is needed to manage shared water resources. In 1909, the US and Canada signed the Boundary Waters Treaty which led to the establishment of the International Joint Commission. The IJC was established to help in the prevention and resolution of disputes that may arise concerning the use and quality of boundary waters. The Commission is also expected to advise the two governments about issues concerning boundary waters. Unfortunately, countries in the African Great Lakes basin have not been so successful in managing the lakes. Factors such as colonialism and political instability and armed groups operating in the region have made cooperation very difficult.

The purpose of this paper is to examine how the US and Canada have effectively managed the Laurentian Great Lakes and why the Great Lakes of Africa are being poorly managed. The paper will identify the challenges facing the lakes, the measures that have been put in place to address these challenges and make recommendations.

DEDICATION

This work is especially dedicated to my wife Mabel, my daughter Maabena, my mother, Akosua Abrafi, my father, Kwadwo Fordjour, my uncle, Nana Osei Kwadwo, my grandmother, Ama Boatemaa and my siblings, Alberta, Priscilla and Nicholas.

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CHAPTER 1

INTRODUCTION

Background to Study

In all aspects of human life, water is very essential. Of all the earth's natural resources, water is the most widely distributed. The sources of the earth's water include oceans, seas, rivers, lakes and underground water. According to du Plessis (2017), water covers approximately 75% of the earth's surface. Of this, only 3% is freshwater and 69% of this freshwater is "locked up in glaciers, ice caps and permanent snow cover in the Polar Regions. Groundwater accounts for 30% while only 0.3% of all freshwater is contained in river systems, lakes and reservoirs" (p. 4). Although water abounds on earth, freshwater is, therefore, limited and scarce. Population growth and climate change are putting more pressure on this already scarce natural resource. These and other factors have increased global demand for freshwater.

Global demand for water has increased water scarcity leading to conflicts throughout the world. The situation gets even worse in transboundary water situations. Paisley and Henshaw (2013) define transboundary waters as water resources that two or more sovereign countries share. Access to transboundary water resources is the major cause of all water conflicts in the world. A 2015 United Nations report estimates that there are "approximately 276 transboundary river basins on the earth with a geographical area corresponding to almost half of the earth's surface and 60% of freshwater supplies. Almost 3 billion people in 145 countries live in this area" (p. 1). It is, therefore, important that there should be cooperation between countries to ensure the effective management of transboundary water resources. For the purpose of this paper, I will be looking at how the United States and Canada have effectively managed the

numerous water resources they share (especially the Great Lakes) and compare it to the three Great Lakes in East Africa which are poorly managed.

Literature Review

Many researchers argue that as resources continue to be scarce and access decreases, there will be increasing "frustration, which in turn creates grievances against the state, weakens it and civil society, and leads to opportunities for insurrection" (Koubi, Spilker, Böhmelt & Bernauer, 2014, p. 228). The situation is more complex in transboundary resources where there are legal, historical, cultural and technical differences (Raadgever, Mostert, Kranz, Interwies & Timmerman, 2008). Thus, when not properly managed, resources shared by two or more countries can lead to disputes and violent conflicts. On the brighter side, the proper management of transboundary resources through cooperation can lead to economic prosperity and social cohesion. The process by which transboundary resources are managed provides opportunities for people to co-exist peacefully while ensuring effective and equal distribution of the resources for the betterment of all parties involved. The most common transboundary resource is water. As such, "surface and groundwater that cross international boundaries present increased challenges to regional stability because hydrologic needs can often be overwhelmed by political considerations" (Wolf, 2006). There is, therefore, a high potential for disputes and conflicts.

Although there have been several suggestions that conflict over water resources that cross borders could lead to wars, there is little or no evidence to support this notion (Uitto & Duda, 2002). However, Bencala and Dabelko (2008) recognize "at the same time that it would be wrong to conclude that water does not precipitate conflict simply because states have not fought full-fledged wars over it in the past" (p. 22). If we should go beyond this classic observation, and even focus on conflicts at the subnational level, we will find that there is extensive violence

surrounding water. Bencala and Dabelko argue that there continues to exist serious tensions between countries over water.

Haftendorn (2000) recounts the conflict between Brazil and Paraguay on one side and Argentina on the other over the construction of the Itaipu Dam on the Parana River that captured the world's attention. The river which serves as the border between Brazil and Paraguay also flows through Argentina and Uruguay. The project faced stiff opposition from Argentina which lies on the lower basin of the river. Two years after the construction of the dam began, the three parties signed an agreement in 1977 which settled the conflict. Kameri-Mbote (2007) observes a similar dispute over the Nile River. In her paper, *Water, Conflict, and Cooperation: Lessons from the Nile River Basin*, she recalls the Egyptian president in 1979 warning that water is the only matter that could take Egypt to war again. Egypt which lies at the lower basin of the Nile River has threatened Ethiopia on several occasions as the latter seeks to build the biggest dam in Africa on the river. While Ethiopia which is at the upper basin of the river is trying to use the water to get more power, Egypt is trying to use power to get more water. This is what Hanasz (2014) calls Hydro-hegemony. It "occurs when one state within a shared river basin asserts its power over other riparian states—even upstream ones" (p. 98). Hydro-hegemony rests on political, economic and military power. Egypt, which famous Greek historian Herodotus referred to as the 'gift of the Nile', had been granted unrestricted access to the river due to its historical ties to the river. But right after independence from Britain, Sudan demanded that the 1929 treaty be renegotiated. A strained relationship followed and Egypt moved an army to the border as a show of force (Swain, 1997).

