



UNIVERSITY OF LEEDS

This is a repository copy of *Conflicts about water in Lake Chad: Are environmental, vulnerability and security issues linked?*.

White Rose Research Online URL for this paper:  
<http://eprints.whiterose.ac.uk/91926/>

Version: Accepted Version

---

**Article:**

Okpara, UT, Stringer, LC, Dougill, AJ et al. (1 more author) (2015) Conflicts about water in Lake Chad: Are environmental, vulnerability and security issues linked? *Progress in Development Studies*, 15 (4). 308 - 325. ISSN 1464-9934

<https://doi.org/10.1177/1464993415592738>

---

**Reuse**

Unless indicated otherwise, fulltext items are protected by copyright with all rights reserved. The copyright exception in section 29 of the Copyright, Designs and Patents Act 1988 allows the making of a single copy solely for the purpose of non-commercial research or private study within the limits of fair dealing. The publisher or other rights-holder may allow further reproduction and re-use of this version - refer to the White Rose Research Online record for this item. Where records identify the publisher as the copyright holder, users can verify any specific terms of use on the publisher's website.

**Takedown**

If you consider content in White Rose Research Online to be in breach of UK law, please notify us by emailing [eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk) including the URL of the record and the reason for the withdrawal request.



[eprints@whiterose.ac.uk](mailto:eprints@whiterose.ac.uk)  
<https://eprints.whiterose.ac.uk/>

# Conflicts about water in Lake Chad: are environmental, vulnerability and security issues linked?

Uche T. Okpara<sup>1,2\*</sup>, Lindsay C. Stringer<sup>1\*\*</sup>, Andrew J. Dougill<sup>1\*\*\*</sup>, Mohammed D. Bila<sup>3\*\*\*\*</sup>

<sup>1</sup>Sustainability Research Institute, School of Earth and Environment, University of Leeds, LS2 9JT, UK

<sup>2</sup>Department of Agricultural Economics, University of Nigeria, Nsukka, Nigeria

<sup>3</sup>Lake Chad Basin Commission, N'Djamena, Chad Republic

\* eeuto@leeds.ac.uk (corresponding author)

\*\* l.stringer@leeds.ac.uk

\*\*\* a.j.dougill@leeds.ac.uk

\*\*\*\* m.bila@cblt.org

**Abstract:** This paper builds on the growing literature that explores the relations between environmental change and non-traditional security, defined as non-military threats that challenge the survival and well-being of peoples and states. The Lake Chad basin in Africa is used as a case study for analysis. Focusing on a set of questions that has dominated recent theoretical debates, the paper investigates if conflicts resulting from water scarcity are as much about the broader vulnerability of the Lake Chad region as they are about changes in the Lake system and its environment. It argues that conflict is a probable outcome only in locations that are already challenged by a multitude of other context-specific factors beside resource scarcity. In the Lake Chad context, the likelihood of scarcity-driven conflict depends on whether vulnerability increases or decreases in the face of a declining water supply. The paper provides perspectives for a nuanced understanding of how the receding Lake Chad has led to conflict and outlines an integrated, forward-looking research agenda for linking environmental change, vulnerability and security issues in integrated human-environment systems.

**Key words:** water conflict, water scarcity, environmental change, security, vulnerability, Lake Chad

## **I Introduction**

Water – its quantity, quality and distribution - has several potential consequences for human well-being in a way that its connection with security and conflict has become a subject of growing concern globally. With the redefinition of security in the early 1980s to reflect non-traditional threats such as cross-border environmental degradation and resource depletion, the types and sources of threats are now wide-ranging (Lowi, 1999). Much research focusing on the nexus between environmental change and security argue over whether environmental issues should be considered as a type or source of threat to security (Gleditsch, 1998; Hauge and Ellingsten, 1998). Some analysts claim that security has a militarised framework and including environmental issues as a security concern will be inappropriate strategically (Deudney, 1990). Others suggest that changes to the natural environment constitute a potential security threat because security is essentially about the well-being of people, which is influenced by the degradation of natural resources (Homer-Dixon, 1999; Le Billion, 2001).

A key issue linked to this argument is assessed in this paper by examining how water factors into conflicts based on an understanding of the relationships between environmental change, vulnerability and security. There are few studies that specifically link environmental change, vulnerability issues and security in the field of water resources and water conflict (Goulden *et al.*, 2008). Existing case studies concentrate on the Nile river basin and individual basins in the Middle East (e.g. Lowi, 1999). To date, case study analyses on the Lake Chad basin are sorely lacking and yet concerns about relationships between water and conflict in Lake Chad abound. The rate of hydrological changes in the basin is unprecedented. Between 1960 and 2000, the region where the lake is located experienced one of the most substantial and sustained reduction in rainfall events recorded anywhere in the world (IPCC, 2001). In 2003, the Lake region was classified among the ten most water impoverished locations in the world (UNEP, 2003). The impact of this on human systems has triggered large-scale social disruptions at various times in the past (Odada *et al.*, 2006). While growing numbers of riparian agencies and policy makers have voiced concerns over the security implications of the receding lake (FAO, 2009), there is currently little effort to

systematically analyse and understand how and why the receding Lake Chad connects with regional insecurity.

The aim of this paper is to provide a series of responses to a set of questions that often feature in debates in the environmental security research domain. The responses are framed specifically to reflect the challenges in Lake Chad. The questions are as follows:

1. What factors are shaping the relationship between environmental change, vulnerability and security?
2. Can understanding why and how people are vulnerable enhance understanding of the links between water and conflict?
3. What institutional and policy responses are there to mitigate current and future regional insecurity?
4. What further research is needed?

Deepening water resource scarcity (i.e. less than 1000 m<sup>3</sup> *per capita* availability of water resources *per annum* (Rijsberman, 2006)) in a setting where decline in water supply is leading to several conflict outcomes, challenges us to conceptualise security beyond the traditional notions of protection from the consequences of external military threats or internal manipulation of governance or political order. In this sense, security is perceived as a non-traditional threat (i.e. water scarcity or degradation) requiring non-military responses (i.e. evidence-based policies) to mitigate actions (i.e. conflicts) caused by environmental change. The term 'environmental change' here refers to the context-specific case of the Lake Chad basin in terms of decline in water quantity and quality following the shrinkage of the Lake Chad. The paper holds the notion that both climate variability and human activities can induce environmental changes which can influence the foundations of livelihood subsistence by reducing access to, and the quality of, the natural resources that support human well-being. In this way, environmental changes can affect regional security. A concern with regional security relates security to the well-being of individuals and communities in the four nations of Nigeria, Niger, Cameroon and Chad - which constitute the Lake Chad region. Regional security is conceptualised as a condition whereby the Lake region has the option to respond to natural resource scarcity based threats to its environmental and socio-economic well-being. We adopt the

notion of regional security (in which human security is embedded) in the context of threats to human capabilities and well-being (NNC, 2007).

Though context-specific, this study offers detailed insights into the underlying complexities around how environmental changes and security connect in high risk regions, as well as advancing understanding of society's efforts to reduce its vulnerability to those changes.

## **II Engaging with the literature on water and conflict**

Fresh water has become an increasingly scarce resource in many parts of the world, particularly in sub-Saharan Africa (SSA) where approximately one quarter of the population currently live in water-stressed villages and communities (Freitas, 2013). Because water is at the core of human existence, the literature about its connection with conflict is extensive. Major lines of research focus on scale dynamics by investigating water and conflict at trans-boundary/regional level (Wolf *et al.*, 2003) and at local community level (Funder *et al.*, 2012). Another line of research explores the mechanisms behind water scarcity and conflict interactions (Frijters and Leenstyaar, 2003; Gehrig and Rogers, 2009). Other approaches focus on specific issues such as power relations (Zeitoun and Warner, 2006; Zeitoun and Allan, 2008; Stetter *et al.*, 2011), institutions (Tir and Stinnett, 2012), violent versus nonviolent water conflict (Bernauer and Siegfried, 2012) and water conflict management (Hensel *et al.*, 2006).

