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The Tale of the Shrinking Lake Chad: Implications for the Implementation of the Sustainable Development Goals in the Lake Chad Basin

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ABSTRACT
As the global climate change intensifies and human population continues to grow, water resources are expected to come under intense pressure. The Lake Chad, a trans-boundary water body and one of Africa's great lakes, has continued to shrink, losing most of its water. The Lake which was about 25,000 square kilometres in surface area back in 1963 is now about one-twentieth of its size. Scientists and resource managers are concerned about this dramatic loss of fresh water that sustains diverse livelihoods of more than 30 million people. Using information drawn mainly from secondary sources, this paper examines the contraction of the Lake Chad and the implication this has on the implementation of the Sustainable Development Goals (SDGs) in the Lake Chad basin. The paper concludes that since almost all the SDGs have a form of linkage with water, real implementation of the SDGs will require that riparian governments and donor agencies do all it takes to save the Lake Chad from becoming extinct. The paper lends its support for the proposed inter basin water transfer to augment the Lake's waters and recommends adaptive measures to deal with the current situation.
Keywords: Climate Change, Lake Chad, SDGs, Trans-boundary waters, Riparian, Rivers.

1.0 INTRODUCTION

A reliable supply of freshwater is a prerequisite for socioeconomic development, socio-political stability and human prosperity (Kandeel, 2019). Unfortunately, there is a water supply challenge in Africa occasioned mainly by the continents' extreme variability of rainfall (in time and space) which is reflected in the uneven distribution of surface and ground water resources. Global Climate change scenarios predict an increase in extreme events, thus increasing the vulnerability of Africa's water resources, most of which are already facing significant risks to their sustainability.

A manifestation of these threats on Africa's waters in recent decades is the drying up of lakes. Available reports show for instance that the Lake Chad, one of Africa's largest lakes and a major source of water supply and livelihood to over 40 million people, is in distress. Over the last three decades, the area of the Lake Chad has significantly reduced drastically; the lake which was about 25,000 square kilometres in surface area back in 1963 is now about one-twentieth of its size (Ngatcha, 2009). The Food and Agriculture Organisation (FAO) has called the situation an ecological catastrophe, predicting that the lake could disappear by the end of this century. The implication is a destruction of livelihoods and loss of invaluable biodiversity.

The aim of this paper is to examine how this 'ecological catastrophe' impedes on the implementation of the Sustainable Development Goals (SDGs) in the Lake Chad basin.

2.0 Hydrology Of The Lake Chad

The Lake Chad occupies the central region of the Lake Chad Basin which covers an area of about 2,400, 000km^2, which is about 8% of the total area of the African continent. According to Abdullahi and Mustafa (2019), the hydrology of the Lake Chad Basin shows that the annual water balance of the Lake Chad is made up of the following fluxes:

- Inflow due to precipitation on the surface of the lake- 17% (Precipitation amount = 382mm/year)
- Combined inflow from Komadugu-Yobe system and Yedseram-Ngadda system in Nigeria = 3%
- Inflow from Logone and Chari river in Cameroon = 80%
- Wet dry years inflow averaged 20bm^3 per annum with the lowest flow of 16m^3 recorded in 1984
- Evaporation losses = 2170mm/year

The hydrology of the Lake Chad drainage basin has undergone large changes over the past four decades (Coe and Foley, 2001); the lake's surface has reportedly shrunk from 22,000 km^2 to a meager 300 km^2 (Singh, Diop and M'mayi, 2006). Satellite images and aerial photographs have been used to monitor the Lakes fluctuations since the 20th century (figure 1). According to Leblanc et al (2011) five major recession phases of the Lake occurred during the 19th and 20th centuries, during which the lake was alternatively described as Mega, Large/Normal, Average, Small and Dry small Lake Chad according to its water levels, depth and areal dimensions.