Tir and Stinnett (2011) opine that some water disputes are difficult to be addressed with the signing of treaties especially in areas where a country's activities on shared water impacts

negatively on another country. In most instances, a change in government could mean a total overhauling of existing treaties. A case in point is the conflict in the Euphrates-Tigris River System. The Euphrates and Tigris Rivers are shared by Turkey, Syria and Iraq. They originate in Turkey and flows through Syrian and Iraq (El-Fadel, Ibrahim, Sayegh & Jamali, 2002). Disputes over these two rivers can be traced back to the 1960s when each of the three countries started to develop large scale projects on the rivers. Initially, the three countries had aimed at regulating the flow of the rivers to curb flooding and droughts. However, the building of hydro dams and increases in population started to put stress on the rivers' capacity. Realizing the dangers that their activities on the rivers are causing, they started reaching out to each other to find solutions to the problem. Unfortunately, political rivalry and affiliations prevented any meaningful cooperation between the countries (Kibaroglu & Scheumann, 2013).

"The future of transboundary water conflict may not look like the past, given the severe and deteriorating conditions for water quality and quantity, which are pushing people into unprecedented territory. Therefore, we leave open the possibility for future conflict (Bencala and Dabelko, 2008). Nonetheless, agreements such as treaties, protocols, binding and non-binding policies that comply with international law and reflect the appropriate principles of equitable and moderate utilization of resources could be implemented to manage transboundary water related disputes.

Research Questions

Based on the assertion that transboundary water challenges can and have resulted in violent inter-state conflicts, the following questions are posed:

1. What factors have contributed to the effective management of the North American Great Lakes and the poor management of the African Great Lakes?
2. What challenges are facing the African Great Lakes and the North American Great Lakes?
3. What measures did Canada and the United States take to resolve conflicts over the water resources they share?
4. What interventions have been taken to address the challenges facing the African Great Lakes?

Organization

This paper is organized in four parts. Part one contains the introduction and literature review. Part two and three concentrate on the historical accounts and geography, the challenges facing the lakes, interventions that have been taken and the successes and challenges of these interventions. The final part contains the recommendations and conclusion.

Thesis

Transboundary resource conflicts are very difficult to deal with. Most of these conflicts that turn violent leading to the loss of lives and properties have occurred as a result of lack of cooperation between countries. And transboundary water conflict is no exception. On the international level, there have been various conventions and treaties aimed at fostering cooperation between countries in managing transboundary water resources. Notable among them are the 1997 Convention on the Law of the Non-Navigational Uses of Transboundary Watercourses and the 1992 Helsinki Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

In this paper, I will argue that cooperation between the United States and Canada has been the major contributing factor that has led to the absence of conflict and improved the health of the North American Great Lakes. Under the Boundary Waters Treaty of 1909, the United States and Canada established the International Joint Commission with the core mandate of resolving conflicts between the two countries over the numerous water resources that they share. On the other hand, I will argue that the seven countries that share the three Great Lakes in East Africa have failed to cooperate in managing the lakes. This has created tensions in the basin which sometimes turn violent leading to the loss of human lives and properties.

Methods

This paper will be a comparative study of the Great Lakes of North America and the Great Lakes of Africa. Both the North American Great Lakes (with the exception of Lake Michigan) and the African Great Lakes are transboundary water resources. While the former is shared by Canada and the United States, the latter is shared by Rwanda, Kenya, Tanzania, Burundi, Malawi, Uganda and the Democratic Republic of Congo. Together, they constitute almost half of the world's freshwater. The paper will be a qualitative and exploratory research paper. The main mode of data collection is the analysis of existing literature.

Scope and Limitations

The main weakness of this paper has to do with the fact that the political atmosphere which exists in Canada and the United States is different from that of the countries in the African Lakes basin. The current tension in the African Great Lakes basin is absent in Canada and the United States. Also, while the North American Great Lakes are shared by only Canada and the US, the African Great Lakes are shared by seven countries.

This research will be limited to the use of existing research as opposed to travelling to east Africa due to financial constraints and availability of time. This paper will concentrate solely on the North American Great Lakes and the African Great Lakes.

CHAPTER 2

NORTH AMERICAN GREAT LAKES

All over the world, there are about 260 watersheds that cross the boundaries of two or more countries. 40 percent of the world's population is affected by these watersheds and cover about half of the surface of the earth. Canada and the United States "share one of the world's longest common borders, and with it a number of important transboundary watersheds. The Great Lakes and St Lawrence River system is the world's single largest source of freshwater…" (Flaherty, Pacheco-Vega & Isaac-Renton, 2011). This water system is, therefore, the most important of these transboundary watersheds.

The North American Great Lakes are sometimes referred to as the Laurentian Great Lakes. They are a series of interconnected freshwater lakes found primarily in the upper-east region of the North American continent along the Canada-US border. Through the Saint Lawrence River, they empty into the Atlantic Ocean. Hales, Cai, Mitchell, Sabine & Schofield (2008) estimate that with about 23,000km^3 of water, the lakes can flood the entire United States by 3 metres. Together, they cover almost 16,000 km of coastline with 244,000 km^2 total area and about 60 million people are estimated to be living in the Great Lakes basin. Lakes, Superior, Michigan, Huron, Erie and Ontario together make up the Laurentian Great Lakes. They are shared by the Canadian province of Ontario and the US states Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin. With the exception of Lake Michigan which is found entirely in the US, all other four lakes are shared by Canada and the US. (McDonagh-Dumler, Pebbles & Gannon, 2006).