A range of debates exist which provides insight into the possible ways in which water can drive conflict or cooperation. One strand of the literature reflected in a seminal study conducted by Wolf *et al.* (2003) adduces that instances of cooperation over shared water resources outnumbered incidences of conflict. This finding reinforced an earlier observation by Postel and Wolf (2001) where they noted that riparian countries have long signed water-related treaties to reduce competing claims and to promote cooperation over a water resource, its allocation and uses. These scholars present water as an important resource that functions more as a “connector” than as a “divider”, and thus as a catalyst for unity and interdependence among people and nations.

A contrary view posits that given the increasingly scarce situation of fresh water, coupled with the lack of suitable substitute for most of its uses, a causal relationship exists between water scarcity and conflict. A large number of past and current studies promote this line of argument (e.g. Hauge and Ellingsen, 1998; Bernauer and Siegfried, 2012; Kreamer, 2012). Using case studies from the Middle East, South Asia and South America, Remans (1995) suggests that competition over scarce fresh water leads to severe social and political tensions. Butts (1997) noted that the Earth's history is replete with examples of water-related violent conflicts. Eriksson *et al.* (2003) observed that between 1989 and 2003, 80 to 90 % of recorded armed conflicts have been internal (within nations). They identified water scarcity as one of the significant causes. It has been reported that on 37 occasions, in the second half of the 20th century, countries concerned about water (e.g. Israel and its neighbours - Jordan and Palestine) fired gunshots, burnt houses, blew up dams and undertook some form of water-related military and political actions (Gleick, 2008). An African example is the loss of over 250 lives during a series of water clashes in Rabdore village, Somalia during the region's relentless 3-years drought, 2002 - 2005 (Wax and Thomason, 2006).

From the vast water conflict literature, it is possible to find three key linkages between water and conflict. First, water conflict can materialise when tensions involve access to and allocation of water. Allocating water among different users and uses, even when water supplies are adequate (abundant), can be a cause of disputes. Similarly, a decline in water quality, which threatens human health, can be a source of potential disputes. Decline in water quantity or quality can trigger mass migration which could socially and politically destabilise destination states or cities (Carius *et al.*, 2004). Second, the importance of water in sustaining livelihoods, mostly agricultural livelihoods, provides a link to conflict (Conca, 2006). Livelihood loss can lead to poverty, which is a traditional driver of conflict. Third, there are instances where power relations and inadequate water governance affect the potential for conflict, especially in settings where rivers flow across state boundaries and where institutions lack human, technical and administrative capacities (Gehrig and Rogers, 2009; Ludwig *et al.*, 2011).

Although the world is yet to record any example of countries going to war over water (Wolf *et al.*, 2003), the focus on cause-effect relations in this field has failed to frame water conflicts in a way that allows vulnerability to explain why the same environmental issue produces different effects across a range of different social, economic and political settings. Vulnerability, as used in this study, means the characteristics of a region, state or people and the situations that define and influence their capacity to adjust to, resist and recover from the impacts of environmental change, such as climate change or water degradation (Wisner *et al.*, 2004). Although vulnerability can have different definitions, it is usually approached from three key angles - exposure, sensitivity and adaptive capacity (Smit and Wandel, 2006; IPCC, 2007). Exposure is the presence of people, livelihood assets, environmental resources and infrastructure in locations that are predisposed to be adversely affected by an external shock or stress (IPCC-SREX, 2012). Sensitivity is the degree of responsiveness to both problematic and beneficial stimuli resulting from environmental changes (Smit and Pilifosova, 2001). Adaptive capacity is the ability of a system to adjust to internal or external changes, to moderate potential harms or take advantage of beneficial opportunities (IPCC, 2007).

This paper recognises the limited attention given to vulnerability thinking in linking water problems to social conflict as a key gap in water conflict literature. It therefore seeks to move the literature forward by including notions of vulnerability, particularly by outlining the role of vulnerability in explaining water-to-conflict pathways, rather than the conventional notions of water scarcity or abundance.

### **III Lake Chad and its environment**

Located in west-central Africa, Lake Chad's dynamic nature, as seen in its size, shape and depth, is constantly changing in response to variations in temperatures and rainfall. A variety of ecological zones surround the Lake including deserts, forests, wetlands, savannas and mountains (Ovie and Emma, 2011). Three main drainage systems supply its water: the Chari-Logone River (in the Central African Republic), the Komadugu-Yobe River (in Nigeria) and the Yedsaram/Ngadda River (in Cameroon). Lake Chad was identified in a study conducted by Wolf *et al.*, (2003) as one of the Lakes at greatest risk of socio-political stress. Over 7 years since this observation, the state of the Lake's

basin has worsened as it has shrunk by over 90 % compared with its size (25, 000 km<sup>2</sup>) in the 1960s (Gao *et al.*, 2011). Lake Chad was vastly bigger (up to 400,000 km<sup>2</sup>) several thousand years ago than it was in the 1960s, then it was known as Lake Megachad (Drake and Bristow, 2006). For the entire 20<sup>th</sup> century, the Lake was at its highest level between 1960 and 1963 (Figure 1). This informs why discussions about the Lake’s shrinking state often make reference to this period.

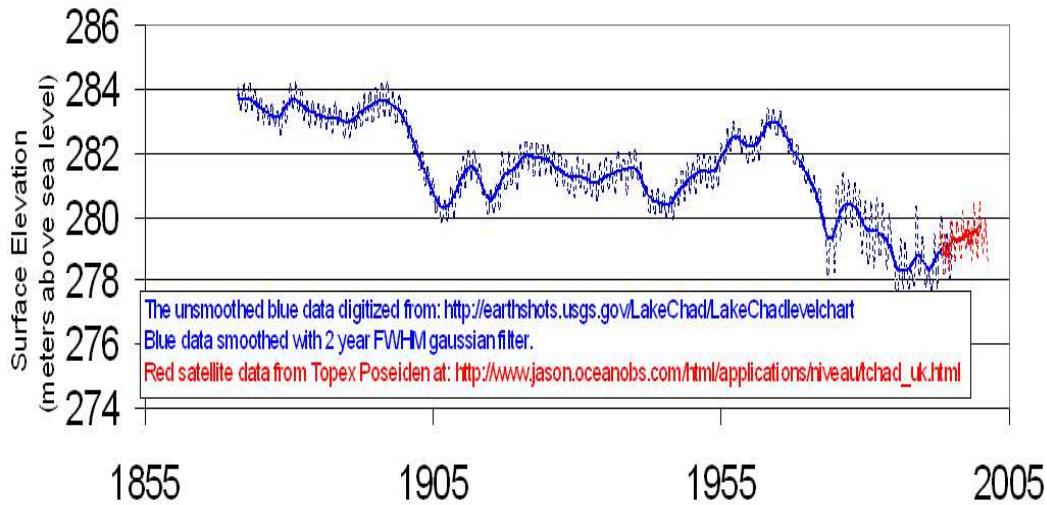


Figure 1: Historical variations of Lake Chad up to 2005  
(Sources: GIWA, 2004; US Geological Survey, 2014)

Hydrological and biophysical changes resulting from natural climatic variability and various human activities threaten the entire Lake Chad basin, the Lake itself and the natural resources and ecosystem services used by communities to pursue their livelihoods (UNEP, 2004). The climate of Lake Chad basin is characterised by high temperatures, strong winds, high evapo-transpiration (estimated at 2,200 mm/annum) and fluctuating rainfall patterns (FAO, 2009). Annual rainfall varies spatially from nearly 1,400 mm along the southern pools to less than 150 mm near the northern end (Odada *et al.*, 2006). The history of drought in the basin is defined by its changing rainfall patterns. From the middle of the 1960s, rainfall started to drop intermittently until the droughts of 1972 - 1975 which coincided with the shrinking of the basin to 10,700 km<sup>2</sup> from its initial level of 25,000 km<sup>2</sup> in 1963. Another drought of 1982 - 1985 resulted in a



drop in basin area to 1,410 km<sup>2</sup> (GIWA, 2004), the lowest basin surface level recorded over the past 100 years.

