2 Climate change, population surge and resource overuse in the Lake Chad area

Implications for human security in the north-east zone of Nigeria

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INTRODUCTION

It is evident that Africa is facing a number of climate shocks that are intensifying poverty, inequality and the disruption of livelihoods. Indeed, concern in the early 1990s over the negative impact of climate change strengthened fears that environmental degradation and demographic pressures would displace millions of people in the developing world and lead to huge social upheaval.[1] Sub-Saharan Africa is among the most vulnerable to the negative effects of climate change, and faces the greatest challenges of adaptation.

The Intergovernmental Panel on Climate Change (IPCC) has found that Africa is already experiencing the negative effects of climate change and will experience greater changes in future.[2] In Africa, the lakes are among the major victims of the deleterious effects of climate change. Without doubt, the lakes are part of the essential natural capital that local people depend on for their livelihood and survival. Although Africa's lakes hold about 30 000 cubic kilometres of water, and yield 1,4 million tonnes of freshwater fish each year, they are among the most heavily exploited of all the continent's freshwater resources.[3] A recent United Nations report reveals that more than 600 lakes in

Africa are declining rapidly owing to the combined impact of climate change and resource overuse.[4]

In the Lake Chad area, climate change is not just a future threat, but also a present danger that confronts the communities living around the lake.[5] An obvious major impact of climate change on the lake is the rapid decline of its surface water. Lake Chad lost over 50 per cent of its water between 1973 and 2002.[6] Yet, the lake, like any other transboundary watercourse, is a vital source of fresh water and other resources that sustain human, livestock and wildlife communities in four African states, namely Cameroon, Chad, Niger and Nigeria.

Over the past four decades the waters of the lake have continued to diminish. This, in turn, has affected aquatic and terrestrial ecosystems, the quantity and quality of fresh water availability, and the wider environment. Adverse impacts include reduced fish stocks, siltation, loss of vegetation and depletion of grazing land. Although the local people have lived with these problems for many years and have evolved ways of coping with them, albeit ineffectively for the most part, their scale and intensity are exacerbated by climate change as this adds another dimension to the matrix of global water insecurity.

Against this backdrop, this chapter examines the emerging and future human security risks posed by the diminishing water resources of Lake Chad for Nigeria, especially the north-east zone. It explores this matter by focusing mainly on how human activities interact with the effects of climate change to induce the rapid shrinkage of the lake, and discusses the attendant implications for human survival and development.

LAKE CHAD: A STRATEGIC TRANSBOUNDARY NATURAL RESERVE

Lake Chad is a unique transboundary natural reserve that crosses national frontiers, linking users across borders and supporting different economic livelihoods. It is located between latitudes 6° and 24°N and longitudes 7° and 24°E. It is the most important natural feature of the conventional basin, and, as Figure 1 indicates, is shared by Cameroon, Chad, Niger and Nigeria. Although Lake Chad is one of Africa's largest lakes, it is one of the least studied lakes compared with other lakes on the continent.[7]

It is an extremely shallow lake – rarely more than 7 metres deep – and has been susceptible to increasing climatic variability and human impact over the

Figure 1 Map showing the shorelines of Lake Chad and its riparian states

Source Microsoft Encarta, Map of Lake Chad (lake) Africa

past 40 years. About 90 per cent of Lake Chad's water comes from the Chari-Logone River, which enters the lake from the south-east, with its sources in the humid uplands of the Central African Republic. Historically, the Komadougou-Yobe River, which enters the lake in the north-west, has contributed about ten per cent of its water.[8]

The main economic activities in the Lake Chad Basin include fishing, agriculture, hunting and pastoralism. Fishing is a major occupation around the lake and all four riparian countries depend heavily on supplies from the lake. The lake has also attracted migrant workers from other African countries, for example from Ghana and Burkina Faso. Over 150 000 fishermen live on the lake's shores and its islands. Recent estimates of annual fish production range from 60 000 to 70 000 tonnes.[9] However, as a result of environmental changes

since the 1970s, there have been considerable changes and a marked decrease in the lake's fish stocks.

The raising of cattle, sheep and camels by local as well as nomadic herders provides additional means of economic livelihood in the basin. The fresh water and grazing lands around Lake Chad have been the traditional convergence point for herders and pastoralists, including the Tuareg, Toubou, Feda, Kanembu, Shuwa, Fulani and Wadai from Chad, Niger, northern Cameroon and northern Nigeria.[10] Some people raise livestock, typically moving closer to the lake for grass in the dry season, and then move away in the rainy, mosquito season. However, after the droughts of the 1970s, many herders shifted from grazing animals (cattle and camels) to browsing animals (sheep and goats), which adversely affected the area's vegetation as these animals consumed the woody plants.[11]

The lake also serves as a source of fresh water for drinking, sanitation and irrigation in the basin area. At its largest in around 4000 BC, the lake was estimated to have covered an area of 400 000 square kilometres. In the early 1960s it had an area of more than 26 000 square kilometres. However, it has shrunk from 25 000 square kilometres in 1966 to less than 1 5000 square kilometres in 1997. And between 1994 and 2004, it receded further dramatically to cover an area of only some 532 square kilometres. This amounts to shrinkage of nearly 90 per cent of its size in 1960.

THREE FORCES DRIVING LAKE CHAD TO EXTINCTION

The progressive diminution of the waters of Lake Chad over the last four decades has been a subject of growing concern for political leaders of its riparian states, environmentalists and scholars. Its progressive shrinkage is attributed to three key forces: resource misoveruse population surge and climate change variability.

