

# Executive summary

The Lake Chad Basin (GIWA region 43) is located in central Africa covering 8% of the surface area of Africa, shared between the countries of Algeria, Cameroon, Central African Republic (CAR), Chad, Libya, Niger, Nigeria and Sudan. The Basin comprises a number of transboundary waters that include three main aquifers and a network of catchment rivers. The Lake Chad itself experiences a close interaction between rainfall, evaporation, the generation of lateral inflow, groundwater leakage under the body of the Lake and human abstraction. Its water supply is primarily from the Chari-Logone River, which provides approximately 95% of the total input and empties into the southern pool, and the Komadugu-Yobe River, which contributes less than 2.5% and is the only river flowing into the northern pool. The water balance of the Lake is highly variable resulting in fluctuating open surface waters that have exhibited dramatic expansion and contraction over geologic and recent history (Servant & Servant 1983). In the last decades the open water surface has reduced from approximately 25 000 km<sup>2</sup> in 1973, to less than 2 000 km<sup>2</sup> in the 1990s (Olivry et al. 1996, Grove 1996, Coe & Foley 2001). The northern pool has not contained permanent open waters for more than 25 years although recently there has been some flooding observed, associated with wet years in 1994 and 1999 (Diouf 2000).

The Komadugu-Yobe River Basin is located in Nigeria and Niger and is formed by various tributaries, in particular the Hadejia, Jama'are and Misau rivers that flow from the Jos Plateau (northern Nigeria). The Chari-Logone River Basin is located in CAR, Cameroon and Chad and contains various rivers that flow from the Mongos Hills (CAR), as well as the Adamawa Plateau and Mandara Mountains (Cameroon). The major tributaries are the Pende, which become the Logone oriental on entering Chad, and the Chari. There is seasonal flooding in both the Chari-Logone and Komadugu-Yobe basins, which feeds the extensive Waza-Logone floodplains and Hadejia-Nguru wetlands, respectively. These are used extensively for pasture, fishing, flooded rice production

and flood recession cropping (FAO 1997). The Yedseram and Ngadda sub-system and its tributaries rise in the Mandara Hills and 'loses' most of its water while flowing northwards through a floodplain. From Sudan in the east flow seasonal wadis (Wadi Kaya and Wadi Azum), whereas from the north there is virtually no surface flow.

The Lake Chad Basin contains numerous ethnic groups, whose language, legal and administrative systems are based upon traditional pre-colonial culture and the English and French colonial powers. The population of the Lake Chad Basin has experienced rapid growth in the last decades (2.5 to 3 %) and is currently estimated to be over 37 million (based on ORNL 2003). The people are involved in production activities dominated by the primary and tertiary sector with a predominance of informal, low productivity activities such as agriculture, livestock rearing and fisheries. Industry, mining and manufacturing are less prominent although oil abstraction has recently begun in Chad.

The countries are among the poorest in the world and are characterised by extremely slow and variable economic growth. For example Chad, was ranked 155<sup>th</sup> out of 162 countries in the United Nations 2001 Human Development Index, with annual per capita income of only 200 USD and GDP growing by barely 1.4% per year over 20 years (IMF 2003). Poverty is widespread and is particularly acute in the countries in the south of the Basin. This is reflected in the poor standard of health: excluding Algeria and Libya, the life expectancy of the Basin ranges from only 43 years in CAR to 56 years in Sudan (World Bank 2002c). Illiteracy is a major hindrance to development in the region, with Niger having the lowest literacy rates in the world (World Bank 2002c).

The bulk of water resources is used in agriculture followed by domestic use. Access to safe drinking water in the Basin for domestic use is very limited and water is mainly obtained using traditional methods. Sanitary conditions for rural dwellers are particularly poor with severely limited

waste disposal facilities. Traditional agriculture in the Basin is generally rain-fed, although farmers in the downstream regions rely on flood farming and recession farming. In the last 40 years there have been many large irrigation projects developed located predominantly in the Komadugu-Yobe Basin. There were also projects around the Lake Chad, but except for the farming of the polders, these projects are not functioning.

The Lake Chad Basin Commission (LCBC), an Inter Governmental Agency, has a responsibility to regulate and control the utilisation of water and other natural resources in the Basin. There are now five member countries: Chad, Niger, Nigeria, Cameroon, and CAR. Sudan was admitted in 2000 but is yet to ratify the convention establishing the commission. Since 1989, in cooperation with the LCBC, there has been a set of initiatives and studies aimed at improving the environmental situation in the region. These have included a Diagnostic study of environmental degradation in 1989, the formulation of a Master Plan and Action Programme in 1992 and a Strategic Action Plan in 1998. As a result a GEF project (UNDP/World Bank implemented) entitled "Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem" was initiated which entered its implementation stage in September 2003.