Stream flow modification and water diversion, associated with the construction of large irrigation and water development projects along the Chari-Logone River and Kamadugu-Yobe River, are also identified as contributory factors in the shrinkage of the basin over the period 1970 - 2013 (US Geological Survey, 2014). The construction (between 1979 and 1990) of Yaguou-Tekele Dyke and Maga Dam beside the Chari-Logone River in Chad, and a series of other dams, such as the Alau dam, Tiga dam, and the Yeders dam at the Nigerian end of the Kamadugu-Yobe River have impacted greatly on the Lake's waters (Onuoha, 2008). Between 1970 and 1990, the average water discharge from the Chari-Logone River to the basin was 55 % of the average of the period 1950 - 1970 (Olivry *et al.*, 1996). It is estimated that about one-third of the water flow (since the 1980s) is diverted from the Chari-Logone River in Central African Republic before it reaches the Lake Basin (Glantz, 2004). Water diversion for irrigation and hydropower generation increased greatly between 1981 and 1990 (GIWA, 2004). About 50 % of the depletion in the Lake's size since the late 1970s to 2000 was attributed to unsustainable water diversion and use for human activities (Coe and Foley, 2001).

The current state of the Lake is one of acute water shortage. In 2000 water supply was less than 500 m<sup>3</sup> *per person per year* (Henninger *et al.*, 2000); this has not changed to date though population has continued to increase. A change from cultivation of low water intensity food crops (such as wheat) to high water intensity food crops (such as rice) has added to the water scarcity (Odada *et al.*, 2006). Reduced water levels have caused increased alkalinity, increased anoxic conditions and worsened the effects of eutrophication (Ovie and Emma, 2011). Because the Lake region is generally and historically exposed to intense drought events, water scarcity is increasingly associated with the myriad of socioeconomic and livelihood shifts around the Lake, for which climate variability acts as an amplifier.

#### **IV Method**

To provide a comprehensive answer to the questions posed in this paper, we undertake a qualitative historical analysis of water-related conflicts (also vulnerability and security) in Lake Chad. Our method is qualitative since the assessment of multi-scalar processes in linked water-to-conflict relations cannot coherently be undertaken through a quantitative analysis of correlations and/or regressions between supposedly 'dependent' variable – conflict, and 'independent' variables – water scarcity and other location-specific factors (Selby and Hoffmann, 2014). We focus on water conflict specifically because, of all environmental resources within the Lake, it is water which is most often linked to conflict. Water conflict is conceptualised in the words of OECD (2005) as “any conflict arising between two or more parties holding competing claims over a water resource, its allocation or its use.” In this sense, we emphasis the spectrum of water conflict that stretches from non-violent expression of differences in opinion and value, through verbal assaults/heated arguments to deliberate contamination/pollution of water and to outbreak of violence (open competition, riots and aggression) within a regional scale (Stetter et al., 2011).

In order to unpack reported water conflict events in the region, we reviewed several open access conflict datasets (specifically, the Uppsala Conflict Dataset of the Peace Research Institute Oslo, the Armed Conflict Location and Event Data Project and the Social Conflict in Africa database). This review was complemented by water conflict and vulnerability narratives in peer-reviewed, Lake Chad-related literature, including official documents from the Lake Chad Basin Commission, Food and Agriculture Organisation and United Nations Environment Programme. Findings from key informant interviews were used to provide additional insights about the role of the shrinking Lake in conflict. Regional water conflicts – which include intrastate (household, village and community levels), interstate, bilateral, multilateral, armed or non-armed, were identified to coincide more with specific drought events (and less with non-drought events) for the periods 1970 to 2010. Our interest is to identify whether drought events, i.e. periods of water scarcity led to water conflict and how vulnerability is aiding it. Because the Lake region is historically prone to conflict, we recognise the likelihood of conflicts occurring during non-drought periods. However, since the paper is designed to better capture water

conflicts using evidences within drought years over the course of the shrinking Lake Chad, we do not focus on non-drought years. Thus, the study selected four periods/years during which the region witnessed severe droughts (i.e. 1972 – 1975, 1982 – 1985, 1989 – 1992 and 2002 – 2005) and situated them within Lake Chad socio-economic and political context of vulnerability and regional insecurity.

## **V Security and conflicts in Lake Chad**

While there is no anticipation of any future large-scale war over water, past studies reveal that increasing water scarcity can induce regional tension and conflicts, drive border disputes and can be the focus of political arguments, tribal violence and cross-border terrorism (Kreamer, 2012). The security concern referred to in this paper implies security in the wider sense of threats to human capabilities and well-being, driven by environmental changes through water resource degradation and scarcity. Such threats could have implications for food supply, mass migration and regional cooperation and development. The Norwegian Nobel Committee conceptualised security in this wider sense during its announcement of the 2007 Peace Prize to the IPCC and Al Gore (NNC, 2007).

Much speculation about how water scarcity and the shrinking Lake Chad endanger regional security encompasses a variety of mechanisms. The importance of Lake Chad trans-boundary waters creates a situation where conditions in one country can create adverse repercussions in another. A river basin is a source of ecological interdependence under which water stress and conflicts in one country can be transmitted to another (Tir and Stinnett, 2012). With climate change causing reduced rainfall, reduced river runoff and more frequent droughts, the extent and impacts of water scarcity are far reaching, particularly in the context of livelihood security.

A synthesis of various documented reports on Lake Chad (Figure 2) shows that there were increased water crises in the region during the droughts of the 1980s and 1990s. This period witnessed several militarised conflicts over competing river claims, especially as resource users migrated in response to the shrinking Lake. For example, between 1980 and 1994, almost 60,000 Nigerians followed the receding Lake waters;

fishing, cultivating crops and rearing animals within Cameroon's border of the Lake Basin (Hall, 2009). As communities and individuals in the receiving cities and states could not engage diplomatic options to resolve conflicts, several people lost their lives. By triggering hostilities with neighbours or damaging relationships between and among nations sharing the Lake's common pool resources, the shrinking Lake threatens regional security.

As Figure 2 indicates, between 1982 and 1985 interstate water and boundary conflicts increased among the riparian nations (Wallenstein and Margareta, 1999; Odada *et al.*, 2006; UCDP, 2008). In 1982 local people from Cameroon and Nigeria clashed over access to the water resources around the south end border of the Lake Basin (Odada *et al.*, 2006). In 1983, Chad engaged in an interstate violent conflict with Nigeria over the status of the islands in the Lake to which both countries have borders (UCDP, 2008). This violence resulted in over 100 casualties (Wallenstein and Margareta, 1999). In the late 1980s, Nigeria and Niger Republic clashed over water diversion and access to the Komadugu-Yobe River flow within the Lake Basin. In 1992 there were clashes between upstream (Nigeria) and downstream (Niger) communities over access to the waters from the Tiga and Challawa Gorge dams at the south-west end of Lake Chad (Odada *et al.*, 2006).

Since 2005, competitions and conflicts over the use of resources within the Lake have continued to create security concern at the Lake's southern pool where the largest population of resource users live (GIWA, 2004). Water shortages and loss of livelihood options have driven vulnerable people into risky behaviours such as drug trafficking and trading of arms. Ohlsson (2003) argued that large cohorts of young people deprived of their sources of livelihoods constitute the major share of terrorist groups/rebels in third world militias. The rising of violent jihadist militants which has killed over 10,000 people in the southern portion of the Lake, has been linked to loss of livelihoods and joblessness created by environmental degradation around the Lake (Ifabiyi, 2013).