Resource mis/overuse

Unsustainable exploitation of the water of the lake by riparian states to support poorly planned irrigation projects appears to be the critical factor in the misuse of the water of the lake. The signing of the Lake Chad Basin Commission (LCBC) Convention as far back as 1964, to a large extent,

signalled an early cooperative impulse by the riparian states to promote and regulate the joint exploitation of the resources of Lake Chad. The primary objectives of the LCBC are to regulate and control the utilisation of water and other natural resources in the basin; initiate, promote and coordinate natural resources development projects and research within the basin area; examine complaints, and promote the settlement of disputes, thereby promoting regional cooperation.[12]

Regrettably, the pattern of exploitation of the lake's water by riparian states has been in sharp contrast to the institutional provisions envisaged in the Convention. By the mid-1970s, riparian states were resorting to unilateral exploitation of the lake's water to sustain agricultural irrigation and development projects. Of particular relevance were the construction of the Yaguou-Tekele Dyke and the Maga Dam by Cameroon in 1979, the Mamdi Polder Project in Chad and a series of dams in Nigeria.[13] The most extensive irrigation project, the South Chad Irrigation Project (SCIP), has been developed in Nigeria.

Coe and Foley, for instance, have found that competing demands for fresh water by the four riparian states of Lake Chad, mostly through massive irrigation projects, account for almost 30 per cent of the observed decrease in lake area since the early 1960s. Until about 1979, irrigation had a modest impact on the hydrology of the region. However, between 1983 and 1994, the volume of water diverted for irrigation quadrupled compared with the previous 25 years, accounting for 50 per cent of the additional decrease in the size of the lake.[14] While irrigation projects have contributed to the drying up of the lake, the decreasing water level, in turn, affected irrigation projects. For instance, the SCIP was designed to irrigate 67 000 hectares, but as water levels in the lake dropped in the late 1980s, no irrigation could take place.[15]

Population explosion

The surge in the human population around the lake in the last few decades has also contributed to resource overuse. Harden has long hypothesised that 'Africa's growing population is the major cause of the degradation and pollution of most of the continent's lakes'.[16] Since the 1960s, human demands for water near Lake Chad have increased rapidly. Between 1960 and 1990, the number of people living in the lake's catchment area has doubled from 13 million to 26

million.[17] In 2007, the basin population was estimated to be slightly above 37 million.[18] Yet, the population is expected to increase by 75 per cent by 2025.[19]

The growing human population in the lake region necessitated the raising of increased numbers of livestock to feed the teeming masses. The combined surge in human and livestock populations led to overgrazing, unhealthy agricultural practices, intense fishing and pollution of the lake. Consequently, the lake's carrying and replenishment capacity has been greatly undermined. This portends serious danger for the future survival of the lake, given the predicted impact of climate change on the basin.

Climate change and climate variability

The chemical composition of the Earth's atmosphere is undergoing rapid change, with consequent effects on Africa's lakes. Increases in atmospheric concentrations of greenhouse gases are expected to cause more rapid changes in the Earth's climate than have been experienced for millennia.[20] Recent environmental trends suggest that Africa is experiencing dangerous extremes in terms of rising temperature and weather events attributable to climate change. Climate change causes alterations in rainfall patterns, water levels and volumes in lakes, ponds, rivers and streams, and the frequency of droughts and storms. Consequently, the arid and semi-arid areas in northern, western, eastern and some parts of southern Africa are becoming drier, while equatorial Africa is getting wetter.[21] Natural watercourses such as Lake Victoria, Lake Chad and parts of the Nile River are gradually drying up due to warmer temperatures.

Historically, Lake Chad received most of its water from the annual monsoon rains that fell from June to August. However, since the late 1960s the region has experienced a series of declines in rainfall, culminating in two major droughts in 1972 to 1974 and 1983 to 1984. Areas of the lake that once experienced a mean annual rainfall of 320 millimetres received less than 210 millimetres. Recently, the United Nations concluded that 'the size of the region affected by this change and its duration are without precedent in hydro-climatic chronicles'.[22]

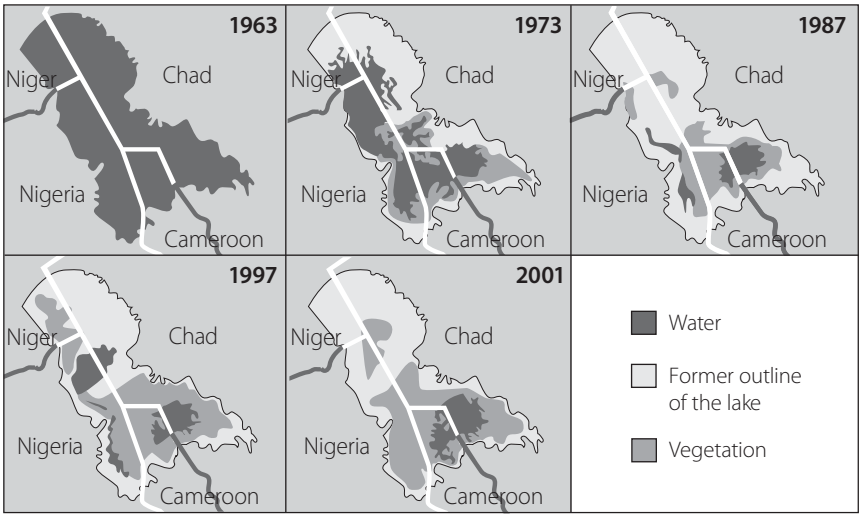
Early studies on the hydrological history of the lake have found that the balance between water intake and evaporation is continually fluctuating, with the result that Lake Chad, owing to its shallowness, is continually changing its

size and shape.[23] These fluctuations reflect variations in rainfall not only in the area of the lake itself but particularly in the watershed areas of the feeder rivers. Connah, therefore, concludes that 'fluctuations in Lake Chad are a fairly sensitive indicator of climate change over a substantial area of Africa'.[24] Although specifics on the impact of climate change on Lake Chad are still unclear, a United Nations study has identified 'climate change as the most important global change relevant to Lake Chad Basin'.[25] A recent study has used parameters like temperature, humidity, evaporation and transpiration to assess the effects of climate change on Lake Chad.[26]