The GIWA Assessment evaluated the relative importance of the different impacts on the international aquatic system of the Lake Chad Basin. The environmental and socio-economic impacts were assessed for present and future conditions, and overall impacts and priorities were identified. The GIWA Assessment ranked Freshwater shortage as severe and as the priority concern, driving many of the other concerns. All the other concerns except for Pollution have had a moderate impact. Although there has been significant modification of habitats and significant fluctuations in fish production, these are predominantly a function of freshwater shortage, rather than as a consequence of direct habitat modification or unsustainable exploitation of fish.

The concerns for the Lake Chad Basin were ranked in descending order:

1. Freshwater shortage
2. Climate change
3. Habitat and community modification
4. Unsustainable exploitation of fish and other living resources
5. Pollution

Freshwater shortage has the highest severity of impact due to both climatic variability and anthropogenic freshwater shortage issues, namely stream flow modification. Stream diversion, associated with the

construction of water infrastructure, has been the immediate cause of anthropogenic stream flow modification. Water resources have been used at an unsustainable level for the climatic scenario of the past 40 years. The Maga Dam located in the Chari-Logone Basin and the numerous dams located in the Komadugu-Yobe Basin have disrupted the timing and extent of the flooding of the Waza-Logone and Hadejia-Nguru wetlands, respectively. There are very prominent indicators of freshwater shortage including the shrinkage of the Lake Chad by 90% in the past four decades (Lemoalle 1991, USGS 2001) and reduced river discharges, for example the mean discharge of the Chari-Logone River between 1970 and 1990 is 55% of the mean for 1950 to 1970 (Olivry et al. 1996). Freshwater shortage has impacted heavily on the Basin's economic activities including the fisheries, agriculture, animal husbandry, fuel wood provision and wetland economic services. There has been consequential food insecurity in the region and combined with a lack of potable water has had implications on the health status of the Basin's population. Social impacts of freshwater shortage have included upstream/downstream conflict over who has the right to use the diminishing water resources. Social tensions have also been further provoked by the increased pressure on resources from the migration of people from the drought stricken northern regions of the Basin into areas surrounding the Lake and associated river basins.

Global change has influenced directly and indirectly all of the GIWA concerns (except for Pollution) that affect the Lake Chad Basin. Climatic variability exerted throughout the history of the Basin is therefore considered as playing a key role in causing the fluctuations in freshwater availability (Servant & Servant 1983). The GIWA Assessment of global change refers to human induced changes. The role of anthropogenic climate change in the recent episode of freshwater shortage is undetermined. Several studies have demonstrated that rainfall events in particular have reduced and in turn led to drought (Nicholson 1988, in Le Barbé & Lebel 1997). A comparison of isohyets of the 1950s, which is regarded as the wettest decade with the driest in the 1980s showed considerable shift towards the south (LCBC 2000b). Changes in precipitation in the Sahel (that includes the Lake Chad Basin) have been linked with Sea Surface Temperature (SST) patterns. These patterns have been attributed to changes in the heat transfer between the southern and northern hemisphere that have been influenced by changes in deep ocean circulation, as well as the reduction in sea ice and an increase in sulphate aerosols (Evans 1996). Land anomalies are also believed to have played a role in the recent trend of climate change. A combination of factors including vegetation cover, soil moisture, monsoon dynamics and SST is thought to best explain the reduction in rainfall in the Lake Chad Basin (Xue & Shukla 1997).

Habitat and community modification of the aquatic ecosystems has been experienced in both the Lake and river environments. Intensive cultivation and large numbers of domestic animals have degraded the wetland ecosystems. The primary reason for the reduction in the extent of the wetlands has been attributed to the changes in the seasonal timing and extent of flooding. Consequently since the 1960s wetland resources in the Basin, such as the Yaérés in Cameroon and Hadejia-Nguru in Nigeria, have been reduced by almost 50% (Barbier et al. 1997). Furthermore, the fish habitat in the Lake has altered from being an open water environment to being a predominantly marshy environment. The fish species composition has changed to reflect this (Benech et al. 1983, Benech & Quensière 1989, Neiland & Béné 2003). However, although there has been significant habitat modification this has been largely a consequence of the freshwater shortage situation.

The unsustainable exploitation of the fish and other living resources was not considered as the primary reason for the fluctuations in fisheries production experienced over the past four decades. It is difficult to talk of fisheries in terms of sustainability in such a naturally fluctuating environment. Freshwater shortage and the consequential habitat modification were regarded as the main influencing factors. Prior to the drought years the fisheries had developed rapidly with fishing effort increasing by 50 times between 1967-1972 (Durand 1973). The contracting lake and wetlands caused fish to be concentrated and more vulnerable to fishing gears and eventually the fisheries collapsed in the northern pool followed by the southern pool fisheries in 1982. The fishing communities migrated eastwards following the receding waters, and they also changed their livelihood strategies to take advantage of the fertile lake recession floor for agriculture. Since 1982, the fisheries have shown a good recovery, which demonstrates the Lake's ability to regenerate the fish stocks during periods of greater freshwater availability (Neiland & Béné 2003). A major concern regarding the fisheries is that of socio-economic differentiation, as the 'poor' critically do not have access to the fisheries resource (Béné et al. 2002).

