Freshwater Trends and Projections: Focus on Africa

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Report prepared by Carmen Revenga[1] and Angela Cassar[2] for WWF-International

What is happening to water resources and freshwater ecosystems worldwide?

Despite the recognition and increased formal commitments by many countries to the ideas and principles of sustainable development, implementation of policies and strategies that manage water resources for people, while still maintaining functioning ecosystems, are still far from being the mainstream approach to water management.

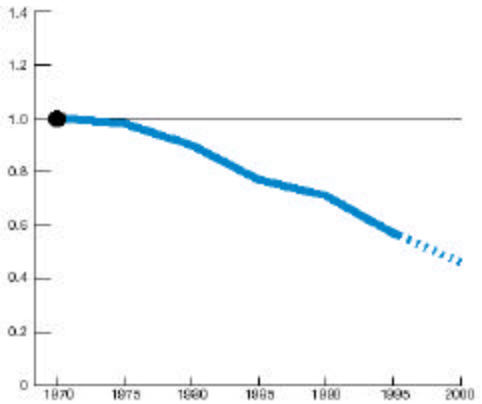
Throughout history, human activities have severely affected the condition of freshwater ecosystems. Surface water and groundwater are being degraded in almost all regions of the world by intensive agriculture and rapid urbanization. And while people have shown resourcefulness in their utilization of water resources as evidenced by the dramatic global increases in irrigated agriculture and widespread dam and reservoir developments, more than 40 percent of the world's population still lives in conditions of water stress. With the current population growth projection, this percentage is estimated to grow to almost 50 per cent by 2025 (WRI 2000).

In addition, increased pollution and the continued degradation of riparian and wetland habitats that help filter water are exacerbating the scarcity problems in many regions of the world. Lack of access to clean water continues to be a leading cause of illness and death in much of the developing world. Between 1990 and 2000, approximately 816 million additional people gained access to some form of improved water supplies, however, nearly 1 billion people in rural areas in the developing world still have no access to clean water and two-fifths of the world's population lack access to adequate sanitation facilities. The majority of these people live in Africa and Asia. Polluted water is estimated to affect the health of more than 1.2 billion people, and to contribute to the death of an average 15 million children every year (WHO/UNICEF, 2000).

Fish from rivers, lakes and wetlands are a major source of protein and micronutrients for a large part of the world's population, particularly the poor. This fact plus the current belief that inland fisheries are greatly underreported makes the protection of functioning ecosystems an important food security issue. Food production from wild fisheries has been affected by habitat degradation, overexploitation, and pollution to a point where most of these resources are not sustainable without fishery enhancements such as introduction of non-native species or restocking of lakes and ponds. Asia and Africa are the two leading regions in inland capture fish production. In some landlocked countries, such as Malawi, inland fisheries, both wild and aquaculture, provide about 70–75 per cent of the total animal protein for both urban and rural low-income families (FAO 1996).

Finally, the capacity of freshwater ecosystems to support biodiversity is highly degraded at a global level, with many freshwater species facing rapid population declines or extinction. As the freshwater species population index in *Figure 1* shows there has been a 54 per cent

Figure 1. Freshwater Species Population Index



Source: Living Planet Report, WWF 2002

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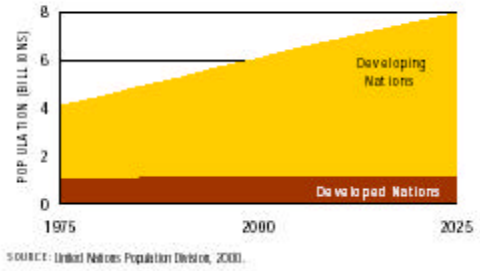
decline in the population of 195 freshwater-dependent species of birds, mammals, reptiles, amphibians and fish.