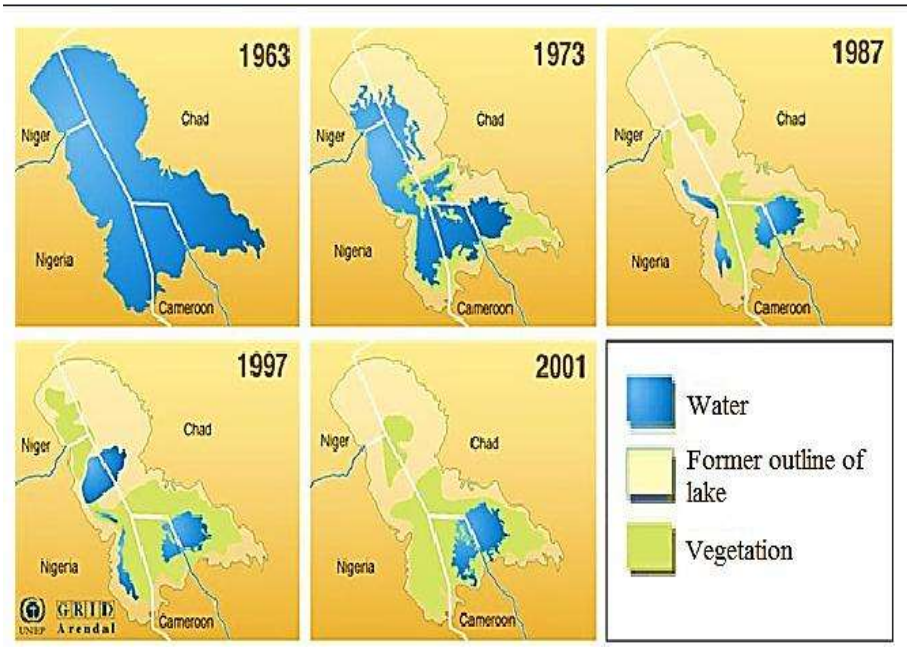

Fig 1: A Chronology of change in the Lake Chad.

3.0 CAUSES OF THE SHRINKING OF THE LAKE CHAD.

The shrinking of the Lake Chad has been studied broadly using remote sensing data, but the main cause of the shrinking is still uncertain due to limited availability of ground truth data (Lee, Ichoku, Bolten, Policelli and Djimadoumnga, 2015). However, evidence from the literature show that the major propositions put forward to explain the drying up of the lake have centred on Climate change (with particular emphases on drought and rainfall variability), increased water withdrawal for irrigation, lake bathymetry and population pressure.

3.1 Climate change/variability: A number of climate change studies have provided sufficient evidence to show that water resources are vulnerable and will be greatly impacted by variability in the climate (especially in terms of changes in precipitation and temperature), with resultant effects on societies and ecosystems (Ahile, Mailumo and Ade, 2017; Odada, 2016; Arnell, 2004). Climate change has deterred the flow of rivers that drain into the Lake Chad resulting in large changes to the water balance of the Lake Chad drainage basin (Yunana et al, 2017) as well as the receding of the lake. For instance, the discharge of the Chari/Logone river system (which account for about 96% of the water of the lake Chad) is reported to have decreased by almost 75% over the last 40 years, from about 40km^3 /year in the early 1960s to about 10-15km^3/year in the 1980s and 1990s (Coe and Foley, 2001).

Some modelling studies have attempted to quantify the effect of climate variability on the Lake Chad. Using the IBIS and HYDRA models which were run with long term climatic data, Coe and Foley (2001) concluded based on simulated results that the 30% decrease in the lake area observed between1956-1965 and 1966-1975 can be attributed primarily to long-term climate variability. In addition, they also noted that climate variability also controls the inter-annual fluctuations of the water inflow into the lake.

The climate of Lake Chad basin is characterised by high temperatures, strong winds, high evaporation and fluctuating rainfall patterns which has defined the history of drought in the basin. Rainfall in the basin dropped intermittently from the middle of the 1960s, triggering the droughts of 1972-1975, which coincided with the shrinking of the basin to 10,700km^2 from it's initial level of 25km^2 in 1963 (Odada, Oyebande and Oguntola, 2006). The region was also hit by another drought between 1982 and 1985 resulting in a drop in the basin area to 1400 km^2, the lowest basin surface recorded over the past 100 years.

