The availability of and access to freshwater is an important determinant of patterns of economic growth and social development. This is particularly the case in Africa where most people live in rural areas and are still heavily dependent on agriculture for their livelihoods. Water is an essential resource for sustaining economic development in all sectors. Freshwater is a necessary input for industry and mining, hydropower generation, tourism, subsistence and commercial agriculture, fisheries and livestock production, and tourism. These activities are central to livelihoods and human well-being; they provide employment and contribute to national economies through, among other things, export earnings.

Water is not only an economic good but also a social good. Safe water supply and appropriate sanitation are the most essential components for a healthy and prosperous life. The provision of safe drinking water and adequate sanitation facilities, to the rural and rapidly expanding urban populations, can reduce mortality rates related to water-borne and water-related diseases, such as cholera, diarrhoea and malaria.

Economic security and human well-being are dependent on the protection of this resource. This demands that water be managed as part of a healthy functional ecosystem, in order to ensure it continues to deliver essential environmental goods-and-services. The hydrological cycle links the different components of the environment (atmospheric, marine, aquatic, terrestrial and subterranean), and this means that water resources are linked, via the water itself, to all the other components of the broader environment (MacKay and others 2004). This has important implications for management choices: integrated water resource management (IWRM) approaches ensure that water resources are managed as ecosystems. Further, the transboundary nature of water means that regional and sub-regional cooperation are essential to ensure the beneficial and sustainable use of this resource.

Africa is endowed with immense renewable natural resources including freshwater resources. Yet, natural phenomena, such as rainfall patterns and climate change and variability, and human factors, such as population growth, competition over water, and pollution, increasingly threaten the sustainability of resources, and hence the livelihoods of many, particularly poor, people. It is widely recognized that a radical change in approach is required in order to adequately address these threats and so that the available water resources do not become a constraint, but serve as an instrument for accomplishing New Partnership for Africa’s Development (NEPAD) development goals. These goals include poverty alleviation, economic recovery and securing a sustainable environment. It is in this light that a shared Africa Water Vision and water supply and sanitation targets were defined at the World Water Forum in The Hague in 2000. The Vision calls for a new way of thinking about water and a new form of regional cooperation. It aspires to “An Africa where there is an equitable and sustainable use and management of water resources for poverty alleviation, socioeconomic development, regional cooperation, and the environment” and specific targets have, as shown in Box 1 been set to achieve this (ECA and others 2000). Achieving this Vision requires new approaches to governance and institutions, including, among other things, the adoption of integrated and participatory approaches, management at the lowest possible level and the mainstreaming of gender issues.
OVERVIEW OF RESOURCES

Africa’s extreme variability of rainfall – in time and space – is reflected in an uneven distribution of surface and groundwater resources, from areas of severe aridity with limited freshwater resources like the Sahara and Kalahari deserts in the northern and southern parts, to the tropical belt of mid-Africa with abundant freshwater resources.

Internal renewable freshwater resources average about 3,950 km³ per year, as shown in Table 1. This amounts to about 10 per cent of the freshwater resources available globally and closely resembles Africa’s share of the world population at 12 per cent (Donkor 2003).

There are over 50 internationally shared river and lake basins in Africa. Figure 1 shows the major river basins. These are the Niger, Lake Chad, Nile, Zambezi and Orange river basins. Most of the surface water resources are concentrated in the Congo, Niger, Ogooue, Zambezi and Nile. Less than 10 per cent of Africa’s river and lake basins are covered by wetlands (IUCN and others 2003). Nevertheless, wetlands are an essential part of freshwater systems as they provide an array of environmental goods-and-services, such as flood and erosion control, water storage and filtering, a range of food and material products, as well as opportunities for recreation. Some basins, such as the

### Box 1: The Africa Water Vision for 2025: targets for urgent water needs

**By 2015:**
- Reduce by 75 per cent the proportion of people without access to safe and adequate water supply.
- Reduce by 70 per cent the proportion of people without access to safe and adequate sanitation.
- Increase by 10 per cent water productivity of rain-fed agriculture and irrigation.
- Increase the area of irrigated land by 25 per cent.
- Realized 10 per cent of the development potential for agriculture, hydropower, industry, tourism and transportation.
- Implement measures in all countries to ensure the allocation of sufficient water for environmental sustainability.
- Implement measures in all countries to conserve and restore watershed ecosystems.

**By 2025:**
- Reduce by 95 per cent the proportion of people without access to safe and adequate water supply.
- Reduce by 95 per cent the proportion of people without access to safe and adequate sanitation.
- Increase by 60 per cent water productivity of rain-fed agriculture and irrigation.
- Increase the area of irrigated land by 100 per cent.
- Realized 25 per cent of the development potential for agriculture, hydropower, industry, tourism and transportation.
- Implement measures in all river basins to ensure the allocation of sufficient water for environmental sustainability.
- Implement measures in all river basins to conserve and restore watershed ecosystems.

### Table 1: Renewable water resources

<table>
<thead>
<tr>
<th>Sub-region</th>
<th>Population (million)</th>
<th>Area (1,000 km²)</th>
<th>Average precipitation (mm/yr)</th>
<th>Internal renewable resources (km³/yr)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Africa</td>
<td>174</td>
<td>8 259</td>
<td>195</td>
<td>1 611</td>
<td>79</td>
</tr>
<tr>
<td>Western Africa</td>
<td>224</td>
<td>6 138</td>
<td>629</td>
<td>3 860</td>
<td>1 058</td>
</tr>
<tr>
<td>Central Africa</td>
<td>82</td>
<td>5 366</td>
<td>1 257</td>
<td>6 746</td>
<td>1 743</td>
</tr>
<tr>
<td>Eastern Africa</td>
<td>144</td>
<td>2 758</td>
<td>696</td>
<td>1 919</td>
<td>187</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>150</td>
<td>6 930</td>
<td>778</td>
<td>5 395</td>
<td>537</td>
</tr>
<tr>
<td>Western Indian Ocean islands</td>
<td>19</td>
<td>594</td>
<td>1 518</td>
<td>2 821</td>
<td>345</td>
</tr>
<tr>
<td>Total</td>
<td>793</td>
<td>30 045</td>
<td>744</td>
<td>22 352</td>
<td>3 949</td>
</tr>
</tbody>
</table>

Source: AQUASTAT 2003
Nile, Volta and Zambezi, have large dams (>60 metres high) for water supply and power generation. New dams are currently under construction in the Niger and Orange river basins. Compared with the last few decades, the rate of construction of new dams has greatly slowed down (IUCN and others 2003).

The urban population of sub-Saharan Africa (SSA) is expanding at a rapid rate, and as a result there is a rise in demand for potable water supply. Changing population patterns and growth are discussed in Chapter 1: The Human Dimension. Groundwater can be a viable resource to meet growing demand provided the necessary protective and institutional measures are in place and enforced. Annual groundwater recharge per capita is lowest for Northern Africa: 144 m$^3$ per capita for the Atlas Mountains and 350 m$^3$ per capita for the North African basins; the extent of groundwater development in these parts is 49 per cent and 22 per cent of mean annual groundwater recharge respectively (IGRAC 2004).

In other sub-regions, annual groundwater recharge ranges from 2 400 to 9 900 m$^3$ per capita (IGRAC 2004). Climate change and variability, population growth and increasing water demand, overexploitation and environmental degradation have significantly contributed to the worsening of the state of freshwater resources, leading to an increasing number of African countries where water demand outstrips available resources. Fourteen African countries experience water stress (less than 1 700 m$^3$ per capita/year) or water scarcity (less than 1 000 m$^3$ per capita/year; WRI and others 2000).
ENDOWMENT AND OPPORTUNITIES

Africa’s freshwater system holds a vast array of opportunities. In 2005, only about 5 per cent of the development potential of these resources – irrigation, industry, tourism and hydropower – was expected to be utilized (ECA and others 2000). Freshwater resources can potentially be used to improve human well-being through meeting urgent water needs in the areas of health and food security.

Wetlands

Freshwater is an integral part of the environment and its temporal and spatial availability is indispensable to the efficient functioning of wetlands and lakes, including coastal beneficiaries such as mangrove forests and other coastal wetlands.

The largest inland wetlands include: the Congo River swamps, the Sudd in the upper Nile, the Lake Victoria basin, the Chad basin, the Okavango Delta, the Bangweulu swamps, the Lake Tanganyika basin, the Lake Malawi/Nyasa/Niassa basin, and the floodplains and deltas of the Niger and Zambezi rivers (NEPAD 2003).

These wetlands provide a number of environmental goods-and-services including flood control, erosion control, and toxicant removal and/or retention. (see Box 2). The lakes are a habitat for major sources of nutritional supplies of fish, which are mostly treated as open access resources for subsistence and commercial use. Wetlands and freshwater bodies are associated with rare varieties of plant and animal species. In addition to this rich biodiversity they are also an important source of food. Further, they may
serve as important transport waterways and are important areas for tourism, such as the St Lucia Wetlands on South Africa’s east coast which have been declared a World Heritage Site.

**Health and well-being**

In 2002, the United Nations Economic and Social Council (ECOSOC) recognized water as a human right. Clean and safe drinking water for domestic use is widely considered as one of the most urgent water needs. As shown in Figure 3, 51 per cent of rural areas had access to water supply in 2002, compared with 86 per cent in urban areas (WHO and UNICEF 2004).

Access to safe water is a precondition for health and for success in the fight against poverty and hunger. It is crucial for meeting several of the Millennium Development Goals’ (MDGs) targets (Annex 1 lists and shows progress made towards meeting these targets) including:

- Target 1: Reduce by half the proportion of people living on less than a dollar a day;
- Target 2: Reduce by half the proportion of people who suffer from hunger;
- Target 5: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate; and
- Target 10: Halve, by 2015, the proportion of people without access to safe drinking water and basic sanitation.

Recreation and rest are also important aspects of human well-being. For many rural people, especially children, rivers provide one of the few opportunities for recreation.

**Irrigation**

Meeting irrigation water needs, for food security and economic development, is another important area. Several basins are used for irrigated agriculture. These
include the Limpopo basin which provides 82 per cent of the potential irrigation area of approximately 0.3 million ha, and the Nile basin which provides over 50 per cent of the potential 10 million ha (AQUASTAT 2003). Egypt and Sudan utilize 70 per cent of their respective shares of the basin land of 4.4 million ha and 2.8 million ha (AQUASTAT 2003). Utilization of potential irrigation areas of other basins is less (eg Congo: only 0.4 per cent; Zambezi: only 5 per cent; and Niger: 33 per cent). With its 30.3 million km² of irrigation potential, Africa provides considerable opportunities for further expansion of irrigated agriculture. Irrigation, along with other opportunities and challenges faced in the agricultural sector, are considered more fully in Chapter 3: Land.

In meeting urgent water needs, there is scope for alternative technologies, such as rainwater harvesting, wastewater recycling and desalination. Wastewater recycling is practised in particular in Southern Africa. As early as 1994, Windhoek, Namibia, was recycling 1.5 per cent of its wastewater for domestic consumption, while Harare, Zimbabwe, was recycling 10 per cent (Mohammed and Francis 2002). Gaborone, Botswana, plans to recycle 60 per cent of its urban flow by the year 2020 (Mohammed and Francis 2002). Artificial groundwater recharge may be applied to enhance the sustainability and yield of aquifers (see eg Murray 2004). In Egypt, for example, at present 40 million m³ per annum of drainage water is re-used for irrigation. An extra 30 million m³ per annum in Egypt could be considered for re-use in the future. Another way of recycling is re-use of treated wastewater which could be increased from the present 5 million m³ per annum to 25 million m³ per annum by the year 2010.