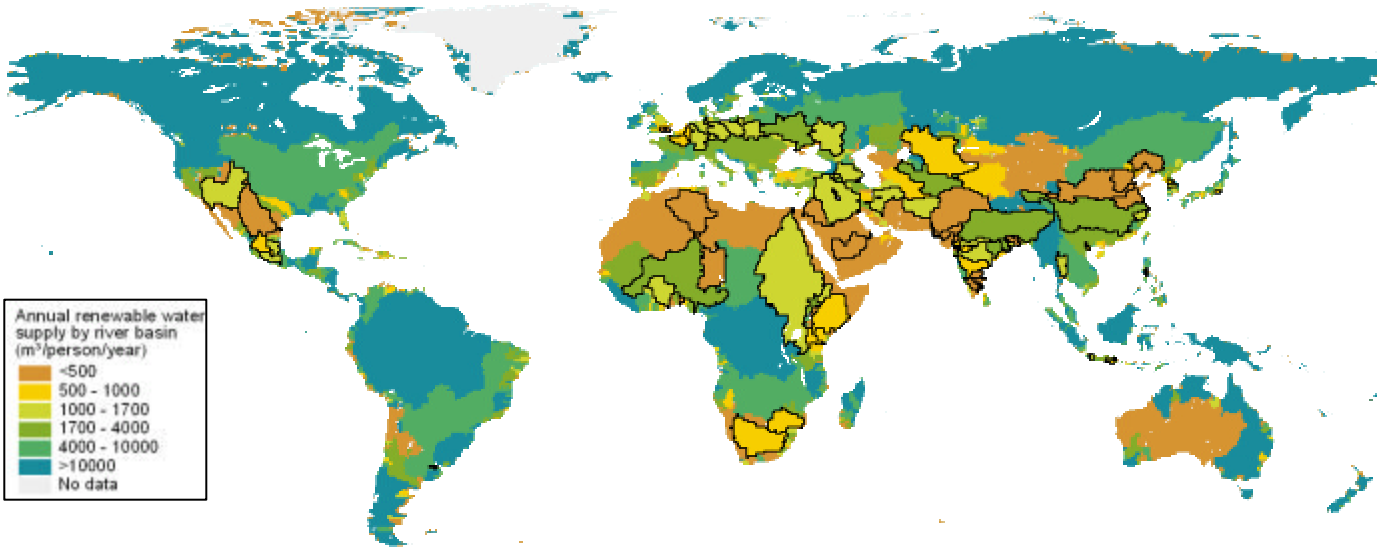
What is in store for the future with respect to water?

Figure 2: World Population, 1975-2025



The period 1990-2000 saw a 15 percent increase in the global population, from 5.27 to 6.06 billion and this number continues to rise (WHO/UNICEF, 2000). At the regional level this trend becomes more alarming, when one considers that Africa, one of the most water stressed regions in the world, during the same period experienced a population increase of 27 per cent—from 615 to 784 million. This is the highest regional population increase, within a continent that, after Australia, is considered the driest in the world.

Figure 3. Projected Annual Renewable Water Supply per Person by River Basin, 2025



Source: Revenga et al. 2000.

Water withdrawals worldwide during the period 1900-1995 increased sixfold, more than twice the rate of population growth (WMO 1997). Dams, which have a particularly significant impact on freshwater ecosystems, for example have increased sevenfold since 1950 and now impound 14 per cent of the world's runoff. Even with this dramatic increase in water storage capacity, water scarcity projections for the future are daunting. As shown in *Figure 3* water scarcity projections calculated by river basin for 2025, emphasize that of the 63 outlined river basins in the world that are projected to have more than 10 million people, using the UN low range population projections, 29 are already experiencing water stress and will descend further into scarcity by 2025, a further 6 will move into water-stress conditions, and 12 additional basins will experience a strong negative change in water supply per person between 1995 and 2025 (Revenga et al. 2000). *Table 1* provides some statistics for those African basins that are projected to have a population of more than 10 million and will suffer from water stress in 2025.

Table 1. Selected Water Scarce Basins in Africa

Basin Name	Basin Area (km^2)	Average Population Density (per km^2)	Water Supply per Person in 1995 (m^3/person/year)	Projected Water Supply per Person in 2025 (m^3/person/year)	Degree of river fragmentation
Lake Chad	2,497,738	12	7922	< 500	Low
Limpopo	421,123	32	716	500-1000	High
Nile	3,254,853	44	2207	1000-1700	High
Niger	2,261,741	32	4076	1700-4000	High
Orange	941,351	11	1050	500-1000	High
Volta	407,093	42	2054	1000-1700	High

Source: WRI 2000.