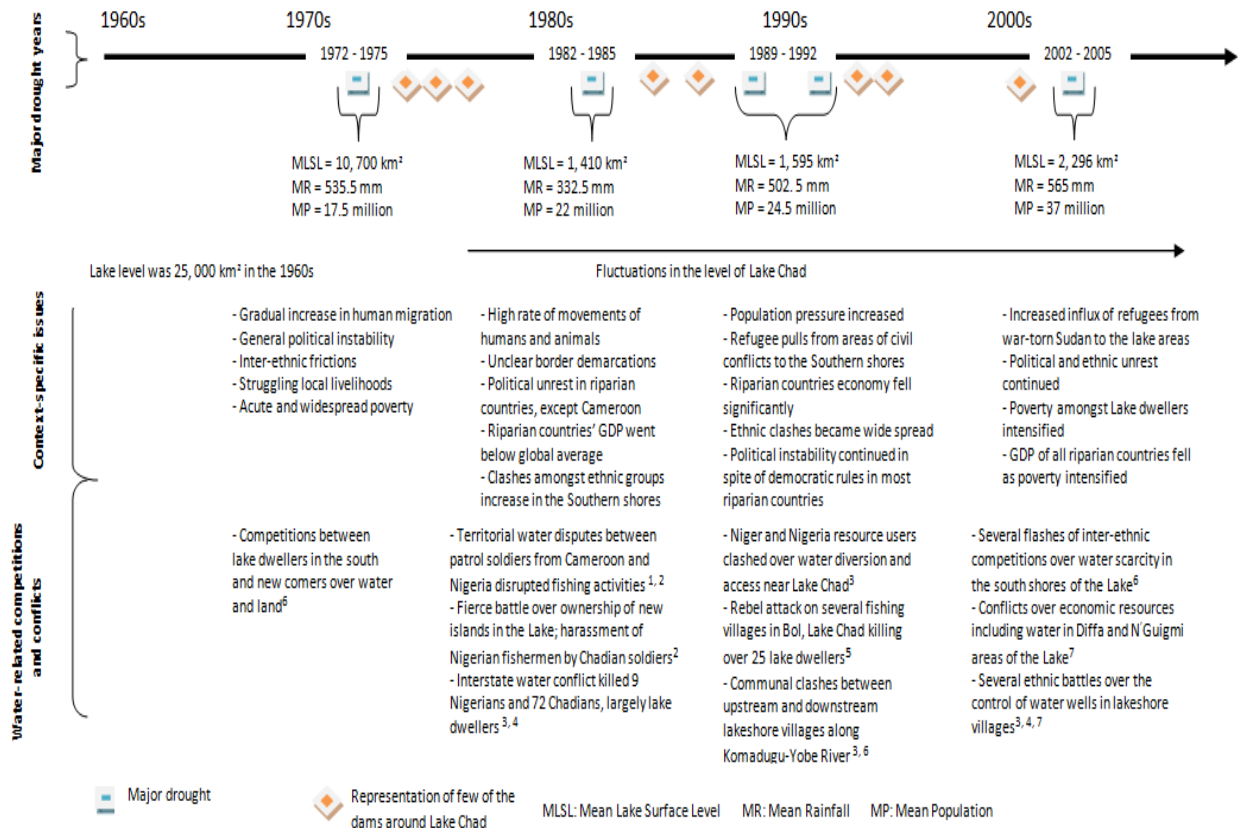


Figure 2. Synthesis of major droughts and water conflict events (<sup>1</sup>UCDP, 2008; <sup>2</sup>International Crisis Behaviour Project Database; <sup>3</sup>Odada *et al.*, 2006; <sup>4</sup>Hall, 2009; <sup>5</sup>Lane, 2004; <sup>6</sup>GIWA, 2004; <sup>7</sup>Social Conflict in Africa Database). Here vulnerability is captured in the notion of the context-specific nature of the Lake area as seen in increasing migration, political unrest, poverty, social instability, ethnic differences and historical conflict events

As water scarcity and poverty become more amplified and intense, the economic and political value that communities and nations place on the Lake resources will increase. Growth in unilateral consumption and unregulated allocation and use of water (e.g. through damming, diverting, dumping and draining activities) by one nation will decrease the amount available to another state. In the wake of the droughts and water shortages of the 1980s, each riparian country unilaterally took decisions to construct dams and divert water away from the Lake without recourse to existing water agreements and consultations with the LCBC (Onuoha, 2008). This implies that previously agreed river diversion arrangements (e.g. for agriculture, human consumption and industrial use) are becoming politically problematic as rivers flowing into the basin continue to drop and as the resulting externalities become a burden for downstream countries (Odada *et al.*, 2006).

## **VI Environmental change, vulnerability and (in)security**

One of the significant pathways by which environmental change influences security and induce social tensions and conflicts is through its impact on water scarcity and people's vulnerabilities or adaptive capacities (Ludwig *et al.*, 2011). There is now a substantial body of literature that focuses on the various determinants or drivers of vulnerability (Kelly and Adger, 2000), how systems differ in their vulnerabilities (Ford and Smit, 2004; Adger, 2006) and what vulnerability issues to focus on when conducting vulnerability assessments (Smit and Wandel, 2006). Whilst this literature offers useful directions on the different ways vulnerability can be approached, it is yet to expand to high risk, conflict-prone settings where research is able to link vulnerability issues with conflict to explain how vulnerability feeds into water and conflict interactions (Ludwig *et al.*, 2011). Further, within the regional security context for river basins, an in-depth investigation of conflict-oriented vulnerability to water scarcity or degradation is needed to improve our understanding of how vulnerability to resource scarcity makes certain locations susceptible to insecurity.

We argue, as have others, that vulnerability to water scarcity can widen, rather than close, the water-to-conflict pathways, particularly in a region where sources of income and subsistence are declining and where people and societies lack capacities to adapt (Adger, 2006; Wisner, 2009; Fraser *et al.*, 2011). Embedding the notion of vulnerability in environmental security assessments provides a holistic insight into the multifaceted, interlinked variables in resource conflicts identified in Peluso and Watt (2001). This insight emphasises that every state globally has its own specific vulnerability signature which defines the 'nature of the state' (Raleigh *et al.*, 2014), and on this basis, an argument can be processed on why the same environmental condition can create a range of different effects in different locations (spatial variation) and at different periods or seasons (temporal variation). In practical terms, what vulnerability thinking does is to point attention to why emphasis on resource scarcity or abundance is not a necessary or sufficient reason for conflict outbreaks (Le Billion, 2001) and why perspectives solely based on environmental determinism can lead to inferior policy suggestions. Situating water conflict within the context of location-specific vulnerability, where emphasis is on

how people's vulnerability under environmental change leads to conflict, has therefore become a critical next step research focus in this field.

Lake Chad and its riparian communities provide a breadth of conditions in support of this argument. The Lake region is highly vulnerable to many domestic and external shocks and stresses (Ovie and Emma, 2011). This vulnerability is driven by factors which touch on the exposure, sensitivity and adaptive capacity of the region. An assessment of the vast body of literature that focused on the problems of Lake Chad identifies the drivers as climate change-induced water scarcity, high population density ( $\geq 100$  person/m<sup>2</sup>), low *per capita* GDP ( $\leq$  US\$765 *per person per year*), poor/unfriendly relations, politically active minority ethnic groups, large dams and other water development projects and an absence of water allocation laws and treaties (Odada, *et al.*, 2006). These factors agree with the issues Yoff *et al.* (2003) identified as key drivers that predispose a lake or river basin to water insecurity.

To allow for a closer assessment, we have grouped these into climate, population dynamics and socio-economic-political conditions (Odada *et al.*, 2006). These factors cut across the entire Sahel, a region that is highly exposed and sensitive to harsh climatic conditions, and characterised by over-exploitation of natural resources, poor infrastructure, widespread poverty, high illiteracy rates, social conflicts, poor health care and high dependence on climate-sensitive livelihoods (Benjaminsen, 2012).

### *Climate*

This paper posits that the significant driver of environmental impacts on Lake Chad remains climatic variability and change. These influence the Lake on many fronts – by reducing the river flows that feed it, by driving the evaporation of its water and by inducing water quality changes through heavy precipitation of chemical elements (Ovie and Emma, 2011). The climate of Lake Chad has been clearly highlighted earlier (see Section 3) but it is relevant to emphasise that while climate drives water quantity (supply) and distribution, population dynamics and socio-economic conditions (such as institutional development, water legislations and economic growth) are the principal factors affecting quality and demand (UNEP, 2005). Where renewable water resources are less than 1000 m<sup>3</sup>/person/annum, water availability is considered to create a

condition of discontent and desperation, especially when socio-economic development is constrained as a result (Gleick, 2008).

