

Policy options

This section aims to identify feasible policy options that target key components identified in the Causal chain analysis in order to minimise future impacts on the transboundary aquatic environment. Recommended policy options were identified through a pragmatic process that evaluated a wide range of potential policy options proposed by regional experts and key political actors according to a number of criteria that were appropriate for the institutional context, such as political and social acceptability, costs and benefits and capacity for implementation. The policy options presented in the report require additional detailed analysis that is beyond the scope of the GIWA and, as a consequence, they are not formal recommendations to governments but rather contributions to broader policy processes in the region.

Problem definition

The Policy options analysis aims to describe the freshwater shortage issues that need to be resolved or mitigated, and will describe alternative courses of action that may be taken by policy-makers in the region. Each course of action will have a set of projected outcomes with the trade-offs of each action discussed. The policy options are a preliminary analysis of actions and conceptual ideas for projects that are currently being considered and/or being developed. Specific policy options are evaluated for the entire conventional basin and for the Chari-Logone/Lake Chad and the Komadugu-Yobe sub-systems.

Two of the broad challenges facing water management in the Lake Chad Basin were noted as being: (i) how to control unsustainable water consumption; and (ii) how to enhance the water allocation mechanisms.

However to successfully implement projects/policy actions aimed at alleviating these challenges, water governance issues, primarily the institutional and legislative failures identified during causal chain analysis, need to be addressed as a priority. Many of the root causes were identified, and recommendations made, by the Lake Chad Basin Commission (LCBC) Master Plan (LCBC 1992), followed by an update of this plan and the formulation of a Strategic Action Plan (SAP) (LCBC 1998). Implementation of these recommendations by riparian countries has been very slow (see Root causes, Governance, Slow implementation of mitigation measures). The GEF project entitled the '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. The projects development objective is "to build capacity within the 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). The GIWA Policy option analysis firstly outlines the recommendations made by the SAP, followed by project options aimed at addressing base-wide root causes, and then in turn, more specific project options that can be implemented once the fundamental root causes have been addressed.

The following projects 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/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;
7. Maintenance and improvements for safety and improved efficiency of dams and stream flow.

Recommendations from the GEF project Strategic Action Plan

The Strategic Action Plan described the aims and objectives for a 20 year strategic plan (LCBC 1998). The overall aim was 'Sustainable Development of the Lake Chad Basin' and the main objective 'Lake Chad is sustainable protected by concerted, integrated management of the Basin's resources, guaranteed by all players within the Basin taking responsibility and cooperating'.

Long-term objective 1

Concerted management of international waters, based on regional cooperation and national policies harmonised and applied in each sub-basin.

- A water policy in each country, taking into account, the value of hydrosystems and aquatic ecosystems in sectoral economic policies and in environmental legislation.
- Updated regional cooperation agreements between countries with a view to ensuring sustainable management of the international waters of the Lake Chad Basin, particularly with respect to risks of cross border pollution and overexploitation of water.
- Reforms and new institutional mechanisms for cooperation and consultation in each country, for each international sub-basin and for the Lake Chad Basin, so that water can become a link and catalyst for balanced regional development, and not a source of conflict.
- People placed at the heart of decision making, in particular by enabling local associations to draw up their own community development scheme and seek sustainable means of existence, with the active participation of the local inhabitants (environmental awareness teaching), linking up this activity with policies and water management in the Basin.
- The creation of essential links between research programmes, the fight against poverty, biodiversity programmes, the fight against desertification, modifications in the climate and in international waters throughout the Lake Chad Basin.

Long-term objective 2

Integrated management of the use of finite and vulnerable water resources in the ecosystem, based on better knowledge of these resources.

- Rehabilitation and development of a permanent network to monitor water, the environment and the way they are exploited, to provide better knowledge of the way in which the hydrosystems function.
- Dynamic monitoring of water management (floods, droughts, etc.) and regular monitoring of development works and resources in the Basin, using modern integrated data management tools and simulations to assist in decision-making and anticipate possible crises.
- Preparation of two Sustainable Basin Development Plans to enable the LCBC member States to evaluate, on a continuous and scientific basis, the break-down of costs, benefits and environmental impacts of the alternative development works proposed by the various countries.

Long-term objective 3

Players in the Basin take responsibility for protecting common heritage.

- Concrete priority actions, to protect Lake Chad, and the international waters that feed it, in order to preserve the ecosystems against new risks.
- Regional promotion of productive, water saving, economically beneficial techniques and practices that are accepted by local people and local economic operators, and do not harm the environment.
- A renewed framework of incentives and laws in each country harmonised on a regional basis in particular with respect to risks of cross-border pollution.
- Development of suitable mechanisms and instruments for mobilising internal and external financial resources, aimed at progressively achieving self-sufficiency for the sustainable management of patrimonial resources in the Lake Chad Basin.

Priority actions

Once the main guidelines had been met the SAP (LCBC 1998) identified through national workshops six priority actions:

1. Initiate shared management of water resources, with mechanisms for cooperation and integration both within and between the countries, at the various levels (national, sub-basin and basin).
2. Set up viable networks for collecting basic information in order to identify and monitor water resources, ecosystems and the ways in which they are exploited more accurately.

3. Carry out basic sectoral measures to control water demand in order to combat desertification and the loss of biodiversity.
4. Ensure the prevention and control of contaminants and preserve fisheries resources.
5. Improve methods of exploiting aquatic ecosystems and protect floodplains in relation with regional development.
6. Begin pre-feasibility studies (physical, technical and economic) and environmental impact studies to intra- and inter-basin water transfers.

The 8-year action plan in fact includes four programmes, the first of which (A) represents the GEF comprehensive regional programme based on: (i) institutional coordination; (ii) scientific knowledge of water resources and ecosystems; and (iii) pilot or research actions, to be carried out on cross-sector (priority) issues and in the particular sub-system of the Lake Chad itself.

Each of the 36 projects of the Master Plan (LCBC 1992) was examined critically to take account of the new strategy and conditions outlined in the SAP. Certain pertinent modules will be taken up at the time the sub-programmes are formulated in detail.

Lake Chad Basin

Political and organisational frameworks

For details on the political and institutional framework for the entire Lake Chad Basin, see Regional definition, Institutional arrangements.

Options

Option 1: Implementation of the GEF project for the 'Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem'.

The development objective of the GEF project is "to build capacity within the Lake Chad Basin Commission (LCBC) at 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" (LCBC 2002).

The United Nations Development Programme (UNDP) first prepared the project, and a PDF-B was approved by the Global Environment Facility (GEF) in 1995 and executed by UN Department of Economic and Social Affairs (UNDESA). Work at that time resulted in an update of a Diagnostic Study, an update of LCBC Master Plan, as well as the elements of a Strategic Action Plan.

The project will address the following root causes identified by the GIWA Causal chain analysis: Lack of water resource environmental planning, lack of stakeholder participation, lack of coordination and integrated management, and the lack of capacity to promote compliance and enforce agreements and policies. The LCBC member States recognised that uncoordinated development is unsustainable in terms of investment, socio-economic and ecosystem welfare, and that they needed to coordinate their national plans and actions with each other at the regional level (World Bank 2002a). The GEF project appraisal states that "for the LCBC to assume a more central role within the basin, working with the countries and regional projects, its capacity will need to be strengthened" (World Bank 2002a).

The primary development objective of the GEF project, in accordance with the SAP, is to strengthen the capacity in the LCBC, by placing a Project Management Unit (PMU) to work within and alongside it, to work together in implementing the project, so that the LCBC may be able to execute fully future projects. Although the project will not undertake national-level policy or institutional reforms, it will strengthen existing regional policies and institutions to better manage the shared Lake Chad resources. This will occur by drawing support from LCBC member States in order to raise awareness of impacts at regional level of national policies, and therefore, the need to harmonise national actions at the regional level. This should in turn translate into stronger regional mechanisms and coherence, as voiced in the SAP, and raise donor interest.

Links to policy and institutional change and renewal in each component are highlighted as follows in the first component of the project: (i) LCBC members review and recommit to the institution; (ii) define and promote integration of transboundary water and environmental policies into national development plans; (iii) review and recommend means to harmonise relevant frameworks so as to get integrated regional approach to long-term management of the resources; and (iv) establish regional structures that review, harmonise and coordinate management of shared resources and uses. The second component of the project will initiate a number of pilot projects that constitute the country-identified most urgent priority actions, and it is hoped, the successful implementation of these projects by the LCBC and countries as soon as possible, will build donor confidence. Formulating these new institutional mechanisms will link regional, national and local planning initiatives. The third component of the project will finalise a Transboundary Diagnostic Analysis (TDA) with regional validation and agreement on LCBC SAP, and subsequent mobilisation of donor support (LCBC 2002).

Option 2: Water allocation agreement

A water allocation agreement has been proposed by the LCBC and a draft agreement based upon an earlier draft by the FAO is presently under negotiation.

Integrated river basin management requires a suitable and effective legal framework to achieve its required goals. There needs to be an agreement between the member States to share responsibility for the management and allocation of water resources. A water allocation process cannot simply be achieved from technical specifications, but to be successful requires economic analysis and a legal framework to be installed. The Lake Chad Basin Commission has not had the legal framework to implement and enforce the equitable sharing of the Basin's water resources. A draft water allocation agreement was prepared by the FAO after a request in 1969 at the 9th Council Meeting of the LCBC, but was never ratified. A revised version of this draft was presented in 2000 and has since been under discussion by member States. This agreement will set minimum flow rates for points along the Komadugu-Yobe and Chari-Logone sub-systems. Water users will not be able to abstract water at a level that would cause flows to drop below these levels. The flows will be maintained by controlled flood releases from the dam infrastructure. This aims to increase water availability for downstream users and ecosystems and maintain the extent of the Lake Chad during times of low precipitation. There is a need to "formulate principles of equitable water utilisation, development, conservation, management and protection, with a view to the promotion of optimal and sustainable utilisation thereof for present and future generations" (LCBC 2000a). Water allocation is distinct from the task of distribution, which is defined as delivering water in accordance with allocations.