To meet the needs of the increasing population, sustain long-term human welfare, and conserve functioning ecosystems that provide us with the wide variety of goods and services we depend on, humanity's consumption of renewable natural resources must stay within the limits of the Earth's biological capacity over the long term. Water use, water scarcity, sanitation and species decline indicate that current management approaches are not sustainable if present trends continue. A holistic, long-term, and ecosystem-based approach must be adopted to address water scarcity and development issues.

Why are ecosystems important?

Functioning ecosystems form the basis for the generation of multiple goods and services that humans depend on. Freshwater ecosystems provide among other things, water for human consumption, natural flood control, nutrient cycling and retention, carbon storage, water filtering, water storage and aquifer recharge, shoreline protection and erosion control and a range of food and material products, such as fish, shellfish, timber and fibre. These goods and services are rarely priced and therefore are not usually incorporated into water resources management. The current approach to management is mostly fragmented and sectoral. An appropriate freshwater management regime needs to integrate the complex biophysical interactions between climate, ecosystems, and species with the political, economic and development objectives of each country or region.

The need to consider ecosystems in water resource management is multifaceted. Firstly, development objectives and poverty alleviation are at stake if food security is compromised. To ensure food security, it is necessary to consider the wider implications of a fragmented management approach of water resources. For example, building a dam to increase irrigation for cereal production, may increase the yield of this particular crop in the upstream region, but can also cause freshwater quality and quantity declines downstream, with its consequent loss of wetland fisheries, increase the frequency of flooding events, and other impacts that in the long-run will compromise development objectives and poverty alleviation. Fish account for roughly one fifth of all animal protein in the human diet (Williams 1996), with freshwater fisheries, being the primary protein source for many land-locked countries in Africa. Current harvest trends and watershed conditions put both people and the resources they depend on at risk (WRI 2002). If water supply depletion and water stress projections are accurate, and if long term sustainability, and the systems as a whole are not adequately considered, all aspects of water use particularly an increasing reliance on irrigated agriculture and sanitation are likely to suffer.

Secondly, freshwater biodiversity and the goods and services that humans derive from freshwater ecosystems are at risk. Freshwater ecosystems harbor an extraordinary concentration of species, and physical alteration, habitat loss and degradation, water withdrawal, pollution, overexploitation, and the introduction of nonnative species all contribute directly and indirectly to declines in freshwater species. The current condition of our rivers and

lakes shows that much damage has already been done. An analysis of the degree of alteration of major rivers of the world carried out by the World Resources Institute in collaboration with the University of Umeå in Sweden, shows that 60 per cent of the largest 227 rivers are strongly or moderately fragmented by dams, diversions and canals (Revenga et al. 2000). Even though dam construction has slowed down in many developed countries, and actually some countries like the United States are decommissioning dams to improve ecosystem functions and restore important habitats, most developing countries have plans to expand the number of dams for irrigation, water supply and hydroelectricity. Adopting and implementing the recommendations set forth in the Dams and Development report of the World Commission on Dams and taking a holistic, ecosystem approach to water resource management can mitigate the impacts of dams and other infrastructure projects on ecosystem functioning (WCD 2000).

Taking an Ecosystem Approach to Water Management: Institutional Challenges

An ecosystem approach requires that ecological units be managed in their entirety. Freshwater management thus requires a river basin approach, including the management and consideration of the different habitat types and ecosystems in that particular basin. However overcoming institutional compartmentalization and sovereign protectionism is not an easy task. Even river basins contained within a single State or province may be constrained by local administrative boundaries, preventing an unhindered river basin approach.

In contrast, human development has historically favoured activities with high economic returns that maximized single objectives, such as abstracting water for irrigation schemes and urban aqueducts, draining wetlands, or erecting dams for electricity production (WRI, 2000). Commitment to sustainable development requires balancing a triple bottom-line" approach to environmental, social and economic objectives.

One of the major challenges in adopting and implementing an ecosystem approach to water resources management is overcoming compartmentalized institutional approaches to sustainable development. No longer is it appropriate to separate water management into its traditional components, yet this trend has prevailed with entrenched institutional structures. For example, sanitation and adequate water supply has been emphasized as vital in improving quality of life in developing countries, however institutional approaches tend to focus on direct causes and solutions such as installation of sanitation services, with little attention to the hydrological cycle as a whole and the important role that healthy maintenance of the ‘system’ plays in overall water quality.

The interdependency of pathways must be acknowledged towards comprehensive systems approach, and the interconnectivity between societal health and both water quantity and quality must be linked to the wider environment.

