Chapter 2
An Assessment of Climate-Induced Conflict Risks Over Shared Water Resources in Africa

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Abstract This paper was designed to inform policymakers and stakeholders about the implications of climate change and the scarcity of water due to climatic and non-climatic factors. This scarcity in shared water resources could lead to a dispute over its distribution and use. Consequently, the study is specifically aimed at shedding light on negotiation as a mitigation tool for conflict resolution in water-stressed areas. Both historic and scientific data that shows the frequent occurrences of water dispute among African countries are used. A conflict resolution technique to disputing parties is proposed.

The results of the analysis suggested that threats to water security are already the primary cause of some of the most intractable conflict in Africa. Salinization of coastal aquifers due to heavy withdrawals of freshwater, pollution of rivers, lakes, and reduction in hydropower energy as direct consequences to climatic changes, as well as other abuses of water resources, could lead to extremely serious disputes. The study has also shown that even though technical solutions are now available for solving most of the existing problems related to water resources and other environmental issues, the social and political mechanisms for realistically implementing these solutions within the sustainable development paradigm are still unknown. Furthermore, conflict over the utilization of water resources within a sustainable development paradigm is especially pronounced in the context of transboundary river basins, as well as transboundary aquifers that cross international boundaries. Negotiation on water in areas of conflict could be used as a valuable tool to help negotiate policies, treaties and laws that promote sustainable development throughout the basin, and especially with respect to the equitable utilization of water from both quality and quantity viewpoints.

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W.L. Filho (ed.), *The Economic, Social and Political Elements of Climate Change*, Climate Change Management, DOI 10.1007/978-3-642-14776-0_2,

Keywords Conflict · Mitigation · Shared water resources · Transboundary · Water-stressed basin

Introduction

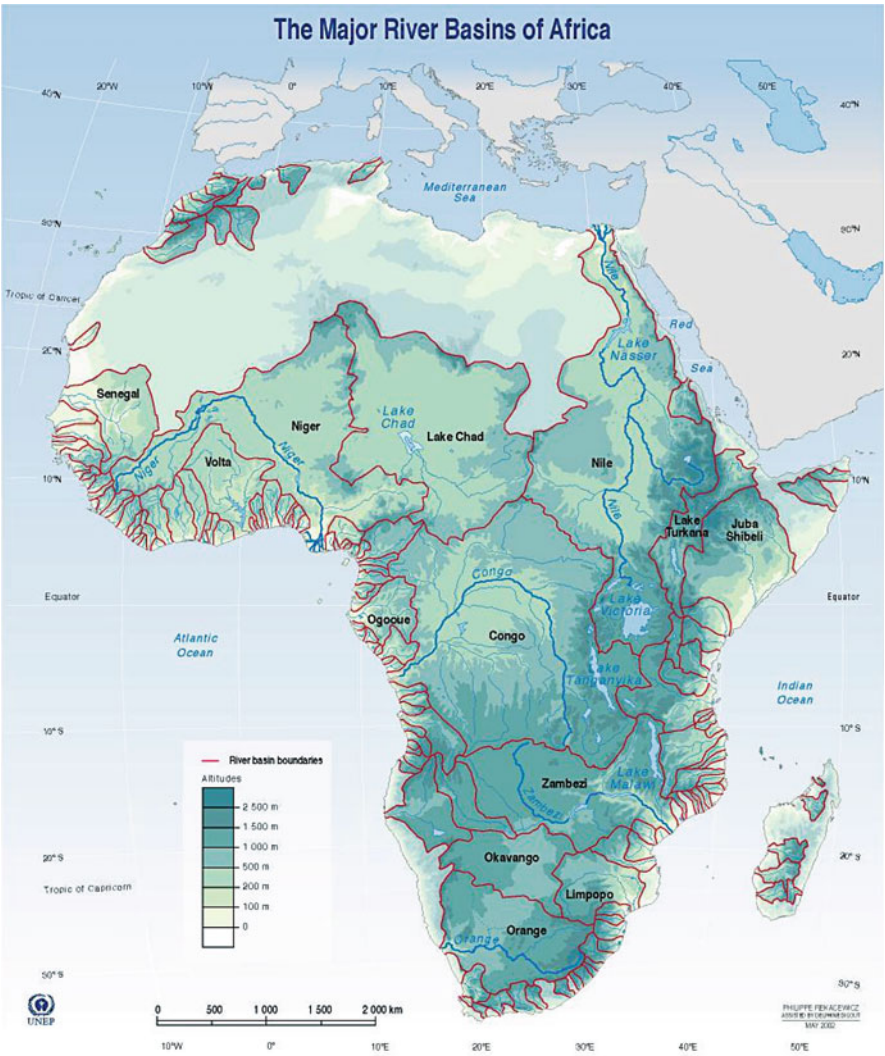
Water is one of several current and future critical issues facing Africa. About 25% of the contemporary African population experiences water stress, while 69% live under conditions of relative water abundance (Vörösmarty et al. 2000). However, this relative abundance does not take into account other factors such as the extent to which that water is potable and accessible, and the availability of sanitation. Despite considerable improvements in access in the 1990s, only about 62% of Africans had access to improved water supplies in the year 2000 (WHO/UNICEF 2000). One-third of the people in Africa live in drought-prone areas and are vulnerable to the impacts of droughts (World Water Forum 2000), which have contributed to migration, cultural separation, population dislocation and the collapse of ancient cultures. Droughts have mainly affected the Sahel, the Horn of Africa and southern Africa, particularly since the end of the 1960s, with severe impacts on food security and, ultimately, the occurrence of famine.