The theory "Tragedy of the Commons" is applicable to water use in the Lake Chad Basin (Hardin 1968). Each water user sees the benefits of using more water as the productivity of an individual's economic activities increase with a greater use of the common water resource. However with common access to the water supply, if one individual after another uses too much, other water users will suffer. The "tragedy" appears when the common resource is overused, and then all will suffer (Hardin 1968). Property rights to any resource are therefore much more than a title on paper: they are essentially a relationship between people and the use of natural resources. A single user rarely has full ownership rights to control, use, and dispose of the resource purely as he or she sees fit. Rather, it is useful to think of a bundle of rights, with different users and stakeholders having the right to use water for a certain purpose, or subject to various types of conditionality. Water rights are a basis for a claim on the resource, and include formal rights embodied in official titles, permits and seasonal irrigation schedules, less formal

rights based on customary patterns and rights implicit in social norms and local practices.

A possible incentive could be to put a value on the quantity of water that farmers save. Water that is saved can be purchased and then diverted to the river channels to reallocate the water to downstream users.

Option 3: Inter-basin water transfer

The LCBC Master Plan and Strategic Action Plan identified water transfer as an option amongst a list of projects.

Preliminary studies of the feasibility of this project have now begun in accordance with the SAP (LCDC 1998). Inter-basin transfer supporters argue that "there cannot be much water saving to be expected from efficient management as the largest amount of water is attributed to evaporation" and thus "conditions in the Lake Chad Basin call for measures beyond management of the available water resources in the Basin." It is argued that a major water transfer to the region is "required to restore the Lake, improve base flow and channel storage, arrest groundwater recession and falling water table, and enhance groundwater recharge, so that a state of equilibrium may ultimately be attained" (UNECA unpublished).

The 49th session of the Council of Ministers of LCBC held in Yaoundé, Cameroon, January 2002, discussed a possible feasibility study of the project to feed Lake Chad with water from the Congo Basin. The commission members directed a contribution of 1 million USD by member States for the project feasibility study. However a feasibility study has not found backing from any international donor organisation. Feasibility studies for the inter-basin transfer in terms of engineering design have not yet begun, as not all member States have submitted their contributions. There are therefore insufficient funds to finance the feasibility studies and requisite social and environmental assessments. There was a previous International Competitive Bidding (ICB) process launched unsuccessfully, for which several private sector firms submitted bids (and tendering fees), but which was later suspended for lack of funds on the part of the LCBC.

This project proposes moving 900 m³/s of water from the Oubangui; the major tributary of the Congo River in a navigable canal. In current proposals the infrastructure comprises: construction of one dam at Palambo (65 km upstream from Bangui) to regulate the flow on the Oubangui River in CAR; construction of one main canal to transfer water by gravity from Palambo Dam reservoir to Fafa-Ouham River in CAR and to link the two basins; river channel improvement works from Ouham River through Chari to Lake Chad; construction of a navigable

canal to link Chari, Logone, and Benue rivers through the Mayo Kebbi onward to Port Harcourt; improvement works on the existing river port at Garoua, taking into consideration the new river flow regimes; improvement works to increase the Lake Chad storage capacity and reduce evaporation losses; construction works of river port at Bouca in CAR; identification of irrigable areas and agro-allied industries for profitable uses of available water resources; and installation of a hydroelectric power plant at Palambo to supply Bangui and other regional demands.

Proponents suggest that by restoring Lake Chad, it will also allow the reinstatement of activities such as recession farming, fishing, and animal husbandry in which the local population used to be engaged. It is also intended that it would facilitate communication among countries by allowing year round navigation. The water transfer project is envisaged to deter environmental degradation, enhance environmental and ecosystem equilibrium and reduce migration of people and conflict among settlers and environmental refugees (UNECA unpublished). However there has been no environmental or social assessment (including stakeholder analysis) of the negative impacts this could have on both the Lake Chad Basin and the Congo Basin. This option remains firmly in a conceptual stage and there are many drawbacks in resorting to this option (see Identification of recommended policy options for drawbacks).

Global change mitigation

Global change was identified as playing a very important role in determining freshwater shortage in the Lake Chad Basin. There are many policy options being discussed at the global forum that are aimed at reducing the extent of anthropogenic climate change. The emission of greenhouse gases such as carbon dioxide has been identified as one of the causes of global warming. Box 4 provides estimates of potential greenhouse gas reductions in the 2010 to 2020 time frame.

Chari-Logone/Lake Chad sub-system

Political and organisational framework

In CAR the Ministry of Transport and Civil Aviation (Department of Meteorology and Hydrology) is responsible for surface water, but the Ministry of Mines and Energy also play a role in groundwater. The Chad government formed in 1997 includes a Ministry of Environment and Water and a Master Plan was prepared in 2000 by the Ministry of Planning and Co-operation regarding water resources. Institutes

Box 4 Potential greenhouse gas emission reductions.

The GIWA Assessment identified global climate change as a key factor in determining rainfall patterns in the Sahel and thus the freshwater availability in the Lake Chad Basin. Below is a summary of the results from many sectoral studies, largely at the project, national and regional level with some at the global levels, providing estimates of potential greenhouse gas emission reductions in the 2010 to 2020 timeframe. Some key findings are:

- Hundreds of technologies and practices for end-use energy efficiency in buildings, transport and manufacturing industries account for more than half of this potential.
- At least up to 2020, energy supply and conversion will remain dominated by relatively cheap and abundant fossil fuels. Natural gas, where transmission is economically feasible, will play an important role in emission reduction together with conversion efficiency improvement, and greater use of combined cycle and/or co-generation plants.
- Low-carbon energy supply systems can make an important contribution through biomass from forestry and agricultural by-products, municipal and industrial waste to energy, dedicated biomass plantations, where suitable land and water are available, landfill methane, wind energy and hydropower, and through the use and lifetime extension of nuclear power plants. After 2010, emissions from fossil and/or biomass-fueled power plants could be reduced substantially through pre- or post-combustion carbon removal and storage. Environmental, safety, reliability and proliferation concerns may constrain the use of some of these technologies.
- In agriculture, methane and nitrous oxide emissions can be reduced, such as those from livestock enteric fermentation, rice paddies, nitrogen fertiliser use and animal wastes.
- Depending on application, emissions of fluorinated gases can be minimised through process changes, improved recovery, recycling and containment, or avoided through the use of alternative compounds and technologies.

(Source: IPCC 2001)

therefore exist to control environment and water policy in Chad. The Chad-Cameroon Joint Commission was created to develop consultation on the water use in the Logone River between the two neighbouring states, but it is presently inactive. In Cameroon local technical administrations and other institutions operate in the region, which include the Hydrological Service. The SEMRY is a company for agricultural development in Cameroon, which formerly specialised on rice but has diversified in recent years. The present project in the Chari-Logone (SEMRY 3) is aimed at small irrigation schemes.

IUCN Waza-Logone or CACID project

The IUCN Waza-Logone Project (WLP), which is also known as the 'Cellule D'Appui à la Conservation et aux de Initiatives Développement Durable' (CACID), was started in 1987 with the support of the Government of the Netherlands. Over three phases CACID did the following: (i) gathered data and conducted studies in socio-economic, ecological and hydrological issues; (ii) provided training for villages, and study tours and seminars for project and government staff; (iii) undertook ecomanagement activities regarding resource management for livestock, sustainable forest use, formed apiculture groups, ecotourism and water and sanitation; (iv) encouraged community participation and awareness through a communication programme; (v) catalysed pilot releases for floodplain rehabilitation through a large-scale re-inundation programme; (vi) audited releases made in 1994 and 1997; (vii) jointly with the communities drafted proposals for the sustainable use of floodplains' natural resources; and (viii) assisted in developing management plans for the Waza and Kalamaloue National Parks (World Bank 2002a).

Waza-Logone Pilot Project

Based upon recommendations from the Lake Chad Basin Commission's member countries and institutions involved, and guided by integrated ecosystems management principles and GEF objectives, the Waza-Logone Pilot Project aims to support the CACID project and its partners by promoting the sustainable management and use of the Basin's resources (water and biodiversity) by relevant institutions and communities; and developing and implementing an effective monitoring and evaluation system that looks at the overall ecosystem, hydrology and socio-economic issues (World Bank 2002a). The project has not been implemented and is still in a planning stage.

Options

Option 4a: Reinundation of the Waza-Logone floodplains

(Proposed by the IUCN Waza-Logone Project)

The high productivity of the Waza-Logone region depends to a large extent on the overbank flooding of the Logone River between September and December each year. Since 1979 the annual inundation of the Waza-Logone floodplain has reduced significantly, due to a combination of climatic factors and the construction of the Maga Dam as part of the SEMRY project. The Project of Conservation and development of the Waza-Logone has initiated studies to explore the effects of reinundation by controlled flood releases (IUCN 2002) that led to two pilot flood releases in 1994 and 1997. The studies concluded that although reinundation could not re-establish the flooding patterns seen before the construction of SEMRY, the release of waters from the Logone River and Lake Maga will be able to contribute towards the rehabilitation of the region's hydrology, ecology and biodiversity and consequently restore the economic activities that depend on the Waza-Logone floodplain (IUCN 2002).

Reinundation could have many positive impacts on floodplain goods and services (IUCN 1999b, Mott MacDonald 1999, Wessling et al. 1994 in IUCN 2002). Increased flooding will contribute to the restoration of the floodplain fisheries including greater fish migration. It may also rehabilitate some of the dry season grassland and improve crop agriculture including an increase in the area available for dry season millet, cultivation around Lake Maga and the SEMRY scheme and the return of flood-fed rice around the Logomatya, El Beid and Waza National Park borders. A recovery of wildlife populations may also be possible, through the restoration of grazing and watering areas in and around Waza National Park, and an increase in fish and waterfowl populations in the wider floodplain. Increased flooding will assist in the replenishment of surface water through increased storage and availability of water, especially in dry seasons.