Institutional Challenges for Africa

Governments, NGOs, local communities and other interest groups have justifiably focused their attention on development and poverty alleviation in the African region. The problem has been however, a lack of long-term perspective that considers the interconnectivity of environment and development. The gravity and urgency of this situation is increasing, however institutional fragmentation remains a hindrance.

The New Partnership for Africa's Development (NEPAD) represents a pledge by African leaders to eradicate poverty and "place African countries both individually and collectively on a path of sustainable growth and development" (NEPAD 2001). NEPAD represents renewed commitment to democracy and to cooperation through the African Union (AU).

In relation to water, NEPAD identifies adequate water supply and sanitation as a sectoral priority. Specific objectives concern sustainable access to safe and adequate clean water supply and sanitation; the need for cooperation on shared rivers among member states; the maintenance of ecosystems, biodiversity and wildlife; and need for enhanced irrigation and rain-fed agriculture to improve agricultural production and food security. Elsewhere, the importance of wetland conservation for sustainable development is acknowledged in NEPAD's Environment Initiative, while one of NEPAD's Energy objectives is to exploit and develop the hydropower potential of river basins of Africa (NEPAD 2001).

While NEPAD recognises that managing water resources is an important basis for national and regional cooperation and development, an important weakness in the NEPAD strategy is the failure to recognise the connectivity of the hydrological cycle as a whole. Further integration of the sectoral objectives relating to water into a common, ecosystem-based approach that can meet development needs while maintaining functioning ecosystems is critical to ensure that NEPAD's achievements are sustained in the long term. Failure to create these linkages will result in a continued fragmentation of water management and continued ecosystem decline, together with the goods and services derived from them.

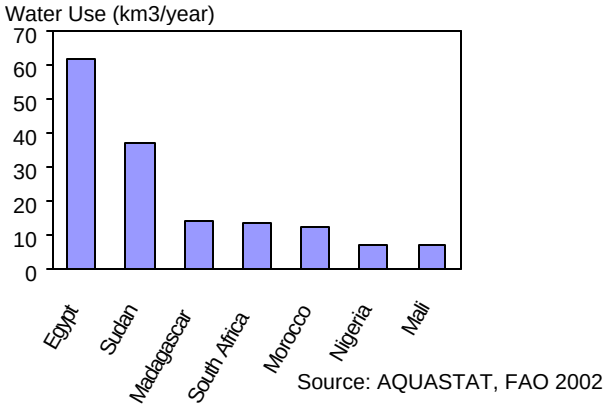
The case of Africa: Freshwater Trends and Projections

Water Use and Availability

Water resources are unevenly distributed across the African continent, with about 50 per cent of the total surface water on the continent contained within a single basin—the Congo River basin—and 75 percent of total water resources concentrated in eight major river basins, the Congo, Niger, Ogooue (Gabon), Zambezi, Nile, Sanga, Chari-Logone and Volta (Donkor and Wolde, 1998).

The countries with the most volume in annual renewable water resources include the Democratic Republic of Congo with 1283km^3/year, the Republic of Congo with 832km^3/year, Madagascar with 337km^3/year, Nigeria with 286km^3/year, Cameroon with 285km^3/year, Liberia with 232 km^3/year, Guinea 226km^3/year, and Mozambique with 216 km^3/year. In terms of water use however, the top users of water by volume are Egypt, Sudan, Madagascar, South Africa, Morocco, Nigeria and Mali (*see Figure 4*).