Climate Change and Freshwater Demands in Africa

Water access and water resource management are highly variable across the continent (Ashton 2002; van Jaarsveld et al. 2005; UNESCO-WWAP 2006). In order to shed light on water resources in Africa on a "vis-à-vis" basis, it should be noted that out of the 261 transboundary river basins in the world that represent surface water resources, 61 are recognized in Africa covering 62% of Africa's surface area (Fig. 2.1). In West Africa 25 transboundary rivers basins are shared among 17 African countries (Fig. 2.2) of which 11 for Niger-Benue, 4 for Senegal, 6 for Volta and 4 for Comoe. Transboundary rivers are increasingly disputed as a result of increased freshwater demand and decreased availability (due to worsening climate conditions).

The 17 countries in West Africa that share 25 transboundary rivers (Fig. 2.2) have notably high water interdependency (Niasse 2007). Eastern and southern African countries are also characterized by water stress brought about by climate variability and wider governance issues (Ashton 2002; UNESCO-WWAP 2006). Significant progress has, however, been recorded in some parts of Africa to improve this situation, with urban populations in the southern African region achieving improved water access over recent years (van Jaarsveld et al. 2005).

As far as the shared groundwater resources are concerned, 38 transboundary aquifers are recognized in Africa (UNESCO 2004) (Fig. 2.3). Within the scope of the present paper, only notable case examples from West Africa will be considered.



Source: Aaron T. Wolf et al., 1999; Revenga et al., *Watersheds of the World*, World Resources Institute (WRI), Washington DC, 1998; Philippe Rekacewicz, *Atlas de poche*, Livre de poche, Librairie générale française, Paris, 1996 (revised in 2001).

Fig. 2.1 Major river basins representing surface water resources in Africa

Observational records and climate projections provide abundant evidence that freshwater resources all over the world and in Africa in particular are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems. In global-scale assessments, basins are defined as being water-stressed if they have either a per capita water availability below 1,000 m^3 per year (based on long-term average runoff) or a ratio of withdrawals to long-term average annual runoff above 0.4. A water volume of 1,000 m^3 per capita per year is typically more than is required for domestic, industrial

Fig. 2.2 Major river basin in West Africa
Source: Transboundary Freshwater Dispute Database (2000)

and agricultural water uses. Such water-stressed basins are located in northern Africa. In water-stressed areas, people and ecosystems are particularly vulnerable to decreasing and more variable precipitation due to climate change. As a direct consequence, habitats and ecosystems in Africa are currently under threat from a variety of impacts and climate change is likely to be an additional stress. Higher temperatures and increased variability of precipitation would, in general, lead to increased irrigation water demand, even if the total precipitation during the growing season remains the same. The impact of climate change on optimal growing periods, and on yield-maximizing irrigation water use, has been modelled assuming no change in either irrigated area and/or climate variability (Döll 2002; Döll et al. 2003).