According to McManamon, Cordell, Lightfoot & Milner (2009), it was towards the end of the last ice age (known as the Wisconsinan Glaciation) some 14,000 years ago that the lakes began to take shape. Water from the melting glacier formed large lakes within the exposed basins and subsequent erosion gave rise to the formation of the Great Lakes basin (p. 25).

Lake Superior

Of all the five Laurentian Lakes, Superior is the largest. It has the largest "surface area of any freshwater lake in the world and the second largest in volume after Lake Baikal in Russia". It has a surface area of 82,103 km^2. It is a significant natural and renewable resource for both the US and Canada (Bennett, 1986, p. 272). The lake is located on the northernmost part of the US state of Wisconsin. From the upper peninsula of Michigan, it extends north to Ontario and west to Minnesota. The lake was named Superior due to its size and its position as the northernmost of all the Laurentian Great Lakes (Zimmermann, 2017). For the past 500 years, the Anishinaabe are believed to have lived in the regions surrounding Lake Superior. According to the University of Wisconsin Sea Grant Institute, Lake Superior is most susceptible to pollution as it will take about 200 years to clean it and make it pure again. The lake supports the shipping of iron ore, grain and manufactured products. It is shared by the US states of Minnesota, Michigan and Wisconsin and the Canadian province of Ontario.

Lake Michigan

Lake Michigan is the second largest lake by volume and the third largest by surface among the North American Great Lakes. And it is the only one found entirely within the US. It is shared by the US states of Michigan, Illinois, Indiana and Wisconsin and covers approximately 57,800 km^2. Lake Michigan is connected to Lake Huron by the Strait of Mackinac and

sometimes referred to as Michigan-Huron. The New World Encyclopedia estimates that about 120 million people live the shores of the lake. For these people, the lake serves as a source of drinking water, recreation, and also for agricultural and industrial purposes. The word 'Michigan' is derived from the Indian word 'mishigami' which translates as the 'great water' (Zimmermann, 2017).

Lake Huron

With a shoreline of 6,200 km and a surface area of approximately 60,000 km², Lake Huron is considered the second largest of the Great Lakes by surface area. This makes it the fifth largest lake in the world. The lake is shared by the US state of Michigan and the Province of Ontario in Canada (Eshenroder, Payne, Johnson, Bowen & Ebener, 1995). The lake supports important economic activities such as agriculture, mining, food processing, chemical production and transportation. Lumbering and fishing, both economic and sportfishing, have long been the two most essential economic activities in the Lake Huron region. The region surrounding the northern part of the lake is virtually isolated and underdeveloped with scattered settlements. The common activity found at that part of the lake is lumbering and mining. Agriculture thrives at the southern region of the lake (Munawar, 2006). Transportation on the lake is only possible between April and late December. The French named the lake was named after the Huron people who occupied the region (Encyclopaedia Britannica, 2017).

Lake Erie

In terms of surface area, Lake Erie is the 11th largest lake in the world and the fourth largest of the Laurentian Lakes. Although the Iroquois people inhabited the area before the arrival of Europeans in the early 17th century, the lake was named after the Erie Indians who

used to live along the shores of the lake. It is shared by Ontario and the US states of Ohio, Michigan, Pennsylvania and New York (Encyclopaedia Britannica, 2017). According to Zimmermann (2017), Lake Erie is the southernmost lake of the five, making it the warmest. The Erie Canal, constructed on the lake in 1825, connected the lake in the west and the Hudson River in the East. The canal provided the cheapest mode of transporting cargo between the west and the east which attracted people to settle in the west. The lake played an important part in the history of the War of 1812. The Battle of Lake Erie was fought between the US navy and their British counterparts. The former defeated the latter to recapture Detroit.

Lake Ontario

Lake Ontario is the 14th largest lake in the world and the smallest among the Laurentian Lakes in terms of surface area. It covers a total surface area of 18,960 km^2 (Rukavina & Boyce, 2006). It is shared by Ontario and New York (Encyclopaedia Britannica, 2018). Lake Ontario serves as a source of drinking water for 9 million people (Lockhart, 2017). A French scout, Étienne Brûlé and Samuel du Chaplain, were the first Europeans to explore the lake in the early 17th century. By then, the region surrounding the lake was inhabited by the Iroquois who were strong allies of the British. The French managed to broker peace with the Iroquois which paved the way for the French to build ports along the shores of the lake. “The French and Indian Wars led to British control, and the American Revolution hastened settlement, trade, and shipping in the region” (Encyclopaedia Britannica, 2018).