Figure 4. Top Users of Water in Africa



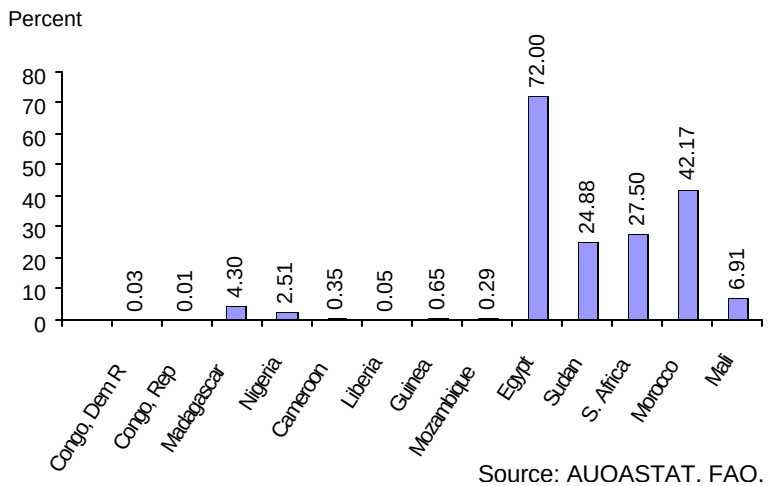
Source: AQUASTAT, FAO 2002

As these numbers show, and as represented in Figure 5, countries with the most water resources are not necessarily the largest consumers.

Egypt, for example, which is the largest user of water with 61.7km^3 of water use per year, is climatically in a water stressed region, having only 85.7km^3 of annual renewable water resources, of which only 58.3km^3 are for Egypt's use, because it has to reserve some water for other basin countries. The Egyptian figure indicates that more freshwater is used than available, however this discrepancy is attributed to the amount of storage capacity of major dams, such as the High

Aswan Dam, which stores close to 162km^3 of water (ILEC 2002). Dams in Egypt, and in particular, the Aswan High Dam, supply nearly 100% of the water used for irrigated agriculture (WCD 2000). In contrast, Madagascar, which is climatically in a water plentiful zone, with 337km^3 of annual renewable freshwater, only withdraws 14.48km^3 of water per year.

Figure 5. Water Use as a Percentage of Total Water Resources



Source: AUOASTAT. FAO. 2002

By sector, the highest water user is agriculture. Egypt, for example uses 88% of its water for agriculture, Sudan uses 97% and Madagascar uses 99% (*see Figure 6*). These figures are consistently high Africa-wide with a few exceptions, those being the Central African Republic (5%), Equatorial Guinea (10%), Lesotho (31%) and Rwanda (33%).

Per capita water withdrawal reflects a different trend with Madagascar (1611m^3), Mauritania (923m^3), Sudan (637m^3), South Africa (366m^3) and Senegal (202m^3) being the greatest per capita users of water (WRI 2002).

In terms of overall water availability per capita of renewable water resources, the countries with the least available freshwater per person are Burundi (538.3m^3), Kenya (947 m^3), Burkina Faso (1024 m^3), South Africa (1131m^3) and Somalia (1413m^3), and conversely, the most water abundant areas per capita are not unexpectedly, the equatorial high rainfall areas of the Dem. Rep. of Congo (259,547m^3) Gabon (126,789m^3), Liberia (70,348m^3), Central African Republic (37,565m^3) and Sierra Leone (33,237m^3) (WRI 2002).