Table 12 The incremental benefit of reinundation over current situation.

	Additional flow (m ³ /s)	Reflooded area in average year (km ²)	Incremental net benefit of flooding (million USD/year)	Net present value of investment (million USD @ 10%)	Benefit: Cost ratio of investment
Maximum flood release option	215	867	2.32	7.76	6.57
Middle flood release option	165	687	1.78	7.19	6.13
Minimum flood release option	115	479	1.15	5.61	4.66

(Source: IUCN 2002)

Valuation studies conducted by IUCN (2002) on the economic impacts of the pilot flood releases in 1994 and 1997, calculated an added value of 800 000 USD per year through restoring floodplain goods and services. They predict that by implementing the reinundation options currently under consideration there will be incremental economic benefit of between 1.1 million USD and 2.3 million USD per year over the current situation, translating into positive net present values of between 5.6 million USD and 7.8 million USD when investment and operational costs were taken into account (Table 12). On a per capita basis, this equates to 50 USD added economic value per floodplain-dependent member of the population (IUCN 2003b). Non-monetary benefits and development improvements could include poverty alleviation, food security, diversified production base, and future economic growth with possible multiplier effects.

The studies also identified that there would be management and opportunity costs and economic costs to other activities in the Waza-Logone floodplain and give rise to a number of flood related economic costs. These will include: investment and recurrent costs of designing, planning installing and maintaining the infrastructure required to reinundate the floodplain, and of monitoring its effects; costs of training staff to operate and monitor the reinundation programme; programmes to mitigate any negative health and other socio-economic impacts of the reinundation programmes; loss of millet, sorghum, and gum Arabic harvesting areas to flooding; and crop damage resulting from increased populations of wildlife and birds.

According to the Pilot release studies when comparing the economic costs and benefits, all of the proposed flood release options would have net economic benefits over the current situation of reduced flooding. The flood release measures proposed by the project would cost between 2-8 billion CFA (franc de la Communauté Financière Africaine) to implement over a period of 5 years. The incremental benefits would be 0.9-1.8 billion CFA per year or 2 million CFA/km².

The IUCN argue that the results of their valuation study present a convincing argument for investment in flood release measures in the Waza-Logone floodplain as a mechanism for rural poverty alleviation and sustainable livelihood development (IUCN 2003b).

Option 4b: Assessment of changing land use in the head waters of the Chari-Logone sub-system

This project initiative is based on the concern of the CAR Ministry of Environment on the present rapid changes in land use in the north-northeastern part of the Central African Republic and its likely impact on water resources downstream in the Lake Chad Basin (Scholte 2000). From an agricultural point of view, the changes in the northwest seem to be equally pressing, an argument supported by the northwest's important hydrological functions. Given the low knowledge level of both parts of the basin, these concerns have been considered as complimentary. It is therefore proposed that this project will be dealing with the entire CAR part of the Lake Chad basin. A comprehensive land use information system needs to be developed and disseminated. There is also need for data rescue especially from numerous studies previously conducted on vegetation, wildlife, livestock agriculture and fisheries in the area but scattered in different places. These studies would culminate in a detailed impact study of upstream activities on the water resources of the Chari-Logone sub-system.

Option 5: Chad-Niger Transboundary Project to Combat Sand Dunes and Reverse Water Degradation Trends in Lake Chad

The project has been proposed under the GEF project 'Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem'. It is planned that the intervention zone will cover Diifa, N'Guigmi, and Mainé-Soroa in Niger and Bol, Liwa and Rig-Rig in Chad.

The overall objective of the project is to restore the ecosystems of the Lake Chad. The specific objectives are to develop a mechanism for coordination of the management of shared resources; to create greater synergy in implementing the Conventions on desertification (UNCCD 1994), the Climate Change Convention and the Kyoto Protocol (UNFCCC 1992, UNFCCC 1997), the Convention on Biodiversity (CBD 1992) and to improve living standards.

The decline in rainfall which has caused a decline in the Lake Chad poses a serious threat to farming, pastoral, and fishing activities, at both the local and transboundary level, and is leading to the degradation of the Lake's ecosystem, upstream and downstream. This project attempts to reverse the influence that soil and vegetation cover degradation has had on the rainfall and temperature fluctuations in the region, which in turn have influenced water flow patterns. This will be based upon the

rationale, that to halt the degradation of waters and ecosystem of the Lake Chad Basin, it is essential to combat the degradation of soils and vegetation cover, which is exacerbated by sand dune formation in areas either side of the Chad-Niger border.

Reversing the degradation, tributary basins will require efforts to promote sustainable water management practices and to preserve biodiversity. The chances of survival and reproduction of plant and animal species will be improved through sand dune fixation by biological means (planting). Over the long-term, the regeneration of vegetation cover will promote carbon fixation. This will assist in mitigating severe atmospheric disturbances resulting from the level of soil humidity, the roughness of terrain, and the composition of the atmosphere.

The Environment Ministry in both Chad and Niger will be responsible for monitoring sand dune fixation. The Lake Chad Basin Commission (LCBC), and the livestock extension and environmental services agencies will be closely involved in pastureland management and dissemination of information. Regional coordination will be provided by the LCBC. An important task is to ensure the logical alignment between the implementation of the regional Action Program to Combat Desertification (UNCCD 2003) and the execution of this project.

Both the Chad and Niger Governments back the project. The traditional management systems that are predominant in the region must participate in the planning and implementation process for the long-term success and permanence of the project. The project aims to benefit groups that rely on the fertile "sinks" and ponds; users of the surrounding grazing lands; women engaged in farming and algae production; residents of villages isolated by encroaching sand dunes. The pastoralists must be consulted, but communications may be difficult due to the migratory nature of their activities. Educational programmes facilitated through local community groups would be a useful tool in increasing awareness amongst these stakeholders.

Komadugu-Yobe sub-system

Political and organisational framework

(extracted from Bdilya et al. 1999, updated).

The Federal Ministry of Water Resources (FMWR) is the apex organ of the government that has the statutory responsibility for policy formulation and coordination for water resources development and management throughout the Federation of Nigeria. The FMWR functions through the

National Council on Water Resources (the highest policy body) and the National River Basin Development Coordinating Committee (NRBDCC). However, due to the dependence of other sectors of the economy on this critical resource, as well as the three tier system of government which Nigeria operates, several other statutory and non-statutory institutions are active players in the management of water resources in the sub-system. These include the following: the Federal Ministry of Environment (FME); the Hadejia-Jama'are River Basin Development Authority (HJRBDA) and the Chad Basin Development Authority (CBDA); the governments of Bauchi, Borno, Jigawa, Kano and Yobe States which have interests in the Basin; the North East Arid Zone Development Programme (NEAZDP); Local Government Authorities; the IUCN Hadejia-Nguru Wetlands Conservation Project (HNWCP) recently taken over by the Jigawa Enhancement of Wetlands Livelihoods (JEWEL) project and several water-user associations, such as the Stakeholders Consultative Forum.

Only two governmental institutions (FMWR and FME) and two non-government organisation (HNWCP-JEWEL and the Stakeholders Consultative Forum) are concerned with the sustainable utilisation of the water resources of the Komadugu-Yobe sub-system (Bdilya et al. 1999).

The Niger sector of the Komadugu-Yobe Basin is far from the capital Niamey and the government institutions involved consists of the Department of Hydraulics and Department of Agriculture. The Nigeria-Niger Joint Commission was established to resolve bilateral disputes.

The Federal Government of Nigeria has two legal instruments which, when properly applied, can control the uncoordinated development of water resources in the Basin. These are the Water Use Decree No. 101 of August 1993, and the Environmental Impact Assessment Decree No. 86 of 1992. Although both decrees are already enforced the modalities are being finalised by their custodians. It is planned that a water management plan is to be implemented according to the provisions of the two decrees.

Hadejia-Nguru Wetlands Conservation Project (HNWCP)

The project was established in 1987 by the Federal Government of Nigeria, the Nigerian Conservation Foundation, the World Conservation Union (IUCN), and the Royal Society for the Protection of Birds (British NGO) and the International Council for Bird Preservation (now renamed Birdlife International). Objectives of the project were (World Bank 2002a):

- To explore appropriate use options for water resources for the benefit of wildlife and human communities;
- To monitor wildlife resources, especially migrant water birds;
- To develop conservation education and public awareness programme;
- To train the staff in the State Wildlife Departments.

Komadugu-Yobe pilot project

Based upon recommendations from the Lake Chad Basin Commission's member countries, and institutions involved, and guided by integrated ecosystems management principles and GEF objectives, the Komadugu-Yobe pilot project aims to support the HNWCP by promoting the sustainable management and use of the Basin's resources (water and biodiversity) by relevant institutions and communities; and developing and implementing an effective monitoring and evaluation system that looks at the overall ecosystem, hydrology and socio-economic issues (World Bank 2002a).

The Komadugu-Yobe Integrated Management Project

The project "aims to create the institutional environment that allows participatory and informed decision-making [...] based on agreed principles for equitable use and sustainable management of the Komadugu-Yobe Basin" (IUCN 2003b). The project is part of the IUCN Water and Nature Initiative (WANI), which is a 5-year partnership for action to promote sustainable water use and management.

Options

Option 6: Grant subsidies to irrigation farmers in northern Nigeria for implementing water conservation measures

This option was formulated during the GIWA workshop hosted by the LCBC. However, water conservation has already been under discussion within the LCBC and by donor organisations. In exchange, farmers would dedicate water rights to water saved. This water could be allowed to flow into the river systems so that there is greater water available for downstream users.