### *Population dynamics*

The human population dynamics around Lake Chad are driven by a southward migration trend following the collapse of the Lake's northern pool in the 1970s and 1980s (GIWA, 2004). This trend has changed the Lake's demographic structure and created new production and development concerns. The population of the region is well over 30 million, growing at the rate of between 2.5 and 3.0 % annually (Hall, 2009). There are over 70 ethnic groups around the Lake (Bene *et al.* 2003; Ovie and Emma, 2011), each exploiting the natural environment through a range of diverse activities. The dominant groups are the Hausa, Fulani and Kanuri groups along the western shores of the Lake (Nigeria), the Mousgoun in Yaere (Cameroon) and the Sara and Kotoko in the Chari Delta (Chad). This population is predominantly rural, thriving on climate-sensitive agriculture-related activities.

Research has shown that rapid population growth under changing environmental conditions makes resource users insecure and vulnerable to violence (GIWA, 2004). For Lake Chad, vulnerability is shaped by a growing population that is pursuing similar resources at the same time; resources that are limited in their supply (Onuoha, 2008; Hall, 2009). The role played by ethnic heterogeneity in local resource conflicts in this region contributes to its population dynamics. Ethnic composition remains a crucial factor for mobilisation and turning protest into collective violence through the use of language and religion. In trying to make a living through exploitation of water and land resources, the multi-ethnic groups have often engaged in inter-ethnic and sectorial conflicts (Le Barbe and Lebel, 1997). One particular instance is the recurrent clashes between the Shuwa Arabs from the east (of Lake Chad) and the Fulani pastoralists from the south west over the limited fishing and animal husbandry opportunities at the southern pool of the basin (Odada *et al.*, 2006).

### *Socioeconomic and political conditions*

Socioeconomic conditions in this environment cut across a range of challenging issues. The riparian countries are characterised by slow and unstable economic systems.



Poverty is acute and widespread. In the 2013 United Nation's Human Development report, Niger was ranked 186, Chad 184, Nigeria 153 and Cameroon 150 out of 186 countries globally (UNDP, 2013). These countries face very low labour productivity, absence of a dynamic private sector, an oversized informal sector and inadequate infrastructure (GIWA, 2004). Series of civil wars coupled with increases in military expenditures has further retarded economic progress, particularly in Chad and Niger (Hall, 2009).

The receding of the Lake has contributed to the dwindling fortune of the region. Before the current state, the Lake waters supported massive agricultural production: fishing, animal husbandry and growing of food crops (such as cotton, groundnut, cassava, millet, onions, rice, maize and sorghum) - which in turn supported the economy of the region (Odada *et al.*, 2006). Since the droughts of the 1970s and 1980s, agricultural production has continued to decline. For example, annual sorghum yield was less than 250,000 tonnes during the 1972-1975 droughts and 180,000 tonnes during the 1982-1985 (GIWA, 2004). This has further declined to date (US Geological Survey, 2014).

Water shortages have initiated shifts in livelihood patterns. As the amount of grazing land for animals has decreased, herders in several locations have shifted from rearing grazing animals (cattle and camel) to browsing animals (sheep and goat) (Onuoha, 2008). This practice has led to increased removal of vegetation cover (US Geological Survey, 2014). In addition, with a declining annual fish catch (for example, annual fish catch from the Lake's fisheries decreased from 141,000 tonnes in the early 1970s to 70,000 tonnes in 2002 (Living Waters, 2003)), fishers engaged in small-scale open water fishery have had to switch to swamp and floodplain fisheries. This required a change in fishing gear, from open water gear to specialised passive gears such as gill nets, cane traps and hooks. Because of reduced fishing areas, large-scale fishers have had to invest in bigger and safer boats to enable them migrate longer distances to access open waters of the Lake to catch species of higher value. Only the wealthy fishing households are able to make these adjustments (Ovie and Emma, 2011).

A combination of these varied economic conditions has affected the social and political space in the region which further creates severe implications for the riparian livelihoods.

Diminishing river flow has influenced inland transport (Ngatcha, 2009), cutting off trade links, creating hostile neighbours and slowing down economic growth (Neiland and Bene, 2003). The population lacks education, face limited employment opportunities, live under extreme weather conditions, exploit the environment in an unsustainable way, face food/nutrition insecurity, prone to numerous health challenges and lack access to credit facilities and adequate health care. Prevailing political instability and poverty inhibit the capacity of communities to initiate and implement viable adaptive strategies. Lack of effective institutions, poor information network and absence of welfare support systems add to the burden in the area (Odada *et al.*, 2006). All these combine to explain why and how the people are vulnerable and consequently can enhance knowledge of the link between environmental change and conflict.

*Synthesis: are environmental change, vulnerability and security issues linked?*

Environmental change, vulnerability and security issues appear to be linked in this case study. Changes in the Lake's environment coupled with the vulnerability of the peoples and states have always been part of the security debates. While environmental change, as seen in climate-induced water scarcity and droughts for Lake Chad, does not constitute a sufficient cause of insecurity, how this change combines with the Lake Chad context-specific factors (climate, population, socio-economic and political factors) to either increase or decrease vulnerability provides a necessary condition for conflict to evolve and thrive. A shift in environmental conditions, either due to climate change or human activities, creates a lot of challenges for household and livelihood systems. A number of studies have indicated that in conflict settings, environmental factors tend to function more as triggers or intervening variables (Lowi, 1999). For example, excessive flooding and prolonged droughts at certain times of the year in Lake Chad often combine to weaken communities that lack external supports and burdened by corrupt, insensitive leaders. However, it is possible to find situations in a developing world setting where environmental factors tend to go beyond just being the intervening variables to being part of the context of conflict. This can be the case where livelihood subsistence is heavily linked to the natural resource base.

We argue therefore that because the environment in Lake Chad is already vulnerable to a number of external shocks, this vulnerability adds up or combines with the vulnerability of the region in terms of its households and livelihoods, to create pathways leading to insecurity. This suggests that the linkage is more about the broader contextual vulnerability of the region, which has been on the increase as climate becomes more chaotic and as a multitude of other context-specific factors threatens the survival and well-being of humans in the area (Figure 3).