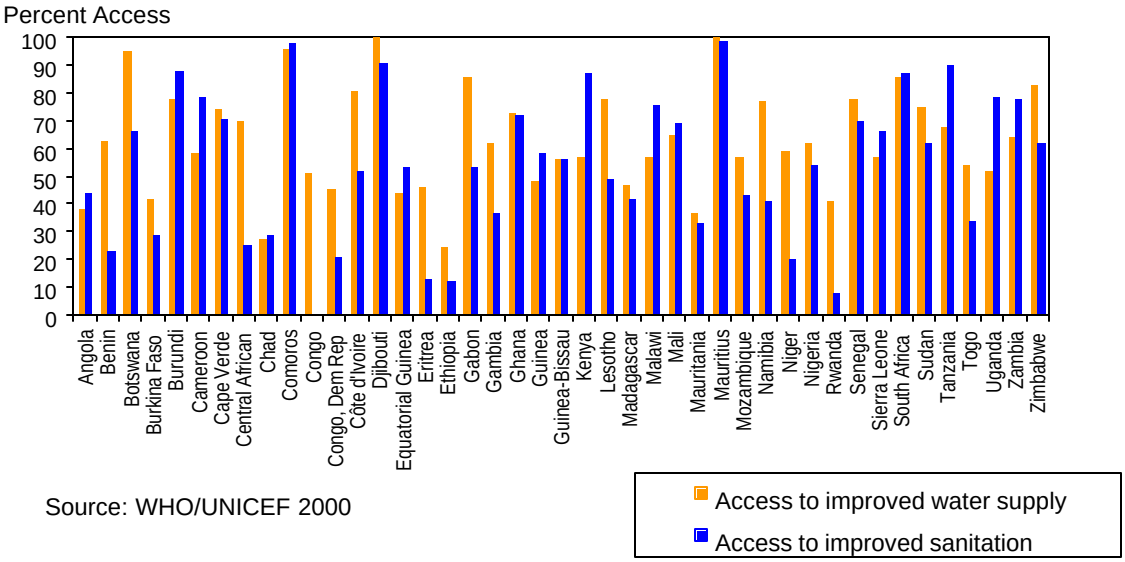
Water Supply and Sanitation

Africa has seen the largest regional population rise for the period 1990-2000. Over the next 25 years, population projections indicate an expected increase of a further 65 percent. Africa also has the lowest total water supply coverage of any region, with only 62 percent of the population having access to improved water supply since 1990 (WHO/UNICEF 2000). This represents a huge challenge to services in the region, largely determined by water supply.

During the International Drinking Water and Sanitation Decade, 1981-1990, sub-Saharan Africa experienced an increase in water supply coverage from 32 to 46 percent, while sanitation coverage increased from 28 to 36 percent (*see Figure 7*). Since then, however, progress has stagnated, and more people are without adequate services in Africa today than in 1990 (WHO/UNICEF 2000). Overall, the increase in the numbers of people served with adequate sanitation facilities was just sufficient to keep pace with population growth. Population growth is likely to continue over the coming decades increasing the pressure on services that are already overwhelmed, especially in urban areas. To reach the 2015 development targets for access to sanitation and water supply for Africa–that is provide access for an additional 211 million people in urban areas and 194 million people in rural areas–the rate at which people get access to sanitation and water delivery facilities will need to be tripled (WHO/UNICEF 2000). A way to

achieve this goal is to use an ecosystem-based approach management, where intact wetlands and riparian habitats can act as filters and eliminate waste by natural processes.

Figure7: Access to Improved Water Supply and Sanitation in Africa, 2000



Source: WHO/UNICEF 2000

Inland Fisheries

Inland fisheries in rivers, lakes, and wetlands are a major source of protein for a large part of Africa's population, particularly poor communities in rural areas. According to FAO (1999), inland fisheries that depend on natural production are being exploited at or above their sustainable yields and habitat degradation is today the leading cause threatening inland capture fisheries. In 1999, world production from inland capture fisheries was approximately 8.2 million tonnes, with an additional 19.8 million tons coming from inland water aquaculture. More than 90 per cent of this production comes from developing countries (FAO 2000).

In Africa, total landings for inland capture fisheries were slightly over 2 million tones, while aquaculture figures for freshwater fish, molluscs and crustaceans from inland and brackish waters were 283,409 tonnes (FISHTAT 2002). The top inland water-fishing countries in Africa in include Uganda, Tanzania, Egypt, Kenya and the Democratic Republic of Congo, all with catches of more than 200,000 tonnes, with Nigeria and Mali closely following (*see Table 2*).

Table 2. Top Producing Countries in Africa for Inland Capture Fisheries and Aquaculture, 2000

Country	**Inland Capture Fisheries[a] (tonnes)**	**Country**	**Inland Aquaculture Production[a] (tonnes)**
Uganda	355,831	Egypt	240,670
Tanzania	280,000	Nigeria	25,718
Egypt	224,940	Zambia	4,240
Kenya	210,343	Madagascar	2,480
D. Rep. Congo	204,503	South Africa	1,735
Nigeria	132,315	Côte d'Ivoire	1,197
Mali	109,870	Morocco	1,020

[a] Production figures are for freshwater crustaceans, molluscs and fish caught or produced in inland and brackish waters.

Source: FISHSTAT, FAO, 2002.

The majority of the catch in all these countries is Nile perch, different species of tilapia and cyprinids. In terms of aquaculture production, the biggest producer in Africa is Egypt. More than half of Egypt's freshwater aquaculture production in the year 2000 was Nile Tilapia, followed by carps. With a few exceptions carps and tilapias are the main species produced by the other top freshwater aquaculture producing countries in Africa (*see Table 1*). The introduction of nonnative fish such as these, however, has its ecological costs and is today the second-leading cause, after habitat degradation, of species extinction in freshwater systems.