**Hydropower**

Per capita electricity consumption in Africa is still low (515 kWh/cap) compared to the world’s average (2326 kWh/cap) (Lokolo 2004). At the household level, only 20 per cent have access to electricity: However, in Northern Africa household access is significant, averaging 86 per cent, with some countries including Algeria, Egypt, Libya and Tunisia reaching 95 per cent. In contrast, the rest of Africa averages 15 per cent, with Central Africa having the lowest rate at only 9 per cent (Ogunlade and Youba 2002).

Although many of Africa’s rivers could be utilized for electricity generation, less than 5 per cent (ECA 2000) of the economically feasible hydropower potential, of one million GWh per year, is being utilized. Hydropower contributes about 20 per cent to overall electricity generation (Lokolo 2004).

The Congo River accounts for nearly 30 per cent of Africa’s surface water reserves and has the largest hydropower potential in the world (ECA 2000). Current usage is discussed in the Central African section of this chapter. It has vast untapped potential. It is estimated that it could generate, 40 000 megawatts, sufficient power supply for the whole of Africa and to have sufficient over to export (ECA 2000). South Africa’s power generating company, ESKOM, plans to develop a hydropower dam at Inga on the Congo River. It will have a series of 52 750 mw turbine installations at the Inga Rapids, and its installed capacity would be more than twice that of the huge Three Gorges Dam in China. Its estimated cost is US$50 000 million (Hathaway 2005).

Small-scale generation also holds important opportunities with, perhaps, fewer of the environmental

---

Hydroelectric dam, Tanzania.

Source: M. Edwards/Still Pictures
costs. Small power plants have the potential to meet the energy needs of rural and off-grid communities. These plants are classified into three types: small (1 – 10 MW), mini (100 KW – 1 MW) and micro (< 100 KW). Hydropower has the potential to supply low-cost electricity in several countries. However, droughts are increasing in severity and frequency, posing a major threat to a reliance on hydropower.

Hydropower development faces several barriers. These include lack of investment, low technical capacity, and a weak regulatory and policy environment. Several factors contribute to the high cost of hydropower plants. These include the employment of foreign experts in planning and design, lack of local investment and production capacity, and comparatively low demand or poor economies of scale. The environmental and social costs associated with large dams are making this a less attractive option for harnessing hydropower potential. The World Commission on Dams (WCD), for example, noted that, “The global debate about large dams is at once overwhelmingly complex and fundamentally simple. It is complex because the issues are not confined to the design, construction and operation of dams themselves but embrace the range of social issues, environmental and political choices on which the human aspiration to development and improved well-being depend. Dams fundamentally alter rivers and the use of a natural resource, frequently entailing a relocation of benefits from local riparian users to new groups of beneficiaries at a regional or national level. At the heart of the dams debate are issues of equity, governance, justice and power – issues that underlie the many intractable problems faced by humanity” (WCD 2000).

With careful planning, however, hydropower potential can be developed and utilized while minimizing the negative environmental and social impacts.

The feasibility of large dams and the implications for environment and social systems are contested.

**Tourism**

Water-based tourism is important in several localities and in such places it is often an integral part of livelihoods systems, providing a range of income and business opportunities. Zimbabwe’s Lake Kariba and Malawi’s Lake Malawi are examples of this, and support photographic and sports-based tourism. Lake Malawi hosts a rich diversity of tropical freshwater fish – it has more species of fish than any other lake in the world (S & E Bulletin 1999). The value of tourism and the opportunities it presents are discussed more fully in Chapter 3: Land.

**Challenges faced in realizing opportunities for development**

Climate change and variability, population growth and increasing water demand, overexploitation and environmental degradation will continue to contribute to a worsening of the state of freshwater systems. In 2000, the United Nations noted that, “Global freshwater consumption rose sixfold between 1900 and 1995 – more than twice the rate of population growth. About one-third of the world’s population already lives in countries considered to be water stressed – that is where consumption exceeds 10 per cent of supply. If present trends continue, two out of every three people on Earth will live in that condition by 2025” (Annan 2000).

The overexploitation and regulation of water resources have caused significant changes in the flow regimes of rivers, resulting in negative impacts on the environment and loss of ecosystem functioning. Poor land-use practices have resulted in pollution and sedimentation of river channels, lakes and reservoirs, and changes in hydrological processes. Dams, in particular large dams, threaten freshwater resources by fragmenting and transforming aquatic systems. The region is marked by a recurrence of climatic extremes in the form of flooding and drought. Global change scenarios predict a continuing global warming for this century of between 1° and 6°C, a sea-level rise of between 0.1 and 0.9 m (IPCC 2001), and an increasing frequency of climatic extremes that may further aggravate the state of available freshwater resources.

Not only is the quantity of freshwater fundamental for the development of all sub-regions, but the quality of the resource is equally important. Deterioration of the quality of water resources resulting from further increases in salinity and nutrient loads from irrigation (irrigated agriculture) and the domestic, industrial and

---

**Global freshwater consumption rose sixfold between 1900 and 1995 – more than twice the rate of population growth. About one-third of the world’s population already lives in countries considered to be water stressed – that is where consumption exceeds 10 per cent of supply. If present trends continue, two out of every three people on Earth will live in that condition by 2025.**

---

Kofi Annan, Secretary General of the United Nations. 2000

---

Pollution of rivers from industry is a growing problem in many parts of Africa.

Source: M. Chenje
mining sectors will significantly deplete available resources and increase water scarcity. Increased human activities lead to the exposure of the water environment to a range of chemical, microbial and biological pollutants as well as to micro-pollutants. The mining and industrial sectors, in particular, produce high concentrations of wastes and effluents that act as non-point sources of water quality degradation and acid mine drainage. Increased groundwater pollution is a particular concern for the more arid countries.

**Governance of water resources**

Governance is the central issue for water resources, especially in the light of water scarcity and environmental change, and is critical for maximizing available opportunities. Threats to good management and regional cooperation include climate variability (with droughts over the past 30 years) because it results in a decrease in water availability and an increase in competition over water, political instability, and low priority given to water and sanitation in terms of investment in infrastructure and maintenance. The high rates of population growth and subsequent increased demand from the agricultural and domestic sectors for freshwater resources, have increased the pressure on the resources, even in areas like Central Africa with its relative abundance of water resources. There is the possibility that increasing water scarcity may lead to water-related conflicts.

**Implementation and enforcement**

The lack of, or weak, regulatory instruments, institutional frameworks and human capacity make realizing policy objectives a challenge. For example, in Central Africa, legislation for water management is not only weak but also difficult to enforce. In several countries, the implementation and enforcement of law and policy is a problem. In Cameroon, for example, the Environmental and Water Management Law (1996), which aims at protecting continental and maritime waters, is still awaiting its implementation.

**Water resource management**

Water-sector reforms have been constrained by various factors, including internal resistance from executives of institutions, the lack of political will, frequent changes in government, and dependence on development partners to find the resources for the reforms. Other common obstacles for effective water resource management are the fragmentation of water management administration among various institutions, the absence of mechanisms for coordination, inadequate institutional capacity and resources, and the lack of an integrated approach towards water management.

Some countries lack adequate organizational frameworks to achieve sustainable water management. Burundi, for example, has no water authority to coordinate water-related activities; management and conservation are shared among nine ministries, which tend to compete with rather than complement each other (GWP 2006). The extended civil war – over 12 years – affected donor funding, financing and organizational and institutional development. This has resulted in a decline in water quality, delivery services and management capacity in the country (GWP 2006).

One of the biggest challenges, that must be addressed if the targets of the Africa Water Vision and the MDGs are to be met, is the lack of adequate human (technical and managerial), financial and material resources water authorities face, in particular as this relates to planning and implementing water and sanitation policies and programmes. There is generally a lack of know-how and institutional “strength”, particularly in the area of IWRM, and this has limited the success of water resource management initiatives. Africa is also faced with the problem of retaining trained and highly skilled personnel, as many leave to work in countries where financial rewards and research opportunities are offered. The cost and implications of this are considered in Chapter 1: The Human Dimension.

**Information generation and management**

A key limitation at national, sub-regional and regional levels that is linked to inadequate financial and human capacity is the lack of adequate and good quality data on water resources. Good quality data is a prerequisite for effective and sustainable water resource management. Water-related data and information are often too general or of poor quality, due to inconsistencies or the period
over which the records were compiled. Data gaps may also result from disruptions to management from conflict or lack of funds. In Uganda, for example, there is a paucity of data on the quality of the country’s surface and groundwater. In Ethiopia, there is a clear need for more detailed groundwater data, and in Central Africa hydrometric monitoring networks need to be revitalized. Another obstacle is the shortage of facilities and of skilled people at various levels to collect and analyse the information and data for longer-term water management.

Knowledge gaps
There is generally an information bias towards water quantity against quality. Information on groundwater resources is also less detailed and accurate in comparison with surface water resources. More information is needed in the areas of climate variability and change, water pollution and environmental flow. More and longer-term time-series of data and analyses are also needed, and what still needs to be resolved is the often restricted access to databases and the limited sharing of transboundary information. Better governance systems which increase opportunities for participation, accountability and transparency may help correct this information bias.

Another area in which there is a lack of knowledge is in early warning and disaster management. Fluctuations in rainfall, pollution of water sources and so on, have implications for food security, human and livestock health, and general economic opportunity, and thus need to be carefully monitored. Early warning gives users the opportunity to avoid harm and find alternatives.

Safe drinking water and sanitation
Despite improvement in the coverage for drinking water supply between 1990 and 2002 (Figure 3, WHO/UNICEF 2004), the coverage still falls short of the progress needed to achieve the MDG target of 75 per cent coverage by 2015. Regarding the MDG sanitation target, the situation is critical, though Northern Africa is almost on track in meeting both targets.

Poor sanitation, unsafe water and unhygienic environments are a leading cause of illness and death among children in Africa (WRI and others 2005, Gordon and others 2004) and cause millions of children in the developing world to suffer needlessly from disease. Chapter 1: The Human Dimension considers this more fully.

Obstacles to accelerating the rate of progress towards the MDG targets in all sub-regions, with the exception of Northern Africa, include, as stated above, political instability, high rates of population growth and the subsequent increased demand from the agricultural and domestic sectors, and the low priority given to water and sanitation in terms of investment in infrastructure and maintenance.

Food security
Currently, huge losses due to crop failures, arising from droughts and flooding, are being experienced more frequently than ever before in Africa, causing famines and economic hardships. Insufficient investment and operational funds for irrigation infrastructure is a major constraint. In Eastern Africa, as elsewhere, there is a pressing need for development strategies that ensure food security. There is a growing pressure also on Southern Africa’s water from the growing population and the major sectors of the different economies. In Western Africa, agricultural production will have to rise rapidly in the coming years to secure food and nutrition for the population. Meeting water needs for food security is therefore an important challenge.

Public health
Africa has relatively high morbidity and mortality rates concerning water-borne and water-related diseases, such as malaria, cholera and diarrhoea. It also has the highest incidence of HIV/AIDS in the world (up to 36 per cent in Southern Africa; Ashton and Ramasar 2002). The implications of these diseases are enormous and affect the water sector in terms of water demand and supply, sanitation and human resource capacity

Many people do not have easy access to potable water. Here, women collect water in a forest in Cameroon.

