

# Conclusions and recommendations

First and foremost, the assessment of the Guinea Current region has shown the extreme difficulties in speaking in general terms of a huge land area of more than 8 million km<sup>2</sup> - plus an unspecified area of marine waters. In particular, the environmental and climatic conditions vary from the Sahara desert over the Sahel drylands to the rainforest of Western and Central Africa. Accordingly, it was found necessary to make a further sub-division of the region. The four major international river basins (Congo, Niger, Volta and Comoe) covering 90% of the international basins were treated as separate entities, as was the Guinea Current Large Marine Ecosystem (GCLME).

As such, the basin assessments are to a large degree representative for four characteristic ecosystems of the region:

- The Sahel desert and drylands, with sparse precipitation and vegetation (Niger and Volta basins);
- The West African coastal regions, with more humid conditions, woodland savannah and rainforest; and a relatively dense population (Comoe Basin);
- The equatorial Central Africa with tropical conditions (Congo Basin);
- The Guinea Current LME.

Due to lack of sufficient data and information, it has been difficult to make complete assessments, causal chain analysis and policy option analysis in the Congo Basin, and it is recommended that more detailed studies be focused separately on this huge and complex basin in the future. Nevertheless, the priority concerns of the Congo were established as Pollution and Unsustainable exploitation of fish and other living resources, and the conclusions from other regions on these concerns apply to a large degree to the Congo Basin as well.

The socio-economic conditions also vary over the region, in particular related to religious and cultural issues. But in many ways, there are important similarities:

- Population growth is high - but decreasing - and the growing population by its very numbers increases the pressures on the water resources of the region. Transmigration from rural to urban areas is strong.
- There is a lack of qualified human resources due to insufficient education and training, combined with the impact of poverty. Governance is also weak.
- Economic growth is low, and heavily dependent on development assistance. The private sector investment contribution is limited, and a large proportion of the population lives below the poverty limit, dependent on subsistence agriculture and cattle herding.
- Large parts of the region are rich in mineral resources and in agricultural and timber productivity.
- Exports are dominated by agricultural and mineral commodities, since the industrial sector is undeveloped. Trade conditions - nationally, regionally and internationally - are characterised by significant market failures and inefficiencies.

In the following conclusions, the two priority concerns/issues, their causes and some potential policy options are given for three general ecoregions.

## Deserts and drylands in Sahel

Deserts and drylands are characteristic of the northern parts of the Niger and the Volta basins. Major countries in these areas are Mali, Burkina Faso, Niger and Ghana. Precipitation is scarce and erratic, and a significant decline in annual rainfall has caused severe impacts on water resources and the natural ecosystems. As most of the population are highly dependent on the natural resource base, socio-economic impacts of the "Sahelian drought" have been severe.

### **Freshwater shortage: Case of the Volta Basin**

An important GIWA concern in the Niger and Volta basins was identified to be Freshwater shortage, in particular related to stream flow modification and to lowering of the groundwater table.

Stream flows have decreased by up to 40% in the last 20 years, and the impacts of the shortages have been aggravated by the increased demand from a rapidly growing population, in particular in the urban settlements. Also, the needs of agricultural irrigation projects have been impacted by the stream flow depletion, and hydropower production in both river systems have decreased due to reduced inflows to the reservoirs. A further impact is the modification and reduction of natural wetlands, in particular the large and important Inner delta of the Niger River.

Groundwater levels have also been decreasing, with impacts on wetlands, rural water supply and groundwater based irrigation systems.

The most important immediate causes of the water shortages have been identified to be related to the significant climatic variations (natural and/or anthropogenic) which have caused substantial reductions - and increased variability - in annual rainfall, causing subsequent reduction in stream flow and groundwater recharge. But also resources have been depleted by diversions for increased water supply needs from a rapidly growing population (increasingly concentrated in urban settlements) and from associated increases in agricultural water needs, most significantly in the dry periods with low flow. Evaporation from a multitude of reservoirs also increases the water losses from the rivers.