Pollution is presumed, due to the lack of industry and relatively limited and localised application of agricultural fertilisers, to have the least impact out of all the GIWA concerns assessed. However, cotton and rice industries are known to use large quantities of agro-chemicals and therefore chemical pollution is not out of the question. The distribution and quantity of these chemicals in the environment is not known. In general it is considered that pollution is discharged in quantities that do not exceed the ecosystem's assimilative capacity. However, further studies are needed to scientifically justify this presumption; there is currently a severe lack of monitoring and information networks regarding pollution.

The GIWA regional experts predict that all of the GIWA concerns will increase in severity by the year 2020. Consequently, the concerns of freshwater shortage, habitat and community modification, unsustainable exploitation of living resources, and global change are predicted to have severe impacts on the ecosystems and population of the Lake Chad Basin. The threat of pollution, which is currently assessed as having a slight impact, is predicted to become increasingly significant in the future. The following are predicted to be major factors in controlling the future severity of the concerns in the region:

- Climate change;
- Further water development projects;
- Increased demographic pressure;
- Increased demand of water;
- Oil development;
- Increased use of agro-chemicals.

The Causal chain analysis determined the root causes of the prioritised freshwater shortage concern, that have resulted in the unsustainable use of freshwater resources in the climatic scenario experienced in the Lake Chad Basin over the past 40 years.

#### **Root causes for Chari-Logone and Lake Chad sub-system**

- Demographic: Pressures from rapid population growth and environmental refugees escaping drought in the northern regions of the Basin and from fishermen migrating following the receding lake waters.
- Economic: Poverty in the sub-system is widespread and for their short-term survival communities employ practices which are harmful to the environment.
- Knowledge: There are extreme deficiencies in information availability and public awareness in the Chari-Logone/Lake Chad sub-system and the countries have difficulties cooperating and sharing information. There is also a lack of knowledge predicting the future climate changes and the impact changes will have on the region.
- Legal: There is no water allocation agreement existing between the riparian countries. There are no legal instruments to enforce agreements and there are weaknesses in the Fort Lamy Convention established in 1964. Not all member States of LCBC have water laws in place that uphold the principles of sustainable water management and where there are semblances of law, the provisions are not administered and enforced. Governments of

member States do not comply with the Fort Lamy Convention that requires them to give prior notification on their proposed projects; they only notify LCBC of donor-funded projects.

- **Governance:** There is no integrated management strategy in the sub-system; there are conflicting policies between government departments; a short-term policy focus has resulted in unsustainable management; there has been insufficient account of the impacts of stream flow modification from the Maga Dam and on downstream humans and ecosystems; there was a lack of stakeholder involvement in the initial planning and implementation of and management of the SEMRY project (a large-scale irrigation project); and there is highly inefficient and poor water use management.

#### **Root causes for Komadugu-Yobe sub-system**

- **Demographic:** The sub-system's population has experienced rapid growth and is the most densely populated river basin in the region. It is estimated to represent over 55% of the Lake Chad Basin's total population. This has put increasing pressure on the water resources in the region.
- **Economic:** Endemic poverty in the region is a catalyst for environmental degradation because for short-term survival natural resources are exploited at an unsustainable level. Upstream water diversion did not take into account the essential income and nutrition benefits for local populations from the Hadejia-Nguru wetlands (Barbier 1997). Large irrigation and water development projects are thought to have provided more negative economic impacts than positive (IUCN 2002).
- **Legal:** There is no water allocation law between Federal Nigerian States or between Nigeria and Niger. Customary rights established by traditional management systems remain highly influential. The rules and regulations for the administration and enforcement of the Nigerian Water Resources Decree 101 of 1993 has not been published (gazetted).
- **Knowledge:** There is poor information dissemination, particularly to the traditional communities; weak information sharing networks; and limited pollution monitoring and regulations. Currently, there is a lack of knowledge of future climate changes, which is hindering sound water management planning.
- **Governance:** There is no overall water management strategy for the Komadugu-Yobe River Basin (Bdliya et al. 1999) and the most acute obstacle in achieving this is the absence of a coordinating

mechanism to harmonise the activities of the water users. Water management institutions are only concerned with meeting their water requirements, with minimal or no concern for the impacts of their activities on other users (Bdilya et al. 1999). Management is also fragmented with ill-defined and often conflicting responsibilities between government agencies and stakeholders. The hydro-agricultural schemes were planned with minimal stakeholder involvement and without consideration of the climatic variability of the region and the impact reduced flows would have on downstream communities. Water use by these irrigation projects continues to be inefficient due to poor water use management, which continues to lack measures aimed at conserving water resources. There is no known system in place to monitor return flows from large irrigation schemes in the basin if there are return flows.