The series of satellite images in Figure 2 shows the dramatic decrease in the size of the lake over the past four decades owing to a combination of climate change and human impact. As the lake shrinks, it moves towards the Chadian and Cameroonian territories, a factor that underpins potential interstate conflicts in the lake's area.

Once the progressive diminution of Lake Chad became more obvious and devastating in the 1980s, the LCBC, in collaboration with the riparian states and donor partners, embarked on several projects to help salvage the lake. Besides the parliaments of the five member countries of the LCBC establishing the Regional Parliamentary Committee in 2004, other initiatives,

Figure 2 Progressive shrinkage of Lake Chad over the last four decades



Source United Nations Environmental Programme (UNEP), vital climate graphics Africa

including studies and environmental projects, have been undertaken. One of these initiatives seeks to reverse land and water degradation trends, and to regenerate the lake's ecosystem. Its implementation is estimated to cost US$ 10,6 million, which will be provided by the World Bank through the Global Environment Facility (GEF) for the integrated management of Lake Chad. Another priority intervention identified has been a major inter-basin water transfer project, 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 Lake Chad. However, the successful implementation of these projects has been stifled mainly by financial constraints.[27]

LAKE CHAD AND HUMAN SECURITY IN NORTH-EASTERN NIGERIA: CURRENT AND FUTURE RISKS

Geographically, the portion of Lake Chad that is situated in Nigerian territory borders the states of Borno and Yobe in the north-east zone of Nigeria. The north-east zone is one of the six geopolitical zones of the Nigerian federation. It consist of the current six states of Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe, with an estimated population of about 18 971 965 million people and an area of 279 363 square kilometres.

The zone is very heterogeneous and accounts for nearly half the estimated 300 or more ethnic groups in the country. Although different religious faiths are practised in the region, the inhabitants are predominantly Muslim. The zone shares international boundaries with Niger, Chad and Cameroon to the north, north-east and east respectively.[28] In 2003, it was estimated that of the 20 million people that lived in the Lake Chad basin, 11,7 million lived in Nigeria, mainly in the north-east zone. The rest of the people included five million in Chad, 2,5 million in Cameroon, 193 000 in Niger and 634 000 in the Central African Republic.[29]

As a unique transboundary watercourse situated at the edge of the Sahara Desert, Lake Chad provides a lifeline to millions of people living in the catchment area. It is used for sanitation, drinking, agriculture, fishing, and religion-cultural activities. Given its relevance to local livelihood and economic progress, further shrinkage of the lake resulting from climate change will undermine the very base of human development in the basin, including in the north-east zone

of Nigeria. The implications of such an occurrence include, but are not limited to, water scarcity/insecurity, falling health standards, food insecurity, poverty and intensified migration, with the tendency to instigate resource and identity conflicts within and beyond the basin.

By transforming the hydrological patterns that determine the availability of water in the world, climate change is expected to account for about 20 per cent of the global increase in water scarcity. The IPCC has predicted reduced rainfall and run-off, and increased desertification in the Sahelian belt near Lake Chad.[30] This would compound the problem of water scarcity in the basin area, which is already known to afflict 300 million people and claim at least 6 000 lives annually in Africa.[31] Nigeria has been identified as one of the countries likely to run short of water in the next 25 years.[32] 'Water scarcity' is defined as a situation where the volumes of water withdrawn from lakes, rivers or groundwater is so large that water supplies are no longer adequate to satisfy all human or ecosystem requirements, resulting in increased competition between users and demands.[33] Situations of water scarcity greatly compromise people's entitlement to water security. Water security entails every person having reliable access to enough safe water at an affordable price to lead a healthy, dignified and productive life, while maintaining the ecological systems that provide water and also depend on water.[34]

Undoubtedly, water security is a core component of the broader notion of human security. When access to water is constrained or disrupted, people become exposed to serious human security risks such as poor health, loss of livelihood, increased vulnerability, poverty and conflicts as a result of competition over a dwindling natural resource base.[35]

Although the lake's surface water and underground aquifers provide fresh water for the local communities, people living around the lake lack access to safe drinking water and proper sanitation. While climate change-induced decreases in annual rainfall have contributed to the reduction of the quantity of water in the lake, pollution as a result of local people defecating and washing clothes in the lake has consequently degraded the quality of the lake's water. For the dependent population, therefore, water scarcity is defined as much by an insufficient quantity as by poor quality.