Difficulties, Constraints and Limitations Related to Climatic Changes in Africa

Low adaptive capacity of African countries, as well as consecutive dry years with widespread disruption, are reducing the ability of the society to cope with droughts by providing less recovery and preparation time between events. Furthermore, future rainfall patterns are not clear cut but it is likely that over the next 50 years

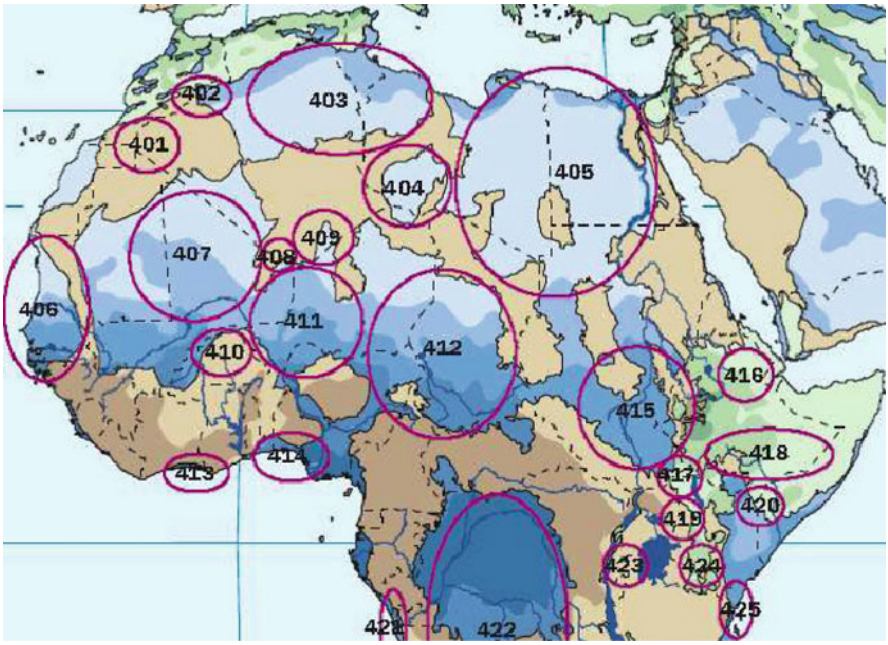


Fig. 2.3 Major transboundary aquifers representing groundwater resources in Africa
Source: UNESCO 2004

there will be a decrease in rainfall of 10–25% over northern parts of Africa in the months of June, July and August and a 10–60% decline in March, April and May. In contrast, western Africa may see an increase in rainfall of 10–35% in the December, January and February period, which is normally a dry time, with an increase also during September, October and November of between 7% and 28%.

Another difficulty arises from the low distribution density of weather stations which is one per 26,000 km^2 – eight times lower than the World Meteorological Organization's minimum recommended level. In addition to the lack of good monitoring of the El Niño Southern Oscillation as it relates to Africa; the onset of the Sahel precipitation and the interaction of Saharan dust with climate.

Case Studies on African Water Conflicts

Cameroon Versus Nigeria on Lake Chad

Problem Definition

The flooded area of Lake Chad (Fig. 2.4) has declined drastically as a direct consequence of climatic change from 37,000 km in 1963 to 25,000 in 1973 and then to 2,000 km^2 at present. So the total area of the lake was split; with only the southern part

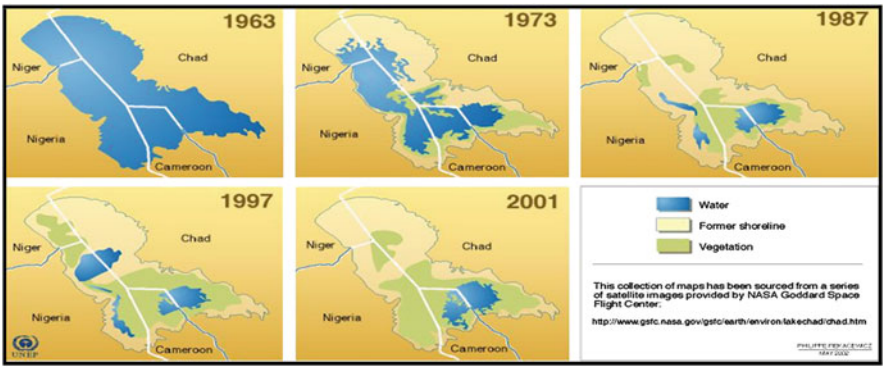


Fig. 2.4 Changes in the spatial distribution of Lake Chad and its associated resources