Source: J. Nguebounou/ CIFOR
(including service provision). Any decline in drinking water quality and inadequate sanitation facilities will lead to increased health risks, particularly for those people with compromised immune systems.

**Environmental degradation**

Environmental degradation in surrounding ecosystems and of freshwater bodies threatens water quality and the opportunities derived from them.

For countries relying on hydropower generation for their electricity supply, environmental degradation is a serious concern. Hydropower generation requires the reliable flow of water for most of the time (wet and dry seasons). Among the many factors leading to the degradation of watershed ecosystems, dams are the main physical threat. They fragment and transform aquatic and terrestrial ecosystems with a range of effects that vary in duration, scale and degree of reversibility (WCD 2000). Degradation of the catchment area’s environment results in the decline of springs, streams and rivers, with catastrophic consequences for human welfare and environmental integrity.

Pollution of water resources is also a great concern as it is a threat to both the environment and the availability of freshwater. Agricultural chemical use contributes to pollution of rivers and lakes, including eutrophication which threatens aquatic life. The burning of biomass contributes to the atmospheric deposition of nutrients into freshwater systems. This can promote the formation of blue-green algae, which is toxic and potentially poses a health hazard to domestic animals, aquatic life and people (S & E 1999). Chapter 11: *Chemicals* discusses the opportunities and challenges faced by increasing chemical use.

Invasive alien species threaten freshwater resources, undermining their sustainability and contribution to livelihoods. The threats faced in this regard are considered in Chapter 10: *Invasive Alien Species*.

**Financial resources**

The World Panel on Financing Water Infrastructure noted that the flow of financial resources for water and sanitation has fallen over the last years (WWC 2003). Governments have not been giving enough priority or resources to their water sector, international loans and equity investment in water have been low and falling, and official aid for the water sector has also fallen. This trend constitutes a huge challenge, and must be reversed if water resource development goals are to be achieved.

A further challenge is that many water sector agencies are not adequately prepared for absorbing increased funding. A major effort of capacity-building is thus required to strengthen the public sector in the preparation and implementation of projects and programmes, including those involving private participation (WWC 2003).

The absence of economic incentives and appropriate price regulation may not encourage resource users and polluters to take conservation or other measures. In Northern Africa, for instance, irrigation water has been provided free of charge to farmers and consequently no conservation measures are taken by them. Another issue is the effective allocation and use of governments’ budgets. Due to capital shortage, only part of the potential for irrigation in Africa could possibly be reached.

One major problem that water authorities are faced with is the low collection of water revenues and the use of flat-rate charging for water services. Regarding the latter, water meters may be used to encourage efficient use of the scarce resource and to reduce wastage.

Small water-supply and sanitation providers, such as community-based organizations (CBOs) and private-sector suppliers, play an important role in the water and sanitation sector. However, these providers are faced with problems related to finance and access to credit facilities.
STRATEGIES FOR ENHANCING OPPORTUNITIES FOR DEVELOPMENT

Improved governance

An improved legal and institutional context with enhanced transparency and accountability could contribute to more effective resource management, and at the same time maximize available opportunities and ensure the fair and equitable distribution of benefits. This would have positive spin-offs at multiple levels, including for human well-being and in particular health and nutrition, livelihoods and economic development.

An improved governance framework will need to address:

- Basic principles, such as equity and efficiency in water allocation and distribution, the need for integrated management approaches using the catchment and basin as basic units, and the need to balance the different water uses (eg for socioeconomic development versus maintenance of ecosystem integrity);
- The roles of government, civil society and the private sector and their responsibilities regarding management and administration of water resources;
- Regulatory regimes (eg water tariffs and subsidies to resource users and polluters) and;
- Risk management of water-related disasters, and climate variability and change.

An increasing number of countries are developing new policies, strategies and laws for water resource development and management based on the principles of IWRM that aim at decentralization, integration and cost-recovery. The Global Water Programme (GWP), for example, seeks to encourage dialogue among financiers, water professionals, decision-makers and water users at regional and country level. For example, in Ethiopia a process has been initiated to develop an IWRM plan to be implemented in connection with the process of decentralization in the country, and to this end has developed various laws, policies and strategies (GWP 2006). Countries which are undergoing water-sector reform have often restructured their institutional and legal frameworks. This may include setting up river and lake catchment and basin organizations.

The multiplicity of transboundary water basins in Africa has led to international cooperation and action plans, such as the establishment of the Africa Ministerial Council on Water (AMCOW) and the Africa Water Task Force to steer the processes. Through the New Partnership for Africa’s Development (NEPAD), a short-term action plan (STAP) was prepared, with the aim of strengthening the enabling environment for effective cooperative management and development of transboundary water resources, and of initiating the implementation of prioritized programmes (see Box 3). Also, the Southern African Development Community (SADC) Protocol on
Shared watercourses, and the Nile Basin Initiative (NBI) are examples of transboundary cooperation that unlock development potentials and seek win-win benefits. Though it is necessary to manage water resources at national and sub-regional levels, the management of water resources is best done at local level. Community-based natural resource management — especially water management — plays a critical part within holistic and integrated approaches for solving water scarcity problems. Key components of successful local water management are decentralizing decision making, accountability, and fostering ownership.

Capacity-building needs to be systematically included in IWRM plans. The capacity should be developed at all levels. Tailor-made capacity-building programmes for Africa can be developed and sustained that include institutional, human (technical and managerial), material and technological as well as financial aspects. Creative approaches (these are described more fully in Box 4) can be applied, in particular:

- Networking of education and training institutions, nationally and internationally (e.g., Capacity Building for Integrated Water Resources Management (Cap-Net and GWP);
- Establishing and sustaining national and international centres of excellence for critical issues;
- Enhancing distance education (e.g., the United Nations University (UNU) Water Virtual Learning Centre); and
- Strengthening partnerships with international training institutions (the United Nations Educational, Scientific and Cultural Organization’s (UNESCO) Institute for Water Education (UNESCO-IHE)).

Opportunities can be increased through establishing partnerships between the public sector and civil society and the private sector. This may improve the implementation of community projects, particularly targeting the poor (see for example, Box 14: Private Sector Participation in the Zambian water supply and sanitation sector).

Political will and a strategic approach to address this issue of capacity strengthening and retention, are essential. At the Pan-African Conference on Implementation and Partnership on Water (PANAFCON 2003), African water ministers recognized that one of the biggest challenges that must be addressed immediately to reach the African Water Vision and the MDGs is human and institutional capacity-building (AMCOW 2003).

For establishing adequate monitoring and assessment programmes that can answer today’s questions and prepare for tomorrow, new and emerging monitoring technologies (e.g., the European Space Agency (ESA) and the UNESCO Earth Observation for Integrated Water Resources Management in Africa (TIGER-SHIP)) exist that can be exploited (PANAFCON 2003 recommendations). Institutions have been established (e.g., International Institutions for Geo-Information Science and Earth Observations (ITC)) that can underpin such advances and can provide on-the-ground monitoring, assessment and associated capacity development.

Mainstreaming gender

Central to integrated water management at basin level are the interests of the people who carry buckets of water to their homes or fields to ensure a minimum level of welfare. Women are usually the ones who are most directly concerned with the family’s water supply. Women also play a pivotal role in agriculture by providing labour to family fields or their own fields. Although the pivotal role of African women in the provision and safeguarding of water for domestic and agricultural use is widely recognized, they have a much less influential role in the management and decision-making processes related to water resources than men (Box 5).

Sustainable water resources management requires that the role of women is reflected in institutional arrangements, and that men and women alike are given influential roles at all levels in water resources management.

Source: AfDB 2004
programmes, including in decision making and implementation. Mainstreaming gender concerns along these lines can speed up the achievement of sustainable water management by improving the access of women and men to water and water-related services to meet their essential needs. Nevertheless, in realizing the active and effective participation of women in IWRM, consideration has to be given to the way in which societies assign certain social, economic and cultural roles to men and women. These social and cultural differences require tailor-made approaches, mechanisms and activities for women to participate in IWRM.

**Finances**

The World Panel on Financing Water Infrastructure (WWC 2003) proposed several measures for solving the problem of financing water projects in developing countries. One such measure was to urge donors (multilateral financial institutions like the World Bank Group, the regional development banks and the European Investment Bank [EIB]) to honour their commitments to increase aid to the water sector. Others included the encouragement of international commercial lending, the promotion of private investment and operations, and the recognition and support of community initiatives and non-governmental organizations (NGOs) by providing them with the resources necessary to perform their important role.

In the light of the MDGs, urgent water needs of poor households take centre stage. The Water and Sanitation Program (WSP) acknowledges the important role played by small water supply and sanitation providers, such as CBOs and the private sector. However, these providers are faced with problems related to finance and access to

**Box 4: Water sector capacity-building initiatives**

Capacity constraints are a severe limitation to realizing the opportunities for development associated with freshwater. Capacity-building is an essential and continual response reflecting society’s need to engage with new ideas and technologies, and to change social and political realities (Cap-Net 2002). Water-sector capacity-building supports the process of transformation for the implementation of integrated water resources management, including water policies and legislation, institutional development and human resources development. The complexity of the IWRM demands a capacity-building approach that addresses a wide range of issues, problems and opportunities across sectors. There is no one correct solution, and thus it is essential to emphasize the importance of local control and local solutions backed by local adaptation of internationally-accepted knowledge and principles.

The Cap-Net capacity-building initiative led by the United Nations Development Programme (UNDP) is guided by three principles: local ownership, partnership and motivation from demand. Its African initiatives focus on education and training, institutional capacity and research. Sub-regional cooperation is an important aspect of its activities. It has three Africa initiatives:

- West Africa Capacity Building Network (WA-Net).
- WaterNet (a Southern Africa network for capacity-building in IWRM).

The GWP is a working partnership among all those involved in water management including government agencies, public institutions, private companies, professional organizations, multilateral development agencies and others committed to the Dublin-Rio principles. Its mission is to support countries in the sustainable management of their water resources. Specifically, its objectives include identifying gaps and stimulating partners to meet critical needs within their human and financial resources and supporting action at the local, national, regional or river basin level that follows principles of sustainable water resources management.

The Internet-based “Virtual Learning Center for Water” provides distance learning opportunities and information on best water management practices for developing countries. It is a new United Nations (UN) project in which the UNU’s Canadian-based International Network on Water, Environment and Health (UNU-INWEH) will play a leading role.

**Sources:** Cap-Net 2002, GWP 2005 and UNU/INWEH 2001

**Box 5: How is gender policy working on the ground?**

A study conducted in the Peddie region of South Africa looked at four villages, Cisira, Ncala, Nqwenerana and Mgwangqa, to determine the effects of gender policies on the involvement of rural women in water supply and sanitation schemes. The Peddie water scheme is a Build, Operate, Train and Transfer (BOTT) scheme, which means that the community was involved in the sustainability of the scheme, and to a certain extent the maintenance. The study found that cultural norms restricted women from asserting themselves in the presence of men. Culture practices did not allow women to interact with outsiders such as project implementing agents. As a result, the needs and concern of the most vulnerable members of the communities were not properly addressed.

**Source:** Berold 2004
credit facilities. Microfinance is proposed as an option to financing small water and sanitation services in SSA (Mehta and Virjee 2003). Opportunities exist for microfinance in Africa due to two main factors: the market size is quite significant and market penetration to date has been very low due to inappropriate financing products. It has been estimated that there are over 1 000 providers or initiatives in SSA, of which perhaps only 20 are on their way to sustainability, while market penetration is only 7 per cent of all poor households in Western Africa and even lower in Eastern and Southern Africa (Mehta and Virjee 2003).