With less potable water, water-related diseases such as diarrhoea, cholera and typhoid fever have been a common occurrence in the basin.[36] It has been noted that access to safe drinking water is very limited in the north-eastern zone of Nigeria.[37] Health and sanitary conditions in the zone are expected to

worsen, as 'future climate change will directly and indirectly play an important role in determining the future severity of freshwater shortage'.[38]

Climate change-induced shrinkage of the lake's water poses serious threats to food security, aggravating the poverty in the region. People around Lake Chad are among Africa's most chronically vulnerable to food insecurity. However, they have managed to cope with this challenge through mobility, switching of livelihoods, and by adapting to a diversity of food sources. The northern states of Nigeria are among the most vulnerable. The existential condition of the vast majority of the inhabitants of the north-eastern zone was the lowest in 2004. While the prevalence of poverty (in percentages) in the south-south was 35,1, the south-east stood at 26,7, the south-west at 43,0, the north central was 67,0, the north-west was also high at 71,2, and north-east was the poorest with 72,2.[39] Therefore, poverty levels in the north-east zone will increase as further shrinkage of the lake contributes to crop failures, livestock deaths and the collapse of fisheries, significantly disrupting economic livelihoods.

Another implication is the tendency for violent conflicts to erupt over competition for dwindling water resources. The diminution of Lake Chad has contributed to conflicts in two notable ways. First, by intensifying the frequency of contact between and among the major livelihood systems, thereby making them more competitive rather than complementary. Second, it intensifies the pattern of migration as a response to the contraction of the lake.[40]

Consequent upon falling agricultural, fishing and pastoral output, the rate of migration and cross-border movement within the basin has intensified with serious implications for resource and identity conflicts in the north-east zone and even beyond. As the water of the lake recedes, farmers move closer to the lake's shoreline to cultivate the emerging lands. Also, the frequency of pastoralists moving closer to the remaining water to feed their livestock intensifies, thereby accentuating the rate of contact between major livelihood systems (such as herders and farmers) and thus sowing the seed of conflict. According to Anada Tiega, a director at the Lake Chad Basin Commission, 'we are already experiencing some conflict between fishermen and pastoralists, and between fisherman and farmers, and vice versa'.[41]

The risk of conflict degenerating into intercommunal clashes in the region could manifest in the near future if existing political institutions fail to reconcile conflicting interests over access to such shared water resources. In a situation where governance institutions in the basin are weak, inequitable water management can heighten

inequities and water insecurity, resulting in conflicts among users (households, industries and private water firms) and demands (irrigation agriculture, industries).

With the surface water of the lake diminishing because of demographic and climate factors, some reallocations among users and sectors are inevitable, which could lead to competition and deprivation. Urbanisation would exacerbate the level of deprivation, which in turn, would worsen the level of social grievances. As deprived individuals and social groups engage in fierce competition for dwindling natural (freshwater) resources in the lake region and further afield in the north-east zone, future access will increasingly reflect the strength of claims from different users and actors. It could also create problems between upstream and downstream communities in the feeder rivers. When existing political institutions and structures are incapable of resolving these competing claims, the tendency for violent intergroup conflicts over access to shared resources becomes more likely.

More fundamentally, the climate change-related diminution of Lake Chad has blurred international boundaries in the region. Fishermen, particularly Nigerians and Nigeriens, have crossed political borders in pursuit of the receding waters. This has resulted in a complex web of social, economic, environmental and political issues, threatening to spill over into human rights issues and interstate conflicts in the basin. The drifting of the lake away from Nigerian and Nigerien territories towards Chadian and Cameroonian territories (see Figure 2 is propitious to interstate conflicts and tensions.[42]

In the 1980s, for instance, there were allegations of serious infractions and dehumanising treatments meted out to Nigerian fishermen by Cameroonian and Chadian gendarmes.[43] Such tensions over territory and fishing rights still persist in the area. For instance, a Nigerian fisherman recently argued:

It is difficult to determine boundaries on [Lake Chad] water, yet the gendarme from Cameroon and Chad always come after us and seize our fishing nets and traps and we have to pay heavily to get them back.[44]

As a result of the lake's contraction, some farmers have switched to other livelihood systems like fishing. Others have migrated to cities, taking up menial jobs or remaining unemployed, adding to the urban social crises. Lake Chad's diminution has also increased the influx of Udawa nomadic cattle herders from the Republic of Niger as well as the migration of citizens of Chad and Niger further south in search of optimum opportunities. These 'long-distance migrants, usually referred to as Udawa, have been well-armed since the mid-1990s and are willing

to use violence to assure their grazing'.[45] This has contributed to the violent conflicts between herders and farmers in the northern part of Nigeria.

Furthermore, farmers and cattle herders have moved deeper southwards where they have ended up competing for the available scarce resources such as fresh water and arable or grazing lands with other economic groups or with host communities. Harsh environmental trends in the northern part of Nigeria, such as the shrinkage of Lake Chad and desertification, have made the seasonal movement of the Hausa and Fulani cattle rearers to the southern part of Nigeria more permanent. Previously, these pastoralists migrated to the southern part during the dry season and moved back to the north during the rainy season. Because of the deteriorating situation in the region, many of them are now settling down in some areas of southern Nigeria such as, for example, Ilorin, Umuahia, Ogbomoso, Shaki, Ubakala, Uzo-Uwani and Oyo. This has contributed to resource conflicts in these areas with the potential to spill over into ethnic clashes.

STRATEGIES FOR MITIGATING THE IMPACT OF CLIMATE CHANGE ON LAKE CHAD

Climate change is set to worsen the environmental and survival problems faced by the people living around Lake Chad, if measures are not taken to mitigate its impact or to build and sustain the adaptive capacity among the dependent population. To mitigate present and future climate change-related impacts on Lake Chad, the following recommendations are presented.