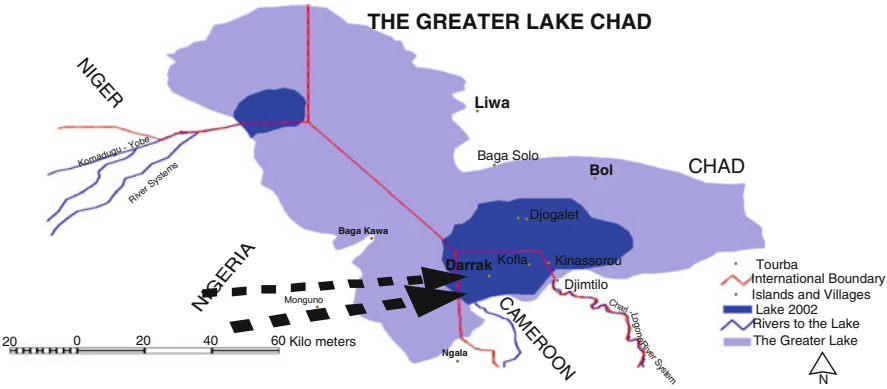


Fig. 2.5 Migrations of Nigerian fishermen to Cameroon
Source: Transboundary Freshwater Dispute Database (2000)

now as perennial surface water bodies. Accordingly, fishermen from the Nigerian shore had to follow the receding lake (Fig. 2.5) – a situation which has ended with them settling in Cameroon territory. Eventually, the government of Nigeria followed its citizens: administration, school, health facilities, police, military, i.e. border dispute Cameroon-Nigeria (Transboundary Freshwater Dispute Database 2000).

Senegal Versus Mauritania

Problem Definition

The Senegal river has its main source in the Fouta-Djalon Mountains in Guinea and provides water to the semi-arid parts of Mali, Senegal, and Mauritania. The basin

Fig. 2.6 Senegal river basin
Source: Transboundary Freshwater Dispute Database (2000)

has a total area of ~483,000 km^2 and the river course is 1,800 km long (Fig. 2.6). Mauritania has the largest area of the basin with 50%, followed by Mali with 35%, Senegal with 8%, and Guinea with 7%. Box 3.5 summarizes the main basin characteristics (Gibb et al. 1987).

Eight severe drought events have occurred during the period from 1970 to 1980. The whole area has suffered from chronic rainfall deficits particularly from 1986 to 1988 where, in September 1988, the traditional transboundary land use practices constituted a dispute and it was the beginning of a real crisis and the consequent loss of lives in both countries. Eventually 75,000 Senegalese and 150,000 Mauritanians were repatriated. In June 2000, fresh tension for the same reasons has occurred (Transboundary Freshwater Dispute Database 2000).

Ghana Versus Burkina Faso (1998)

Problem Definition

The White Volta and Black Volta contribute 56% of inflows into the Akosombo Reservoir of the Akosombo and Kpong Dams which produce more than 90% of Ghana's electricity. Consequently, any decline in rainfall will be expressed directly on the decline in water level in the Akosombo Reservoir (Fig. 2.7), and this situation will impact directly on energy production in Ghana, provided that total storage capacity of the entire Burkina Faso reservoir is about 1.49 billion m^3 which