The corresponding root causes have been identified to be primarily related to the natural environmental conditions in the arid Sahel region, with severe climatic changes resulting in decreasing precipitation. This problem is compounded by the rapidly increasing population, creating increasing demand for basic water supply and for agricultural production. There is also a lack of appropriate technological responses to the water shortages, such as development of water efficient agricultural production systems and urban-industrial water supply systems. However, first and foremost there is a lack of an appropriate governance framework to address the severe water limitations and conflicts in the Volta Basin.

To address these causes, it is recommended to consider the following initiatives and actions:

- Actively addressing the climatic evolution in the Sahel region, which is strongly related to the actual magnitude of the water

resources, and ultimately limits this resource, and correspondingly, the number of people and water-related activities, that may be sustained in the Basin. It is highly questionable if the climatic change can be reversed by human actions, but there are ways of addressing the climatic changes through policy responses. First and foremost by establishing a close monitoring framework of the actual trends and by identifying their impacts on the development of the Basin. Robust policies with a minimum of risk of failure due to adverse climatic conditions should also be advocated.

- Controlling the population growth and the rural-urban transmigration patterns in the Basin through incentives, awareness campaigns, regulation, etc., would be a valuable instrument to alleviate unforeseen and unwanted developments increasing water demand, where water resources are scarce.
- Improving water sector technology, based on the likely scenario that neither demographic, nor climatic trends are readily controllable by policy interventions within a short-term time horizon, a realistic response would be to look into technological developments to increase the efficiency of the water uses: consume less water per capita and produce more crop value per volume of water used. The urban water supply sector has many policy opportunities for technological water savings, such as minimisation of losses in distribution pipes through leakage monitoring and leakage remediation. Industries may be enticed to introduce water-saving technologies and practices. Demand side management, such as extension services for small- and medium-sized enterprises (SMEs) and selective pricing of wasteful and non-productive uses may serve as useful tools. Correspondingly, the important water consumers in the agricultural sector can also be addressed by promotion of technological innovations, such as introduction of more drought resistant crops through breeding and genetic modification. Efficient water harvesting techniques, appropriate for local conditions should be developed e.g. development of water-efficient, small-scale irrigation methods, in particular drip irrigation and sprinkler irrigation.

However, first and foremost, it is recommended that the water governance framework be strengthened on both international and national water issues, since such an initiative appears to be a prerequisite for successful initiatives in relation to the other policy options.

Such an initiative may comprise:

- Establishment of an international basin agreement on shared water resources management, specific for the Volta Basin key issues.
- Creation of a basin management institution co-managed by the six countries of the Basin, with a mandate to:

- Monitor all pertinent water issues related to both supply and demand and present critical issues for the Governments of the Basin with proposed alternatives for action;
- Facilitate specific resolution of international conflicts;
- Assist national authorities in capacity building of national water authorities within a uniform framework for the entire Basin.
- Facilitate multidisciplinary research and development of improved technologies for efficient water uses.
- Elaboration of a number of national - but internationally linked - action plans for integrated water resources management in the countries of the Basin.
- Funding of the priority actions, with particular emphasis on solving the water scarcity problems in the human settlements that face the most critical situations (e.g. Ouahigouya in the White Volta Basin in Burkina Faso).

### **Modification and loss of ecosystems: Case of the Niger Basin**

Most aquatic ecosystems are associated to the floodplains of rivers and watercourses of the Basin. The strongly seasonal rains cause over-flowing of almost all the southern rivers and watercourses. The fisheries in the rivers supply an important source of protein to the rural population. The “Inner delta” is a wetland of international importance and covers a land area of around 3.2 million ha. The wetlands support 20% of the population in Mali and produce almost 100 000 tonnes of fish annually. The Niger delta and its associated wetlands is one of the largest wetlands in the world. Here, the very productive - but also fragile - brackish ecosystems suffer from even minor changes in salinity. These ecosystems have been modified due to the changes in stream flow. Reduced low flow and changes in the annual variation have had impacts on the ecological systems, which have been unable to adjust to the changes. Changes in sediment loads have also altered river morphology and changed the transparency of the waters.