First, there is a need for the adequate representation and participation of local people in the management of the lake. The role and functions of local communities in the management of lakes are absolutely essential in achieving the goal of sustainable lake management. The management of Lake Chad has operated largely at the supranational level, with little or no involvement of the local people who are directly dependent on the lake's resources. The integration of local communities must go beyond the mere perception of them as stakeholders to their being key participants whose knowledge and participation are critically needed to ensure the sustainability of any project or policy designed to replenish the lake.

For instance, consider the LCBC plans to carry out the inter-basin water transfer project known as the Lake Chad Replenishment Project to salvage the

lake. To enhance the sustainability of such a project, it is crucial to involve the local people to enable them to play a more active role in articulating their needs in relation to their livelihood priorities, as well as to work with the government and environmental groups, the LCBC and donor agencies in support of the new integrated lake management vision.[46]

Secondly, the Nigerian government (federal, state and local governments of the six states of the north-eastern zone) in partnership with environmental groups should undertake a capacity-building programme for local people to help them contribute to safeguarding the lake. Local communities should be empowered to protect both the shoreline of the lake and the adjacent areas by preserving or maintaining natural vegetation by planting new trees or replacing dead ones. Tree planting is one of the most effective ways of controlling climate change because the growing of trees halts erosion and degradation, protects water resources, and reduces carbon emissions. Because the root systems of woody vegetation typically bind soil in place, the vegetation would act as a natural buffer that would help protect the lake from erosion. This, in turn, would assist the regeneration of lost vegetation in the area, which is critical for reviving the lake's replenishment capacity. However, a major challenge envisaged here would be to get enough water or moisture to sustain new plants in the area. One strategy would be to use drought-resistant trees or shrubs. Also, effective legislation should be enacted and vigorously enforced to ensure the protection of the trees by local communities.

Thirdly, there is a need for sustained environmental education at global, regional, national and local levels to raise awareness regarding the degradation of Lake Chad. In addition to sensitising local communities to avoid polluting the lake, the government should collaborate with civil society groups on capacity-building initiatives for local people that assess the risks developing from climate change and how best to adapt indigenous knowledge and assets to respond and cope with the challenges of climate change.

Fourthly, Nigeria is a significant contributor to global carbon dioxide emissions, particularly through gas flaring by its oil industry. The federal government, in addition to supporting international conventions aimed at controlling carbon emission, should start cutting back on carbon dioxide emissions by effectively enforcing stringent legislation aimed at ending gas flaring in the country. This is in addition to investing in the development of other potential sources of clean energy such as wind power and solar energy to reduce reliance

on hydrocarbon fuels such as petroleum products, coal and fuel woods that contribute to carbon emissions.

Fifthly, the federal government should fast track the establishment of a national climate change commission. Such a commission should be tasked with, among other things, the responsibility of conducting extensive research on the subject of climate change; producing regional-based and seasonal climate forecasts (including short, medium and long-term forecasts); working with the local people to identify context-specific climate challenges as well as adaptive capacities in various communities, which can be strengthened and possibly replicated where and when necessary; developing an early warning system and mechanism for detecting emerging environmental trends and disasters; and advising governments, agencies, organisations, communities and individuals on possible climate shocks and mitigative measures that can be adopted.

Finally, the Nigerian government should, as a matter of urgency, institute and sustain a robust network of political ties with co-riparian states and donor partners to promote a paradigm shift in water resource management in the basin, from unilateral utilisation of the water resources of Lake Chad to an integrated water resource management strategy involving regional, national, sub national and local authorities. This will require the strengthening of the LCBC through proactive legislative interventions, financial support and capacity building of staff to enable the LCBC to initiate, promote and coordinate sustainable natural resources development to attain regional cooperation as envisaged in the LCBC Convention.

CONCLUSION

This chapter argues that the downward spiral of the diminution of Lake Chad is a complicated and intricate process engendered by the complex interaction between anthropogenic factors (resource mis/overuse and population surge) and climate change. It posits that further shrinkage of Lake Chad owing to climate change and climate variability will exacerbate human security risks in the north-east zone of Nigeria with attendant implications for national and region stability. Climate change is already transforming the hydrological patterns that determine the availability of water in the world, including in the Lake Chad Basin. This chapter concludes that the situation will be worst in the years ahead if efforts are not made to salvage Lake Chad, which has served and will

continue to serve as a critical natural reserve that sustains human security and development in a semi-arid region.

NOTES

1 A Surhke, Environmental change, migration, and conflict: a lethal feedback dynamic?, in C A Crocker, F O Hampson and P Aall, (eds), *Managing global chaos: sources of and responses to international conflict*, Washington D.C: United States Institute for Peace, 2000, 11.

2 Van Wyk: IPCC. *Summary for policymakers*. Working Group II Fourth Assessment Report. Geneva: IPCC Secretariat, 2007.

3 M Selva, Landscape under attack: changing shape of Africa's lakes, *The Independent* (London), 4 November 2005, http://www.independent.co.uk/news/world/africa/landscape-under-attack-changing-shape-of-africas-lakes-513837.html (accessed 7 March 2006).

4 UNEP, *Africa's lakes: atlas of our changing environment*, Nairobi: UNEP, 2006.

5 International Union for Conservation of Nature (IUCN), Climate change in the Lake Chad, Niger, and Senegal basin, International Union for Conservation of Nature, October 2008, http://www.iucn.org/about/work/programmes/water/wp_resources/congress/day3/chad.cfm (accessed 12 January 2009); T Sanni, Nigeria: Lake Chad – Renewed fear over shrinking Impact, *Thisday* (Lagos), 16 September 2008; S Hancock, Climate change, human pressure shrink Lake Chad, *Reuters,* 5 February 2007. http://www.planetark.com/dailynewsstory.cfm/newsid/40156/story.htm (accessed 11 November 2008).