Interventions

Since the 18^{th} century, there have been several interventions between the US and Great Britain concerning the usage of water resources shared by the US and Canada. The first of these

is the Definitive Treaty of Peace which was signed in 1783. The treaty agreed that the River St. Croix "should form a part of the boundaries of the US" but the exact location and the nature of the river were disputed by the two parties. This dispute was addressed in the 1794 Jay Treaty. To resolve this issue, the King of Britain and the US President each nominated a commissioner to look into the issue. The two commissioners then nominated a third commissioner and together they found out that the River St. Croix "emptied into Passamaquoddy Bay and was the Scudiac" (Riddell, 1913, p. 545). Other treaties signed between the US and Canada include the Rush-Bagot Agreement of 1817, the Webster-Ashburton Treaty signed in 1842, the 1846 Treaty of the Northwest Boundary, the Reciprocity Agreement concluded in 1854 and the Treaty of Washington in 1871 (IJC, n.d.).

International Joint Commission

On January 11, 1909, the US and Great Britain signed the Boundary Waters Treaty in Washington. The treaty was signed in relation to the questions that had arisen about water resources shared by Canada and the US. The main objective of the treaty, according to Burpee (1916) was to:

> Prevent disputes regarding the use of boundary waters, and to settle all questions which are now pending between the United States and the Dominion of Canada involving the rights, obligations, or interests of either in relation to the other or to the inhabitants of the other, along their common frontier, and to make provision for the adjustment and settlement of all such questions as may hereafter arise. (p. 5)

Under the treaty, the International Joint Commission was created as a result of negotiations "entered into pursuant to recommendations of a temporary International Waterways Commission

which analyzed the current and possible future problems along the boundary of the US and Canada and recommended a permanent organization to deal with them" (Weber, 1959; p. 71). The treaty defined boundary waters as "waters from main shore to main shore of the lakes and rivers and connecting waterways… thereof, along which the international boundary between the United States and the Dominion of Canada passes…but not including tributary waters…(Burpee, 1916; p. 5). The IJC is made up of 6 commissioners. Both the US and Canada appoint 3 commissioners each. The commission is co-chaired by one commissioner from each country.

Although the commissioners are appointed by their respective governments, they do not take instructions from the governments. Once appointed, they take decisions based on recommendations from professionals and scientists on the various boards created by the IJC. The Commission takes decisions by consensus and investigates and monitors situations when requested by both the Canadian and US governments. However, the recommendations of the Commission are not binding on the two governments and they do not have to be implemented.

The IJC has different boards that are responsible for a particular boundary water issue. Currently, there are about 19 boards that provide scientific and professional advice to the IJC. These include the Great Lakes Science Advisory Board, Great Lakes Water Quality Board, Great Lakes-St. Lawrence River Adaptive Management Committee, Health Professionals Advisory Board and the International Columbia River Board of Control. Others are International Lake of the Woods Control Board, International Lake Ontario-St. Lawrence River Board, International Lake Superior Board of Control, International Niagara Board of Control, International St. Croix River Watershed Board, etc. The IJC operates from three offices in Ottawa, Washington, D.C. and a regional office in Windsor (IJC, n.d.).

Great Lakes Water Quality Agreement

During the 1960s, the health of the Laurentian Great Lakes became a major concern for the US and Canada. The health of the lakes was deteriorating at an alarming rate. The Canadian and US governments instructed the IJC to identify the causes and provide recommendations to help address the issues. The IJC reported that there were excessive levels of phosphorus at several locations in the lakes. In its final report, the Commission concluded that industries were polluting the lakes on both sides of the boundary. The Commission recommended, among other things, that a new institution be established to oversee the overall cleanup effort of the lakes. As a result, Pierre Trudeau, Prime Minister of Canada and President Richard Nixon of the US signed the Great Lakes Water Quality Agreement (GLWQA) in 1972. This agreement was signed specifically to resolve the wide problems faced by the Great Lakes and the internationally recognised section of the St. Lawrence River.

Through binational consultation and cooperation, the Agreement has guided the restoration, protection and enhancement of the Great Lakes water quality since 1972. The IJC serves as an independent body that assesses the progress made to achieve the objectives of the GLWQA by the two governments. The main objective of the GLWQA "is to restore and maintain the chemical, physical, and biological integrity of the Waters of the Great Lakes" (IJC, 2005, p. 4). Between 1970 and 1980, there was significant reduction in the level of phosphorus in the lakes. It was an unprecedented success that demonstrated the value of inter-state cooperation (Binational.net, n.d.).

In 1978, Canada and the US replaced the 1972 agreement. The 1978 agreement built upon the earlier agreement. The focus of the new agreement shifted from phosphorus and other

conventional pollutants to toxic pollutants. Also included in the new agreement was the term 'Great Lakes Basin Ecosystem' which refers to the interacting components of air, land, water and living organisms, including humans, within the drainage basin of the lakes and the international section of the St. Lawrence River.

The Agreement was amended in 1983. The focus of the amendment was to further reduce phosphorus inputs into the lakes. The amendment outlined a number of measures to reduce the loading of phosphorus which were adopted by the two governments. In 1987, there was an extensive review of the Agreement after which new programs and initiatives were added to the existing Agreement. Seriously polluted areas in the basin were identified and labelled as Areas of Concern (AOCs). Per the Agreement, the AOCs are defined as the "geographic areas that fail to meet the general or specific objectives of the Agreement where such failure has caused or is likely to cause impairment of beneficial use of the area's ability to support aquatic life" (IJC, 2005; p. 8). This review, according to Jetoo and Krantzberg (2014), undermined the work of the IJC which "resulted in lessened engagement and constrained reporting" (p. 1). In 2012, a new Great Lakes Water Quality Protocol was adopted. The three new issues identified under the new Agreement include invasive species, climate change and habitat and species.