The most important immediate cause of this ecosystem depletion has been the stream flow reduction caused by the Sahelian drought. But equally important has been the depletion of the soils due to inappropriate agricultural practices, adapted to the increasing aridness and desertification of the Basin. Soil erosion, and associated sediment loads in the rivers, has increased, when vegetation becomes scarce, or when lands are developed for agriculture without sufficient erosion control.

The corresponding root causes have been identified as:

- The natural climatic trends have further reduced the flows in the aquatic ecosystems and the low productivity of the arid lands of Sahel;

- Population growth has significantly increased the pressure on the natural resources;
- Lack of technological innovation has led to unsustainable land management practices and poverty limits the potential to address the degradation efficiently;
- Lack of efficient governance constrains the possibilities for Governments and stakeholders to address the issues.

To address these causes, it is proposed that the following initiatives and actions be considered:

- Addressing the climatic changes, since the issue of climatic change is strongly related to the health and productivity of the ecosystems. A direct control of the climatic changes appears unrealistic, but there are still ways and means to address the climatic changes through policy responses. Similarly to the Volta Basin, a close monitoring framework of the actual trends should be established, the impacts of these trends on the development of the ecosystems of the Basin should be identified, and robust policies with a minimum of risk for failure due to adverse climatic conditions should also be advocated.
- Controlling the population growth and transmigration patterns, because with less people, the excessive land pressure - and the associated impact on the aquatic ecosystems - would decrease. Evidently, in spite of many decades of extensive efforts on family planning, birth control, education and awareness raising, the continued growth pattern in the Basin calls for further actions.
- Improving agricultural and land use technology as it is a likely scenario that neither demographic, nor climatic trends are readily controllable by policy interventions within a short-term time horizon. A realistic response would be to look into technological developments to increase the efficiency of the land uses in order to minimise the detrimental impact on ecosystems. The agricultural sector may be assisted by development and promotion of appropriate technological innovations to decrease soil erosion and silting of aquatic ecosystems from agriculture, forestry and mining activities. Sustainable practices in natural resource exploitation should be promoted by development of appropriate technologies such as low-impact rain-fed agriculture and introduction of incentives for and empowerment of rural people.
- Reducing poverty and addressing lack of investment in land and water conservation, as it is generally accepted that poverty is one of the key constraints for efficient resource management, and for depletion of natural resources. The links between poverty and environmental degradation are complex, and often contrary to many standard perceptions, but it is unquestionable that improvement of income opportunities is an important prerequisite for the farmer population to afford to address more than basic day-to-day needs.

But first and foremost, it is recommended that the natural resource management framework be strengthened through introduction of Integrated Land & Water Management in the Basin. Such an initiative should be focused on public sector reform and improved stakeholder participation. The mandates of an institution to address these issues would include:

- Monitoring of the state and development trends of aquatic ecosystems, including socio-economic driving forces;
- Revision and improvement of inadequate legislation, in particular related to land tenure, as local responsibility and care for natural resources is preconditioned on local ownership;
- Establishment of comprehensive land-and-water management frameworks, including specific accounting for protection of the productivity of aquatic and terrestrial ecosystems in the entire Basin;
- Promotion of improved technologies for erosion control and ecosystem protection;
- Appropriate reform and capacity development of public sector institutions;
- Establishment and mobilisation of stakeholder participation networks.

### **Coastal basins throughout the region**

South of the Sahel region, along the Gulf of Guinea from Guinea in the west to Nigeria in the east, a more humid region replaces the drylands of the north. The natural vegetation of the northern part is woodland savannah, and closer to the ocean this is replaced by rainforest. Under these more favourable climatic conditions, key concerns change from water shortage to pollution, further aggravated by the large transmigration of people from the less fortunate northern regions to the coastal area.

#### **Eutrophication: Case of the Comoe Basin**

Pollution has been identified as a priority concern in the Comoe Basin, in particular eutrophication caused by excessive nutrient loads. Point and non-point sources of nutrients result in enrichment of the Comoe River waters, causing algal growth and a proliferation of aquatic weeds, in particular water hyacinth, water lettuce and water fern.