The current water requirements from the Hadejia river system are already exceeding available resources during periods of lower precipitation. Any further expansion of the requirements of one use will deprive others of water. Potential water requirements are at least 2.6 times greater than the mean available water resources. Annual available water resources are able to sustain the present water requirements in the Jama'are and Yobe river systems. However, if construction is finished on the Kafin Zaki Dam (Jama'are Valley Irrigation Project), the potential water requirements for the Jama'are river system will be 1.8 times the available water resources in a mean year (Bdilya et al. 1999). Table 13 compares the available surface water resources with current and potential water requirements in the Hadejia, Jama'are and Yobe river systems. Water demand management therefore needs to be a priority in addressing freshwater shortage.

Increasing demands for water and the increasing costs of water supply are giving rise to a need for countries to maximise the use of their

Table 13 Relationship between water resources and both current and potential water requirements for the Hadejia, Jama'are and Yobe river systems.

River system	Available surface water resources (million m ³ /year)	Mean river flow reduction (million m ³ /year)	Present water requirements (million m ³ /year)		Potential water requirements (million m ³ /year)	
			Formal	Informal	Formal	Informal
Hadejia	536-2 567 (mean 1 739)	798 ¹	894 ⁴	765	2 353	2 241
Jama'are	518-4 577 (mean 2 194)	919 ²	0	1 620	1 388	2 635
Yobe	381-2 551 (mean 1 201)	855 ³	58	246	111	504

Note: Part of the natural flow reduction is due to evaporation. The total surface water resources are the flows at the upstream ends of each river system. ¹Wudil to Hadejia, Hadejia to Likori and Likori to Nguru. ²Foggo to Gashua. ³Gashua to Yau. ⁴144 million m³/year extra in 2002 when expansion of the Hadejia Valley Project has been completed. Formal requirements: evaporation and domestic water supply from reservoirs and irrigation. Informal requirements: all other users (e.g. flood and small-scale agriculture and contribution to Yobe River), these partly depend on natural flow reductions. (Source: Blidya et al. 1999, updated)

existing water supplies and make use of hitherto unexploited freshwater resources. Despite the freshwater shortage concerns that the people of the Komadugu-Yobe Basin face, water is utilised extremely inefficiently. For example, Isiorho et al. (2000) estimated that in the Maiduguri region of Nigeria 10 to 25% of water is used inefficiently. However, there have been no studies that accurately quantify the level of water wasted in the sub-system. Agriculture is the largest user of water in the Komadugu-Yobe Basin; in the Hadejia river system upstream of Hadejia, irrigated agriculture accounts for approximately two-thirds of the total water requirements for agriculture, domestic, industrial and livestock use (Bdilya et al. 1999). These irrigation projects, particularly large-scale government schemes, are utilising water resources inefficiently. Irrigation channels are unlined and open resulting in infiltration and evaporative losses. By implementing water conservation measures less water will be needed to produce a unit of rice. Presently there are no guidelines or incentives for the farmers to conserve water; farmers do not have to purchase the water and by saving water they do not achieve any personal gain. Education programmes and incentives may therefore be necessary to promote water conservation. Water conservation strategies in northern Nigeria are discussed in a study by Dabi & Anderson (1999).

Water conservation is one of the most effective tools in demand management and is often the cheapest policy action to increase water availability (Box 5). More efficient use of water in the Hadejia river system would allow more water to reach the Hadejia-Nguru wetlands without decreasing the productivity of large irrigation projects e.g. Kano River Irrigation Project (KRIP). Greater flooding of the Hadejia-Nguru wetlands will rejuvenate fishing, flood and recession farming, grazing lands and other wetland resources. In order for communities downstream of the Hadejia-Nguru wetlands to benefit from the increased water supply,

Box 5 Water conservation techniques.

Numerous techniques, modern and traditional, for improving the use, and augmenting the availability of water resources have been developed and implemented in different parts of the world that can be replicated within the Lake Chad Basin. The technological improvements to conserve water must be suitable for the farmers; operation and maintenance must require minimum technical skills and financial constraints must be considered. Commercial farmers in the sub-system have objectives usually aiming to maximise yield and income, but the subsistence farmer is likely to be more interested in improving food security by reducing crop failure, or improving the return on inputs of seed, fertiliser, and labour (Hudson 1995). Technologies must therefore be suited to the local and specific conditions based on local resources, skills and knowledge (Batchelor et al. 1998).

Technological methods that could be employed in the agricultural sector for water conservation include: improved maintenance of existing irrigation systems; altered tillage and soil management; changes in cropping patterns (e.g. reduce hectares cropped, and switch from rice to less water intensive crops e.g. sorghum). Structural methods include: lining of irrigation canals; replacing of open canals with underground pipes; and the switching from gravity irrigation to more efficient irrigation techniques such as drip or sprinkler irrigation systems.

Rain water harvesting would also be another useful technique of storing water from the rainy season for later use during periods of low rainfall. Rainfall can be collected either from rooftops or *in situ*. For freshwater augmentation using rainwater harvesting from rooftops, there are three components to the rainwater harvesting system: the collection area, the conveyance system, and the storage facility. The collection area is usually the individual rooftop of a house or other building. Large communal catchments including hillsides may also be used. The conveyance system is a series of gutters that carry the rainwater from the collection area to the cistern. The cistern or storage facility varies from steel and polyethylene tanks of various sizes to underground concrete tanks. It could be a part of the home or constructed separately, above or underground (IETC 2000). Rainfall harvesting *in situ* consists of using topographic depressions, either natural or artificial, to store rainwater where it falls for future use. Construction of furrows and raised beds is a normal practice in this technology.

Another form of water augmentation method is run-off collection using surface and underground structures. There are two types of structures commonly used: local impoundments and dams. Local impoundments are storage ponds dug into the ground, while dams are designed to increase the storage capacity of areas of a river or stream by intercepting run-off and storing it for future use. The extension of this technique is the artificial recharge of aquifers. There are several different artificial recharge techniques, ranging from infiltration basins and canals, water traps, surface run-off drainage wells, to septic tank system effluent disposal wells, and the diversion of excess flows from irrigation canals into sinkholes.

channels in the Hadejia river system will need to be cleared of weeds and silts on a regular basis to allow Hadejia River to contribute to the Yobe River.

A study on the efficiency of water uses by the large irrigation projects, such as KRIP and Hadejia Valley Project, and the applicability of freshwater augmentation technologies would be required before efficiency improvements could be implemented. An education programme and improved communication networks would promote the advantages of using more efficient water use techniques, provide training in new techniques and help farmers to adapt from habitual methods. Local associations that represent the interests and needs of the user communities should be utilised as a means to disseminate information and to promote appropriate technologies. However there may be difficulties in encouraging the farmers to change and invest in more efficient methods, due to there being no purchase price

for water and also due to financial constraints in a poverty stricken region. Incentives may therefore be needed (Dabi & Anderson 1999, Gardner & Stern 2002).

A possible incentive could be to put a value on the quantity of water that farmers save. Water that is saved can be purchased and then diverted to the river channels to reallocate the water to downstream users. A regulatory body would be needed and meters installed to monitor water use. A source of funding for the subsidies would need to be found, be it governmental or from donor agencies. However a concern of providing incentives to save water is that farming may become more attractive, and hence increase the number of farmers and thus water requirements. Consequently, the net outcome on water demand is uncertain. Subsidies may also not be the most cost-effective technique for encouraging farmers to convert. An alternative economic incentive for more efficient use could be to put a price on the water used by irrigation farmers; the revenues collected can then be used to help invest in more efficient technologies. In the economic situation of this region, particular attention needs to be paid to what price the farmers can afford and the impact of increased costs on domestic and export markets.

Although improved policies of the Nigerian government will not result in the adoption of water efficient technologies, they can play an important role in encouraging the uptake of improved technologies or methods as well.

Option 7: Maintenance and improvements for safety and improved efficiency of dams and stream flow in the Komadugu-Yobe Basin

Option 7 was formulated at the GIWA workshop, although the World Bank/GEF project, LCBC and others have discussed the issue of maintenance and improvements that are needed in the Basin.

Water resources management is the application of structural and non-structural measures to control natural and man-made water resources systems for beneficial human and environmental purposes (Grigg 1996). The goal is to provide water in the quantity and quality required, when it is needed, where it is needed, and with the appropriate level of reliability. In the Komadugu-Yobe dam infrastructure is not effectively regulating the flow of water to achieve these goals. Currently the dams have been ill-maintained and therefore to implement the water allocation agreement (Option 2) the dams need to be repaired so that flood releases can be undertaken effectively. The height of the Tiga Dam has already been lowered, and the reservoir level accordingly, in 1992 due to structural instability. Although the GEF project does not plan to

construct dams, the safety of dams is important, as the project will rely on the performance of existing dams. The project reviewed two dams in the Komadugu-Yobe Basin (Tiga and Challawa Gorge) and the Maga Dam in the Chari-Logone. The Maga and Tiga dams were considered a threat to the safety of the populations below the dams (see Root causes, Governance, Poor water use efficiency).

The following activities were recommended by the review for the Tiga Dam (World Bank 2002a):

- Further lowering of reservoir level as a short-term non structural measure, to minimise overtopping by floods;
- Improved monitoring e.g. improved seepage monitoring;
- Installation of an Early Warning System, e.g. sirens in communities downstream;
- An Emergency Preparedness Plan (EPP). To include a dam-break analysis, flood propagation study, population awareness, and training;
- Reduction of the full storage level by additional excavation of the emergency spillway of the left bank.

The installation of a valve at the second outlet structure of Tiga Dam is recommended to enable the dam to contribute to peak wet season releases for flood farmers and to serve as back-up in case the other outlet is out of order.