Successes and Challenges

The GLWQA is accredited with driving a new mechanism for controlling pollution of the lakes by both Canada and the US. The US passed the Clean Water Act into law right after the 1972 Agreement was signed. Lake Erie which was considered 'dead' in the 1960s was revived through aggressive control of phosphorus pollution. Modern sewage treatment was also given a major boost to help control domestic pollution and clear the other areas that were plagued with

algae blooms. Under the 1978 Agreement, Polychlorinated biphenyls (PCBs) were identified as one of the most toxic substances found in the lakes and they were subsequently banned.

The 1987 amendment recognized more than 40 AOCs and recommended that they should be cleaned up and restored the health quality of the lakes. The amendment also recommended the controlling of air pollutants such as mercury from settling into the lakes. Conditions for human health and wildlife have improved due to the investments by the two countries. This stimulated a boom in "wastewater infrastructure, fostered a recreational fishing renaissance in Lake Erie, and built scientific capacity in freshwater ecology and related fields that has solved problems around the world" (Great Lakes United, 2012). A 2006 report by the IJC indicated that the goals set for phosphorus reduction have been met because the open-lake total phosphorus concentration for Lakes Superior, Michigan, Huron and Ontario has reduced drastically (IJC, 2006).

Although the GLWQA has achieved tremendous success, a lot needs to be done in order to restore and maintain the Great Lakes water quality. As an Alliance for the Great Lakes (2007) report indicates, new pollutants find their way into the lakes' ecosystem every day. Advances in the pharmaceutical sector and new industrial processes introduce thousands of new unregulated substances whose effects on the environment are unknown. Jetoo & Krantzberg (2014) also argue that:

> The Canada-European Union (EU) comprehensive Economic and Trade Agreement (CETA) can also be a threat to the Great Lakes if it is used only for profit maximization. Some of the key partnership sectors include agriculture and agrifood, manufacturing, food, fish and seafood and chemicals and plastics…When CETA is entered into force, there is likely to be increased production of crops that no longer carry a tariff. This

> increased production of agricultural products will likely have a negative environmental impact on the waters of the Great Lakes. Under the full removal of tariffs scenario, the concomitant changes in demand will affect land and water usage and quality, waste creation, biodiversity and air pollution. This raises the question of how well positioned are relevant annexes in the 2012 protocol, such as nutrients, chemicals of emerging concern, habitat and species positioned to counteract these potential threats. (p. 20).

Major Threats

Canada and the US have successfully avoided the tensions that normally are associated with transboundary water resources by establishing a bi-national organization. The International Joint Commission (IJC), since its creation, has managed to address all boundary disputes between Canada and the US. In a 2018 poll, 4,250 respondents drawn from the Canadian province of Ontario and the US states of Michigan, New York, Ohio, Illinois, Wisconsin, Indiana, Pennsylvania and Minnesota were asked to identify the most significant problems facing the Laurentian Lakes. Pollution and invasive species were the two most significant problems identified by a majority of respondents. 30% of respondents identified pollution as the greatest threat to the lakes. 17% identified invasive species as a significant threat while 24% said they did not know. Other threats identified include waste being pumped into lakes (6%), algae (4%), water levels/fluctuations (3%), oil spills (3%) and endangered species (3%). Others are climate change (3%), drainage (2%) and fracking (1%) (IJC, 2018).

Pollution

Although the IJC have put in place measures to address pollution, it still remains the greatest concern for managers of the lakes. The health of the lakes is impacted by human

activity. It is home to about 90% of Ontario's population and provides drinking water to almost 9 million people in Ontario. The region accounts for 40% of Canada's economic activity (Bejankiwar & Ahmed, 2016). The economic activities in the region have drawn a large number of people to the region. The increase in population means more demand for water for domestic, agricultural and industrial uses. As the population of the region increases, it puts pressure on the Great Lakes.

Agriculture, industry and manufacturing have been identified as the three major causes of pollution in the lakes. Chemical waste from industries and the production of toxic pollutants, when exposed to the lakes, affect the human population through the consumption of fish. Ahmad (2017) reports that a study conducted by the Minnesota Department of Health in the Lake Superior basin found that 8% of newborns who were tested had mercury levels higher than the accepted reference dose and that the mercury found in these newborns were the same mercury found in fish. Chemical pollutants such as nitrogen and phosphorus increase algae bloom which in turn decreases the oxygen level in the lakes making survival difficult for fish and wildlife. In the 1960s, Lake Erie, due to a high level of phosphorus was pronounced 'dead' (Walker, 2013). Pollution from plastics is also one of the biggest challenges facing the Great Lakes. Researchers from the Rochester Institute of Technology estimate that about 10,000 metric tons of plastic find their way into the Great Lakes every year (Rochester Institute of Technology, 2016).

Invasive Species

There are over 4,000 species of animals and plants in the Great Lakes. The lakes "have been especially hard-hit by invasive species due to the presence of canals and international ship traffic, which have facilitated the movement of these species into the region" (Atkinson &

Domske, 2015; p. 20). The introduction of these invasive species has had diverse effects on the ecology of the lakes threatening the biodiversity of the lakes. Reaser (2003) defines invasive species as non-native species that have been introduced outside their natural environment that "harm or threaten to harm biological diversity…" (p. 4). Because these invasive species might not have any predators in the lakes, it becomes difficult to control their growth. The US Environmental Protection Agency estimates that about 25 invasive species of fish have entered the Great Lakes since the 1800s.