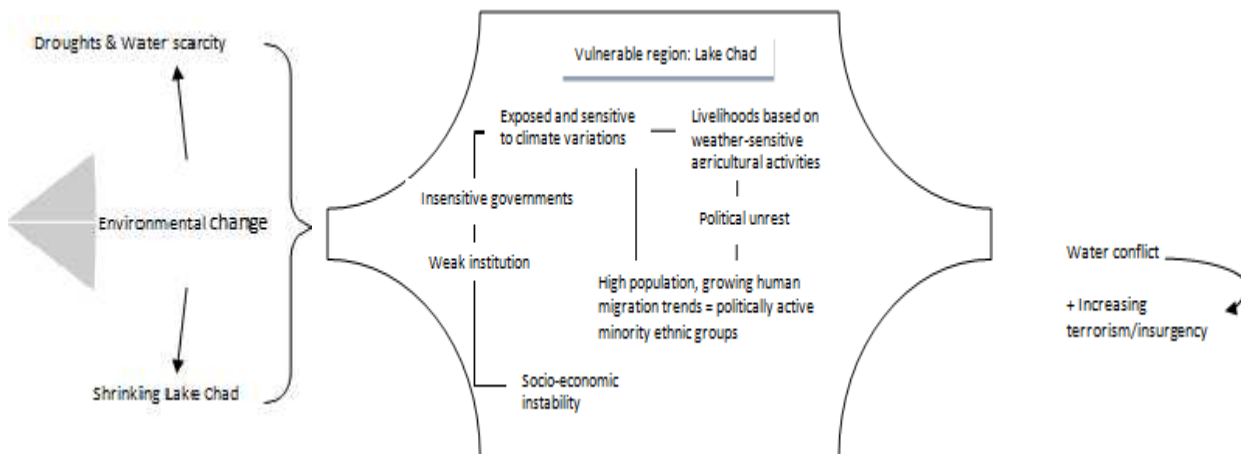


Figure 3: A linked environment-vulnerability-conflict nexus for Lake Chad

This synthesis posits that environmental and security concerns may be secondary to vulnerability concerns in a developing world context such as the Lake Chad region, because it is on the basis of vulnerability dynamics that we can better understand why locations facing the same environmental conditions are impacted differently. Much as the factors driving vulnerability in Lake Chad have been identified (earlier in this section), they combine to shape the link between environmental change(s), vulnerability and insecurity. Insight from this region supports conclusions from previous studies (e.g. Hauge and Ellingsen, 1998; Homer-Dixon, 1999; Ludwig *et al.*, 2011; UNEP, 2005) that the environment is connected to human well-being; that livelihood opportunities are linked to a stable environment; and that all of these are connected in one way or another to security. However, it is the presence of severe demographic factors, weak justice and poor resource governance mechanisms and arrangements for establishing rights of

resource access and use that differentiate locations facing similar environmental challenge in terms of whether conflict happens or not. These factors are within the purview of vulnerability issues and support the notion that efforts to unpack regional vulnerability issues can be a critical first step towards addressing environmental and security challenges.

## **VII Pathways towards cooperation and human well-being**

Enabling vulnerability assessment in the context of environmental change and conflict analysis can inform various institutional and policy interventions targeting social stability and peace building. Current military strategies by the riparian countries to contain insecurity in Lake Chad do not touch on the root causes of conflict, particularly the drivers of vulnerability. Non-military strategies such as the proposed water transfer from Congo River basin via the Ubangi River to recharge the Lake waters might increase livelihood opportunities if successfully implemented (LCBC, 2012). However, under weak institutional arrangements for efficient water allocation and use, rapid population growth and mass migration means that demand for water will increase and might further create conditions where vulnerability would encourage a closer linkage between environmental change and insecurity.

A key pathway to peace and human well-being therefore will be to reduce vulnerability in the region and enhance people's resilience with or without the Lake waters. Conflicts can be prevented by increasing the capacity of the people to both adapt and diversify beyond the current total reliance on environmental resources. To progress, states and communities must find ways to manage population growth, address migration, prevent unsustainable environmental practices (e.g. overgrazing and over fishing) and conserve and distribute resources in a manner that support human welfare. A robust water charter that promotes equity and justice should form part of the policy drive to create 'friendly' neighbourhood relations in the region.

The Lake Chad Basin Commission has the responsibility to work with stakeholders across the region to address sharing, conservation and management of the Lake resources and in engaging diplomatic options to resolve conflicts. Water may be scarce,

but capacities to mitigate environmental constraints are not. However, for a variety of reasons ranging from insensitive, predatory governing structures to political conflict to terrorism to weak institutions, problem-solving scientific capacities have not yet been effectively mobilised to advance cooperation and security of peoples and communities.

Enhancing the capacity of the region awaits the right socio-economic and political context. If the creative capacities of local people are enhanced and efforts are made to develop the conditions that allow those capacities to be mobilised and deployed, then human welfare can be improved and future insecurity can be prevented. Institutional and policy inputs are required to create and sustain the pathways towards security.

### **VIII Conclusion**

The limited attention given to vulnerability thinking in several attempts to link environmental issues to security can influence how we understand the interactions between water problems and social conflict. In this paper, we argue that vulnerability perspectives can offer an important lens for assessing the complex interactions between environmental issues and security. Drawing upon evidence in Lake Chad, we demonstrate that the explanations for conflicts about water lie not only with the natural environment or changes to it, but also with the underlying vulnerabilities that characterise the region. The notion of vulnerability used in this paper addresses more searchingly the issues of climate change, population growth and socio-economic-political deprivations. These are challenging issues intellectually. Their influence in shaping the environment-vulnerability-security nexus can be holistically unpacked by engaging more with locally-embedded, place-based contexts. Around these three issues, we find reasons why locations facing the same environmental conditions can have different water-to-conflict pathways.

Although a vulnerability perspective can represent a useful point of entry into environmental change and conflict assessments, the paper suggests that it will be totally misguided to focus attention on reducing people's vulnerability or addressing water scarcities alone, either in an effort to reduce or resolve regional insecurity. Focusing on all components and linkages from environmental conditions to conflict is critically

important. This again is where vulnerability assessment can be very useful particularly in terms of identifying linkages of broad relevance.

Further research, therefore, needs to focus more on why and how the various connecting variables or components emerge, and how they thrive and combine to create potential avenues for conflict. The composition of institutions and how they relate with external shocks on the environment need to be examined to advance the capacity of institutions to create and sustain pathways towards the well-being of the region. On these bases, scholars can better construct useful arguments to advance the need for non-military engagements towards regional cooperation and human well-being.

## References

- Adger, W.** 2006: Vulnerability. *Global Environmental Change* **16** (3): 268-281.
- Bene, C., Neiland, A., Jolley, T., Ovie, S., Sule, O., Ladu, B., Mindjimba, K., Belal, E., Tiotsop, F., Baba, M., Dara, L., Zakara, A and Quensiere, J.** 2003: Inland fisheries, poverty and rural livelihoods in the Lake Chad Basin. *Journal of Asian and African Studies*, **38** (17): 3334-4782. Doi: 10.1177/002190960303800102.
- Benjaminsen, T.** 2012: The Sahel and climate security debate. In: OECD (2012). *Global security risks and West Africa: development challenges*. West African Studies, OECD Publishing (online) URL: <http://dx.doi.org/10.1787/9789264171848-en> (accessed 14/5/2013).
- Bernauer, T. and Siegfried, T.** 2012: Climate change and international water conflict in central Asia. *Journal of Peace Research* **41** (1): 227-239.
- Butts, K.** 1997: The strategic importance of water. *Parameters and Spring Bulletin*: 65–83.
- Carius, A., Dabelko, G. D., and Wolf, A. T.** 2004: Water, conflict, and cooperation. *ECSP Report, Issue 10* (Policy brief - the United Nations and Environmental Security) URL: [http://www.wilsoncenter.org/sites/default/files/ecspr10\\_unf-caribelko.pdf](http://www.wilsoncenter.org/sites/default/files/ecspr10_unf-caribelko.pdf) (accessed on 7/10/3013).
- Coe, M.T. and Foley, J.A.** 2001: Human and natural impacts on the water resources of the Lake Chad Basin. *Journal of Geophysical Research*, **106** (D4): 3349-3356
- Conca, K.** 2006: The new face of water conflict. *Navigating Peace* **3** (online) URL: <http://wilsoncenter.org/sites/default/files/NavigatingPeaceIssue3.pdf> (accessed on 7/10/2013).
- Deudney, D.** 1990: The case against linking environmental degradation and national security. *Millennium-Journal of International Studies* **19**: 461. Doi: 10.1177/03058298900190031001.
- Drake, N. and Bristow, C.** 2006: Shorelines in the Sahara: geomorphological evidence for an enhance monsoon from palaeolake Megachad. *The Holocene* **16** (6): 901 – 911. Doi: 10.1191/0959683606hol981rr.
- Eriksson, M., Wallenstein, P. and Sollenberg, M.** 2003: Armed conflict: 1989-2002. *Journal of Peace Research*, **40** (5): 593-607.
- Food and Agriculture Organisation (FAO)** 2009: Adaptive water management in the Lake Chad Basin. Addressing current challenges and adapting to future needs. *FAOWater Seminar Proceedings of the World Water Week*, Stockholm, August 16-22. URL: <http://www.fao.org/nr/water/docs/ChadWWW09.pdf> (accessed 19/01/2014).