6 D Garcia, The climate security divide: bridging human and national security in Africa, *African Security Review* 17(3) (2008), 8.

7 T O Adewuyi, Examination of the spatial extent of Lake Chad over five time points, *Pakistan Geographical Review* 60(1) (2005), 1.

8 Africa: Africa's lakes, *Africa Focus Bulletin* (September 2006), http://www.africa.upenn.edu/afrfocus/afrifocus091006.html (accessed 12 May 2007).

9 Living waters, Lake Chad, 2003, http://assets.panda.org/downloads/mrwlakechadcasestudy.pdf (accessed 25 October 2006), *Managing Rivers Wisely*.

10 I James, Lake Chad as an instrument of international co-operation, in A I Asiwaju and P O Adeniyi, (eds), *Borderlands in Africa: a multidisciplinary and comparative focus on Nigeria and West Africa,* Lagos: University of Lagos Press, 1989, 109.

11 S R Schneider, D F McGinnis and G Stephens, Monitoring Africa's Lake Chad basin with LANDSAT and NOAA satellite data, *International Journal of Remote Sensing* 6(1) (1985), 59–73.

12 International Monetary Fund (IMF), Lake Chad Basin Commission, April 2002, *http://www.imf.org/external/np/sec/decdo/lcbc.htm* (accessed 31 May 2007).

13 E O Odada, L Oyebande. and A J Oguntola, *Lake Chad: experience and lessons learned brief,* N'Djamena: Lake Chad Basin Commission, 2005; R Hassan, *Climate change and African agriculture*, Policy Note No. 33, Pretoria, South Africa, Centre for Environmental Economics and Policy in Africa, 2006.

14 M T Coe and J A Foley, Human and natural impacts on the water resources of Lake Chad basin, *Journal of Geophysical Research* 106(D4) (2001), 3349–3356.

15 Integrated Regional Information Network, Replenishing Lake Chad, *Science in Africa,* March 2003, http://www.scienceinafrica co.za/2003/march/chad.htm (accessed 5 May 2006).

16 G Harden, The tragedy of the commons, *Science* 162 (1) (1968), 238.

17 UNEP, *Global environment outlook 2000*, Nairobi: UNEP, 1998, 398.

18 UNESCO, Water Portal Weekly Update No. 178 Lake Chad Basin, 2007, http://www.unesco.org/water/news/newsletter/178.shtml#pub (accessed 4 July 2007).

19 A B Sambo, Introductory remarks, presented at the International Workshop on Current Challenges and Future Prospects of Lake Chad Basin, organised by the Regional Parliamentary Committee on Lake Chad Basin, Transcorp Hillton Hotel, Abuja, 27–28 October 2006, 2.

20 A B Ali-Dinar, Africa: Africa's Lakes, *Africa Focus Bulletin,* 10 September 2006, http://www.africa.upenn.edu/afrfocus/afrifocus091006.html (accessed 8 November 2007).

21 A Murphy (ed), *Africa – Up in smoke* 2, London: London: New Economic Foundation (nef) and International Institute for Environment and Development (IIED), 2006, 5.

22 UNEP, *Africa's lakes: atlas of our changing environment.*

23 G Connah, *Three thousand years in Africa: man and his environment in Lake Chad region of Nigeria,* London: Cambridge University Press, 1981; Sylvia K Sikes, Lake Chad, London: Eyre Methuen Ltd, 1972.

24 Connah, *Three thousand years in Africa:* 21.

25 UNEP, Lake Chad: GIWA regional assessment 43, 2004, http://hqweb.unep.org/dewa/giwa/areas/reports/r43/assessment_giwa_r43.pdf (accessed 11 November 2007).

26 Paul Noupa, Lake Chad basin, paper presented at the International Union for Conservation of Nature (IUCN) World Conservation Congress at Centre de Convencions Internacional de Barcelona (CCIB), Barcelona, Spain, 5 – 14 October 2008.

27 For instance, Hon Mohammed Kumalia, the president of the Regional Parliamentary Committee on Lake Chad, in a communiqué read after the committee's meeting in November 2004 at Abuja, raised an alarm over the poor financial situation of Lake Chad Basin Commission. See A Ogbu, Lake Chad commission raises alarm over funds, *LakeNet,* 1 November 2004, http://www.worldlakes.org/shownews.asp?newsid=1859 (accessed 31 May 2005).

28 International Institute for Democracy and Electoral Assistance (International IDEA), *Democracy in Nigeria: continuing dialogue(s) for nation building,* Stockholm: International IDEA, 2000, 264.

29 Integrated Regional Information Network, Replenishing Lake Chad, *Science in Africa,* March 2003, http://www.scienceinafrica co.za/2003/march/chad.htm (accessed 5 May 2006).

30 Cited in A B Ali-Dinar, Africa: Africa's Lakes, *Africa Focus Bulletin,* 10 September 2006, http://www.africa.upenn.edu/afrfocus/afrifocus091006.html (accessed 8 November 2007).

31 Integrated Regional Information Network (IRIN), Africa: Diminishing water resources could fuel conflicts – Experts, Integrated Regional Information Network, 5 November 2004, http://www.globalpolicy.org/security/natres/water/2004/1105diminishing.htm (accessed 8 May 2007).