Fig. 2.7 Ghana versus Burkina Faso location map

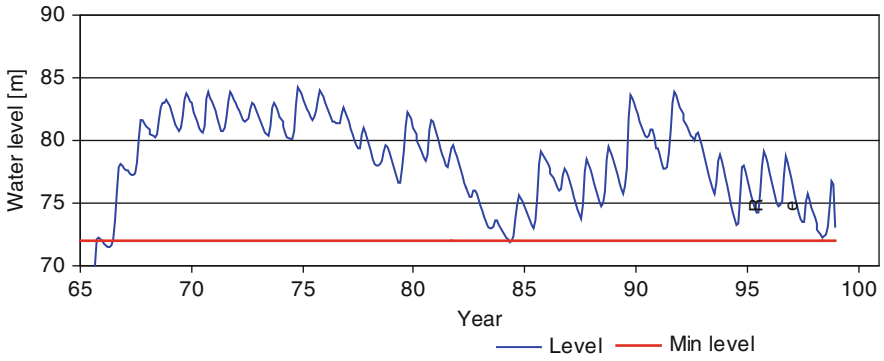


Fig. 2.8 Water level in Akosombo Lake (Niasse 2007)

constitutes less than 5% of the volume of the Akosombo Reservoir (Fig. 2.8). Burkina Faso cannot therefore be blamed for any decline in the reservoir producing hydroelectricity for Ghana (Niasse 2007).

Niger Versus Nigeria on the Niger River Basin

Problem Definition

The Niger river basin, located in western Africa, covers 7.5% of the continent and spreads over ten countries (Fig. 2.9). The area of the Niger river basin in Guinea is only 4% of the total area of the basin, but the sources of the Niger river are located

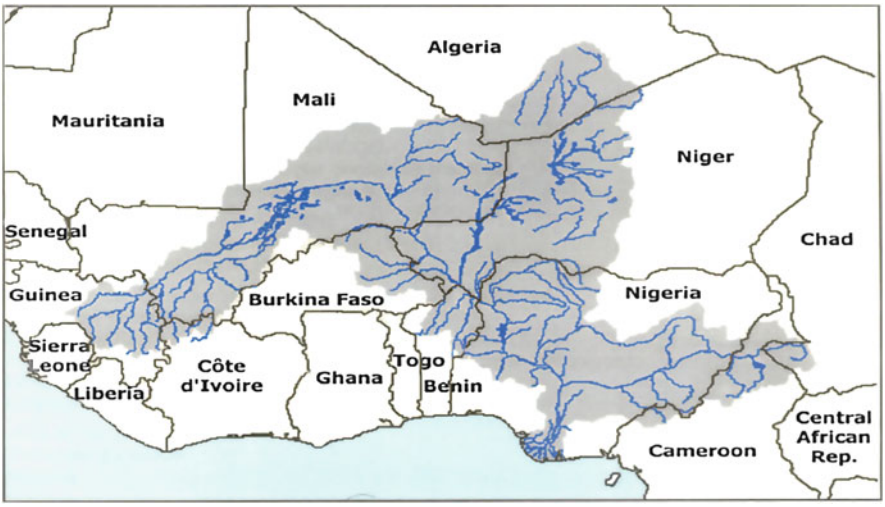


Fig. 2.9 Niger river basin

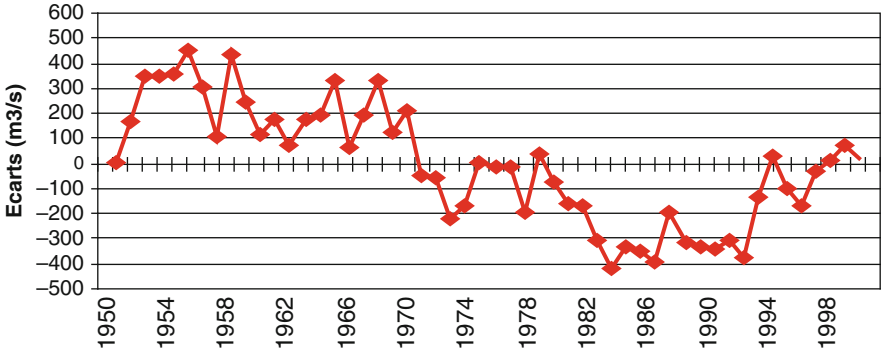


Fig. 2.10 Annual discharge of Niger river at Niamey (Le Barbe and Tapsoba 2002)

in this country. The quantity of water entering Mali from Guinea (40 km^3 per year) is greater than the quantity of water entering Nigeria from Niger (36 km^3 per year), about 1,800 ha further downstream (IUCN-IWMI-Ramsar-WRI 2003).