Biodiversity
Loss of habitat, pollution, introduced species, river fragmentation by dams, and water extraction, have all negatively impacted the conservation status of freshwater species. According to the IUCN Red List of Threatened Species, and taking into account that many freshwater species have not been assessed because of insufficient data, there are a total of 1,041 species of vertebrates threatened with extinction (Hilton-Taylor 2000). This number includes only those animal species that live exclusively in freshwater. If the number of species dependent on freshwater habitats were included this number would be much higher.

Africa harbors some of the most unique and extremely rare freshwater habitat types in the world. In particular the Rift Valley Lakes, which were created by the moving of tectonic plates beneath the crust of Africa, exhibit extraordinary levels of species richness and endemism. Some lakes in the eastern rift represent a globally rare habitat type with upwards of 800 cichlid fish and many more species yet to be discovered. The lakes also support high numbers of endemic molluscs and crustaceans. Lake Tana hosts one of only two known flocks of cyprinid fish species in the world and is the only one that remains intact. (Olson et al. 2000)

Although a comprehensive assessment of the status of freshwater species in Africa is not possible given the gaps in information, initial assessments from IUCN's show that in total there are 171 species of threatened animals in Africa. These include 15 species of freshwater-dependent birds, many of which are found only in Madagascar, 11 species of freshwater mammals, 15 species of amphibians, 5 species of freshwater reptiles, and 125 freshwater fish. These threatened animal species include charismatic mammals such as the river otters and the pygmy hippos, to less known species like the Madagascar big-headed turtle or Namibia's cave catfish.

In terms of threatened aquatic plants the information is even more limited. Taking into account that only a small number of aquatic plants have been assessed so far, IUCN lists a total of 14 as globally threatened. Of these 4 are found in Africa, all of them in Cameroon (Hilton-Taylor 2000).

Conclusions: The Way Forward

Working towards improved integrated river-basin management in Africa, and indeed worldwide, will be no easy feat given the enormity of existing problems. As this report shows, there are many areas in Africa already suffering from water scarcity. At least 9 basins, with a projected population of more than 10 million people, will go further into scarcity conditions by 2025. Africa has also been hard hit by fluctuating climatic conditions with increased frequencies of floods and droughts that have severely affected crop yields and livestock production.

Fisheries, which are a key component to food security in the region, have also been impacted by overexploitation, introduced species and water quality degradation. And even though Africa has seen an increase in non-native fish production through introduced species and aquaculture, local communities that had depended on the native fish for decades did not benefit from it,

primarily because these activities require expensive gear that local fishermen could not afford. In addition, because most of the non-native fish production like Nile perch and tilapia are shipped out of the region, the local availability of fish for consumption has declined impacting the food security of rural communities and their nutrient intake.

A good example of the need for an ecosystem approach to water management is the case of Lake Chad, which borders Nigeria, Niger, Chad and Cameroon. Lake Chad, once one of Africa's largest lakes, has dramatically decreased in size since the 1970s. Today it is estimated to be 1/20th the size it was 35 years ago (NASA Goddard Space Flight Center 2002). The Lake Chad region, has suffered from an increasingly dry climate, experiencing a significant decline in rainfall since the early 1960's. As the climate became drier, the vegetation that supported grazing livestock began to disappear, leading to overgrazing of the savannah, which exacerbated the aridity problem (Coe and Foley 2001). Vegetation has a big influence, especially in semi-arid regions, in determining weather patterns, therefore the loss of vegetation in itself contributed to a drier climate (Coe and Foley 2001). In addition massive water extraction for irrigation also began to increase in 1983. Between 1983 and 1994, the amount of water diverted for purposes of irrigation quadrupled from the amount used in the previous 25 years (NASA Goddard Space Flight Center 2002). The situation created is what Coe and Foley call a "domino effect." Overgrazing reduces vegetation, which in turn reduces the ecosystem's ability to recycle moisture back into the atmosphere, which contributes to the retreat of the monsoons. With a drier climate and less vegetation there was an increase in the use of lake water for irrigation, while the Sahara has gradually edged southward. According to researchers, Lake Chad is not likely to be replenished to its former size in our lifetime, and its decline has had an enormous impact on the 9 million farmers, fishermen, and herders living in the region (Coe and Foley 2001). They have experienced crop failures, dying livestock, collapsed fisheries, and the continuous draining of the lake. The problem is expected to worsen in the coming years as population and irrigation demands continue to increase. The situation illustrates the urgent need to better manage water resources, which are limited.