The primary immediate sources of the nutrient loads have been found to be related to livestock excreta at watering holes, followed by wastewater discharges from urban settlements. Apparently, losses from fertiliser application in the agricultural sector are of minor importance. It has also been suggested that an important source of nutrients derives from land clearance and the associated increase in soil erosion and ashes from burning of trees.

The corresponding most important root causes have been identified as follows:

- An inappropriate framework for water governance is the key root cause since the key constraint against reduction of eutrophication is lack of sound environmental management of the catchment, following Integrated Water Resources Management (IWRM) principles;
- Rapid population growth - in particular related to transmigration from the more arid lands in the north - increases urban waste emissions, but also land clearance for new farmland;
- Lack of ownership and commitment to promote sustainable agricultural practices, because people do not own their land through proper tenure and licensing procedures;
- Lack of knowledge about the links between agricultural practices, urban waste and environmental degradation through pollution and eutrophication.

To address these causes, it is proposed that the following initiatives and actions be considered:

- Reducing population growth is a key prerequisite for obtaining a balance between population pressure and the carrying capacity of natural resources. However, this is a long-term option and it will take at least 10 years before the effects will be visible in the eutrophication of the watercourses.
- Improving local ownership and responsibility for appropriate land management through reform of the tenure system and property rights.
- Developing appropriate technology and improving public awareness among farmers concerning the appropriate use of fertilisers (dosing, amounts and spreading periods) as well as the relation between an inappropriate use of fertilisers and the eutrophication of watercourses. Another technological aspect is the design and the maintenance of purification systems (individual latrines, sewage and drainage systems, etc.).

It will, however, be very difficult to implement such activities, unless the general management framework is improved. Accordingly, it is proposed as the highest priority to establish an advisory management body for the entire Comoe Basin. The tasks for such a body may be to:

- Constitute an exchange forum concerning the problems of integrated management of land and water resources in the Comoe Basin with the aim of identifying, estimating and prioritising the water problems of the Basin, in particular eutrophication, which is considered the most serious problem;
- Seek, through awareness raising and information, the support of the operators in the water sector for the collective management of the water resources of the Basin and search for the best sustainable agricultural practices, etc.;

- Identify the possible disputes that might arise concerning the use of shared water resources and make suggestions to the national authorities on how to avoid or settle such disputes;
- Identify the financial resources that might allow a consistent long-term functioning of a permanent structure.

## The Guinea Current LME

The Guinea Current LME stretches from Guinea Bissau in the west to the Congo delta in the east. It has been selected as a typical example of an international marine area impacted by both land-based pollution and overexploitation of living resources.

### Chemical pollution of marine waters

Due to the presence of many uncontrolled small enterprises and mining activities in the river basins, heavy metal pollution is considered a priority issue. The rivers transport the metals to the Atlantic Ocean, either directly or via the coastal lagoons. When arriving in the Ocean, the pollutants drift to the east with the Guinea Current and spread throughout the entire LME thereby contributing significantly to the pollution of international waters. This is the reason why, among the different types of pollution inventoried in the region, chemical pollution is considered to be one of the most critical international issues, due to its long-distance and long-term impacts. In particular, heavy metal pollution concentrates all along the food chain until the final link i.e. human beings. The corresponding health hazards for the population in the coastal regions are important, and the consequences, in socio-economic terms, may be severe.

The key sources of chemical pollution by heavy metals in the Guinea Current LME were found to be discharge of effluents from industrial or craft activities (mainly surface treatment in urban areas, using silver, copper, chromium, cadmium, etc.). In certain areas, important sources relate to uncontrolled release from mining (e.g. mercury used by artisanal gold miners). A minor source is related to leaching of urban solid wastes.

Studies have identified several causes of chemical pollution. Absence of common effluent discharge standards and of appropriate pollution abatement infrastructure in the region is leading to uncontrolled discharge of untreated effluents and wastes. Also there are insufficient human and material resources assigned to monitoring of the environment and lack of financial resources for investment in treatment and for compliance enforcement of regulations where they exist. In particular, a widespread lack of public and private sector awareness and concern about pollution issues exists.