Some recommendations have been made by different studies within the Basin, particularly in what concerns the Komadugu-Yobe Basin. A flow proportioning structure has been recommended for installation at Likori in the Hadejia-Nguru wetlands (Diyam Consultants 1996). The structure is expected to distribute water between the Marma Channel, the Burum Gana River and the Old Hadejia River. The proposal is considered to be the best option for conveying water from the Hadejia River to the Komadugu-Yobe River without any adverse impact on water uses along the Marma Channel and the Burum Gana River.

There has been proliferation of blockages from weeds and siltation in the Hadejia river system. The blockages in the Old Hadejia River have prevented the Hadejia River from contributing to the Yobe River. These have not been cleared and have consequently continued to impede freshwater from reaching the main river channels. The water is instead restricted to the wetlands of the Hadejia-Nguru and does not reach downstream users. There needs to be a programme to clear these channels to improve flow rates.

Identification of the recommended options

The World Summit on Sustainable Development (WSSD 2002) included a special agreement related to Africa "Sustainable development for Africa". Paragraph 66 states "promote integrated water resources development and optimise the upstream and downstream benefits..." and to "develop and implement integrated river basin and watershed management strategies and plans for all major water bodies". In accordance with this agreement and the SAP, before projects considered by the GIWA assessment can be implemented, there is a need to coordinate the member States national plans and actions with each other at the Lake Chad basin level (see Root causes, Governance, Lack of coordination and Institutional weakness). To achieve regional coordination a review of the LCBC is needed and subsequent strengthening of its capacity. Therefore the GIWA Assessment recommends as a prerequisite to all the proposed projects, the development and prioritisation of recommendations made in the SAP and subsequently the implementation of the GEF project (Option 1).

The two broad challenges facing policy makers in the region were identified as: (i) to improve the allocation of water; and (ii) how to increase freshwater availability. The improvement of water allocation will require the implementation of Options 2, 4a and 7 that complement each other by facilitating the equitable distribution of available surface and groundwater supplies. A water allocation agreement enforced and coordinated by a strengthened LCBC is necessary if integrated management of the Basin is to be achieved. Such an agreement will support the SAP Long-term objective 1: "Concerted management of international waters based regional cooperation and national objectives and national policies harmonised and applied in each sub-basin" by creating "new institutional mechanisms for cooperation" (LCBC 1998) (see recommendations from GEF project Strategic Action Plan). 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 legal framework that this will provide will allow the implementation of Option 4a (the re-inundation of the Waza-Logone floodplains). 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: (i) poor water management; and (ii) the lack of

incentives to promote compliance. The implementation of water conservation measures would allow water supplies that are available in the Komadugu-Yobe sub-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. Such a project would support the SAP Long-term objective 3: "Players in the basin take responsibility for protecting common heritage" through "regional promotion of productive, water saving, economically beneficial techniques and practices that are accepted by local people and local economic operators, and do not harm the environment" (LCBC 1998).

Justification for not recommending Option 3, 4b and 5

Option 4b and 5 were not selected as recommended options not because the GIWA Assessment recognised them as poor actions but because the selected options were more specific in addressing the root causes identified during causal chain analysis and it was therefore considered that these options should be prioritised.

Option 3, inter-basin water transfer, was not selected as a recommended option as it would require substantial investment and although it could significantly increase freshwater availability such projects are associated with high costs per unit of water. The effect that possible future climatic scenarios could have on the current water developments, irrigation and the ecosystems of the Basin would need to be assessed. To undertake such a project, large financial investment is required and the economic viability of such a project in the Lake Chad Basin is undetermined. The systems involved in inter-basin transfer require high operation and maintenance costs. There is usually extensive networks of pipelines and canals. Highly qualified engineers and technicians are required to plan, design and implement and operate inter-basin transfer schemes. The technology employed has high capital and operational costs (IETC 2000). These costs could make this option unaffordable and inappropriate for the people of the Lake Chad Basin.

There is some evidence now that river discharges are increasing in the Lake Chad Basin, with an associated increase in the Lake Chad and the regional floodplains. Presently there are no accurate models for predicting future precipitation rates in the region and although some studies point to greater or similar levels of aridity, there is also the possibility that precipitation will increase and provide greater water resources for the region.

The livelihood strategies of the Lake Chad Basin's population have always been dependent on the intra and inter-annual fluctuations in the water availability. The economic activities of the Basin have adapted

to this dynamic environment. The question should be asked, whether flooding the Lake Chad Basin would actually alleviate poverty and promote economic development or be yet another large-scale water development which on the contrary derogates the rural livelihood safety-net (Neiland & Béné 2003).

Particular attention should be paid to the medium and long-term consequences for the original biodiversity of the Lake Chad Basin with the introduction of alien species into a fragile ecosystem, and the final quality of the water that results from the mixing of the waters of the Lake Chad Basin and the Oubangui and the effect this will have on the ecosystems (Nami 2002). There are also often public health impacts associated with water transfer canals that can serve as water-borne disease vectors (IETC 2000).

At the UNESCO International Workshop on Inter-basin Water Transfer (UNESCO 1999), it was highlighted that “the recipient catchments need to demonstrate that available water is optimally used and reasonable water conservation measures enforced. On the other hand, the rights of donor catchments need to be respected ...” (UNESCO 1999). There has been no economic analysis or exploration of least-cost alternatives, including demand management and solutions that utilise the surface and groundwater resources already in the Lake Chad Basin. It is argued that more effective use and management of current water supplies should be investigated before resorting to such an option. So far, there has been no non-objection from some of the riparian countries with

the Congo Basin for such a development to commence and there has been little involvement from the countries of Democratic Republic of Congo (DRC) and Congo Brazzaville.

CAR, Cameroon, Congo, and DRC have formed a new regional organisation called Commission Internationale du Bassin du Congo-Ubangi-Sangha (CICOS) at the 49th Session of the Council of Ministers of the LCBC, 14-15 January 2002. This commission has been formed both to respond to the LCBC’s plans for the transfer of water out of the Congo Basin as well as to respond to a hydroelectric dam-building project in the region near Inga. International environmental organisations are also closely monitoring progress in the identification and design of the inter-basin transfer proposal.

Priority recommended option

Option 1: Implementation of the GEF project for the ‘Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem’.

Table 14 evaluates the option using criteria stipulated at the GIWA Workshop.

Main reasons for selection

The project directly addresses the root cause of institutional weakness and the lack of coordination in the region by strengthening the capacity of the LCBC. It also addresses secondly, the root causes of: lack of water

Table 14 Evaluation of priority recommended option, using criteria stipulated by GIWA regional experts.

Priority recommended policy option							
Project option	Legal & Institutional framework	Political feasibility (stakeholder analysis)	Administrative feasibility	Information intensity	Efficiency	Equity	Permanence
Option 1: Implementation of the GEF project “Reversal of Land and Water Degradation Trends in the Lake Chad Basin Ecosystem”.	National legislative and regulatory changes to enhance transboundary institutional mechanisms.	Political will and cooperation has been expressed by member states. Pilot projects will bring water users at the local level into the decision making process. Consultations have been undertaken with stakeholders. Risk of member States not realising long-term benefits of regional approach.	LCBC currently lacks capacity to solely implement project. PMU established to implement project, in cooperation with the LCBC. Only five pilot projects were selected due to financial feasibility and project realism. Project financed by GEF and co-financing organisations, as well as member states in kind.	TDA will determine the precise linkages between environmental and social-economic systems. LCBC will report to the World Bank and ensure compliance with GEF project design and contracts. Environmental and social assessments undertaken and an Environmental Management Plan is being prepared. Designated bodies will undertake evaluation and review procedures.	Benefits: Primarily addresses the root causes of institutional weakness and lack of coordination but also: Lack of water resource environmental planning; lack of stakeholder participation; and the lack of capacity to promote compliance and enforce agreements and policies. The primary regional benefit is a stronger LCBC for the decision making process at all levels. Costs: Total project cost 18.07 million USD. Does not include associated infrastructure costs. Technical staff recruitment and training costs. Creation of inter-ministerial committees, and the PMU.	Greater coordination, cooperation and stakeholder participation will ensure a more equitable use of the water resources of the basin.	Consistent and committed effort by member states to the long-term implementation of project. The project needs to work within existing regional mechanisms to ensure the long-term capacity to harmonise national policies at regional level. However, what influence would negative changes in economic and social conditions have on the long-term commitment to a regional approach?

resource environmental planning; lack of stakeholder participation; and the lack of capacity to promote compliance and enforce agreements and policies.

The primary regional benefit of the project is a stronger LCBC for the decision making process at the regional, national and local level. This should result in: (i) strengthened regional institutional capacity for coordinated decision making; (ii) local communities more empowered in managing the Lake Chad resources; (iii) design of an effective mechanism to translate regional policies at the local level for managing the natural resources; and (iv) regional consensus and support for the next phase of work voiced in the SAP (LCBC 1998).

The LCBC will be stronger, as it will be able to build more commitment from members, more capacity to implement projects, and serve its member States efficiently.

There will be improved coordination and environmental planning, as member governments will have mechanisms in place with which to harmonise their activities, will be better prepared to attract donor support and investment following the Project, and will perceive the benefits of a longer-term perspective. The finalisation of the LCBC SAP with implementation methodologies validated on a regional level will create an integrated strategy for environmental planning at the regional, national, and local level. Pilot demonstration projects will test and validate methodologies and implementation modalities before implementing projects throughout the region and therefore reduce the risk of inappropriate project ideas being implemented (LCBC 1998).

There will be improved stakeholder involvement, as local communities will be more involved in decision making processes to manage the natural resources that they depend upon. The parallel design and implementation of the TDA, SAP and pilot projects will stimulate public participation.

The TDA will address the deficiencies in knowledge identified during the causal chain analysis in both the Chari-Logone and Lake Chad sub-system and Komadugu-Yobe sub-system.