The establishment of river basin authorities for the larger African basins are a positive step towards improved ecosystem management at the river basin scale. Some examples of this are the LCBC (Commission du Bassin du Lac Tchad) for the Lake Chad Basin, the OMVF (Organisation pour la Mise en Valeur du Fleuve Sénégal) for the Senegal Basin, and OKACOM (Okavango River Basin Commission) for the Okavango River shared between Angola, Namibia and Botswana. However, to be effective, vastly increased resources are needed. Political tensions, lack of expertise and political will, risk being hindrances to progressive implementation of these cooperative arrangements.

Cooperative arrangement between these river basin authorities and international organizations such as WWF and the Ramsar Bureau, new dialogues between the agriculture and irrigation community and environmental NGOs such as the Dialogue for Food, Water, and Environment, and the recent push by many organizations for establishing environmental water requirements at the basin level are crucial to the sustainable management of water resources, maintenance of biodiversity and poverty alleviation in Africa. The following example in South Africa illustrates an approach that for the moment is working for both ecosystems and human well-being.

South Africa's Working for Water Programme – An Example to Follow

The Working for Water programme in South Africa is an excellent model, which may provide an example of the way forward for the rest of the region. Launched in 1995, the "Working for Water" programme tackles several crucial issues affecting South Africa's economic development and nature conservation. The programme has both environmental and social objectives. South Africa will gain more water flow in many currently dry streams, restore native

flora and fauna to rivers, while at the same time addressing social issues such as poverty alleviation and unemployment. The Working for Water programme is addressing this problem incrementally through widespread clearance of invasive species and presently has 300 ongoing projects throughout the country (Working for Water 2002).

Ecologically, the Working for Water programme takes an overall river basin approach to managing water flow. The introduction of invasive species into South Africa's naturally dry non-wooded catchments has placed further pressure in an already water stressed region. Invasive species such as Asia's Syringa (*Melia azedarch*), North American and European Pines (*Pinus spp.*), Australia's Black Wattle (*Acacia mearnsii*) and the Central and South American Lantana (*Lantana camara*) all have high water uptake compared to the native vegetation (WRI 2000). Within riparian zones the water uptake by these invasives is almost twice that in areas away from rivers (van Wilgen and van Wyk 1999). This ambitious task is, however, making headway. In the period 2001-02, 242,913 hectares of invading alien plants were cleared and 365,653 hectares of follow-up clearing was undertaken, up significantly from the 2000-01 period in which 242,913 hectares were cleared, with 183,736 hectares of follow up (Preston pers comm. August 2002).

The social benefits of this programme are many, including meaningful community empowerment and skill enhancement, knowledge, the fostering of responsible citizenship and reducing unemployment, in some cases also offering childcare (WRI 2000). Working for Water's 2000/1 Annual Report states that overall, 23,998 people are employed in the programme, 54 per cent of these workers being women and 26 per cent youth (Working for Water 2000-01).

This initiative is an example of the benefit of bottom-up management approaches and community empowerment. This model may provide an example for holistic water management to the rest of Africa. In the long term, however, it is less clear whether the Working for Water programme can provide meaningful long-term sustainable livelihoods for present participants. Positively, the programme has the ambitious aim of shifting 92 per cent of current participants into higher paying permanent jobs in, for example, fire management and ecotourism, and it is hoped that this programme will meet that goal. (WRI 2000)

Overall, working towards improved management coordination at the river basin scale and encompassing all issues of sustainable development need to be more diligently sought than at present. The data presented in this report demonstrates that compartmentalized approaches which focus only on providing improved water sources to the poor is not an adequate approach for the long-term sustainability of these freshwater systems and will ultimately be to the detriment of those in developing countries, especially in the face of increasing population. A number of rivers, such as the Nile and the Orange are, from the perspective of healthy environmental flow, nearly fully exploited and the human population in these basins continues to rise. The way forward for water management, particularly in more water stressed regions is to recognize that adequate water supply is dependent on protecting the entire source at the river basin scale. Sustainable use of freshwater for people and nature relies on improved efficiency in freshwater withdrawal/diversion to meet the needs of growing populations balanced with management of all aspects of whole ecosystems.

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