CHAPTER 3

THE AFRICAN GREAT LAKES

The area commonly referred to as the Great Lakes Region consists of about seven major lakes and river basins and are shared by eleven countries. The seven lakes are Lakes Victoria, Tanganyika, Malawi, Turkana, Albert, and Kivu (BirdLife International, n.d.). However, only the first three are usually referred to as the Great Lakes of Africa. This is due to their huge sizes and tropical location (Bootsma & Heckey, 1993). These lakes are primarily located in East Africa and are essential natural resources that support transportation, agriculture, industry, recreation, tourism and a source of drinking water for the millions of people that live in the region. Unlike the Laurentian Great Lakes, the African Great Lakes are surrounded by other smaller lakes that are quite substantial compared to other lakes in the world. The three lakes are shared by Uganda, Kenya, Rwanda, Burundi, Malawi, Tanzania, Zambia and the Democratic Republic of Congo (New World Encyclopedia, 2017), and about 107 million people are believed to be living in the African Great Lakes region.

Lake Victoria

Lake Victoria is the second largest lake in the world and the largest in Africa. With an area of 68,800 km^2, it spans 400 km from north to south and 240 km from east to west. The lake is shared by 3 countries: Uganda, Tanzania and Kenya. Uganda has access to 51% of the lake while Tanzania is entitled to 43% with Kenya claiming 6% of the surface area. Lying in the drainage basin of the lake are Burundi and Rwanda (Kayombo & Jorgensen, n.d.). “The Lake Victoria basin is used as a source of food, energy, domestic drinking and irrigation water and agricultural production, for shelter and transport, recreation and as a repository for human,

agricultural and industrial waste." The lake serves as a source of tourism and conservation of biodiversity. The huge populations in the basin rely on the lake for farming activities, commercial fishing for export and industrial development. The lake serves as an important source of drinking water in the region and also for the larger Nile Basin including Egypt, Sudan and Ethiopia (Okungu, Njoka, Abuodha & Hecky, 2005, p. 3). The lake is recognized as the source of the River Nile (Johnson, Kelts & Odada, 2009). Verschuren et al (2002) refer to the lake as the largest tropical lake in the world. The basin of the lake supports about 30 million people and has the largest freshwater fishery in the world (Kayombo & Jorgensen, n.d.). The lake was named after Queen Victoria of England by the British explorer, Speke (Encyclopedia Britannica, 2016).

Lake Tanganyika

Of the three African Great Lakes, Lake Tanganyika has the largest volume of water. Containing 19,000 km^3 of water, it is considered as the second largest and second deepest lake by volume in the world (Jorgensen, Ntakimazi & Kayombo, n.d.). Approximately 50 km wide and 150 meters deep, it stretches about 700 km long, making it the longest lake in the world (Blasband, 2016). The lake is estimated to have been formed about 20 million years ago and is considered as one of the oldest lakes in the world. Lake Tanganyika "is also an important resource of water and fish dietary protein to millions of people living in its basin" (Campbell, Verburg, Dixon & Hecky, 2008, p. 1). It is shared by Tanzania, Burundi, Zambia and the Democratic Republic of Congo (Abonyo & Howard, 2012). During the First World War, Lake Tanganyika was a battlefield between Germany and the Allies. Prior to the war, the lake was completely in the hands of Germany. Rwanda, Burundi, Tanganyika (now Tanzania) were German colonies making Germany one of the strongest European nation in East Africa. But the

Allies were able to "cut off the railway link in July 1916, the Germans abandoned the area. To avoid their prize ship falling into Allied hands, they scuttled the vessel, which was later resurrected and renamed the MV *Liemba*" (New World Encyclopedia, 2018).

Lake Malawi

Lake Malawi, also known as Lake Nyasa, is the southernmost lake of the African Great Lakes system (Eccles, 1974) and one of the oldest deep water lakes in the world (Delvaux, 1995). After Lakes Victoria and Tanganyika, Malawi is the third largest lake in Africa. It covers a surface area of 28,800 km^2 making it the ninth largest lake in the world. It is 579 km long and is shared by Malawi, Tanzania and Mozambique. This makes Tanzania the only country in the region that borders the three big lakes (Crul, 1998). 68% of the lake located in Malawi, Tanzania has 26% with Mozambique claiming 6% of the lake's catchment area (Kumambala & Ervine, 2010). Lake Malawi boasts of more species of fish than any other lake in the world. Lake Malawi, therefore, is a great source of food and income for the many people living in its catchment area (Crul, 1998; Bootsma & Jorgensen, n.d.).

Major Challenges

Like any other water resource in the world, the African Great Lakes face a number of challenges and threats. Like the Laurentian Lakes, the African Great Lakes are also threatened by pollution, invasive species and climate change. However, unlike the Laurentian Lakes, there are also institutional challenges that have prevented and keep preventing the countries in the Great Lakes region from addressing the above mentioned issues that are faced by almost all water resources in the world.