- **Traditional management systems:** The rural population is highly differentiated and the poor, critically, do not have access to fishing and farming resources (Béné et al. 2002).

Despite many of the root causes being identified by the Lake Chad Basin Commission Master Plan (LCBC 1992), and subsequent Strategic Action Plan (SAP) (LCBC 1998), recommendations have not been developed into projects for implementation. Downstream users are still being deprived of adequate water supplies to meet their water requirements. Attempts to mobilise domestic and external resources are not helped by the absence of integrated land and water resources management strategies, investment plans and effective coordination (LCBC 2000b).

#### **Policy options**

The policy option analysis aims to describe alternative courses of action that may be taken by policy-makers in the region, and discusses the projected outcomes and trade-offs of each action. These actions should address the root causes identified during the Causal chain analysis. The GIWA Policy option analysis firstly discussed basin wide options followed by projects under discussion for the Chari-Logone and Lake Chad sub-system and Komadugu-Yobe sub-system.

The following options were discussed for the entire Lake Chad Basin:

1. Implementation of the GEF project "Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem".
2. Water allocation agreement.
3. Inter-basin water transfer.

The following projects were discussed for the Chari-Logone and Lake Chad sub-system:

- 4a. Reinundation of the Waza-Logone floodplains (Chari-Logone sub-system).

- 4b. Assessment of changing land use in the head waters of the Chari-Logone sub-system.
- 5. Chad-Niger Transboundary Project to Combat Sand Dunes and Reverse Water Degradation Trends in Lake Chad (Lake Chad sub-system).

The following projects were discussed for the Komadugu-Yobe sub-system:

- 6. Grant subsidies to irrigation farmers in northern Nigeria for implementing water conservation measures (Komadugu-Yobe sub-system).
- 7. Maintenance and improvements for the safety and improved efficiency of dams and stream flow in the Komadugu-Yobe Basin.

Following an analysis of the above options it was concluded that the recommendations made by the LCBC Master Plan and SAP (LCBC 1998) addressed many of the root causes identified during the Causal chain analysis. The GEF project entitled "Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem" is beginning to implement prioritised recommendations made by the Master Plan and SAP. Therefore, as a prerequisite, the GIWA Assessment recommends that the GEF project be implemented "to build capacity within the Lake Chad Basin Commission (LCBC) and its national committees so that it can better achieve its mandate of managing land and water resources in the greater conventional basin of Lake Chad" (World Bank 2002a).

As a subsidiary priority to the strengthening of capacity in the LCBC, a water allocation agreement (Option 2) would be a key legal instrument in addressing the inequitable allocation of the water resources in the Lake Chad Basin. A water allocation agreement enforced and coordinated by a strengthened LCBC is necessary if integrated management of the Basin is to be achieved. The implementation of a water allocation agreement will address the root causes: i) lack of coordination; ii) legal - no water allocation law; and iii) lack of capacity to promote compliance. The reinundation of the Waza-Logone floodplains (Option 4a) can be incorporated within the flow rates stipulated by this legal framework, so that increased flooding can restore floodplain economic activities. Dam maintenance and enhancement, and the improvement of stream flow (Option 7) will allow the effective implementation of Option 2 (water allocation agreement) and Option 4a by allowing greater control and efficiency of water conveyance. The GIWA Assessment recommends Option 6 (water conservation) as a possible means of increasing freshwater availability and addressing the root causes of poor water management and the lack of incentives to promote compliance. The implementation of water conservation measures would allow water supplies that are available in the Komadugu-Yobe system to be used

more efficiently and would be an effective tool for long-term water demand management as part of the wider allocation of water in the basin.

The GIWA Assessment recommends the following actions in priority order:

1. Continued development of recommendations made by the Master Plan and Strategic Action Plan.
2. Implementation of the GEF project for the "Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem".
3. A draft agreement on the equitable and reasonable allocation of water resources should be negotiated, finalised and ratified by member States (Option 2).
4. The reinundation of the Waza-Logone and Hadejia-Nguru wetlands (Option 4a), according to flow rates stipulated by Option 2.
5. Maintenance and improvements in safety and efficiency of dams and stream flow in both the Chari-Logone and Komadugu-Yobe basins (Option 7), to ensure the effective implementation of the water allocation agreement.
6. Feasibility study of water conservation techniques suitable for selected project sites (related to Option 6).