32 UNEP, Fresh water stress and scarcity in Africa by 2025, United Nations Environmental Programme 2002, http://www.unep.org/dewa/assessments/ecosystems/water/vitalwater/21.htm#21b (accessed 11 November 2006).

33 UNECOSOC, Comprehensive assessment of the fresh water resources of the world: Report of the Secretary-General, 1997, http://www.un.org/esa/documents/ecosoc/cn17/1997/ecn171997-9.htm (accessed 12 March 2007).

34 UNDP, Summary: Human Development Report 2006, *Beyond scarcity: power, poverty and the global water crisis,* New York: UNDP, 2006, 12.

35 Ibid 10.

36 UNEP, Lake Chad: GIWA regional assessment 43.

37 International IDEA, *Democracy in Nigeria: continuing dialogue(s) for nation building,* 268.

38 UNEP, Lake Chad: GIWA regional assessment 43, 76.

39 C Soludo, *Collective strategies and action towards vision 2020*, lecture delivered at the graduation ceremony of the participants of Course 15 of the National War College, Abuja, 6 August 2007, 30.

40 F C Onuoha, Environmental degradation, livelihood and conflict: a focus on the implications of the diminishing water resources of Lake Chad for North-Eastern Nigeria, *African Journal on Conflict Resolution* 8(2) (2008), 35–62.

41 Cited in S Hancock, Climate change, human pressure shrinks Lake Chad.

42 F C Onuoha, The state and water conflict in Africa: a focus on Lake Chad, 1960–2007, Unpublished MSc thesis, University of Nigeria, Nsukka, 2007, 70.

43 See, for instance, K Patterson, The endless drought: water conflict in the era of climate change, *Stimson* 20 June 2008, http://www.stimson.org/pub.cfm?ID=631 (accessed 12 December 2008); H A Asobie, The conflict between Nigeria and Cameroon over land and sea borders and territories: the political context and the contending principles, *University of Nigeria Journal of Political Economy* 1(1) (2005), 82–83; O J L Ekpenyong, Potentials of Nigerian boundary

corridors as sources of international economic conflict, in A I Asiwaju and P O Adeniyi (eds), *Borderlands in Africa: a multidisciplinary and comparative focus on Nigeria and West Africa*, Lagos: University of Lagos Press, 1989.

44 S Murray, Lake Chad fishermen pack up their nets.BBC News 5 January 2007. Available at http://news.bbc.co.uk/2/hi/africa/6261447.stm (accessed 12 December 2007).

45 R Blench, *Natural resource conflict in North-Central Nigeria: a handbook and case studies*, United Kingdom, Cambridge: Mallam Dendo Ltd, 2004, iii.

46 F C Onuoha, Saving Africa's shrinking lakes through inter-basin water transfer: reflections on the Lake Chad replenishment project, *Nigerian Journal of International Affairs* 34(2) (2008), 65–84.

BIBLIOGRAPHY

Adewuyi, T O. Examination of the spatial extent of Lake Chad over five time points. *Pakistan Geographical Review* 60(1) (2005), 1–11.

Africa: Africa's lakes. *Africa Focus Bulletin* (September 2006). Available at http://www.africa.upenn.edu/afrfocus/afrifocus091006.html (accessed 12 May 2007).

Asobie, H A. The conflict between Nigeria and Cameroon over land and sea borders and territories: the political context and the contending principles. *University of Nigeria Journal of Political Economy* 1(1) (2005), 74–104.

Blench, B. *Natural resource conflict in north-central Nigeria: a handbook and case studies.* United Kingdom, Cambridge: Mallam Dendo Ltd, 2004.

Coe, M T and Foley, J A. Human and natural impacts on the water research of Lake Chad basin. *Journal of Geophysical Research* 106(D4) (2001), 3349–3356.

Connah, G. *Three thousand years in Africa: man and his environment in Lake Chad region of Nigeria.* London: Cambridge University Press, 1981.

Ekpenyong, O J L. Potentials of Nigerian boundary corridors as sources of international economic conflict. In A I Asiwaju and P O Adeniyi (eds), *Borderlands in Africa: a multidisciplinary and comparative focus on Nigeria and West Africa*. Lagos: University of Lagos Press, 1989.

Garcia, D. The climate security divide: bridging human and national security in Africa. *African Security Review* 17(3) (2008), 2–17.

Hancock, S. Climate change, human pressure shrink Lake Chad. *Reuters,* 5 February 2007. http://www.planetark.com/dailynewsstory.cfm/newsid/40156/story.htm (accessed 11 November 2008).

Harden, G. The tragedy of the commons. *Science* 162 (1) (1968), 239–257.

Hassan, R. *Climate change and African agriculture.* Policy Note No. 33. Centre for Environmental Economics and Policy in Africa: Pretoria, South Africa, 2006.

Integrated Regional Information Network (IRIN). Africa: diminishing water resources could fuel conflicts – experts, 5 November 2004, http://www.irinnews.org/report.aspx?reportid=51955 (accessed 8 May 2007).

Van Wyk: IPCC. *Summary for policymakers*. Working Group II Fourth Assessment Report. Geneva: IPCC Secretariat, 2007.

IPCC. Working Group II: Impacts, adaptation and vulnerability. http://www.ipcc.ch/ipccreports/tar/wg2/377.htm (accessed 8 November 2007).

International IDEA. *Democracy in Nigeria: continuing dialogue(s) for nation building*. Stockholm: International IDEA, 2000.