Accordingly, the root causes related to chemical pollution of the Guinea Current LME are primarily related to inadequate governance, in particular related to ineffective monitoring, lack of proper legislation and regulation, and lack of enforcement. Also, there is a lack of appropriate and affordable treatment technologies, not least in relation to introduction of cleaner technologies. Finally, lack of knowledge and awareness leads to non-compliance by the polluters and passivity by the affected communities.

To address these causes, it is proposed that the following immediate priority actions be considered:

- Promotion of cleaner technologies in the mining sector, and in small-scale enterprises of for example metal plating and tanning. Such a technological program should be comprehensive and include development of appropriate technologies, but also awareness campaigns, advisory services, capacity development and training, and, if needed, economic incentives and fines.
- Strengthening of the national and international management framework, including introduction of efficient legislation, agreements and regulations. In particular, monitoring of chemical pollution sources should be strengthened, and emission standards should be enforced.

However, implementation of such initiatives is condition by an acceptance of the magnitude and the impact of the problems. It is therefore proposed as a highest priority to establish a credible monitoring system for chemical pollution in the region. Such an initiative may include:

- Establishment of a convention or a forum between the 16 coastal states, the representatives of the polluting industries, the large coastal cities, and the coastal populations (fishermen villages, sea farmers, etc.);
- Establishment of a specialised institutional network in the field of water quality and aquatic environment (including ecosystems and biodiversity);
- Systematic registration and monitoring of the most important polluters;
- Installation of a series of systematic observation points along the coasts and lagoons;
- Environmental assessment of the pollution impacts and definition of the indicators of pollution/water quality, including a regional examination of pollutants in the sediments and the tissue of living organisms, and an associated assessment of socio-economic impacts.

## Overexploitation of fish

The rich fishery resources of the region are both locally important by virtue of resident stocks supporting artisanal fisheries, and internationally important due to migratory stocks that have attracted large commercial offshore foreign fishing fleets from the European Union, Eastern Europe, Korea and Japan. As such, the Guinea Current LME is a typical example of an international marine area where the depletion of fish stocks is becoming critical, first for people living around the LME, in terms of food security and loss of income opportunities, and second for the international community, in terms of loss of biodiversity. Significant changes in species composition have occurred over time as a result of overexploitation of several demersal and pelagic fish species, especially by foreign trawlers in the offshore areas. Recent trawl surveys conducted in Ghana showed that significant changes were occurring in the demersal fish biomass in terms of distribution, abundance and reproductive strategy.

A review of the status of marine fisheries resources in 1994 indicated that apart from offshore demersal resources, all other fisheries in the region were near to full or fully exploited. This has resulted in loss of food security and increased conflicts between commercial (industrial) and artisanal (community-based) fisheries. It is now recognised that the coastal and the marine ecosystem of the GCLME and its resources have witnessed various environmental stresses as a result of increasing socio-economic and unsustainable development activities.

The direct causes of the fish stock depletion can be related to an increased fishing effort. The biomass of the small pelagic species in the western and central Gulf of Guinea has been estimated to 392 000 tonnes. The current level of exploitation in the area is about 257 000 tonnes annually clearly showing overexploitation. Demand for high quality fish products and ornamental species have also contributed to the overexploitation of lagoon and coastal resources.

Other causes are related to physical alterations of the coastal ecosystems due to beach erosion, hydrographic changes due to sedimentation, and to mangrove depletion through intensive logging. Such changes endanger many coastal habitats of important species and reduce ecosystem productivity and fish stock viability.

Natural environmental changes manifesting in periodic variation in water temperatures and coastal upwelling intensities also play a role in coastal pelagic fish abundance fluctuations. Shifts in biomass appear to be connected to a shift in the boundary of the Guinea Current. These alterations have been linked to oceanographic changes during Atlantic El Niño events.