Many countries have embarked on cost-recovery approaches in providing water to urban and rural areas at various degrees of recovery rates. In most cases, operations and maintenance (O&M) charges are being covered in cost-recovery schemes. In Madagascar for instance, cost-recovery of O&M for irrigation amounts to 75 per cent (Dinar and Subramanian 1997). Available evidence indicates that only a few countries attempt to recover capital costs from users. One major problem facing water authorities is the poor water revenue and the use of flat-rate charging of water services which is not feasible from either an environmental or financial viewpoint. It does not penalize irrational consumption nor reward rational use of water resources. Furthermore, cost-recovery requires proper functioning meters and monitoring real consumption, in addition to realistic pricing for water production and delivery, and for collecting and treating wastewater. Water management agencies should consider the opportunities for privatizing certain services, such as water treatment. Water meters should be promoted to encourage efficient use of the scarce resource and to reduce wastage.

New financial mechanisms can be developed and delivery systems improved to reach greater numbers of clients. There is a need to find non-conventional financial and economic instruments. Through market research, financial services can be further strengthened.

**SUB-REGIONAL OVERVIEWS**

**CENTRAL AFRICA**

**Overview of resources**

Central Africa is generally well endowed with freshwater resources for its growing population. In 2003, there were 98 million people and by 2020 this is expected to reach 164 million (AQUASTAT 2003) although there are large differences from country to country.

Men on a barge used for transportation of goods along the Congo River.

Source: A. Mohamed

Of the eight countries of the sub-region, six open up to the Atlantic Ocean and two are landlocked – Chad and the Central African Republic (CAR). The largest transboundary basins are the Congo (Africa’s largest river basin) and Ogooue river basins, and the internally-draining Lake Chad basin. Rainfall and freshwater resources are unevenly distributed. The average rainfall in the Congo River basin ranges from 1 200 mm per annum in the north and south to more than 2 000 mm in the centre (ECA 2000).

**Endowment and opportunities**

There are abundant inland wetland resources and lakes that render many socioeconomic benefits to communities. These include, among others, water supply, irrigation, fish rearing, hydropower and transport.

The Congo basin, which straddles Central, Eastern and Southern Africa, contains a wide diversity of freshwater habitats, including swamps, lakes and floodplains, that support diverse ecosystems, and are thus an important livelihood resource. The Lake Chad basin supports more than 20 million people (ECA 2000) and is among the most productive freshwater systems in Africa. Approximately 100 000 tonnes of fish are landed there every year (SFLP 2002). As Box 6 and Figure 5 show, this resource is under threat from a combination of factors, including decreasing rainfall, desertification and increasing agriculture.
Despite the relative abundance of water resources in most countries, rapid population growth and climate variability (with an increasing incidence of droughts over the past 30 years) have increased the pressure on the resources. An appropriate governance of water resources in the long term is needed to ensure its sustainable use. This has become especially urgent for the drought-stricken parts of the sub-region (see Box 6).

Improved regional cooperation is enhancing the opportunities for improved resource management. The Economic and Monetary Community of Central Africa (CEMAC) is an organization of Central African states, including Cameroon, CAR, Chad, the Democratic Republic of the Congo (DRC), Equatorial Guinea and Gabon, established to promote economic integration. The Organisation d’Harmonisation du Droit des Affaires

Box 6: Opportunities for strengthening the governance of Lake Chad

Lake Chad, once one of Africa’s largest freshwater bodies, used to be an important source of water and economic activities, including irrigation projects and fisheries, in the four countries sharing the lake: Chad, Nigeria, Niger and Cameroon. However, the lake has dramatically decreased in size since the early 1960s, from approximately 25 000 km² to around 1 350 km² in 2001.

Fifty per cent of the decrease in the lake’s size is attributed to human water use. The lake has been the source of water for large and unsustainable irrigation projects in Niger, Nigeria, Cameroon and Chad, especially over the period 1983 to 1994, when irrigation water use increased dramatically (four-fold). Another human factor causing the lake to shrink was overgrazing which resulted in the loss of vegetation and deforestation.

The remaining 50 per cent of the decrease in the lake’s size is attributed to shifting climate patterns. Since the 1960s, the region has suffered from a significant decline in rainfall, and IPCC (2001) predicts reduced rainfall and run-off, and increased desertification. This could mean that Lake Chad will continue to shrink.

A holistic and integrated management approach by the lake basin states is becoming increasingly important to stop Lake Chad from drying up and to ensure the sustainable use of the resource. Clearly, this is a major challenge for the Lake Chad Basin Commission.

Source: GSFC 2001, UNEP 2002

Figure 5: A chronology of change: natural and anthropogenic factors affecting Lake Chad

Source: UNEP 2002, data from GSFC 2001
en Afrique (OHADA) is also concerned with regional integration and economic growth. Such collaborative initiatives create opportunities for strengthening governance of transboundary water resources.

Information and data remain a challenge. Several network projects, such as the Waza Logone Project of IUCN-The World Conservation Union (IUCN), the Western and Central Africa Flow Regimes from International Experimental and Network Data (FRIEND) Project of UNESCO and the African Multidisciplinary Monsoon Analysis (AMMA) support data collection and analysis.

There is great opportunity for the expansion of irrigated agriculture. The Congo River is the largest river in Africa, its catchment area amounts to 3.7 million km² (ECA 2000), and total annual discharge is 1 269 km³. The DRC, CAR, and the Congo fall within it (FAO 1997). The DRC, 98.7 per cent of its land area falls within the basin; for Congo this is 72.2 per cent; for the CAR 64.8 per cent; and in Cameroon only 20.3 per cent (FAO 1997). In 1997, the irrigation potential was for these four countries was 8 685 000 ha. This requires about 137.4 km³ of water per year (FAO 1997).

There is huge potential for hydroelectric power generation on the Congo River. The Inga Hydroelectric Facility on the Congo River could play an important role in providing power to Central, Northern and Southern Africa, and even to southern Europe (see Box 7).

**Box 7: The Inga Hydroelectric Facility**

The DRC currently has 1 775 megawatts (MW) of electricity generating capacity at its Inga Hydroelectric Facility. Inga, operated by the DRC’s Société Nationale d’Electricité (SNEL), domestically provides power to Kinshasa and other parts of western DRC. Inga also provides power to the neighbouring Congo power grid along a 220 KV connection. The interconnection supplies nearly one-third of the electricity consumed in Congo. Inga also exports power to Southern African countries including Zambia, Zimbabwe and South Africa.

An expansion of the existing facility, Grand Inga, is proposed. With 39 000 MW, this would be nearly as large as South Africa’s existing capacity (43 110 MW) and provides the possibility for exporting electricity. Feasibility studies indicated that the Grand Inga project and a connection to Egypt are viable, with a Northern Energy Highway (NEH) passing through Congo, Central African Republic and Sudan. A high voltage DC connection from Inga to Nalubale, Uganda, is also being proposed. It is expected that Grand Inga will be implemented in four phases at a cost of approximately US$4 000 million, while the NEH and related infrastructure would cost approximately US$5 billion.

Source: EIA 2002

**CHALLENGES FACED IN REALIZING OPPORTUNITIES**

Central Africa is characterized by an abundance of freshwater resources, except for the northern parts (Chad, northern Cameroon and CAR) where in the past three decades there was a decline in rainfall (shrinkage of Lake Chad; see Box 6 and Figure 5). The demand for water is rising but it is unlikely that freshwater availability, which is currently well above the water-stress threshold of 1 700 m³ per person per year, will be affected much in the short to medium term.

In parts of Central Africa the quality of water resources is declining due to pollution from industrial effluents and sewage outflows, agricultural run-off and, in coastal areas, from seawater intrusion. Further threats include logging operations (that impair water quality through sedimentation) and mining operations. Drought poses a significant risk to the wetland systems in northern Cameroon and Chad. The impacts include loss of vegetation with conversion to bare soils and eventual erosion and loss of fertility.

Improving freshwater management by evolving strategy planning, developing a legal and policy framework for natural resources, developing and facilitating access to the freshwater, and heightening public awareness of water use are challenges Central African governments face in the next decade.

**EASTERN AFRICA**

**OVERVIEW OF RESOURCES**

Eastern Africa’s renewable freshwater resources amount to 187 km³ per year (AQUASTAT 2003). These surface and ground freshwater resources present opportunities for multiple uses in the domestic water supply, agriculture, fisheries, industry, aquatic, biodiversity and energy sectors. However, the availability of freshwater is highly variable both in space and time, and flooding and drought occur frequently. There is also competition for access to water resources between different user groups and between countries. Water availability and access are therefore priority issues.

The sub-region has extensive wetlands which are a buffer against pollution, flooding and sitiation. They also provide critical ecological services, such as habitat for migratory birds, and fish breeding grounds. Wetlands also provide seasonal pasture as the water table recedes during the dry seasons. Many wetlands
are hence undergoing rapid conversion to other land uses. There is also excessive sedimentation, dumping of solid wastes and discharge of huge amounts of sewage in some of the wetlands.

Eastern Africa’s freshwater resources account for only 4.7 per cent of Africa’s total, yet the sub-region is home to 19 per cent of the region’s population (UNDP 2003). This imbalance is set to worsen in the next two decades following unprecedented human and animal population increase.

ENDOWMENT AND OPPORTUNITIES

This sub-region drains in substantial part the Nile, the whole Lake Victoria basin, Lake Turkana and Lake Natron, as well as well-known deltas and swamps, such as the Sudd in Sudan (NEPAD 2003). The lakes of Eastern Africa have abundant fish stocks and are rich with floodplains and wetlands that support diverse ecosystems. Lake Victoria is the second largest lake in the world and has a surface area of between 67 000 and 69 000 km² (ECA 2000); its surrounding wetlands contain 430 fish species, 350 of which may be endemic (NB5 and others 2001).

Eastern Africa is yet to fully maximize the use of its water resources. Fifty-eight per cent of the population still lack access to clean and safe water (WHO/UNICEF 2004). There is also vast unutilized irrigation potential. The irrigation potential of the Shebelli-Juba basin for Kenya, Somalia and Ethiopia is estimated at 323 000 ha (this is less than half the potential irrigable land in the basin). However, currently less than 200 000 ha is under irrigation (ECA 2000). The Nile basin has considerable irrigation potential (ECA 2000):

- In Burundi and Rwanda, given their topography, a well designed irrigation system could support all-year cultivation of 105 000 ha and 150 000 ha respectively;
- In Uganda, at least 200 000 ha of land could be brought under irrigation;
- In Ethiopia, potential irrigated land is estimated at 2.2 million ha; and
- In Eritrea, the Nile basin could support 60 000-300 000 ha of irrigated land.

Meeting urgent water needs can be achieved by maintaining and improving existing water management systems using intermediate technology. Examples are water harvesting, water recycling and leak detection for both drinking water-supply and irrigation practices. Small-scale and traditional water supply and irrigation systems can satisfy pressing needs for safe drinking water and food security. These systems are often more carefully managed than larger systems because communities feel “ownership” and take responsibility for them.

Eastern Africa is currently experiencing an energy crisis yet it has considerable hydropower potential, which is currently in excess of energy needs. It has developed only a fraction of its hydropower potential.