Conditions for successful implementation

Countries will have to make national legislative and regulatory changes to enhance transboundary institutional mechanisms. Changes will include new and updated national water policies in each country that take into account transboundary water issues, encourage environmental protection and are incorporated into National Action Plans (NAPs). Recommendations will be made regarding changes in existing relevant

legislation frameworks to enhance prospects for an integrated regional approach for long-term, sustainable basin management.

The long-term success of the GEF project depends on the political willingness of the LCBC member States, to continue project programmes and approaches after the life of the GEF intervention, and the extent to which activities successfully engage end users at the community level. The LCBC member States have few economic resources and have found it difficult to focus on long-term environmental imperatives. There is however a growing realisation by the countries that environmental sustainability is inextricably linked to the economic and social well-being of the region. Consequently, they have increasingly demonstrated their commitment to improving environmental management and have begun to realise the advantages of a regional approach to environmental concerns. Subsequently, political will and cooperation have been expressed for the GEF project and there has been a high level of participation in the preparatory process. However LCBC member States may not realise the long-term benefits from a regional approach to water issues. To mitigate this risk, the role of LCBC should be strengthened and parallel national-level water resource management dialogue should continue.

Stakeholders will further be encouraged to participate in the project through links to national institutions and the pilots will bring users at the local level into the decision making process. Efforts have already been made to include the public during environmental planning, by disseminating a short version of the executive summary from the environmental and social assessment report to LCBC member States for publication in national and local media outlets in 2002. Stakeholders have also been visited by consultants hired to prepare initial technical demonstration reports, and the Environmental and Social Assessment team.

Although the LCBC is the executing agency, given the current capacity of the institution, it was decided to have the LCBC focus their capabilities on the organisational review of roles and responsibilities, cross-project learning opportunities, and hosting TDA and SAP workshops. A Project Management Unit (PMU) will be established and will be responsible for contracting, fund management, procurement, disbursement, programme administration and project level monitoring. The LCBC will therefore participate in the project but will not carry the whole burden for implementing the project. It is anticipated that by the end of the GEF project in four years time, the capacity of the LCBC will be sufficient to take sole responsibility for project implementation (LCBC 1998).

Only five pilot projects were selected due to financial feasibility and project realism. GEF financing, in the amount of 10.1 million USD, is required to remove barriers to regional management of the Basin, completion of a TDA, and subsequent development and negotiation of the SAP. There is also a total co-financing of 7.3 million USD. There is a risk that the pilot projects are not sufficiently supported in terms of financing, implementation and technical support, and therefore arrangements need to be made to work directly with local communities to serve their needs as well as the interest of the Basin.

The risk of the PMU working independently of the LCBC should be addressed through incentives to balance project implementation with LCBC institutional capacity-building in the project implementation plan.

The third component of the project will undertake a TDA to address the insufficiencies in knowledge building upon and refining priorities from previous efforts, such as the Diagnostic Analysis (Kindler et al. 1990), the Master Plan (LCBC 1992), the PDF-B project, and this GIWA Assessment. The TDA will need to determine the precise linkages between environmental and socio-economic systems and their transboundary impacts.

LCBC will report to the World Bank and be responsible for ensuring that all GEF-funded activities are carried out in compliance with the project design and contracts. Evaluation should rely on both quantitative and qualitative criteria using World Bank guidelines, with independent reviewers to ensure the correct conduct is adhered to.

An Environmental Assessment has been undertaken and an Environmental Management Plan is in preparation. The Lake Chad GEF project has had to comply with GEF Environmental Operational Policy (OP), which has prompted the designation of Lake Chad shoreline as a transboundary Ramsar site, and also initiated field visit assessments on dam safety issues. Evaluation and review procedures will be undertaken by the Project Task Force (PTF), UNDP, Scientific and Technical Advisory Program (STAP) and through the Project Implementation Review (PIR) of the GEF.

The project needs to work within existing regional mechanisms in the Lake Chad Basin to ensure that in the long-term they have the capacity and constituency to coordinate and harmonise national policies at the regional level. There has been consistent and committed effort from the LCBC headquarters and member States, which suggests a long-term commitment to implementing the project. The ability of the countries, with GEF assistance, to solicit enhanced donor support will be crucial to the permanence of project efforts.

Unresolved questions

- What level of donor support will there be following the GEF project?
- Will the PMU work in isolation from the LCBC?
- Will LCBC member States continue to realise the long-term benefits from a regional approach to water issues?
- Will LCBC work in isolation from local level and water resource initiatives in Lake Chad basin member countries?
- Will key regional institutions and national governments work cooperatively?
- Will countries seek to develop alternative, bi-lateral approaches to resolving existing and future potential disputes rather than taking a broader regional approach?
- Will suitable levels of cooperation be established and maintained?
- Will all stakeholders be willing to participate?

Recommended options for enhancing water allocation mechanisms

Option 2: Water allocation agreement

Option 4a: Reinundation of Waza-Logone floodplain

Option 7: Dam maintenance and enhancement, and the improvement of stream flow

The above options compliment each other in achieving greater equitable allocation of water resources. They address the transboundary water allocation difficulties that have been experienced in the Lake Chad Basin. A prerequisite to addressing water allocation, and achieving integrated river basin management, is a suitable and effective legal framework. It is therefore critical for a water allocation agreement to be ratified amongst the LCBC member States (Option 2). Within this framework it will then be possible for the other options to be implemented.

To implement Option 4a (the reinundation of the Waza-Logone floodplains) it is necessary to set minimum flow rates for both the water entering the wetland systems and of that flowing in the main channels to the Lake Chad. The water allocation agreement will stipulate these flow rates. Option 4a can also be replicated for the Hadejia-Nguru wetlands.

The implementation of Option 7 will be necessary to ensure the effective distribution of the water resources. Dam maintenance and enhancement, and the clearance of river channels will allow improved water conveyance and control, to ensure the adherence to minimum flows stipulated by the water allocation agreement.

Table 15 Evaluation of recommended options to improve the allocation of freshwater, using criteria stipulated by GIWA regional experts.

Policy options to improve freshwater allocation							
Project option	Legal & institutional framework	Political feasibility (stakeholder analysis)	Administrative feasibility	Information intensity	Efficiency	Equity	Permanence
Option 2: Water allocation agreement	A water allocation agreement will provide a legal framework. There are currently no water regulation authorities in the river basins. A strengthened LCBC could serve as a regulatory body.	There may be difficulties in achieving an equitable agreement due to political pressures. Politically stronger nations may insist that their water demands are met. Water Authorities and irrigation projects may not cooperate, as they will lose out on water resource rights.	Dam maintenance and enhancement, and the clearance of channels to ensure flow rates that are stipulated by the agreement can be technically implemented.	An analysis of the water requirements of all stakeholders. A study to calculate the appropriate minimum flow rates. An accurate model to predict the ecological and social impacts. Stream flow monitoring network. An analysis of existing information and educational systems.	Benefits: Increased water availability for downstream users and ecosystems. Maintain the extent of the Lake Chad during times of low precipitation. Costs: Decreases in water for upstream users including the large irrigation projects.	Increased water supplies for downstream users. Although traditional management systems may still restrict access to water resources for the poor.	Minimum flows can be maintained in dry years. In wet years, water is stored in reservoir as fall back for drier years. If freshwater shortage continues to increase in severity upstream states may not comply with the agreement.
Option 4a: Reinundation of Waza-Logone floodplains	A legal mechanism for the equitable management of water between riparian countries is needed. A regulatory organisation is needed to manage flood releases.	Objections from remaining SEMRY irrigation farmers, although the project is operating on a smaller scale now.	Maga Dam is presently in poor condition and maintenance is required. There are presently difficulties in effectively releasing floods due to poor upkeep of the flood release outlet. Generally a low cost option. Design and installation of flow proportioning mechanism is required.	IUCN Pilot releases have demonstrated benefits and there is information available on the economic benefits provided. Flow rate-monitoring network, to ensure equitable allocation between Waza-Logone floodplains, and discharges to the Lake Chad.	Benefits: Includes the restoration of fisheries, dry season pasture, recovery of wildlife populations, replenishment of surface water in Waza-Logone floodplain. Costs: Investment and recurrent costs, training. Loss of millet and sorghum production. Crop damage from increased wildlife.	Will give greater water allocation to the communities of the Waza-Logone floodplains.	Minimum flows can be maintained in drier years. In wet years, water is stored in reservoir as fall back for dryer years.

Table 15 uses criteria to rate the performance and feasibility of Option 2 and 4a. Option 7 supplements these policies and is a requirement for the implementation of Option 2 and 4a; it has therefore not been subject to evaluation under the performance criteria.

Option 2: Water allocation agreement

Main reasons for selection

Integrated river basin management requires a suitable and effective legal framework to achieve its required goals. There needs to be an agreement between the member States to share responsibility for the management and allocation of surface and groundwater resources.

The agreement will form the basis for integrated river basin management that will allow increased coordination between water users (see Root causes, Governance, Lack of coordination).

The water allocation agreement will fill the current legislative gap in both the Komadugu-Yobe and Chari-Logone/Lake Chad sub-systems (see Root causes, Legal).

The increases in population in the conventional basin will increase the water requirements of the region, and it will be necessary for water resources to be equitably shared if the population is to be able to subsist (LCBC 2000b). A legal framework for water allocation will allow disputes

to be resolved by the rule of law rather than through conflict where users are confused as to who has the right to the water resources (see Root causes, Demographic).

Water allocation will quantify and designate water resources through a negotiated process involving consultations between claimants/ stakeholders, rather than unilateral decisions that have been associated with previous water management in the Basin (see Root causes, Governance, Lack of water resource environmental planning). The sequencing of legal reforms may be best engaged at the LCBC Heads of State and Council of Ministers.

Within a legal framework it will be possible for Option 4a and 7 to be implemented.

A regulatory body will improve the coordination and cooperation between member States, water users and other relevant organisations (see Root causes, Governance, Lack of coordination).