Colonial Legacy

One of the biggest challenges facing countries in the African Great Lakes is the legacy of colonialism. Tanzania, Rwanda and Burundi were part of German East Africa before World War 1. After the defeat of Germany, Rwanda and Burundi were given to Belgium by the League of Nations while Britain took control of Tanzania. Kenya, Zambia and Uganda were also British colonies. As African countries started agitating for self-governance with a majority gaining independence in the early 1960s, the 'artificial' borders created by the European powers in Berlin in 1884 created tensions among the newly-independent states. The colonialists signed treaties without recourse to the indigenous people. For example, Germany and Britain signed the Heligoland Treaty in 1890 which gave the British territory of Malawi exclusive ownership of the northern part of Lake Malawi (Kenneth, 2016). This is a total deviation from the common interpretation of the 1982 United Nations Convention on the Law of the Sea which states that the middle of the lake should be the border between Malawi and Tanzania. While Malawi is invoking the 1890 treaty to claim the entirety of the northern part of the lake, Tanzania is basing its argument on the 1982 law (Sandner, 2018). To this day, there has not been any clear solution to the problem. When Malawi decided to explore the lake for oil and gas in 2012, the dispute intensified. Following this incident, both Malawi and Tanzania went to the negotiation table but the former pulled out and decided to seek redress at the International Court of Justice which the latter have failed to cooperate (Kürschner-Pelkmann, 2013).

Political Instability

A complex network of political, social, cultural and economic connections in the African Great Lakes region have contributed to the lack of political stability, peace, security and good

governance. The conflicts in the region are interlinked and stem from post-colonial challenges that are hindering national integration and state-building. The common features found in conflicts in the region include tribalism and exploitation of natural resources which the region has in abundance (Kanyangara, 2016). It is only Tanzania and Zambia that have not witnessed any form of violent conflicts in the past three decades. Kenya was engulfed in a bitter ethnic violence after the 2007 elections which claimed the lives of more than a thousand people. Both Burundi and Rwanda have experienced bitter genocides in 1972 and 1994 respectively. Since 1987, Uganda has had to battle with Joseph Kony's Lord Resistance Army rebels. The rebel group is still active in the East and Central African regions. The Democratic Republic of Congo is the worst hit. There are over 40 armed groups operating in the country. The Mai-Mai militia is very active on Lake Tanganyika. The rebel group has successfully established a gold-smuggling trade on the lake. They also extort money from fishermen. In September 2017, Reuters reported the exchange of gunfire between the rebel group and the Congolese army on the lake (Reuters, 2017). The political instability and violence in the region make it difficult for any effective inter-governmental management of the lakes.

Population Growth

When the population of any given jurisdiction increases, it puts pressure on its natural resources. It is estimated that the population in the African Great Lakes Region grows between 3 and 4% every year as compared to 0.6% in developed countries (Ogutu-Ohwayo, Hecky, Cohen & Kaufman, 1993). Bootsma and Hecky (1993) observe that the population of livestock is almost the same as that of the people in the region. The rate at which the population is growing in the region, therefore, is putting pressure on the lakes. Especially along the shores of Lake Victoria, many urban centers are rapidly developing. Deforestation and devegetation have resulted in the

erosion around the lakes leading to siltation, sedimentation, and loading of nutrients into the lakes. “This high population has increased the demand for agricultural and domestic water supply and increased the discharge of waste, and pollutants into the lakes. It has also increased the demand on land for livestock, agriculture and fuel wood” (Ogutu-Ohwayo, Hecky, Cohen & Kaufman, 1993; p. 119).

Interventions

Lake Victoria Basin Commission

The East African Community formed the Lake Victoria Basin Commission in 2005. It is headquartered in Kenya. Its core mandate is to coordinate sustainable development and management of the lake. The Commission was established under the Vision and Strategic Framework for Management and Development of Lake Victoria Basin Protocol. The Commission has been mandated to recommend a long term strategic plan for the sustainability and management of the lake’s resources to promote economic development in the region. The main focus of the Commission is improving living conditions, quality of life and reducing poverty (https://www.lvbcom.org).

Forum of Former African Heads of State and Government

The Forum of Former African Heads of State and Government is an informal group of former presidents and prime ministers of African states and other distinguished Africans. It functions as an advocacy group and policy think tank that helps to implement the objectives of the African Union (http://www.africaforum.org/). Both Malawi and Tanzania, in a bid to find a solution to the boundary dispute on Lake Malawi, turned to the Forum to mediate the impasse in 2012. The mediation team was led by Joaquim Chissano, former president of Mozambique and

former president Thabo Mbeki of South Africa. The team relied on the legal expertise of Abdul Koroma, a former judge at the International Court of Justice. The mediation talks have stalled since 2017 after Malawi accused Tanzania of deliberately sabotaging the work of the mediation team. Malawi has since served notice that it will seek redress at the International Court of Justice. Because the work of the Forum has no legal basis, its decisions are not binding on the parties (Kenneth, 2016).

The Convention on the Sustainable Management of Lake Tanganyika

On June 12, 2003, Tanzania, Burundi, Zambia and the Democratic Republic of Congo adopted the Convention on the Sustainable Management of Lake Tanganyika in the Tanzanian capital of Dar es Salaam. The Convention came into force in 2005. Like the Boundary Waters Treaty of 1909 that brought about the formation of the IJC, this Convention led to the establishment of the Lake Tanganyika Authority. The primary objective of the Convention is to ensure "the protection and conservation of the biological diversity and the sustainable use of the natural resources of Lake Tanganyika and its Basin by the Contracting States on the basis of integrated and co-operative management" (internationalwatersgovernance.com/lake-tanganyika.html). The convention is also mandated to settle disputes that may arise between member states.