Furrow irrigation, drawing on the Nego River waters, Boku, Ethiopia.

Source: A Conti/IFAD
Aside from the traditional uses of freshwater discussed above, it has come to be recognized that adequate and reliable water resources are key to security. Eastern Africa is the “water tower” of the African continent. For example, 11 out of 12 Ethiopian rivers flow into neighbouring countries. The amount of discharge that remains within Ethiopia is not more than 9 per cent of the annual total (EPA 2003). Ethiopia contributes more than 78 per cent of the Nile waters that eventually reach Egypt. On the other hand, Uganda is both an upper and lower riparian state with dependency of 41 per cent on waters originating from outside its borders. Eastern Africa therefore has a duty to ensure that it shares its transboundary waters effectively amongst individuals, economic sectors, intra-state jurisdictions and sovereign nations, while respecting the need for environmental sustainability.

**CHALLENGES FACED IN REALIZING OPPORTUNITIES FOR DEVELOPMENT**

As shown in Figure 2, water stress is likely to increase. Eritrea and Uganda are expected to experience water stress by 2025, whereas the other countries are expected to experience water scarcity (WRI 2000). General circulation models predict an increase in rainfall of up to 20 per cent, a change in seasonal distribution of rainfall and an increase in air temperature of up to 5°C for this century (IPCC 2001), but there are also indications of increasing frequency and intensity of drought.

Eastern Africa’s population is growing rapidly. In 2000 it was 182 million people, by 2010 it is predicted to rise to 230 million and by 2020 to 269 million. The burgeoning population will impact on available freshwater resources and wetlands in several ways. It will lead to increased pressure on the land, destruction of catchment, revegetation of wetlands, and devastation of forests. This will lead to secondary effects of soil erosion, overall loss of fertility of the soils and poor soil moisture retention, further destabilizing the equilibrium of the natural hydrological cycle.

Overexploitation of water resources in some parts of Eastern Africa has led to undesirable effects, such as lowering of the water table and saline seawater intrusion. The current population pressure on forests, wetlands, rangelands and marginal agricultural lands, as well as inappropriate cultivation practices, forest removal and high grazing intensities, have led to unwanted sediment and stream flow changes that impact the downstream communities (UNEP 2004). This has led to unprecedented levels of soil erosion and siltation.

In the last two decades, freshwater resources have been exposed to increased industrial pollution and invasive alien species (IAS). These problems are considered in Chapter 10: Invasive Alien Species and Chapter 11: Chemicals. The rapidly growing population

---

*Image of the Nile River*

The Nile waters offer Eastern Africa opportunities for hydropower, irrigation and recreation—provided they are managed sustainably. Uganda.

Source: IRN
and the attendant agricultural development (which demands more clearing of forests, irrigation, fertilizers and pesticides) and industrialization are the main causes of water quality deterioration. Lack of domestic and industrial waste treatment facilities continue to threaten the quality of Eastern Africa freshwater.

Lake Victoria is of great economic worth to the sub-region and of great scientific and cultural significance to the global community, mainly with respect to its unique water-borne biodiversity. It is suffering severely from: degradation of water quality because of pollution from land-based activities; the introduction of invasive alien species (both fish and plants); and excessive exploitation of living resources. The lake is facing heavy pollution by domestic and industrial wastes, and agricultural run-off that has high nitrogen and phosphorous content. Invasive weeds, such as Eichhornia crassipes (water hyacinth), thrive well in such polluted waters. There is therefore a danger that the continued organic pollution of the lake may reverse the success achieved so far using biocontrol methods to control the water hyacinth.

Human and ecological health problems are a concern in some lake basins, such as Lake Victoria. Water-borne and water-dependent diseases, such as dysentery, malaria, bilharzia, typhoid, cholera etc, are common, erupting violently from time to time during the El Niño rains that often cause widespread flooding. Social habits, lack of education, and ready cash due to the expansion of the fishery have contributed synergistically to the HIV/AIDS epidemic. Whilst high protein foods like fish are available, they are often sold rather than consumed by fishers (UNEP 2004).

Overexploitation of the fisheries sector continues to be a threat to the freshwater ecosystem. The introduction of the Nile perch in Lake Victoria, overfishing, unregulated gill net mesh sizes and exploitative fishing techniques have led to the decline of nearly all the endemic species in the lake (UNEP 2004). It has been observed that there has been an increase in fish mortality, a marked reduction in age attained, and length at maturity of the Nile perch, a reduction in catch per unit effort, as well as an increased proportion of immature fish in the catches (UNEP 2004).

There is high potential for irrigation in Eastern Africa, yet, only half of this potential could possibly be reached due to capital shortage. Redirecting governments’ budgets could be an option and may prove to be more cost-effective and efficient.

**Strategies to Improve Opportunities**

Improved governance and management set the basis for realizing available opportunities. At the national level, responses regarding increased competition over freshwater resources include revision of water resource development policies and greater involvement of stakeholders in water resource management and water supply.

Many countries face implementation challenges. Ethiopia’s Water Resource Policy (1999) focuses on improving clean and safe water supply, but there are no appropriate directives and regulatory instruments to enforce the legislation. In 2001, Ethiopia engaged stakeholders to provide input in the development of a sectoral strategic action plan to realize the objectives of the national water policy. The General Water Resource Development Programme (2002-2016) was initiated to address water quality management as part of integrated water resource management within the river basin. Under this programme, institutional set-ups are to be strengthened and new ones established for effective water quality management and monitoring, such as laboratories at national and regional levels, River Basin Commissions/Authorities and a National Water Resource Council.

Kenya has made progress in reforming the water sector, especially in supply and sanitation. Goals as stated in the 2002 Water Act include enhancing the provision, conservation, control, apportionment and use of water. As a result of these reforms, the Water Resource Management Authority was established, and the first National Water Resource Management Strategy was drafted in 2004 to provide a clear road map for
assessing, developing and managing the limited available freshwater resources in an integrated and sustainable manner. Devolution of responsibilities to the lowest appropriate levels is gradually taking place. Kenya is also preparing a national IWRM and water efficiency plan.

Uganda’s water policy (Ntambirweki and Dribidu 1998) is geared towards privatization and decentralization. Its goal is managing and developing water resources in a sustainable manner through community participation, capacity-building and a demand-driven approach. The major areas of concern pertaining to water resources management are poor watershed management, inadequate water accessibility and quantity, poor water quality, inadequate institutional capacity, and international water rights.

Major international programmes for water resource management include the Lake Victoria Environmental Management Programme (LVEMP) and the Nile Equatorial Lakes Subsidiary Action Programme (NELSAP). The LVEMP was established in 1995 by Kenya, Uganda and Tanzania to improve sustainable use of the basin’s natural resources. It focused primarily on fisheries management, pollution control, control of invasive alien species and land use management.

A more detailed account of the LVEMP is given in Box 8.

Both LVEMP and NELSAP are expected to foster dialogue and cooperation, and contribute to the improvement of food security and the alleviation of poverty.

Capacity-building is critically needed. Ethiopia, for example, recently designed a project called Ethiopian Groundwater Resources Assessment Programme (EGRAP). The EGRAP project is expected to contribute to the development of national groundwater resources assessment strategies.

Box 8: Lake Victoria Environmental Management Programme

Lake Victoria is the world’s second largest body of freshwater. The lake and its catchment support 30 million people, and fisheries and agriculture are the main economic activities. In 1995, the three riparian countries, Kenya, Uganda and Tanzania, established LVEMP, a long-term programme which aims at improving the sustainable use of the basin’s natural resources.

Results of the first phase include:
- A water quality model for Lake Victoria for various uses, the establishment of 56 water quality monitoring stations and standardized monitoring procedures; and
- Reduction in the infestation of water hyacinth by 80 per cent from 1998-2002 and establishment of a Regional Water Hyacinth Surveillance System.

Two major transboundary issues associated with the two upstream countries Rwanda and Burundi were identified during LVEMP-1. These are the influx of water hyacinth and silting associated with deforestation. Both countries will therefore be included in the second phase of the project. Some of the other issues to be considered in LVEMP-2 are:
- Establishment of national steering mechanisms;
- A focus on investment for high priority environmental issues (eg effluent treatment); and
- Development of a management information system.

Source: LVEMP 2005, Nijirabu 2002

Box 9: Ethiopian Groundwater Resources Assessment Programme

A multilateral project was recently designed to carry out detailed hydrogeological studies in the entire country over a period of fifteen years. This project is called EGRAP. The Ethiopian Groundwater Resources Assessment Programme will focus on “type areas” for complete hydrogeologic analysis. They are selected on the basis of hydrogeologic setting, data availability and socioeconomic requirements. The knowledge gained through the “type area” studies will be transferred to similar areas of the country, providing for an efficient and cost-effective approach to assess the groundwater resources of the entire country. EGRAP is incorporated in the Water Sector Strategic Development Programme.

A start was also made with the development of the Ethiopian National Groundwater Database (ENGDA). The Ethiopian National Groundwater Database will be used for storing, processing and analysing groundwater data, and is critical to the long-term programme of EGRAP. At this stage, several standardized field forms have been developed and a data dictionary is being prepared. Obviously, there is still a long way to go to develop the national database.

Three national counterparts (Ministry of Water Resources, Geological Survey of Ethiopia and the Department of Geology and Geophysics of Addis Ababa University), the US Geological Survey and the International Atomic Energy Agency (IAEA) are currently involved in EGRAP.
(EGRAP) with the aim to assess the groundwater resources of the entire country. The country has also started developing a national groundwater database (see Box 9).

NORTHERN AFRICA
OVERVIEW OF RESOURCES
Northern Africa has a number of large water basins that are shared among several countries. These include surface and groundwater bodies. The Nile basin is its most important transboundary water basin. Groundwater aquifers, such as the Nubian Sandstone Aquifer, which are mostly non-renewable and transboundary in nature, play a vital role in meeting basic water needs.

Northern Africa is Africa's driest sub-region and is characterized by limited water resources. The harsh conditions in the Sahara Desert have forced the majority of the people to live along the Mediterranean coast and the Nile. The region lies in the arid or semi-arid climate zones, where dry conditions prevail all over, except for a narrow strip along the northern coast of the Mediterranean. Annual rainfall is highest along the north coast, and decreases southwards. It ranges from less than 50 mm in the southern parts (deserts) to 1 000 mm in few parts of the extreme north-western parts (Figure 6).

ENDOWMENT AND OPPORTUNITIES
The Nile supports a range of ecosystems, such as the highly productive Sudd wetlands in southern Sudan. These wetlands and the Nile delta sustain important fish, mammal and bird species. The 20 000 km² Nile delta in Egypt includes lakes, freshwater and saline wetlands, and intertidal areas, as well as large agricultural areas and towns (NBI and others 2001). The wetlands play an important role in flood retention and release, maintaining flows in the Nile system and thereby supporting vulnerable communities long after the rains have passed.

Inland waters, not associated with the Nile, depend mainly upon drainage from the Atlas Mountains. These rivers are intermittent, with a discharge either to the coast or to the interior into salt pans or sand dunes (NEPAD 2003). In the desert areas, the inland waters manifest as oases, which are crucial life-support systems to nomadic peoples.

Various options for transboundary water sharing have been studied to achieve a more balanced distribution of the available water resources in the region. From a technical point of view, Congo River water could be transferred via its tributary (the Ubangui River) to the north to supply Lake Chad and the northern African countries via the Al-Kufra basin.