Conditions for successful implementation

Studies will be required to establish recommended minimum flow rates for surface and groundwater at strategic positions in the river basins to ensure the equitable distribution of water resources. The development of groundwater data management tools and surface-

groundwater interaction modelling (studies that are being initiated by the World Bank/GEF project) will be required to accurately monitor and predict the impacts of a proposed water allocation agreement.

For an equitable and effective water allocation, stakeholders must be involved through consultations so that the water requirements of the various water users can be identified. If the stakeholders are not included during the planning and implementation of the water allocation agreement, there will be a high level of non-compliance. Consultations should involve all water users ranging from traditional fishing communities to large irrigation projects. Farmers and their representative organisations should be involved in the formulation of policy (UNCED 1992). An effective dissemination of information to disadvantaged groups can help to maintain their rights and thus bring about equality. To improve public awareness educational systems need to be strengthened through supporting local networks and developing education and information programmes (Gardner & Stern 2002).

Furthermore, the institutions through which water rights are negotiated and renegotiated have a critical influence on the possibility of generating equitable and efficient solutions to conflict, or increasing confusion, rigidity, inefficiency and inequity. Traditional management systems are predominant in the Basin and access to water is generally controlled by village leaders rather than modern systems (Neiland & Bene 2003). For an allocation law to be effective, it is essential that these management systems are included during planning and implementation. Educational programmes and improved information dissemination could improve the involvement of these stakeholders. The utilisation of existing community groups could assist in raising the awareness in traditional communities.

For the effective implementation of the water allocation agreement where integrated basin management is achieved it is essential to “encourage knowledge generation and transfer through research, extension, education and communications” (WEHAB 2002). National policies can be designed to facilitate the establishment of function linkages between these desirables (WEHAB 2002).

There must be an extensive process of consultations between member States and stakeholders where water allocation is agreed based on scientific studies on surface and groundwater and the interactions between them. Member States must be willing to make concessions in order to achieve an equitable allocation agreement, as some riparian countries will undoubtedly have to concede water to other member States.

The agreement should apply to the abstraction, diversion or other utilisation of surface waters but also groundwater as well. Applicable minimum rates for groundwater levels and stream flow should be determined. A network of monitoring points will be required to ensure that these minimum rates are maintained.

A comprehensive analysis of the water requirements of all stakeholders in the Lake Chad Basin is required before an allocation process can begin. There should also be an accurate model to predict the ecological and social impacts resulting from alterations in the hydrological cycle by the implementation of an allocation agreement. This model should build upon existing models, such as the flow model management tool already existing for the Komadugu-Yobe Basin (Hollis et al. 1993), and apply remote sensing and GIS technologies. The member States must agree to forward to the LCBC, on a regular basis, available data on the condition of the watercourse.

The agreement should be flexible in that the “minimum” and “safe maximum” rates may be altered by the LCBC should changes in climatic conditions trigger river or lake fluctuations that fall below the “safety level” (see Root causes, Climate change). In other words, it should prescribe rates for different climatic scenarios of wet, average and dry years.

A water regulatory body is required to enforce the agreement. It is important that it is independent and is not associated with a water user group/sector (see Root causes, Governance, Institutional weakness). A strengthened LCBC could be best suited for this task. Equitable access to water resources will only be achieved through a participatory and transparent management including support of effective water users associations and involvement of marginalised groups (UNEP 2003) such as traditional farming and fishing communities of the Waza-Logone floodplains. The agreement should support and enhance the legal capacity of vulnerable groups with regard to access and use of the water resources (UNCED 1992).

Dam maintenance and enhancement, and the regular clearance of river channels (Option 7) will allow the effective implementation of water allocation by allowing controlled flood releases from dam infrastructure and by improving stream flow by clearing river channels and installing appropriate flow proportioning structures.

Unresolved questions

There may be political difficulties in accomplishing a workable agreement that achieves equitable water utilisation, as the upstream countries will be under political pressure to retain adequate water

to meet the demands of their people. The willingness of upstream member States to concede water rights to downstream users is undetermined. In Nigeria there are further irrigation developments planned in the upstream states and water requirements will continue to increase.

The permanence of the agreement will depend on the willingness of the member States to abide by the abstraction rates stipulated, when demand will be increasing as a result of population growth. This is why it has to be a negotiated process involving all the parties from the onset.

- How will the River Basin Development Authorities in Nigeria react to a water allocation agreement that will limit the amount of water that can be stored in the reservoirs and used for irrigation?
- How will the issues of insufficient outlet capacity of Tiga and Maga dams impact on the objective of flow redistribution in the Basin?
- If an agreement is ratified, will member states comply if freshwater availability decreases again in future years? (The draft Agreement already makes provision for reviews of set minimum flow rates and maximum abstraction rates as and when necessary).
- How will natural and human systems respond to changes in water distribution?

Option 4a: Reinundation of Waza-Logone Floodplain

Main reasons for selection

Increased flooding will restore some of the environmental goods and services that were lost/reduced after the construction of the Maga Dam (see Root causes, Economic, Inadequate valuation of environmental goods and services). Reinundation will contribute to the restoration of the floodplain fisheries, rehabilitate some of the dry season grassland and improve crop agriculture and the return of flood-fed rice production. Wildlife populations may also recover, through the restoration of grazing and watering areas in and around Waza National Park, and an increase in fish and waterfowl populations in the wider floodplain.

IUCN predicted that by implementing the reinundation options currently under consideration there will be incremental economic benefit of between 1.1 million USD and 2.3 million USD per year over the current situation (IUCN 2003b).

According to the IUCN studies the proposed reinundation options are robust in the face of possible future changes in climate, flooding, and resource use conditions (see Root causes, Climate change).

By restoring the floodplains, the Chad and Cameroon government policies of: (i) poverty reduction and increasing economic growth and food sufficiency; and (ii) wildlife conservation through the creation of national parks, can both benefit. The floodplain economic activities will be restored and national parks rehabilitated and in the long-term the enhancement of the national parks could also lead to greater tourism (IUCN 2003b).

Conditions for successful implementation

A legal mechanism for the equitable allocation of water between Chad and Cameroon, or for the entire conventional basin (see Option 2) is necessary so that a multi-lateral allocation is achieved. Flood releases from Maga Dam should also be used to feed the Logone River channel to ensure the regulation of stream flows below the Waza-Logone floodplain so that the benefits from flood releases are also experienced by downstream and Lake Chad water users.

A regulatory body would be required to monitor stream flow and regulate flood releases. It should be independent from a water user group so that flood releases are not biased to a particular sector (see Root causes, Governance, Institutional weakness).

Stakeholders such as the SEMRY project, Waza-Logone floodplain communities and Lake Maga fishing communities must be included during planning and the implementation of flood releases (see Root causes, Governance, Lack of stakeholder participation). Community awareness raising programmes and meetings are possible methods to ensure stakeholder participation. The traditional management systems must be taken into account and kept fully informed of flood releases and the impact that this will have on their activities. Communication networks with the rural communities may need to be improved in order to effectively communicate the project (see Root causes, Knowledge, Public awareness and Information sharing). This could be achieved through the IUCN Waza-Logone project, as they have experience in working with the local communities.

A network of flow rate monitoring points is required to ensure flood releases are reaching the intended areas of the floodplain and that downstream water users are also receiving adequate water supplies (see Root causes, Knowledge, Insufficient knowledge of water resources and the functioning of aquatic ecosystems). In accordance with the SAP (LCBC 1998) priority must be given to the following three uses of water resources: (i) inflow to the northern and southern pools of the Lake Basin; (ii) maintenance of the annual flood on the Chari-Logone and Hadejia-Nguru wetlands; and (iii) consideration for the supply of water to big riparian cities and large irrigation areas where there has been

considerable investment and which ensure a minimum guaranteed production. There is equally a need to prioritise water uses to apply to the allocation of water resources when there is shortfall in supply.

There needs to be studies on the impacts on the Maga Reservoir for each flood release option, such as shoreline erosion. Dam maintenance and enhancement, (Option 7) will ensure that the flood releases from the Maga Dam are controlled safely and according to stipulated flow rates.

There also needs to be investigations on the impact of increased flooding on terrestrial wildlife communities in the downstream floodplains. The SEMRY project has been recognised as a failure and has diversified including a new irrigation project, SEMRY 3, which has an emphasis on smaller-scale irrigation rather than large irrigation areas associated with the previous SEMRY projects. The SEMRY 3 needs to be fully incorporated with the flood release scheme and its farmers considered during planning. Many of the original SEMRY farmers have diversified, with many fishing in the Lake Maga, the impact of reduced lake levels on these reservoir fisheries needs to be taken into account. All stakeholders must be kept informed of the new flooding regime so that they can adapt if necessary to the modified environmental conditions.

Communication networks within rural communities should be improved to effectively implement the project. This could be achieved through the IUCN Waza-Logone or CACID project, as they have experience in working with the local communities. The flood release outlet needs maintenance, so that effective and controlled flood releases can be implemented (see Option 7).

Unresolved questions

- What will the impacts be on the Maga Reservoir for each of the flood release options such as shoreline erosion and the fisheries?
- What impacts from increased flooding will there be on terrestrial wildlife communities in the downstream floodplains?
- Who will finance the flood releases, the associated management and opportunity costs, and economic costs to other activities?

Option 7: Maintenance and improvements for safety and improved efficiency of dams and stream flow in the Komadugu-Yobe Basin:

Main reasons for selection

Currently the dams have been ill-maintained and therefore to implement the water allocation agreement (Option 2) and the reinundation of the

Waza-Logone floodplains (Option 4a) the dams need to be repaired so that flood releases can be undertaken effectively.

Dams are currently unsafe and are threatening thousands of people down stream, particularly the Tiga Dam. Flow proportioning structures at Likori will convey water from the Hadejia River to the Komadugu-Yobe River without any adverse impact on water uses along the Marma Channel and the Burum Gana River.