In addition, the bathymetry of the lake also makes it vulnerable to water losses. Because the lake is shallow; just about 7m deep, it responds rapidly to precipitation and runoff changes (Lemoalle, Bader, Leblanc, and Sedick, 2012).

3.2 Increased Irrigation Water Withdrawal: The entire Lake Chad basin is situated in the Sahel region where the climate favours mainly irrigation agriculture. In other words, irrigation seems to be the only means by which inhabitants in the Lake Chad basin can practice intensive agriculture. Lake Chad has been the source of water for massive irrigation projects in the region. Irrigation in the Lake Chad basin was small until the early 1970s, but increased rapidly thereafter (Gae et al, 2011). Coe and Foley (2001) attribute this dramatic increase of irrigation activities along the corridors of the Lake Chad to the dry climate conditions prevalent at the time. This lead to a massive loss of water from the Lake. The amount of water diverted between 1983- 1994, for purposes of irrigation quadrupled from the amount used in the previous 25 years (Oruonye, 2015).

Most studies on the impact of irrigation on the lake size have been based on estimates. However, Gae et al (2011) have demonstrated quantitatively using the VIC model (to simulate naturalized flow from 1952-2006) that without irrigation water withdrawal, the northern part of the lake would have survived the droughts in the 1980s.

In addition to irrigation water withdrawal, dams have also influenced the flow river pattern of rivers that feed the Lake Chad. Several dams are reportedly built on the Komadugu- Yobe River, reducing to only 1% the amount of water now reaching the lake. The rest is absorbed by various water catchment facilities, including illegal channels dug out by farmers along the river to divert water to their fields (World Bank, 2002). Sedimentation of rivers and water courses has also lead to changes in channel flow patterns as well as a reduction in the flows to the lake through channel diversion (FAO, 2008).

4.0 THE SUSTAINABLE DEVELOPMENT GOALS (SDGs): Brief Overview

The Sustainable Development Goals (SDGs) form a cohesive and integrated package of global aspirations the world commits to achieving by 2030 (Picot and Moss, 2014). The SDGs (table 1) are made up of 17 goals and 169 measurable targets; collectively aimed at promoting efforts geared towards poverty eradication and increasing development of poor countries. These goals are interlinked; the key to the success of one will involve tackling issues commonly associated with another (UNDP, 2017).

Table 1: The Sustainable Development Goals

SDG		SDG	
1	End poverty in all its forms	10	Reduce inequality
2	End hunger, achieve food security and promote sustainable agriculture	11	Sustainable cities and communities
3	Good Health and Well-being	12	Responsible consumption and production
4	Ensure quality education	13	Combat climate change and its impacts
5	Gender equality	14	Life under water
6	Access to clean water and sanitation	15	Life in land
7	Affordable and clean energy	16	Peace, justice and strong institutions
8	Decent work and economic growth	17	Partnership for goals
9	Industry, innovation and infrastructure		

Source: UNDP, 2017

5. 0 THE SHRINKING LAKE CHAD AND THE SUSTAINABLE DEVELOPMENT GOALS.

The Lake Chad is an important trans-boundary water source that provides livelihood services to more than 45 million people. It has great potential in terms of biodiversity, natural and cultural heritage. Over the last three decades, the area of Lake Chad has reduced drastically leading to significant imbalances resulting in an increased vulnerability of the hydro-socio ecosystem with multiple impacts (UNESCO, 2018).This situation has already been described as an ecological disaster.

Water is regarded as the cross-cutting factor in the implementation of the SDGs (Ahile and Mailumo, 2018). In a typical discussion on the SDGs, water is synonymous with SDG6 (to ensure availability and sustainable management of water and sanitation for all), which can be directly or indirectly connected with the other goals and targets. The preceding sections will examine the implications of the shrinking Lake Chad on the implementation of SDG 6 and other related SDGs in the Lake Chad Basin.