Being primarily agricultural economies, the agricultural sector requires the most water. The gap between water needs and available resources is narrowed in several ways. In Egypt, for example, where demand is met through the re-use of irrigation and treated water, two non-conventional options that are being implemented are water harvesting for agriculture in the Sinai and desalination of seawater in coastal areas.

Figure 6: Mean annual precipitation in Northern Africa

Source: CEDARE (2005); data from UNEP-GRID
Libya has adopted a different approach and aims at meeting urgent water needs through its Great Man-Made River (GMMR) project by tapping non-renewable resources (Box 11).

Water use is expected to increase with expansion in previously uninhabited land. The area of the Nile valley and its delta represents about 4 per cent of the area of Egypt. With the increase in population, at a somewhat decreasing rate of growth of 2.6 per cent, the Egyptian government has realized the necessity of accelerating its horizontal expansion plans into the deserted and uninhabited regions of Egypt. As part of this expansion plan, agricultural land will expand by an area of just over 1.4 million ha in several regions of Egypt, by the year 2017 (Zalla and others 2000). The Southern Egypt Development Project (Toshka Project) represents 226 800 ha of the total planned agricultural expansion (Box 12).

The gap between water needs and available resources is narrowed in several ways. Water recycling

Box 10: The Nile Basin Initiative

The Nile is the world’s longest river and traverses almost 6 700 km through ten countries, from the Kagera River in Burundi and Rwanda to the delta in Egypt. The Nile basin is home to 160 million people, but despite the basin’s extraordinary natural endowments, these people face considerable challenges: poverty, political instability, rapid population growth and frequent natural disasters, all placing additional strain on the resources.

Over the past four decades, various Nile countries have engaged in cooperative activities but in 1999, all riparian countries united in common pursuit of the long-term development and management of the Nile waters and established the NBI. The NBI provides a basin-wide framework guided by a shared vision: “To achieve sustainable socioeconomic development through the equitable utilization of, and benefit from, the common Nile basin water resources.”

To translate the NBI’s vision into action, a Strategic Action Programme has been formulated to identify and prepare cooperative projects in the basin. Among them are projects addressing issues related to efficient use of water for agriculture, water resource planning and management, stakeholder involvement, environmental management and power trade. Some projects, including those aimed at harnessing energy, are nearing their implementation stage.

The inclusion of all countries in a joint dialogue opens up new opportunities for realizing win-win solutions. It also holds the promise for potential greater economic and political integration of the region, with benefits exceeding those derived from the river itself.

Source: NB1 2001

Box 11: Libya’s Great Man-Made River project

The impending water stress in Libya was recognized by the government at an early stage and its answer to the crisis was the Great Man-Made River (GMMR) project, which commenced in 1984. The decisions for the implementation and funding of the project were made at grassroots level by the Basic Peoples Congresses.

The project intends to draw water from aquifers beneath the Sahara Desert and convey it along a network of huge underground pipes to the more populous northern region to meet the country’s present (47 million m³ per year) and future water demands. The project will also bring a halt to the overexploitation of groundwater in coastal areas, which has resulted in seawater intrusion and increased salinity of the wells.

The GMMR project is massive in many ways. Within a timeframe of around 50 years, a 3 380 km-long network of pipelines will provide for the country’s 5.6 million inhabitants and for 130 000 ha of agricultural land to be developed. Non-renewable (fossil) groundwater, originating from 38 000 to 7 000 years ago, will be drawn from four major groundwater basins, each containing 2 500-3 000 km³ of economically extractable water.

At a total investment cost of US$33 700 million over 50 years, feasibility studies have shown that the cost of each litre of groundwater abstracted and transported in this way is about ten times cheaper in comparison with water from a pipeline connected to southern Europe, desalination or transportation by ship. The main part of the project is funded by the Libyan people in the form of levies on, for example, fuel, tobacco and international travel.

Source: NB1 2001
and water harvesting are options that could be built upon for increasing water availability. In the agricultural sector, modifying cropping patterns and selecting crops using less water will reduce water use.

**Challenges faced in realizing opportunities**

Northern Africa is the most water-stressed sub-region and freshwater availability will become an even more important issue in the coming decades. Increasing water scarcity may lead to water-related conflicts. For the western Maghreb countries (Morocco, Algeria and Tunisia), climate change scenarios predict a rise in temperature of between 2° and 4°C this century, accompanied by a reduction in rainfall of up to 20 per cent and increased evapotranspiration (IPCC 2001). This would result in decreased soil moisture and reduced surface and groundwater resources.

Salinization of soils, which threatens food production, is already a concern in irrigated areas, especially along the Nile, and may worsen. Similarly, as a result of land degradation due to agriculture and livestock grazing, soil erosion is causing sedimentation impacts downstream. Erosion in the Nile delta has increased since the 1960s when completion of the Aswan High Dam stopped the annual flood with its replenishing sediment (NBI and others 2001). Another concern is seawater intrusion resulting from overexploitation of groundwater resources in coastal areas, where the main urban centres are located. The Nile basin’s most polluted wetlands are in the Nile delta, where irrigation drainage water, untreated or partially-treated urban wastes and industrial effluents have destroyed several forms of aquatic life, reduced the productivity of the fisheries and contaminated the fish catch (NBI and others 2001). Throughout North Africa, pollution due to urban wastes and agriculture are causing water quality degradation.

**Strategies to improve opportunities**

Improved institutional and governance frameworks may increase the potential to improve opportunities. Egypt and Sudan have reformed their legal systems to protect water resources from pollution and misuse. At institutional level, both countries have decentralized...
water resource management and established institutions to support the participation of stakeholders in decision-making processes. Transboundary cooperation on water matters takes place within the framework of the Nile Basin Initiative (Box 10).

For all sectors, water demand can be reduced by introducing participatory management approaches and applying key principles, such as the polluter pays principle. Measures are also taken for the protection of water resources and these include the establishment of monitoring networks with water quality indicators and the enforcement of laws.

Across the Maghreb in the northwest, awareness has been raised about the consequences of climate change for agriculture and coastal zones, and the communities who are dependent on them for their livelihoods. This has resulted in the political will to address the issues at regional level and in the development of a three-year vulnerability and adaptation project for the region (the Projet Maghrébin sur les Changements Climatiques). The project aims to achieve:

- A regionally integrated adaptation network, capable of continuing policy development, information exchange, vulnerability monitoring and project identification;
- Strengthened national capacities to respond to climate change;
- Development of national adaptation plans; and
- Deepened public awareness of the risks of climate change and the opportunities of carefully considered options.

Capacity-building is recognized as a basic requirement for water resource development. For this reason, training centres for water professionals have been set up in Egypt and Sudan. Professionals from other African countries are also being trained here. In the Maghreb, capacity exists within “Centres of Excellence” that, if suitably strengthened, would be capable of assuming leadership in the development of a planning framework to identify, assess and implement adaptation strategies in the near future.

Over the past few years, data collection systems have been improved. In Egypt, for example, a countrywide telemetry system was established for measuring water levels in canals. Databases were also built and data formats standardized to facilitate exchange of information. Egypt and Sudan have embarked on cost-recovery approaches for the industrial and domestic sectors. Irrigation water, however, has been provided free of charge to farmers and, consequently, no conservation measures were taken.

Among the strategic options is private sector participation. Investors have been encouraged to own
and cultivate new land using modern irrigation systems, such as sprinklers and drip irrigation. In addition, donors financially and technically assist in improving the legal and institutional arrangements in the water sector, developing water resource plans and transferring knowledge and technology.

**SOUTHERN AFRICA**

**OVERVIEW OF RESOURCES**

Southern Africa is vulnerable to environmental change due to its limited water resources. Poverty is widespread, with large numbers of its people living on less than a dollar a day. HIV/AIDS is a growing problem in many of the countries and its population is largely rural and heavily dependent on agriculture. Chapter 1: The Human Dimension gives an overview of these issues and their significance for environmental management and economic opportunity.

This sub-region has 12 major internationally shared river basins, of which the four largest basins are the Zambezi, Orange, Okavango and Limpopo river basins. Surface run-off in the northern and eastern parts is available in sufficient quantities throughout the year. In the south-western part it only occurs with extreme episodic rainfall events. Under such conditions, people rely largely on dams and groundwater resources. Major groundwater resources are found in the Kalahari-Etosha, Karoo, Cape Fold Belt, East Kalahari Precambrian Belt and the coastal basins of Mozambique and Tanzania. The region has experienced floods in the northeast and episodes of severe and prolonged droughts in other places.

**ENDOWMENT AND OPPORTUNITIES**

Southern Africa’s freshwater resources are critical aspects of local livelihoods and a central component of many economic activities. Several are also recognized as globally significant from a biological diversity perspective. These include the Okavango Delta, the St Lucia Wetlands and Lake Malawi.

Lake Malawi is the third largest lake in Africa. It is 560 km long, 75 km wide (at maximum width), has a maximum depth of 700 m at its western shore and a mean depth of about 290 m, with lake capacity (volume) estimated at 8 400 km$^3$ (ECA 2000). It is an important resource for people in Tanzania, Malawi and Mozambique, who rely on it for potable water, food, irrigation and hydropower (S & E 1999). It is also important for navigation, transportation and tourism, and supports both subsistence and commercial fisheries (ECA 2000). It has the largest number of fish species of any lake in the world, estimated at more than 600, of which half have been identified. Many of these are endemic (S & E 1999).

To meet the demand of the growing population, solutions in the past mainly focused on the supply side of resource management. As a result, as shown in Figure 7, Southern Africa has a high concentration of dams and inter-basin transfer schemes. Yet, cheaper and readily accessible solutions have proven to be...
possible and significant strides have been made towards the development of infrastructure for water supply and sanitation services. Among the adopted measures are improved maintenance and efficiency of urban water distribution networks, and improvement of sewage treatment and disposal facilities. Various tools are deployed to control the impacts of discharges on water quality, such as subsidies per unit of pollution emission abatement, waste charges, and penalties for pollution, following “the polluter-pays” principle.

Irrigated agriculture places the highest demand on water and many countries are introducing more efficient, cost-effective and sustainable water demand management (WDM) measures aimed at controlling demand to conserve water. Namibia, for instance, has been successful in implementing a wide range of WDM measures including plastic covers over the soil to reduce evaporation, block-tariff systems in the urban sector to curb excessive water use, leak detection programmes and public campaigns to educate people about the role of water (Chiuta and others 2002).

**Challenges faced in realizing development opportunities**

Future projections for Southern Africa for 2025 (Chiuta and others 2002) suggest that water availability per person will sharply decrease for most countries (see Figure 2). Southern Africa is among the few regions in the world for which most global climate models agree upon an increase in aridity in the future and hence a further lowering of water availability for livelihoods (DWC 2003, IPCC 2001). In particular, the projection looks bleak for Malawi and South Africa. In addition, Lesotho, Tanzania and Zimbabwe are expected to experience water stress by 2025, while Swaziland is likely to experience water quality and availability problems in the dry season.

The sub-region has experienced floods in the northeast and episodes of severe and prolonged droughts in other places. Repeated droughts affect freshwater availability and make the sub-region prone to soil erosion, which in turn affects water quality through siltation. The extreme amounts of soils transported to the coast especially impact the mangrove forests, causing asphyxiation of the buried roots.