**Ford, J. and Smit, B.** 2004: A framework for assessing the vulnerability of communities in the Canadian Arctic to risks associated with climate change. *Arctic* **57** (4): 389-400.

**Fraser, E. D., Dougill, A. J., Hubacek, K., Quinn, C. H., Sendzimir, J and Termansen, M.** 2011: Assessing vulnerability to climate change in dryland livelihood systems: conceptual challenges and interdisciplinary solutions. *Ecology and Society* **16** (3): 3. <http://dx.doi.org/10.5751/ES-03402-160303>.

**Freitas, A.** 2013: Water as a stress factor in sub-Saharan Africa. *European Union Institute of Security Studies Brief, Issue 12* (online) URL: [www.iss.europa.eu/uploads/media/Brief\\_12.pdf](http://www.iss.europa.eu/uploads/media/Brief_12.pdf) (accessed 4/12/2013).

**Frijters, I. and Leentvaar, J.** 2003: Water conflict: The Rhine case study. *Technical Documents in Hydrology*. UNESCO: IHP-VI, PCCP Publication Series 2, pp 1-37.

**Funder, M., Bustamante, R., Cossio, V., Huong, P., van Koppen, B., Mweemba, C., Nyambe, I., Phuong, L. and Skielboe, T.** 2012: Strategies of the poorest in local water conflict and cooperation – evidence from Vietnam, Bolivia and Zambia. *Water Alternatives* **5**(1): 20-36.

**Gao, H., Bohn, T., Podest, E. and McDonald, K.** 2011: On the causes of the shrinking of Lake Chad. *Environ. Res. Letter* **6** 034021 (7pp). Doi: 10.1088/1748-9326/6/3/034021

**Gehrig, J and Rogers, M.** 2009: Water and conflict: incorporating peacebuilding into water development. *Catholic Relief Services* (online). URL: <http://crsprogramquality.org/pubs/peacebuilding/waterconflict.pdf> (accessed 12/11/2013)

**GIWA (Global International Water Assessment)** 2004: Lake Chad basin: regional assessment 43. Fortnam, M. P. and Oguntola, J. A (eds.), Sweden: University of Kalmar (online). URL: <http://www.unep.org/dewa/giwa/areas/reports/r43/giwaregionalassessment43.pdf> (accessed 21/10/2013).

**Glantz, M. H.** 2004: Lake Chad and the Aral Sea: A sad tale of two lakes. URL: [http://www.fragileecologies.com/sep09\\_04.html](http://www.fragileecologies.com/sep09_04.html) (accessed 22/10/2013).

**Gleditsch, N. P.** 1998: Armed conflict and the environment: a critique of the literature. *Journal of Peace Research* **35** (3): 381. Doi: 10.1177/0022343398035003007.

**Gleick, P. H.** 2008: Water conflict chronology. *Water Brief*. URL: <http://www.worldwater.org/conflictchronology.pdf> (accessed on 21/ 07/ 2010).

**Goulden, M., Conway, D. and Persechino, A.** 2008: Adaptation to climate change in international river basins in Africa: a review. *Tyndall Centre Working Paper 127*. URL: <http://www.tyndall.ac.uk/sites/default/files/twp127.pdf> (accessed on 12/04/2014)



**Hall, E. L.** 2009: Conflict for resources: Water in the Lake Chad Basin. *Research Monograph*, School of Advanced Military Studies, United States Army Command and General Staff College, Kansas, pp 1-45.

**Hauge, W. and Ellingsen, T.** 1998: Beyond environmental scarcity: causal pathways to conflict. *Journal of Peace Research* **35** (2): 299 – 317. Doi: 10.1177/0022343398035003003.

**Henninger, N., Revenga, C., Brunner, J., Kassem, K. and Payne, R.** 2000: Pilot analysis of global ecosystems: Freshwater systems. World Resources Institute, Washington DC. URL: <http://www.wri.org/publication/pilot-analysis-global-ecosystems-2>. (accessed 10/10/2013)

**Hensel, P. R., Mitchell, S. M. and Sowers II, T.E.** 2006: Conflict management of riparian disputes. *Political geography* **25**: 383 – 411.

**Homer-Dixon, T.** 1999: *Environment, Scarcity and Violence*. Princeton, NJ: Princeton University Press

**Ifabiyi, I. P.** 2013: Recharging the Lake Chad: the hydro-politics of national security and regional integration in Africa. *African Research Review* **7**:3, number 30, pp 196-216. Doi: <http://dx.doi.org/10.4314/afrrrev.v7i3.15>.

**Intergovernmental Panel on Climate Change (IPCC)** 2001: *Climate Change 2001: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the *Third Assessment Report* of the IPCC. Climatic Factors in Desertification. URL: [http://www.grida.no/climate/ipcc\\_tar/wg2/403.htm](http://www.grida.no/climate/ipcc_tar/wg2/403.htm) (accessed on 17/01/2014).

**Intergovernmental Panel on Climate Change (IPCC)** 2007: *Climate change 2007: Synthesis Report*. Contribution of the Working Groups 1, 2 and 3 to the *Fourth Assessment Report* of the Intergovernmental Panel on Climate Change. Pachauri, R. and Reisinger, A (eds.). IPCC, Geneva, Switzerland. URL: [http://www.ipcc.ch/publications\\_and\\_data/publications\\_ipcc\\_fourth\\_assessment\\_report\\_synthesis\\_report](http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report) (accessed on 14/12/2013).

**International Crisis Behaviour Project Database (ICBPD)**. Database available online at <http://www.cidcm.umd.edu/icb/dataviewer> (accessed on 13/07/2014).

**IPCC-SREX**. 2012: Summary for policy makers. Managing the risks of extreme events and disasters to advance climate change adaptation. A special report of Working Groups I and II of the Intergovernmental Panel on Climate Change, Geneva. URL: [https://www.ipcc.ch/pdf/special-reports/srex/SREX\\_FD\\_SPM\\_final.pdf](https://www.ipcc.ch/pdf/special-reports/srex/SREX_FD_SPM_final.pdf) (accessed 10/10/2013).

**Kelly, P. M. and Adger, W. N.** 2000: Theory and practice in assessing vulnerability to climate change and facilitating adaptation. *Climate Change* **47** (4): 325 - 352

**Kreamer, D.** 2012: The past, present and future water conflict and international security. *Journal of Contemporary Water Research and Education*, Issue **149**, pp 88-96

**Lake Chad Basin Commission (LCBC).** 2012: Proposed interbasin water transfer. URL: <http://www.cblt.org/fr/projet-de-transfert-deau-interbassin-pteib> (accessed on 14/4/2014).

**Lane, B.** 2004. Chad: recent history, in Murison, K. (ed.) Africa south of the Sahara: regional survey of the world. Europa Publications, 33<sup>rd</sup> edition, UK; pp. 218 – 239.

**Le Barbe, L and Lebel, T.** 1997: Rainfall climatology of the HAPEX-Sahel region during the years 1950—1990. *Journal of Hydrology* **188**, pp. 43-73.

**Le Billion, P.** 2001: The political ecology of war: natural resources and armed conflict. *Political Geology* **20**: 561 – 584.

**Living Waters** 2003: Lake Chad. URL:[http://assets.panda.org/downloads/mrw/lakechad\\_Casestudy.pdf](http://assets.panda.org/downloads/mrw/lakechad_Casestudy.pdf) (accessed on 17/12/2013)

**Lowi, M. R.** 1999: Water and conflict in the Middle East and South Asia: are environmental issues and security issues linked? *Journal of Environment and Development* **8** (4): 376 – 396. Doi: 10.1177/1070496559900800403.

**Ludwig, R., Roson, R., Zografos, C. and Kallis, G.** 2011: Towards an interdisciplinary research agenda on climate change, water and security in Southern Europe and neighbouring countries. *Environmental Science and Policy* **14**: 794 – 803. Doi: 10.1016/j.envsci.2011.04.003.