5.1 Lake Chad Shrinkage and Implication for the Implementation of the SDG 6.1 and other Related Goals.

The shrinkage of the Lake Chad has implication for scarcity and increased demand for water in the entire basin. This puts a limitation on the implementation of target 6.1 and 6.2(which jointly seeks to reduce by half the number of people without access to clean water and sanitation by 2030).The Lake Chad Basin particularly faces physical water scarcity due to its location in the semi-arid region, and economic water scarcity because the region has not developed appropriate technologies to effectively use its water resources (Amali, Bala, and Adeniji, 2016). A report credited to the UN-CERF (2018), shows that 1 in 3 people in the Lake Chad region do not have access to safe drinking. It has also been noted that access to safe drinking water is very limited in the northern part of the Lake, precisely in the north-eastern zone of Nigeria (Onuoha, 2010). Consequently, water-related diseases such as diarrhoea, cholera, and typhoid have become widespread in the basin. Although the Lake's surface water have been used mainly for irrigation and fishing, the continues shrinkage of the Lake Chad puts pressure on the groundwater deposits, which many NGOs and the Lake Chad Basin Commission have depended on to augment water supply through the provision of boreholes.

5.2 Implications for the Implementation of SDG 6.4 and other Related Goals.

One of the propositions put forward to explain the drying up of the Lake Chad is the unsustainable use of water resources particularly the excessive withdrawal of water for irrigation (Oruonye 2013; Odada, Oyebande and Oguntola, 2006; Coe and Foley, 2001). This goes contrary to the implementation of target 6.4 (substantially increasing water-use efficiency and ensuring sustainable withdrawals).As earlier reported, the Lake Chad has been a major source of water for massive irrigation projects. Water withdrawal for agriculture purposes have increased as a result of the lake's contraction. Large and unsustainable irrigation projects built by riparian countries have diverted water not just from the lake but also from the rivers that feed the lake. Consequently, the South Chad Irrigation Project in Nigeria and the

MANDI Polder Project in Chad, which depended on water abstraction from the lake became stranded by the receding lake shoreline and had to be abandoned (Odada, Oyebande and Oguntola, 2016). Regrettably, the pattern of exploitation of the lake's water by the riparian states has been in sharp contrast to the institutional provisions envisaged in the convention signed by the Lake Chad Basin Commission (Onuoha, 2010).This puts a limitation on the implementation of Goal 17 which seeks in part to strengthen the implementation and to revitalize global (basin scale in this case) partnership for sustainable development.

It is important to note that although water withdrawal for irrigation has helped to increase the production of stable foods and vegetables in the region, it has also negatively impacted on food security, a focal point of SDG 2. The shrinkage of the Lake Chad for instance has affected fishing which is a major source of livelihood for people living around the basin. The annual fish catch in the Lake Chad was 130,000 to 141,000 tons/year up to the early 1970s. In recent times, the contribution of fish production from the Lake Chad has dropped; stands at about 60,000 to 80,0000 tons/year (Oruonye, 2013).