The key root causes of overexploitation have been related to a lack of governance, in particular related to an inadequate legal and regulatory framework at regional and local levels. Even where such frameworks exist, lack of monitoring and enforcement makes implementation inefficient. Lack of funds makes it difficult to introduce financial incentives, and a general lack of involvement by the fishermen in the management of the marine resources further aggravates the situation.

Similarly, a lack of data and research into the complex marine ecosystem makes it difficult to introduce a rational and credible management framework.

To address these causes, it is proposed that the following initiatives and actions be considered:

- Reinforcement - and possible adjustment - of fishing agreements between the 16 coastal states, involving the respective governments of the industrial fishing vessels, the industrial fishing companies and the representatives of the non-industrial fishermen.
- Creation of an institutional network, specialised in the management of living resources in the GCLME. The mandate should not only include marine and coastal ecosystems and biodiversity, but also relevant socio-economic issues. This network could be based on existing institutions like the Committee for the Eastern Central Atlantic Fisheries (CECAF).
- Establishment of financing and incentive mechanisms in collaboration with governments of countries with a fishing fleet operating in the GCLME, and with the fishing companies and artisanal fishermen.
- Promotion of responsible development of mariculture and coastal aquaculture through biological and socio-economic assessments of the potential and feasibility. A harmonised policy for the region - crucial if the negative effects of one country's policy on the economic potential of another are to be precluded. Training will be needed, particularly in terms of promoting community-based mariculture, as well as the overall management of mariculture in the region.
- Protection of vulnerable species and habitats through appropriate mitigation solutions need development and implementation for combating beach erosion and reducing unnecessary loss and restoring lagoon productivity.

However, the main obstacle to sound environmental management of the fisheries resources in the region is the lack of data and information on its consequences: the lack of understanding of the dynamics of living

resources in this particularly wide and complex ecosystem. Accordingly, it is proposed to prioritise a comprehensive and thorough assessment of the state of the fisheries resources and the extent of ecosystem degradation (including status and trend analyses) in the region. Beyond this first stage of monitoring/understanding, there is an urgent need to rationalise and make sustainable the fishing practices by facilitating the optimal harvesting of living resources:

- Co-management with fishing communities and industry. Co-financing from the fishing industry and other donors is a priority for effective management.
- Provision of information to facilitate regional assessments of shared resources. A structure should be established to conduct regional stock assessments, ecosystem assessments, evaluate resource-environmental linkages, and facilitate post-harvest technology.
- Joint surveys and assessments carried out co-operatively will help produce enhanced management and optimal utilisation.
- Gathering and calibration of baseline information. This should be carried out for resources, potential resources before harvest, as well as for ecosystems.
- Co-operative analysis of socio-economic consequences. Analyses of socio-economic consequences of non-optimal and improved use of resources should be carried out with a view to facilitating appropriate intervention within the framework of improving sustainable livelihoods.
- Assessment of status of vulnerable species and habitats. Work has started in some countries, but a holistic regional study is needed.
- Assessment of non-harvested species and their role in the ecosystem.

## Regional overview

As mentioned initially, the Guinea Current region and its associated river basins cover such great variations that it is difficult to establish general conclusions for the entire region. However, three overall issues have emerged:

- Lack of efficient governance in the water sector, in particular related to sector co-ordination and stakeholder participation;
- Lack of sufficient data and understanding of the water issues and their causes;
- Lack of appropriate and efficient technological responses to the problems.

It may be argued that lack of funding is a minor constraint in comparison to the three mentioned above.

Accordingly, there appears to be a general need for a regional co-operation for exchange of experiences in addressing these issues.

Such a co-operation may ensure that proposed solutions and responses better respond to the actual conditions in West and Central sub-Saharan Africa. Themes for consideration may include:

- Appropriate frameworks for Integrated Land and Water Resources Management;
- Monitoring of critical environmental, and related socio-economic, developments;
- Initiation of joint research programmes on critical water issues;
- Development of appropriate alternative technologies for water management.

Such a co-operation may be based on further development of existing co-operation frameworks and function with a minimum of external support to ensure sustainability.