This is due among other reasons to the enormous reduction in runoff in the inner delta in Mali through seepage and evaporation combined with almost no runoff from the whole of the left bank in Mali and Niger (Fig. 2.10). According to the Nigerian point of view, more than 10% increased withdrawal compared to the current situation is considered unacceptable. Eventually, there is the risk that water conflict could caused by blaming upstream countries for what is really the fault of climatic change (Niasse 2007).

Eastern Africa (IGAD Region)

Problem Definition

More than 70% of the population of eastern Africa is rural and practises subsistence agriculture (WHO/UNICEF 2000). Rapid population growth and an increasing demand for food, combined with the high variability in rainfall and frequent droughts, are putting growing pressure on natural resources. Analyses of current economic and environmental trends reveal increasing competition over access and use of freshwater resources, at the same time that population growth, industrialization and climate change are adding stress to these resources. There is also competition for access to water resources between countries, some of which depend on fresh water not only for domestic, agricultural and industrial consumption but also for hydropower generation. Freshwater availability and access are thus priority issues for the entire region. The major river basins in eastern Africa that are internationally shared include: Rufiji, Juba, Victoria/Upper Nile, Turkana and Shaballe (Fig. 2.11).

Eastern Africa has experienced at least one major drought each decade over the past 30 years. There were serious droughts in 1973/1974, 1984/1985, 1987, 1992/1994, and in 1999/2000. There is evidence of increasing climatic instability in the region in terms of increasing frequency and intensity of drought (FAOSTAT 2000).

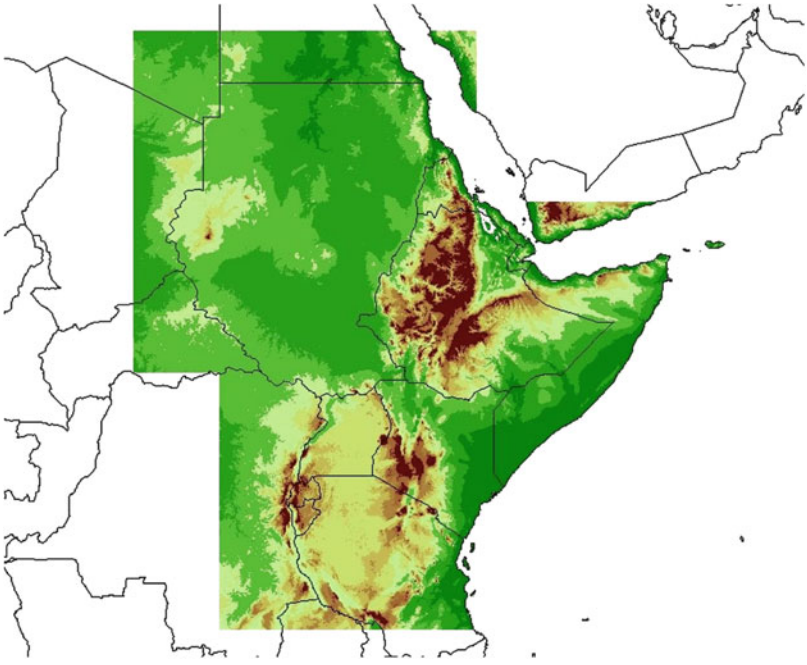


Fig. 2.11 Major river basins and lake drainage areas of eastern Africa
Source: Transboundary Freshwater Dispute Database (2000)

Eastern Africa is fairly well endowed with freshwater, with a total average renewable amount of 187 km^3 per year (UNDP and World Bank 2000). Uganda has the largest share of this, with 39 km^3 per year (1,791 m^3/capita per year) while Eritrea has the smallest, with 2.8 km^3 per year (data on per capita resources is not available; UNDP and World Bank 2000).