The importance of water in sustaining livelihoods, especially agricultural livelihoods, provides a link to conflict. Water has been a potential driver of conflict among countries and communities. Water conflicts can materialise when tensions involve access to and allocation of water (Opara, Stringer, Dougil and Bila, 2015). As earlier mentioned, the rich water resources of the Lake Chad have been a source of economic livelihood, sustaining over 20 million people inhabiting the catchment area of Nigeria, Chad, Niger and Cameroon. Past studies have attributed regional tension and conflicts, as well as border disputes to increasing water scarcity especially among riparian communities or nations (ibid), occasioned mainly by unsustainable use of water from the Lake. Documented reports on the Lake Chad shows there were increased water crises in the region during the droughts of 1980s and 1990s. Specifically, between 1982 and 1985, interstate water and boundary conflicts increased among riparian nations (ibid). In recent times, there has been a rising incidence of conflicts between and among fishermen, pastoralists, and farmers. These conflicts have a tendency to degenerate into large scale intra-ethnic, intra-state and inter-state wars. Also related is the issue of Islamic terrorism which has been featuring more frequently in the volatile portion of the Lake Chad in Nigeria, especially in the states of Borno and Yobe. A cursory analysis of this crisis suggests that the issue at stake is that of environmental deprivation projected by the drying up of the lake (Ifabiyi, 2013). Arising from these issues highlighted above, the Global High-Level Panel on Water and Peace (2017) stressed the need for countries to arrange trans- boundary water agreements. It is therefore the duty of coordinating bodies or institutions to work assiduously to ensure coordinated development and management of trans-boundary water to strengthen water security, improve livelihoods, and fuel economic growth. Livelihood loss can lead to poverty, which is a traditional driver of conflict (Okpara, Stringer, Dougill and Bila, 2015). The preceding discussion demonstrates that conflicts can distort the peace that a people enjoy. People can also loss their sources of livelihood where water war persist. When this happens, it will be difficult to ensure the implementation of Goal 1 (which seeks to end poverty in all its forms), Goal 2 (which seeks to end hunger) and Goal 16 (which seeks to promote peace).

5.3 Implication for the Implementation of SDG 6.3 and other Related Goals.

Another ambition of the SDGs, specifically Goal 6.3 is to improve water quality by reducing pollution. Evidence from the literature shows a high rate of water pollution in the Lake Chad. Salman and Momha (2009) reports that the large quantities of agro-chemicals used to support commercial cotton and rice production pollutes the water of the lake as a large quantity of these chemicals are washed into the lake during the rains. In the Chari River, which is a major source from which the Lake Chad draws its water, massive and uncontrolled chemical-based products pollute the water, leading to considerable environmental degradation (Nambatingar, Clement, Merle, Mahamat and Lanteri, 2017). Another study conducted by Akan, Abbagambo, Chellube and Abdulrahman (2012) reveals that there is a high concentration of heavy metals in water samples collected around Baga area, in the Lake Chad region. This is attributed to runoff of wastewater from surrounding agricultural fields. This has a tendency to affect aquatic life. Available reports show that water pollution in the Lake Chad has affected fishing, a major source of livelihood in the area. This appears to be a stumbling block in the implementation of the SDG

14, particularly target 14.1, which seeks to prevent and significantly reduce pollution of marine resources of all kinds, particularly from land-based activities.

Besides the effect of water pollution on marine resources, polluted water also has a direct effect on human health. Sewerage and industrial effluents have indirect effects through consumption of foodstuffs being irrigated with contaminated water. This hinders the efforts to ensuring healthy lives and promoting well-being for all as enshrined in SDG 3.

5.4 Implication for the Implementation of Goal 6.5 and other related goals.

Target 6.5 seeks to promote the implementation of Integrated Water Resource Management (IWRM), particularly through Trans-boundary Cooperation. The Global Water Partnership (2000) defines IWRM as "A process which promotes the coordinated development and management of water, land and related resources in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." Trans-boundary waters such as the Lake Chad, are crucial for the people particularly because water is a key component of food security and of sustainable agriculture. As important as this may sound, the realization of food security and sustainable agriculture, (the focus of SDG 2) depends entirely on the coordinated development and management of water and related resources as enshrined in the definition of IWRM above. With the continuous disappears of the Lake Chad coupled with increased population pressure, equitable sharing of water resources among riparian nations especially for agricultural purposes has become a very complex issue. Cases of unsustainable water withdrawal in the basin have been widely reported. Water resources misuse/overuse violates Articles 14,15, and 16 of the Water Charter of the Lake Chad (LCBC, 2011). This has led to conflicts and consequently threatened peace within the basin (which is contrary to the aspiration of Goal 16).

The last part of the IWRM definition encourages equitable use of resources (including water) with the aim to intentionally preserve them for future use. The shrinking of the Lake Chad has led to the influx of fishermen, herders and farmers from the southern and northern parts of the basin to areas of the Lake (precisely in Cameroon and Chad) still holding water considerably. This puts pressure on water, fish stock, vegetation, and grazing land. Most struggling fishermen resort to sell of firewood as alternative source of livelihood, thereby further degrading the environment (Oruonye, 2013).