Successes and Challenges

With the exception of Lake Malawi which is still at the center of a dispute between Malawi and Tanzania, there exists some form of cooperation among the states sharing Lakes Victoria and Tanganyika. The main success of the interventions on the African Great Lakes is the formation of inter-governmental organizations to manage the lakes. Although Lake Victoria

Basin Commission and the Convention on the Sustainable Management of Lake Tanganyika may have been established in the early 21st century, they have helped in protecting the health of the lakes. In partnership with other international organizations and donor agencies, these two inter-governmental organizations started educating the people living in the lakes' basin about sustainable methods of fishing and controlling pollution.

These inter-governmental organizations, however, have achieved very little in protecting the health of the lakes. Funding for the activities of the organizations has become a big challenge. Mostly, donor agencies and international organizations such as the United Nations Development Program have been funding research and other activities in the basin. Other developmental issues such as population growth, deforestation and pollution are the biggest challenges facing the organizations. These challenges are hindering the economic benefits of the lakes. It is estimated that about 2 million people depend on Lake Malawi daily for their livelihood.

CHAPTER 4

RECOMMENDATIONS

Invasive species are a threat, not only to the Laurentian Great Lakes, but almost all freshwater lakes in the world. In the 2018 IJC poll, invasive species are ranked as the threat with the most negative impact on the environmental health and water quality of the lakes. In addition to the governments of Canada and the US instituting measures at ports of entry to prevent people from introducing non-native species to Canadian and US waters, the IJC should prioritise the sensitization of residents in the Great Lakes basin in identifying non-native aquatic species. The IJC needs to also educate the public about its activities and the crucial role it plays in ensuring that the lakes are healthy for human consumption, recreation and to support wildlife. In the poll, 80% of respondents recognised that the existence of the IJC is very important. However, only a small group of respondents know about the existence of the IJC despite the crucial role the Commission plays in ensuring the lakes are healthy (IJC, 2018).

In a 2015 report, the IJC expressed their concerns about the lack of adequate funding for their activities. The Commission, therefore, called upon the governments of Canada and the US to come up with long-term funding in order to keep their research on course (IJC, 2015). In the 2018 poll, a greater majority (88%) feel it is important to protect the Great Lakes and 80% of respondents acknowledged the fact that it is important for both Canada and the US to work together to address issues facing the Great Lakes. Also, there should be tougher sanctions for industries that pollute the lakes with toxic waste. They should bear the cost of cleaning the lakes.

What is really needed for the effective management of the African Great Lakes is a strong commitment from the various governments in the region. With a unified force backed by

sustained funding, these countries can team together to rid the region of armed groups. This might seem a very difficult task to accomplish given the political dimensions in the region. However, Wolf (2007) notes that "shared water provides compelling inducements to dialogue and cooperation…" (p. 3.3).

Also, colonial treaties should be revisited to allow all stakeholders the opportunity to be a part of any new process. The territorial dispute over Lake Malawi between Malawi and Tanzania should rather be solved based on the provisions of the United Nations Convention on the Law of the Sea. This is because this law provides equitable distribution and access to transboundary resources. Most colonial agreements were signed without recourse to the indigenous people. It is, therefore, unfair to use these colonial agreements as a basis of laying claim to any part of a transboundary water resource.

Although the international community and other donor organizations have been funding research in the African Great Lakes Basin, more needs to be done. The countries in the basin should make it a priority to allocate resources to fund research to maximize the benefits that the lakes have to offer. This is the more reason why an independent inter-governmental organization like the IJC is needed to administer the African Great Lakes.

Governments in the African Great Lakes Basin need to engage and educate the local people in methods of sustainable fishing methods. Most people still employ indigenous methods in fishing. Some of these methods are very harmful to human health and the ecosystem as a whole. Like in most developing countries, fishermen use deadly chemicals and pesticides in fishing. This has increased the level of mercury and PCBs found in fish in the African Great Lakes.

Unfortunately, there is no clear enforcement of legislation in tackling pollution in the African Great Lakes. Kenya has one of the toughest legislations governing plastic waste but enforcing the law is now a challenge. In sub-Saharan Africa, plastics pollution is the greatest threat to the environment including water bodies. To protect the lakes, there is the need to sensitize the populace about the harmful effects of plastics to the health of the lakes.

Conclusion

Managing shared resources needs the cooperation of all stakeholders involved to make it a success. The IJC model shows that a strong, independent and well-funded inter-governmental organization is very essential in ensuring the equitable distribution and access to shared resources. The IJC is a clear indication that states stand to benefit when they cooperate with each other. Although different political systems are in place in North America and East Africa, the IJC model can be successfully implemented, not only in the management of the African Great Lakes, but also in all transboundary water disputes. The signing of agreements is not just enough but periodic review of agreements must be adopted due to the advancement in technology and emergence of new threats. Climate change is not a new phenomenon but it took Canada and the US four decades to include climate change in the 2012 renegotiated GLWQA. The African Great Lakes pose a challenge to the governments of the basin and until such a time that the countries can come together, identify common interests and propose short term and long term solutions to the problems, the health of the lakes will continue to deteriorate posing a threat to the ecosystem.

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