Overabstraction of surface water resources has caused significant changes in the flow regimes and water quality of many rivers, leading to negative impacts on aquatic biota and subsequent loss of ecological function and health (Hirji and others 2002). For example, the building of the Kariba Dam altered the hydrological regime of the Zambezi River and changed the Marrameu floodplain to a dry, bushy area prone to fire. Additional threats to the remaining Zambezi basin wetlands include reduced flows caused by droughts and water abstractions, aquatic weed infestation, pesticides (especially DDT), infrastructure development like dams, overuse of resources due to human pressures, uncontrolled fires, pollution and deforestation (Schuijt 2002).

Pollution, especially from agricultural drainage and wash-off, urban wash-off and effluent return flows, industries, mining, and areas with insufficient sanitation services, is increasing. Pollution of groundwater resources is of particular concern because it is costly and time-consuming to rehabilitate. Water quality management should therefore form an integral part of a strategy for water resource management (DWAF 2004).

Invasive alien species, and in particular *Eichhornia crassipes* (water hyacinth), threatens many freshwater bodies (Chenje 2000).

**Strategies to improve development opportunities**

There has been good progress in water sector reforms since the late 1990s, with an increasingly integrated approach to water resource management (surface water, groundwater; socioeconomic and other issues dealt with in an integrated manner). The reforms, which...
include the setting up of new institutions with new functions, responsibilities, legislation and guidelines for water resource development and management, take place at different paces and at different scales. Box 13 lists some of the main lessons learnt from the reforms providing opportunities for further improvements in the area of good management.

Most countries have established catchment management institutions with specified powers and responsibilities. Transboundary cooperation on water matters takes place within the framework of the Protocol on Shared Watercourses (SADC 1995, SADC 2000). River Basin Commissions have been established in all of the four largest river basins, with the most recent developments being the establishment of the Zambezi Watercourse Commission in 2004 and the Limpopo Watercourse Commission in 2003.

Box 13: Lessons learnt from water sector reforms in Southern Africa

- There should be proper stakeholder participation and engagement to ensure the development of comprehensive legislation and institutional frameworks that adequately address water-related societal needs and concerns;
- Water legislation, guidelines and institutional set-up should be kept as simple as possible to avoid ineffectiveness and delayed implementation as a result of over-sophisticated documentation (the challenge is the implementation);
- Capacity-building forms an integral part of water sector reform. It is the backbone of successful implementation of IWRM programmes; and
- A systematic approach should be followed within a realistic timeframe for the development of water-related legislation and guidelines, taking into account the above and the availability of financial resources and sound hydro(geo)logical data. The process of water policy development in South Africa, for example, took well over ten years, with the following milestones:
  - 1994: Initiation of water policy development
  - 1996: Development of fundamental principles and objectives for a new water law
  - 1997: Development of national water policy
  - 1998: National Water Act

Source: Sub-regional expert consultations for AEO-2

Capacity enhancement programmes at various academic and institutional levels, such as WaterNet and the GWP, support and facilitate the adoption of IWRM approaches. Water-related data and information are increasingly compiled according to hydrologic boundaries. Opportunities for further work are in the areas of climate variability and change, water pollution, groundwater recharge and environmental flow.

Many Southern African countries have embarked on cost-recovery approaches or on enhancing private sector participation in providing water to urban and rural areas at various degrees of recovery rates. Box 14 describes an initiative that was undertaken to improve water and sanitation service provision to poor urban and rural communities.

Other measures that are possible for solving the problem of financing water projects in developing countries, besides donor support, include the encouragement of international commercial lending, the promotion of private investment and operations, and the recognition and support of community initiatives and non-governmental organizations by providing them with the resources necessary to perform their important role.

Box 14: Private sector participation in the Zambian water supply and sanitation sector

About 45 per cent of Zambia’s population of approximately ten million live in urban areas, of which 50 to 70 per cent live in peri-urban areas. One of the major aims of water sector reforms that the Zambian government has been implementing since 1994, was to alleviate the pressure on the water supply and sanitation situation. Presently, the majority of the water supply and sanitation service provision schemes in low-income peri-urban areas have been commercialized and responsibilities have been devolved to local authorities and the private sector.

A Devolution Trust Fund (DTF) was established in 2001 by Zambia’s National Water Supply and Sanitation Council under a provision in the Water Supply and Sanitation Act of 1997 to improve the service provision in the low-income peri-urban areas. The DTF assists Commercial Water Utilities in expanding their services in these areas and also the establishment of water kiosks. These are low-cost public outlets run by private water vendors who are linked by contract to professional operators of the entire system. The kiosks can achieve an acceptable service standard and have other advantages, such as improving quality of available water, if they are linked to the main water network.

The DTF is perceived by all stakeholders as an appropriate instrument to alleviate the pressure on the water supply and sanitation situation in peri-urban areas. It can contribute to realizing the target of halving the proportion of people with no access to clean water and proper sanitation by 2015.

Source: GTZ 2004
WESTERN AFRICA
OVERVIEW OF RESOURCES

Western Africa’s water resources are characterized by extreme variability over both space and time. It is highly vulnerable to climate variability, as illustrated by the disastrous impact of drought over the past 30 years. The impact of drought is considered in Chapter 3: Land.

In some areas, there is a looming water crisis. The sub-region has six major internationally shared river basins. The three largest basins are those of the Niger, Volta and Senegal rivers. These freshwater resources are unevenly distributed between countries. Temporal variation in rainfall is common, but only the countries in the northern Sahelian zone regularly experience drought, whilst floods periodically affect countries in the wetter coastal belt. Groundwater mainly occurs in basement, coastal and Sahelian sedimentary aquifers. The availability of groundwater varies considerably from one type of hydrogeological domain to another, depending on the local levels of precipitation and infiltration, which determine the actual recharge. In Mauritania, for example, internal renewable groundwater resources are estimated at 0.3 km$^3$ per year and these are important sources of water for domestic use, irrigation and livestock watering (FAOSTAT 1997).

ENDOWMENT AND OPPORTUNITIES

Wetland ecosystems and their resources are diverse, including inland water resources with abundant fisheries (NEPAD 2003). These resources provide food supply and income to many communities. For example, the Niger River system sustains biological communities which include 250 species of freshwater fish, of which 20 are not found anywhere else (WWF 2002). Specialized flora have developed in the floodplains and delta to cope with extreme fluctuations in water level.

There is great opportunity for the expansion of irrigated agriculture. The Senegal River has a maximum irrigation potential of 420 000 ha, of which only 118 000 ha is under irrigation (ECA 2000). The Diama Dam offers irrigation opportunities of 240 000 ha (see Box 15). The Niger River is Africa’s second longest river at 4 100 km, and the basin covers 1 471 000 km$^2$; this amounts to 7.25 per cent of the total area of the African continent (ECA 2000). The irrigation potential of the Niger River is vast (FAO 1997):
- In Guinea it could support 185 000 ha (only 6 000 is under irrigation);
- In Côte d’Ivoire it could support 50 000 ha;
- In Mali it could support 556 000 ha (only 130 000 is under irrigation);
- In Burkina Faso it could support 5000 ha (only 850 is under irrigation);
- In Benin it could support 100 000 ha; and
- In Niger it could support 140 000 ha.

Due to insufficient investment and operational funds for water supply systems and irrigation infrastructure, unaccounted-for water for Africa as a whole is often between 40 and 60 per cent (AfDB and ADF 2000). Exceptions are Abidjan in Côte d’Ivoire and Conakry in Guinea, where unaccounted-for water has been reduced to about 25 per cent. In Lomé (Togo), the public water utility has made major improvements, with losses now down to only 20 per cent, most water bills paid and water subsidies no longer required (Briscoe 2000). Another challenge is to protect the environment. Progress has been made in this regard through public education and awareness.

CHALLENGES FACED IN REALIZING DEVELOPMENT OPPORTUNITIES

Of the 16 Western African countries, two, Burkina Faso and Nigeria, currently experience water stress (WRI 2000) and by 2025 this is expected to rise to five (see Figure 2).

Climate change is expected to bring about reduced rainfall and increased evaporation in the areas to the north, thus advancing the rate of desertification in the Sahel (IPCC 2001). Combined with existing high rates of deforestation and degradation of vegetation cover, this could have serious consequences for soil erosion and agricultural activity (NEPAD 2003).

There is growing concern about pollution of water resources. This is particularly the case in the Niger delta.
in Nigeria, with the frequent spillage from oil production and distribution. Population growth and development are further threatening the Niger River’s ability to supply crucially needed natural resources to the people of West Africa. River flows in the basin are decreasing at the same time that fishing pressure is increasing, leading to drastic declines in the productivity of the Niger’s fisheries (WWF undated).

**Strategies to Improve Development Opportunities**

In the light of the major issues identified, the countries have responded by initiating water sector strategies and reforms at national and transboundary levels. At national level, water sector reforms include:

- Establishing new institutions to improve the coordination of water resources development and management. Water departments were upgraded or converted into public agencies to operate along commercial lines;
- Reorganizing institutions in the water supply, sanitation and irrigation sectors to improve their efficiency; and
- Revisiting the legal framework to create a common approach for water laws as well as to break the state monopoly on water supply and promote competition.

Major challenges for water resource management are to decentralize and devolve responsibilities to the lowest appropriate level, increase investment in the water sector infrastructure, attain cost-recovery, and to provide adequate institutional and legal capacity. Reforms are currently being implemented in Nigeria’s River Basin Development Authorities (RBDA) to address the involvement of marginalized communities in the these structures (Box 16).

At transboundary level, water sector reforms of basin organizations (Niger Basin Authority, Senegal River Basin Organization and Lake Chad Basin Commission) included the review of their focus, functions, financing, structure, leadership and secretariat. Efforts are being made to revive the war-torn Mano River Union and to promote the set-up of new river basin organizations, such as for the Volta River basin. The water sector reforms, however, have been constrained in many countries by various factors, among which are internal resistance from executives of institutions, the lack of political will, political instability or frequent changes in government, and dependence on development partners to find the resources for reforms. Despite these constraints, the Senegal River Basin Organization has been successful in achieving tangible development goals, particularly in the hydropower subsector.

Opportunities have been created to face the challenges, such as the Regional Action Plan for IWRM (2000-2004) and a project for the creation of a permanent structure for the coordination and monitoring of IWRM. In 2002, the African Network of Basin Organizations (ANBO) was established which constitutes an opportunity for basin organizations and authorities to cooperate with international partners in the implementation of their programmes. As such, ANBO could mobilize solidarity for the achievement of the MDGs.

Opportunities for capacity-building exist, for example through WA-Net at the University of Cape Coast (Ghana) and the Water Resources Institute in Kaduna (Nigeria). To date, WA-Net has significantly contributed to the Western African capacity-building endeavour in the water sector.

**Box 16: Reforms in Nigeria’s River Basin Development Authorities in favour of the rural communities**

Previously, most of Nigeria’s river basin development agencies concentrated on developing water distribution infrastructure in a non-participatory manner. This was an important challenge for the government to transform them into participatory management agencies. The government is aware that this is a long-term task and that the sequencing issue is vital. There is broad agreement that it would be best to start with one or two of the twelve RBDA, and to start where there are major users who are demanding greater participation and clarity about rights, allocation procedures and financing. Here there is an obvious (and potentially productive) spin-off from a concession agreement in Lagos, which would make a good pilot case. A private operator cannot depend on the current vague “license agreement” between the Ogun-Oshun RBDA and users, but will require much greater clarity on water rights, operating procedures and financing.