The vanishing of the Lake Chad appears only to have negative effect on its surrounding inhabitants. However, a cursory look at this unfortunate situation will show that some positives can be taken out of it. This should be a reason to further strengthen the partnership for more efficient and sustainable water development and use between riparian countries in the Lake Chad basin (this resonates with Goal 17). The Lake Chad Basin Commission, tasked with this responsibility should wake up to its responsibility.

5.5 Implication for the Implementation of Goal 6.6 and other related goals.

The Lake Chad as already mentioned is a source of livelihood to millions of people around the basin. The shrinkage of the Lake is therefore a threat to livelihood and economic progress. Climate change is widely reported to be the major cause of the shrinkage of the Lake. It has also been identified as the most threatening global change relevant to the Lake Chad Basin (UNEP, 2004). The aspiration of target 6.6 is to protect and restore water-related ecosystems including rivers and lakes. This target resonates with target 15.1. Both targets seek to protect, restore, and conserve all water-related ecosystems. Two key words in this targets; protect and restore, deserve special attention.

Against the backdrop of the shrinking Lake Chad, one of the ways to ensure the successful implementation of targets 6.6 and 15.1(on the part of protection)is to strengthen resilience and adaptive capacity of riparian communities to climate related hazards as highlighted in target 13.1. To this end, Ngatcha (2009) suggests that any project in the Lake Chad basin must focus on improving environmental conditions by paying attention to essential components of the environment. This will include tackling the problem of drought and desertification arising from rainfall deficits in the basin. Another way is to reduce water withdrawal for irrigation by adopting crop and cropping practices that are robust over a wider spectrum of water availability (Adams and Peck, 2008).

Many authorities, policy makers and heads of government have continued to advocate the need to restore the water level of the Lake Chad given its strategic importance to livelihood support. At the 22nd edition of Conference of the Parties (COP) to the United Nations Framework Convention on Climate change (UNFCCC) in Morocco, Nigeria's President, Muhammadu Buhari called for an urgent need to resuscitate Lake Chad. There is a consensus among these advocates that Inter-Basin water transfer is about the best option to restoring the waters of the Lake, hence the birth of the Lake Chad Replenishment Project. This project entails damming the Oubangui River at Palambo in the Central African Republic and channelling some of its water through a navigable canal via the Chari River to the Lake Chad. Unfortunately, this project is bedevilled by challenges that have affected its actualization. One of the challenges is funding of the project. Because of the huge cost (estimated at USD14 billion; Punch Editorial, May 26, 2016), the four main riparian countries who share the lake- Nigeria, Cameroon, Chad and Niger may not be able to execute this project. Again, Nigeria's President, Muhammadu Buhari has been consistent in his appeal to the International Community to support this project. Another challenge is the expected change in regime of rivers en-route the Chari River. Many people have expressed fears that transfer of water will lead to flooding, affecting especially the Chadian communities. There are also unfounded fears that this project will lead to water shortages in the Congo basin.

6.0 CONCLUSION AND WAY FORWARD

This paper has established that the Lake Chad is shrinking. The shrinking and vulnerability of the Lake is attributed to climate change, excessive irrigation water withdrawal, shallowness of the lake and increased population pressure. The paper has also highlighted the importance of water and its centrality in the achievement of sustainable development. The paper further shows that the continuous shrinking of the Lake Chad, described as an ecological disaster, will have adverse implications for the implementation of the Sustainable Development Goals (SDGs) in the basin. Challenges that have been noticed with the implementation of the SDGs focus on promoting; access to water, food security and sustainable agriculture, peaceful co-existence among resource users, and strengthening resilience and adaptive capacity to climate change. Given the strategic importance of the Lake Chad to livelihood support, the paper concludes that protecting and restoring the lake should be should be a top priority of member states of the Lake Chad Basin Commission. The paper lends support for the proposed Inter-basin water transfer project.

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