International Monetary Fund (IMF). Lake Chad Basin Commission. International Monetary Fund, 5 April 2002, Available at http://www.imf.org/external/np/sec/decdo/lcbc.htm (accessed 31 May 2007).

International Union for Conservation of Nature (IUCN). Climate change in the Lake Chad, Niger, and Senegal basin. *International Union for Conservation of Nature* 4 November 2008. http:// www.iucn.org/about/work/programmes/water/wp.../chad.cfm (accessed 12 January 2009).

James, I. Lake Chad as an instrument of international co-operation. In A I Asiwaju and P O Adeniyi (eds), *Borderlands in Africa: a multidisciplinary and comparative focus on Nigeria and West Africa*. Lagos: University of Lagos Press, 1989.

Living waters, Lake Chad. *Managing Rivers Wisely* 2003. http://assets.panda.org/downloads/mrw-lakechadcasestudy.pdf (accessed 25 October 2006).

Murphy, A (ed). *Africa – Up in smoke 2*. London: New Economic Foundation and International Institute for Environment and Development (IIED), 2006.

Murray, S. Lake Chad fishermen pack up their nets.*BBC News* 5 January 2007. http://news.bbc.co.uk/2/hi/africa/6261447.stm (accessed 12 December 2007).

Noupa, P. *Lake Chad basin*. Paper presented at the World Conservation Congress, Barcelona, 7 October 2008.

Odada, E O, Oyebande, L and Oguntola, A J. *Lake Chad: experience and lessons learned brief*. N'Djamena: Lake Chad Basin Commission, 2005.

Onuoha, F C. Environmental degradation, livelihood and conflict: a focus on the implications of the diminishing water resources of Lake Chad for North-Eastern Nigeria. *African Journal on Conflict Resolution* 8(2) (2008), 35–62.

Onuoha, F C. Saving Africa's shrinking lakes through inter-basin water transfer: reflections on the Lake Chad replenishment project. *Nigerian Journal of International Affairs* 34(2) (2008), 65–84.

Onuoha, F C. The state and water conflict in Africa: a focus on Lake Chad, 1960–2007. Unpublished MSc thesis. University of Nigeria, Nsukka, 2007.

Patterson, K. The endless drought: water conflict in the era of climate change. *Stimson* 20 June 2008. http://www.stimson.org/pub.cfm?ID=631 (accessed 12 December 2008).

Sambo, A B. *Introductory remarks*. Presented at the International Workshop on Current Challenges and Future Prospects of the Lake Chad Basin, organised by the Regional Parliamentary Committee on the Lake Chad Basin. Transcorp Hillton Hotel, Abuja, 27–28 October 2006.

Sanni, T. Nigeria: Lake Chad – renewed fear over shrinking impact. *Thisday* (Lagos), 16 September, 2008.

Schneider, S R, McGinnis, D F and Stephens, G. Monitoring Africa's Lake Chad basin with LANDSAT and NOAA satellite data. *International Journal of Remote Sensing* 6(1) (1985), 59–73.

Replenishing Lake Chad. *Science in Africa* (March 2003). Available at http://www.scienceinafrica co.za/2003/march/chad.htm (accessed 5 May 2006).

Selva, M. Landscape under attack: changing shape of Africa's lakes. *The Independent* (London), 4 November 2005.

Sikes, S K. *Lake Chad*. London: Eyre Methuen Ltd, 1972.

Soludo, C. *Collective strategies and action towards vision 2020.* Lecture delivered at the graduation ceremony of the participants of Course 15 of the National War College. Abuja, 6 August 2007.

Surhke, A. Environmental change, migration and conflict: a lethal feedback dynamic? In C A Crocker, F O Hampson and P Aall (eds), Managing global chaos: sources of and responses to international conflict. Washington DC: United States Institute for Peace, 2000.

United Nations Development Programme (UNDP). Summary: Human Development Report 2006. *Beyond scarcity: power, poverty and the global water crisis.* New York: UNDP, 2006.

United Nations Economic and Social Council (UNECOSOC). Comprehensive assessment of the fresh water resources of the world. Report of the Secretary-General**,** *United Nations Department of Economic and Social Affairs* 10 December 1999. http://www.un.org/esa/documents/ecosoc/cn17/1997/ecn171997-9.htm (accessed 12 March 2007).

United Nations Educational, Scientific and Cultural Organisation (UNESCO). Water Portal Weekly Update No. 178 Lake Chad Basin. United Nations Educational, Scientific and Cultural Organisation, 7 March 2007. http://www.unesco.org/water/news/newsletter/178.shtml#pub (accessed 4 July 2007).

United Nations Environmental Programme (UNEP). *Africa's lakes: atlas of our changing environment.* Nairobi: UNEP, 2006.

UNEP. Lake Chad: GIWA regional assessment 43. *United Nations Environmental Programme* 2004. http://hqweb.unep.org/dewa/giwa/areas/reports/r43/assessment_giwa_r43.pdf (accessed 11 November 2007).

UNEP. Fresh water stress and scarcity in Africa by 2025. *United Nations Environmental Programme* 2002. http://www.unep.org/dewa/assessments/ecosystems/water/vitalwater/21.htm#21b (accessed 11 November 2006).

UNEP. Vital climate graphics Africa: problems related to freshwater resources, *United Nations Environmental Programme* 2002. http://www.grida.no/climate/vitalafrica/english/14.htm (accessed 11 November 2006).

UNEP. *Global environment outlook 2000.* Nairobi: UNEP, 1998.