A second pilot basin which might prove productive is the Hadeija-Jamaare, where stakeholders include the city of Kano, irrigators of 20 000 ha, the Hadeija Wetlands (a RAMSAR site whose interests are represented by articulate NGOs) and ultimately Lake Chad (World Bank 2000).

Source: World Bank 2000
Governments’ recognition that water is not only a social but also an economic and environmental good is reflected in economic and environmental reforms. These reforms have seen the removal of government subsidies on prices of commodities and services, and the encouragement of private sector participation. There has been improvement in funding the water supply subsector by establishing modalities for mobilizing investment funds from governments, beneficiaries and donors. Mechanisms have also been established for cost-recovery through water tariffs that take into account the costs of investment, operation, maintenance, system expansion and renewal. Box 17 describes an innovative approach adopted by the city of Conakry, Guinea, to involve the private sector in urban water supply with the aim to improve services. More opportunities exist for small water supply and sanitation service provision because of the significant market size and very low market penetration. It is estimated that market penetration is only 7 per cent of all poor households in Western Africa (Mehta and Virjee 2003).

WESTERN INDIAN OCEAN ISLANDS
Overview of resources

The Western Indian Ocean (WIO) islands are separated by large expanses of ocean and do not share any freshwater resources. Freshwater resources vary considerably across the islands.

Madagascar can be divided into two major basins - one draining to the west into the Mozambique Channel and the other draining to the east into the Indian Ocean. Water in Madagascar, Mauritius and the Seychelles is primarily extracted from rivers on the main inhabited islands through the construction of dams and reservoirs, while the islands of Comoros are heavily dependent on groundwater resources. The islands are subject to tropical storms or cyclones with heavy rainfall from November to May giving rise to periodic flooding. Despite the relative abundance of rainfall, the islands also experience periods of water shortage.

There are large variations in rainfall across the countries and this has implications for available freshwater resources. All the countries experience extended dry seasons with periods of heavy rain, torrential at times, which present technical problems for storage, treatment and distribution. Climatic patterns are discussed in Chapter 2: Atmosphere.

Endowment and opportunities

Wetlands occur throughout the island states. These wetlands are important habitats that provide breeding grounds for large numbers of waterfowl. These natural assets make the island states ideal tourist destinations.

On the Mauritius island of Agalega, 1 000 km north of Mauritius main island (Government of Mauritius 2005), the use of groundwater is declining for domestic or agricultural purposes, because of saltwater intrusion and land pollution; rainwater harvesting from pitched roofs is proving a problem because of faecal contamination from birds.

In the areas of public awareness and information, and economic measures, such as metering and charging for water use, there are opportunities to further curtail the demand for freshwater.

Challenges faced in realizing opportunities for development

Projections for the WIO islands place Mauritius in the category of water-stressed countries and Comoros in the category of water-scarce countries by 2025 (see Figure 2). Comoros is currently on the threshold, with just 1 700 m$^3$ available per person per year (UNEP 2005a). Water availability is a problem across the sub-region (UNEP 2005a).

Box 17: Moving from a vicious to a virtuous cycle - Conakry (Guinea) water supply

A common problem for the development of water utilities is how to escape from a “low-level equilibrium trap.” Such a low-level trap starts with the poor quality of services, causing people to be unwilling to pay, resulting in low revenues, which in turn result in poor services, and so on.

An innovative approach in the city of Conakry shows how creative financing can assist in breaking out of this vicious cycle. In 1987, the government water utility functioned poorly, and the quality of services in Conakry was abysmal. The government of Guinea decided to involve the private sector: No private company, however, would be interested in a contract when revenues are only a fraction of the costs. The private operator was assured of sufficient revenues by a combination of (initially low, but rising) revenues from users and (initially high, but declining) subsidies from the government (largely paid out of a World Bank credit). The “trick” was to use a time-bound, transparent “transition subsidy” to improve services, and then to raise tariffs for the improved services. The vicious cycle was replaced by a virtuous cycle of good services and reliable revenues.

Source: Briscoe 2000
Precise figures for the Seychelles, where most water comes from rivers, are not available, but water shortages were so severe during 1998, partly as a result of the very extreme El Niño event, that the brewing and fish canning industries were forced to close; Mahé, which is part of the Seychelles, is under increasing threat of water shortages as a result of wilt disease that is damaging a tree species, Pterocarpus indica, important for watershed management; and Water supply in the Comoros on the islands of Grande Comore, Mohéli and Anjouan is threatened by the fragile equilibrium between freshwater and seawater.

In the Comoros, seawater intrusion reaches as far as 2 km inland due to the high water table around the coast (UNEP 2004). There are also problems of contamination of groundwater through seepage from septic tanks, substandard equipment and an insufficient number of water pumps. The Intergovernmental Panel on Climate Change’s (IPCC) projected worst-case scenario of a 1 m sea-level rise by 2100 would result in loss of coastal land, agricultural opportunities, groundwater resources (due to salinization), biodiversity critical to community support, and in loss of livelihoods (IPCC 2001). The social impacts of a sea-level rise will cause migration and displacement of people, water-related diseases and water supply problems.

In the Seychelles, high fertilizer use means that rivers have fertilizer loads of up to 25 kg per day (UNEP 2005b). Wells in Mauritius have high nitrate levels reaching 50 microgrammes per litre, which is up to the World Health Organization defined safety limits (UNEP 2005b). Mauritius uses, on average, 57 500 tonnes of fertilizer annually, representing 600 kg per hectare, or three times the rate in western Europe (UNEP 2005b).

For many people in many of the WIO islands, waterborne and tropical communicable diseases are widespread, as a result of contamination of water supplies by human waste. The Comoros, for example, suffered cholera epidemics in 1975, 1998 and 2001. Two recent outbreaks were associated with poor sanitation and pollution of freshwater. Poor disposal of waste, particularly containers, is also generating increased risk of malarial infections, especially in Madagascar and the Comoros. The containers, ranging from old plastic bags to paint tins, accumulate rainwater, which is an ideal breeding ground for disease-carrying insects. Both Mauritius and the Seychelles have developed organized waste management schemes. In the Comoros, collection and disposal of waste is poorly managed.

In the Comoros, malaria is one of the principal causes of morbidity and mortality, being associated with 25 per cent of hospital admissions and 10-25 per cent of deaths in children under five years old (WHO/UNICEF 2003). Diarrhoea is a significant cause of morbidity in children in the Comoros and is associated with poor water quality.

Madagascar has health problems associated with stagnant water in irrigation canals in rice fields which promote mosquito breeding and are host to the spread of the parasites producing bilharzia. Mauritius and the Seychelles are relatively free from diseases affected by poor quality of water. Malaria has been successfully eradicated in Mauritius, although in the past it was responsible for over 2 000 deaths per year. Tourist areas throughout the sub-region have yet to introduce quality controls on water in bathing areas, although the adoption of the Blue Flag schemes of western Europe is being considered.
**Strategies for Improving Development Opportunities**

The role of the private sector in financing water projects and infrastructure is increasing, although more so in Mauritius and the Seychelles than in Madagascar and Comoros (UNEP 2004). In the Seychelles, the role and importance of NGOs in sustainable development has increased since 1996.

In January 2005, the Mauritius Strategy was adopted, by the Small Island Developing States (SIDS) and the international community, to ensure the successful implementation of the 1994 Barbados Programme of Action (BPoA). The BPoA focuses on problems SIDS face related to climate change and sea-level rise, natural and environmental disasters, freshwater resources, and capacity-building. Selected challenges and actions related to freshwater resources are listed in Box 18. The next step is to outline a road map for the implementation of the strategy.

Box 19 illustrates the progress made with disaster management in one of the island states, the Seychelles.

---

**CONCLUSION**

Developing appropriate policy and management systems is essential to enhance the value obtained from freshwater resources and to ensure its sustainability. This includes interventions to strengthen governance, improve knowledge and information systems including data collection and monitoring and evaluation, enhance human and institutional capacity, develop IWRM systems which focus on catchment and basins as the management unit, and mainstream gender. Cooperation and partnership, between multiple stakeholders and at multiple levels, from the local to the sub-regional to the regional, are at the core of successful interventions. These responses should improve the opportunities to meet urgent needs for potable water, sanitation, irrigation and hydropower, among others.

A critical issue that will need to be addressed systematically is financing. The approach of the Africa Water Vision is set out in Box 20.

---

**Box 18: Mauritius Strategy - freshwater challenges and actions**

- Small Island Developing States continue to face water management and water access challenges, caused in part by deficiencies in water availability, water catchment and storage, pollution of water resources, saline intrusion and leakage in the delivery system. Sustained urban water supply and sanitation systems are constrained by a lack of human, institutional and financial resources;
- Further action is required, with the necessary support from the international community, to meet the MDGs and the World Summit on Sustainable Development (WSSD) 2015 targets on sustainable access to safe drinking water and sanitation, hygiene, and the production of IWRM and water efficiency plans;
- Seek international support to build self-reliance and implement agreed priority actions, namely: IWRM, water demand management, water governance, capacity-building; and regional and inter-small island developing states water partnerships.

Source: UN 2005

---

**Box 19: Disaster management in the Seychelles**

For about twenty years after independence, the Seychelles were fortunate in escaping major environmental and natural hazards. That situation changed when the 1997 El Niño floods struck the Seychelles, raising public and government awareness about the necessity of strategic disaster management. In 2004, a National Strategy for Risk and Disaster Management was drafted. In October of the same year, Seychelles created a National Disaster Secretariat. The Secretariat acts as the operational arm of a National Disaster Committee.

Mahé, the largest island of the Seychelles, took the full force of the tsunami on 26 December 2004. The seawater was driven hundreds of metres up into the city drainage system, blocking pipes with silt and flooding roads, shops and houses.

Source: UNEP 2005a
Box 20: Thematic areas towards achieving the Africa Water Vision for the year 2025

**Strengthening governance of water resources**
- Developing and implementing institutional reform and capacity-building at local, national and transboundary water basin levels;
- Using the water basin as the unit for water resource management;
- Strengthening river basin and aquifer basin management;
- Creating an enabling environment for cooperation between countries sharing international water basins;
- Mainstreaming management at the lowest appropriate level and creating institutional arrangements for full stakeholder participation; and
- Liberalizing water markets while meeting the basic needs of the poor.

**Improving capacity and information**
- Establishing a sustainable system for data collection, management, and dissemination, including standardization and harmonization of data;
- Building institutional and human capacity for effective water management;
- Facilitating access to internet services at local levels; and
- Mainstreaming gender and youth concerns in all activities.

**Meeting urgent water needs**
- Expanding safe water supply and sanitation services to meet basic human needs;
- Ensuring adequate water for sustainable food security;
- Ensuring that water for the environment is adequate in quantity and quality;
- Ensuring adequate water for economic development in the areas of agricultural production, energy and hydropower production, industry, tourism and transportation;
- Managing drought and desertification;
- Conserving and restoring ecosystems;
- Protecting water sheds and controlling siltation of hydraulic structures;
- Meeting the needs of rural energy supply; and
- Developing non-conventional water resources such as desalination and re-use of water.

**Strengthening the financial base for the desired future**
- Mainstreaming cost-recovery and service differentiation, allowing for a range of service options, each with its own price tag;
- Securing sustainable financing and initial donor assistance for tackling urgent water needs;
- Securing sustainable financing for institutional reform;
- Securing sustainable financing for information generation and management;
- Shifting from government to private sector financing in the water sector; and
- Establishing mechanisms for sustainable financing of water resources management.

Source: Donkor 2003

References


Chapter 4 • Freshwater