The clearing of weeds and silts from river channels will improve flow rates and thus allow improved water distribution. This will assist in the implementation of Option 2 and 4a. These measures will address the root cause of poor water efficiency management in the Komadugu-Yobe Basin identified in the Causal chain analysis.

Conditions for successful implementation

A legal water allocation agreement, based upon scientific predictive modelling of environmental responses to different water allocation scenarios, should stipulate minimum flow rates. The flow proportioning structures can then be positioned and calibrated to these rates.

Channels should be dry during several months of the year, a pattern similar to pre-dam period, to help control the invasion of Typha. Its growth is limited by a prolonged dry soil, as is occurring naturally in the Jama'are River Basin.

To ensure stakeholder involvement there should be consultations with local fishermen who use the river channels. The clearance of weeds and silts may affect their activities.

Improved monitoring of dam safety, in accordance with recommendations made by GEF review, requires the following elements: upgrading instrumentation system; training local staff; local staff for surveillance; quality control; and independent review on annual basis. Essential records that should be kept are: daily readings of reservoir water levels; weekly readings of seepage flows; monthly readings of piezometer and wells; annual level survey of crest of dam; and inspection of vulnerable areas.

The Hadejia-Jama'are River Basin Authority needs to cooperate to the fullest extent with the civil authorities in the preparation of an Early Warning system. A pre-feasibility study for the further reduction of the full storage capacity of the Tiga Dam is required.

Unresolved questions

- What maintenance and enhancement is required to ensure the effective implementation of Option 2 and 4a? Technical studies

on all dam and water infrastructure should be undertaken to set a work plan for maintenance and enhancement.

- What environmental and social impacts will there be from dam maintenance and stream flow improvements?
- Who will fund the installation of additional outlet structures on the Tiga Dam so that more releases can be effected from the dam?

Recommended option for increasing freshwater availability and/or reducing water demand

Option 6: Grant subsidies to irrigation farmers in northern Nigeria for implementing water conservation measures

Main reasons for selection

Increasing demands for water and the increasing costs of providing water for the sub-systems population will result in the need for authorities to maximise the use of their existing water supplies. Despite the freshwater shortage concern, water continues to be utilised extremely inefficiently. The ever-increasing populations in the Komadugu-Yobe Basin will continue to stretch available water supplies and there is little that can be done to change climate patterns in the region; therefore the population of the Komadugu-Yobe sub-system need to utilise available water resources efficiently. By implementing water conservation measures the poor water management that is currently employing inefficient practices such as the unlined and open irrigation canals, which were identified during the causal chain analysis, will be addressed.

Subsidies will address the current absence of economic incentives for farmers to conserve water resources. An incentive will encourage farmers to learn about and take up the water conservation measures, as they will receive a personal gain. An alternative incentive could be to put a price on water resources to encourage the efficient use of water and reinvest revenues in water efficient technologies. This would be a more cost efficient policy action than subsidies (see Root causes, Economic, Lack of incentives promoting environmentally sound practices).

The Lake Chad Basin is essentially one of the poorest regions in the world. Freshwater augmentation technologies will allow individuals to become self-sufficient in freshwater rather than relying on upstream water developments releasing enough water for downstream users to meet their requirements. Rainwater harvesting will allow the storage of water from periods of abundant rain for use during dry periods, thereby reducing the vulnerability of the poor to climatic variability (Dabi & Anderson 1999) (see Root causes, Climate change).

Numerous techniques, modern and traditional, for improving the use, and augmenting the availability of water resources have been

developed and implemented in different parts of the world that can be replicated within the Basin. These can be tailored to suite the particular local and regional budgetary, technical and workforce skill constraints found in the Komadugu-Yobe Basin.

More efficient use of water in the Hadejia river system would allow more water to reach the Hadejia-Nguru wetlands without decreasing the productivity of large irrigation projects e.g. Kano River Irrigation Project (KRIP). Greater flooding of the Hadejia-Nguru wetlands will rejuvenate fishing, flood and recession farming, grazing lands and other wetland resources.

Conditions for successful implementation

A fundamental requirement for implementing water conservation measures is the involvement of stakeholders, namely the farmers and other water resources users. Incentives will be a useful tool in promoting compliance with water conservation schemes. Traditional management systems that are predominant in the region need to be taken into account, and it is therefore critical that village leaders etc. are kept fully informed and involved in the project.

Although water conservation will not provide a 'quick fix' answer to freshwater shortage due to the time it will take to change attitudes and habits (Eagly & Chaiken 1993), it will contribute to a long-term solution to the concern and will be particularly applicable during future periods of low rainfall. Changing attitudes and habits will be critical for the successful implementation of this project. Strategies on how to change attitudes and behaviour are further discussed by Gardner & Stern (2002). The current lack of public awareness, identified during the causal chain analysis, about conservation measures and the advantages of employing such methods needs to be addressed. The communities need to be empowered, "including through capacity building, to implement projects and programmes to enable small farmers to take up improved technologies" (WEHAB 2002). The promotion of information exchange, networking and technology generation and dissemination related to best practices of agriculture (WEHAB 2002) can strengthen the farmer's role in applying water conservation measures. Education programmes facilitated by local community groups such as farmer organisations could help to increase the awareness and benefits of water conservation measures, and trigger farmer to farmer exchange of water saving practices (WSSD 2002) and hence improve the level of participation and cooperation of local farmers with the project. Farmer organisations should be supported through cooperation with international and national research centres in developing location-specific water conservation measures (UNCED 1992). The Nigeria and Niger Governments, multilateral and bilateral development agencies

and NGOs such as the Hadejia-Nguru Wetlands Conservation Project (HNWCP), the Jigawa Enhancement of Wetlands Livelihood (JEWEL) Project, the North East Arid Zone Development Programme (NEAZDP) and the IUCN-BRAO Initiative on “Improving Land and Water Resources Management in the Komadugu-Yobe Basin”, should collaborate with farming organisations in formulating a water conservation project specific to the Komadugu-Yobe Basin.

Investigations are needed to identify what appropriate technologies will be required to meet local conditions and constraints. This can be implemented through consultations with farmers and through evaluating technologies employed in other drought prone river basins. There is limited public sector finance available for sustainable agriculture. Therefore the provision of appropriate technical and financial assistance and the promotion of private sector investment and support efforts in the Komadugu-Yobe Basin are necessary to strengthen agricultural research in water conservation and the dissemination of the results from this research (WSSD 2002).

There needs to be installation of a monitoring system to quantify water saved, to allow the effective payment of subsidies to farmers and for evaluation purposes. Maintenance and improvements to the efficiency of stream flow in the Komadugu-Yobe Basin will be required to ensure that water that is saved will be able to reach downstream communities (see Option 7).

Unresolved questions

- Should subsidies or water pricing be used as the incentive for farmers to convert to more water efficient practices? How effective would each incentive be?
- Where would the funding for the subsidies come from? Would the governments of countries of the Lake Chad Basin fund the scheme or would external donors be needed? If it is the governments, would they initiate the policy from their own large-scale schemes

and extend to small-scale farmers in the Basin? If external donors intervene with respect to small-scale farmers, would they also consent to subsidising the large-scale schemes belonging to government agencies, particularly in view of the perceived poor regime of cost recovery presently practised on such schemes?

- If donor funds are used, who would implement the project and distribute funds?
- Will the governments also benefit from donor support?
- In what form should the subsidies be provided; monetary, agricultural inputs (agro-chemicals, technologies etc.), inter-sectoral income transfers from other water users to agriculture, or other?
- If pricing is used as an incentive, what impact will this have on domestic and export markets, and how much will the farmers be able to afford?
- How will subsidies be allocated and how much water needs to be saved to justify ‘x’ amount of subsidy?
- How much capital for subsidies will be required to ensure a high level of participation by farmers?
- Will subsidies have to remain in place for farmers to continue to employ water conservation measures, or will farmers change their habits and attitudes in the long-term?
- An analysis of Option 6 would be required to compare the cost efficiency with other freshwater availability increasing measures. Water conservation will not increase freshwater availability to totally meet potential water requirements and it needs to be identified how much water can be potentially saved by implementing water conservation measures and at what cost.
- What probable changes in agricultural cropping choices will there be to obtain lower water consuming crops? What consequences will this have on domestic and export markets? Will the more water efficient crops be marketable? If the crops are not marketable, what impact will this have on the permanence of the project?

Table 16 uses criteria to rate the performance and feasibility of Option 6.

Table 16 Evaluation of recommended option to increase freshwater availability using criteria stipulated by GIWA regional experts.

Policy option to increase freshwater availability							
Project option	Legal & Institutional framework	Political feasibility (stakeholder analysis)	Administrative feasibility	Information intensity	Efficiency	Equity	Permanence
Option 6: Water conservation	Minimal legislation needed as it would be voluntary participation. Regulatory body needed to monitor water use and oversee subsidy allocation. Might require a new mandate for the River Water Development Authorities so that they enforce methods.	Possible difficulties in farmers complying as water is presently free, and there may be an unwillingness to change habits. Subsidies may therefore be needed.	Capital required to purchase saved water. Technology must take into account low budgets and minimal technical skills.	Feasibility study of water conservation techniques. Monitoring system to quantify water saving. Educational programmes for increasing the knowledge and awareness of water issues.	Benefits: Decrease water demand by irrigation scheme whilst not reducing yields. Relatively low cost. Costs: Will not be sufficient enough to solve future imbalance between water availability and potential water requirements. How much capital will be required for farmers to continue to comply?	Increased water supplies for downstream users. Downstream communities will be less reliant on stream flow if they employ freshwater augmentation technologies.	Will subsidies have to remain in place for the continued efficient use of water? However, once technology is in place e.g. drip irrigation, greater efficiency will continue. What effect will changes in agricultural cropping choices have? What consequences will there be on domestic and export markets?