**Neiland, A. and Bene, C.** 2003: Sustainable development of African continental fisheries. a regional study of policy options and policy formation mechanisms for the Lake Chad Basin. University of Portsmouth and European Commission, EU-INCO Project, Final Report 48 pp.

**Ngatcha, B.N.** 2009: Water resources protection in the Lake Chad Basin in the changing environment. *European Water*, **25** (26): 3-12.

**Norwegian Nobel Committee (NNC).** 2007: The Nobel Peace Prize for 2007. (online) URL:[http://www.nobelprize.org/nobel\\_prizes/peace/laureates/2007/press.html](http://www.nobelprize.org/nobel_prizes/peace/laureates/2007/press.html) (accessed 13/11/2013)

**Odada, E., Oyebande, L. and Oguntola, J.** 2006: Lake Chad: Experience and lessons learned brief. URL: [http://www.ilec.or.jp/eg/lbmi/pdf/06\\_Lake\\_Chad\\_27February2006.pdf](http://www.ilec.or.jp/eg/lbmi/pdf/06_Lake_Chad_27February2006.pdf) (accessed on 11/12/2013).

**Ohlsson, L.** 2003: The risk of livelihood conflicts and the nature of policy measures required. In: Nicholas N., Kittrie, L., (eds). *Seeds of True Peace: Responding to the Discontents of a Global Community*, Washington DC, Carolina Academic Press: 342pp

**Olivry, J., Chouret, G., Vuillaume, G., Lemoalle, J. and Bricquet, J.** 1996: Hydrology of the Lake Chad Basin. *Monographs of Hydrology*, **12**: 266.

**Onuoha, F. C** 2008: Environmental degradation, livelihood and conflict: a focus on the implications of the diminishing Lake Chad Basin for North-eastern, Nigeria. *African Journal on Conflict Resolution* **8** (20): 1-47.

**OECD - Organisation for Economic Cooperation and Development.** 2005: Water and violent conflict. *Issues Brief* (online). URL: [http://www.sdc.admin.ch/en/Home/Themes/Conflict\\_prevention\\_and\\_transformation/Conflict\\_prevention/resources/resource\\_en\\_92767.pdf](http://www.sdc.admin.ch/en/Home/Themes/Conflict_prevention_and_transformation/Conflict_prevention/resources/resource_en_92767.pdf) (accessed on 21/02/2014).

**Ovie, I.S and Emma, B.** 2011: Identification and reduction of climate change vulnerability in the fisheries of the Lake Chad basin. in De Young, C.; Sheridan, S.; Davies, S.; Hjort, A. (ed.) Climate Change implications for fishing communities in the Lake Chad Basin. FAO/Lake Chad Basin Commission Workshop, 18–20 November 2011, N'djamena, Chad. FAO Fisheries and Aquaculture Proceedings. No. 25. Rome, FAO. 2012. 84 pp.

**Raleigh C., Linke , A. and O'Loughlin, J.** 2014: Extreme temperatures and violence. *Nature Climate Change* **4**: 76 – 77.

**Peluso, N. and Watts, M.** 2001: *Violent environments*. Cornell University Press, Ithaca, United States. p. 464.

**Postel, S. L. and Wolfe, A.T.** 2001: Dehydrating conflict. *Foreign Policy*, **60** (67): 60 – 67(online)URL:[http://www.transboundarywaters.orst.edu/publications/abst\\_docs/Postel\\_&\\_Wolf\\_final.pdf](http://www.transboundarywaters.orst.edu/publications/abst_docs/Postel_&_Wolf_final.pdf). (assessed 11/3/2014).

**Remans, W.** 1995: Water and war. *Humantares Volkerrecht* **8** (1): 1–14.

**Rijsberman, F. R.** 2006: Water scarcity: fact or fiction? *Agricultural Water Management* **80**: 5 – 22.

**Selby, J. and Hoffmann, C.** 2014: Beyond scarcity: rethinking water, climate change and conflict in the Sudans. *Global Environmental Change* (online) <http://d.doi.org/10.1016/j.gloenvcha.2014.01.008>.

**Smit, B. and Wandel, J.** 2006: Adaptation, adaptive capacity and vulnerable. *Global Environmental Change* **16** (3): 282-292.

**Smit, B. and Pilifosova, O.** 2001: Adaptation to climate change in the context of sustainable development and equity. In McCarthy J. J, Canzianni, O.F, Leary, N.A, Dokken, D.J and White, K.S., editors, Climate Change 2001: Impacts, Adaptation, and Vulnerability - Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

**Social Conflict in Africa Database (SCAD).** Conflict database on Africa. Robert Strauss Centre for International Security and Law. Database available online at <https://www.strausscenter.org/country-search> (accessed on 12/06/2014).

**Stetter, S., Herschinger, E., Teichler, T. and Albert, M.** 2011: Conflicts about water: securitizations in a global market. *Conflict and Cooperation* **46** (4):441-459.

**Tir, J. and Stinnett, D.** 2012: Weathering climate change: can institutions mitigate international water conflict? *Journal of Peace Research* **49** (1) 211-225. Doi: 10.1177/0022343311427066.

**UNDP** 2013: Human development report 2013: the rise of the south – human progress in a diverse world (online). URL:[http://hdr.undp.org/en/media/HDR2013\\_EN\\_Summary.pdf](http://hdr.undp.org/en/media/HDR2013_EN_Summary.pdf) (accessed on 13/11/2013).

**UNEP** 2003: Draft Desk Study Version 1 on the Lake Chad Basin. Report prepared by UNEP AEO, GIWA, UNEP DEPI, Micheal, T.C and the Lake Chad Basin Commission. Department of Early Warning and Assessment (DEWA), UNEP: Nairobi, Kenya.

**UNEP** 2005: Hydropolitical vulnerability and resilience along international waters: Africa. United Nations Environmental Programme commissioned research (online). URL: [http://www.transboundarywaters.orst.edu/research/UNEP\\_Atlas/Hydropolitical\\_Vulnerability\\_%20Resilience\\_Africa.pdf](http://www.transboundarywaters.orst.edu/research/UNEP_Atlas/Hydropolitical_Vulnerability_%20Resilience_Africa.pdf) (accessed 7/11/2013).

**United Nations Environmental Programme (UNEP)** 2009: From conflict to peace building: the role of natural resource and the environment (online) URL: [http://postconflict.unep.ch/publications/pcdmb\\_policy\\_01.pdf](http://postconflict.unep.ch/publications/pcdmb_policy_01.pdf) (accessed on 12/12/2013).

**United States Geological Survey (USGS)** 2014: Earthshots: satellite images of the environmental changes in Lake Chad, West Africa. URL:<http://earthshots.usgs.gov/earthshots/Lake-Chad-WestAfrica> (accessed 05/5/2014)

**Wallensteen, P. and Margareta, S.** 1999: Armed conflict 1980-1998. *Journal of Peace Research*, **18**: 593-606.

**Wax, E. and Thomason, R.** 2006: Dying for water in Somalia's drought. *Washington Post*, April 4.

**Wisner, B.** 2009: Vulnerability. *International Encyclopedia of Human Geography* (2009), pp 176-182.

**Wisner, B. P. Blaikie, T. Cannon, and I. Davis.** 2004: At risk: natural hazards, people's vulnerability and disasters (2nd ed). London and New York: Routledge

**Wolf, A. T., Yoffe, S. B. and Giordano, M.** 2003: International waters: identifying basins at risk. *Water Policy* **5**: 29 – 60.

**Yoffe S., Wolf, A and Giordano, M.** 2003: Conflict and cooperation over international freshwater resources: indicators of the basins at risk. *Journal of American Water Resources Association*, **39**(5): 1109-1126.

**Zeitoun, M and Allan, J. A.** 2008: Applying hegemony and power theory to transboundary water analysis. *Water Policy* **10**: 3-12. Doi: 10.2166/wp.2008.203.

**Zeitoun, W. and Warner, J.** 2006: Hydro-hegemony – a framework for analysis of tranboundary water conflicts. *Water Policy* **8**: 425 – 460. Doi:10.2166/wp.2006.054.