Conflict Resolution Techniques

Theoretically, collaboration for addressing a wide range of environmental disputes involves three phases (Vlachos 1996):

- Problem definition or problem architecture
- Direction setting (predominantly negotiations over substantive problems)
- Implementation (systematic management of inter-organizational relations and monitoring of agreements)

Some countries adopted environmental standards from the EU while others modified their existing guidelines for assessment and impact studies. Subsequently, we assume a hypothetical case study derived from a real world problem (Nachtnebel 1990) by modifying a purely Austrian conflict about hydropower utilization into an international dispute. This case study is a good and typical example for the upper section of the Danube. However its replication to cases in Africa could be of paramount nature. It is assumed that:

- The country acts rationally
- There is complete information about the system
- There is an agreed set of alternatives
- There is full communication among the partners involved
- The countries may have different objectives and criteria
- They have different preferences
- The project's impacts are different in each country

Conclusions and Recommendations

Case examples from Africa show that risks of water conflicts are real. Lessons learned from the foregoing water conflicts have shown that, although high water interdependency can be opportunities for promoting international cooperation, they can also be causes for aggravated conflict risks, especially where the following factors are combined in a lumped parameters approach:

1. Decreased water demand to respond to growing development needs
2. Decreased water availability as a direct consequence of climatic change and climatic variability

3. Large water infrastructure projects planned in isolation by individual riparian countries
4. Weak coordination that results in conflict prevention accompanied by the absence of resolution mechanisms

Eventually, it is recommended that the impact of climate on water resources be recognized on an ad hoc basis in order to reduce risks of climate-inducing water conflict.

References

Ashton PJ (2002) Avoiding conflicts over Africa's water resources. Ambio 31(3):236–242
Ashton PJ, Ramasar V (2002) Water and HIV/AIDS: some strategic considerations in Southern Africa. In: Turton AR, Henwood R (eds) Hydropolitics in the developing world: a Southern African perspective. African Water Issues Research Unit (AWIRU), Pretoria
Döll P (2002) Impact of climate change and variability on irrigation requirements: a global perspective. Clim Change 54(3):269–293
Döll P, Hauschild M (2002) Model-based regional assessment of water use: an example for Northeastern Brazil. Water Int 27(3):310–320
FAOSTAT (2000) AQUASTAT Database. FAO, Rome
Gibb A et al (1987) Etude de la gestion des ouvrages communs de l'OMVS. Rapports phase 1, Vol 1B, Optimisation de la crue artificielle. Electricité de France Euroconsult, France
IUCN, IWMI, Ramsar, and WRI (2003) Water resources eAtlas: watersheds of the world. World Resource Institute, Washington DC (CD available)
Le Barbe LT, Tapsoba D (2002) Rainfall variability in West Africa during the years 1950-90. J Clim 15:187–202
Nachtnebel HP (1990) Comparison of Hydropower utilization and environmental impacts along the Danube downstream of Vienna. Ingenieurs et architectes Suisse 18:412–415
Niasse M (2007) Climate-induced conflict risks over shared waters in West Africa. In: The third international conference on climate and water, Helsinki, Finland, 3–6 Sept 2007
Ramsar sites: List of Wetlands of International Importance, http://www.ramsar.org/
Transboundary Freshwater Dispute Database (2000) Facing the facts: assessing the vulnerability of Africa's water resources to environmental change. UNESCO/UNEP Publications, Geneva
UNDP, UNEP, World Bank, and WRI (2000) World resources 2000–2001: People and ecosystems: The fraying web of life. World Resources Institute, Washington DC
Van Jaarsveld AS, Biggs R, Scholes RJ, Bohensky E, Reyers B, Lynam T, Musvoto C, Fabricius C (2005) Measuring conditions and trends in ecosystem services at multiple scales: the Southern African Millennium Ecosystem Assessment (SAfMA) experience. Philos Trans Roy Soc B Biol Sci 360:425–441
Vlachos E (1996) Hydro diplomacy and dispute resolution in private water resources conflicts. In: Transboundary water resources, vol 7, Nato Asi Series 2. Springer, Berlin
Vörösmarty CJ, Green PJ, Salisbury J, Lammers RB (2000) Global water resources: vulnerability from climate change and population growth. Science 289:284–288
WHO/UNICEF (2000) Global water supply and sanitation assessment 2000 report. World Health Organization, Geneva
World Water Forum (2000) The Africa water vision for 2025: equitable and sustainable use of water for socio-economic development. World Water Forum, The Hague, p 30

http://www.springer.com/978-3-642-14775-3

The Economic, Social and Political Elements of Climate Change

Leal Filho, W. (Ed.)
2011, XII, 875 p. 160 illus., Hardcover
ISBN: 978-3-642-14775-3