# Fisheries Opportunities Assessment

**Appendix 3**

**Africa's Freshwater Fisheries: An Assessment of Potential Investment Opportunities for USAID**

**By Ann Gordon, Patrick Dugan and Catrin Egerton**
**with contributions from Adaoma Wosu**

# December 2006



**Prepared By:**

**Sustainable Coastal Communities and Ecosystems Program (SUCCESS) and Global Water for Sustainability Program (GLOWS)**

**Components of the Integrated Management of Coastal and Freshwater Systems Program (IMCAFS)**

IMCAFS INTEGRATED MANAGEMENT OF COASTAL AND FRESHWATER SYSTEMS

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Cover Photo Credits: *Left:* Filipino fisher mending nets (Alan White); *Center*: Ecuadorian woman cleaning fish (Patrick Christie); *Right*: Fishing boats, Indonesia; (Robert Pomeroy)

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# AFRICA'S FRESHWATER FISHERIES:

# AN ASSESSMENT OF POTENTIAL INVESTMENT OPPORTUNITIES FOR USAID

**By Ann Gordon, Patrick Dugan and Catrin Egerton**
**with contributions from Adaoma Wosu**

**WorldFish Center**
**Regional Office for Africa and West Asia**
**Cairo**

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**Acronyms and abbreviations**

| | |
|---|---|
| AfDB | African Development Bank |
| AWF | African Wildlife Foundation |
| AU | African Union |
| BIOSS | Biodiversity Special Study |
| CAADP | Comprehensive Africa Agriculture Development Programme |
| CAR | Central African Republic |
| CARPE | Central Africa Regional Program for the Environment |
| CCRF | Code of Conduct for Responsible Fisheries |
| CEH | Centre for Ecology and Hydrology |
| CGIAR | Consultative Group for International Agricultural Research |
| CIFA | Committee for Inland Fisheries for Africa |
| COMESA | Common Market for Eastern and Southern Africa |
| CPUE | Catch per Unit Effort |
| CREDP | Congo River Environment and Development Project |
| DFID | Department for International Development (UK) |
| DRC | Democratic Republic of Congo |
| EAC | East African Community |
| ECCAS | Community Economic Community of Central African States |
| ECOWAS | Economic Community of West African States |
| EU | European Union |
| FAO | Food and Agriculture Organization of the United Nations |
| FINNIDA | Finnish Development Agency |
| GDP | Gross Domestic Product |
| GEF | Global Environmental Facility |
| GTZ | Deutsche Gesellschaft fur Technische Zusammenarbeit |
| ha | Hectare |
| HIV/AIDS | Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome |
| HDI | Human Development Index |
| HLC | High Level Committee on Fisheries |
| IUCN | The World Conservation Union |
| IRD | Institut pour la Recherche et le Development |
| kg | Kilograms |
| LCBC | Lake Chad Basin Commission |
| LTA | Lake Tanganyika Authority |
| LTBP | Lake Tanganyika Biodiversity Project |
| LTR | Lake Tanganyika Research Project |
| LVEMP | Lake Victoria Environment Management Programme |
| LVFO | Lake Victoria Fisheries Organization |
| LVFRP | Lake Victoria Fisheries Research Project |
| mm | Millimetre |
| MRAG | Marine Resources Assessment Group |
| NASA | National Aeronautics and Space Association |
| NBI | Nile Basin Initiative |

| | |
|---|---|
| NEPAD | New Partnership for Africa's Development |
| NGO | Non-Governmental Organization |
| NRI | Natural Resources Institute |
| POP. | Population |
| SADC | Southern African Development Community |
| SFLP | Sustainable Fisheries Livelihoods Programme |
| SSC | Species Survival Commission (IUCN) |
| SSA | Sub-Saharan Africa |
| t | Tonnes |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UNFPA | United Nations Population Fund |
| UNOPS | United Nations Office for Project Services |
| UNU | United Nations University |
| USAID | United States Agency for International Development |
| WWF | World Wide Fund for Nature |
| yr | Year |
| ZACPLAN | Zambezi River Action Plan |
| ZAMCOM | Zambezi River Commission |
| ZRA | Zambezi River Authority |

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## Executive Summary

This report concerns Africa's freshwater fisheries. It is one component of a global assessment of capture fisheries. A key emphasis in the assessment is to summarize issues concerning near-shore fisheries management globally, and how these can be matched to USAID interests in biodiversity conservation, poverty reduction, food security, democracy and good governance, and other development objectives.

Africa's freshwater fisheries are overwhelmingly small-scale and informal, supplying affordable protein to millions of people throughout Africa. In addition, millions of men and women are involved in the fishery—the latter often in processing and trade. Commercial freshwater fisheries, in the sense of a capitalized industry providing higher value products, are almost non-existent on the continent. About 50% of the continent's fish supplies are of freshwater origin—much more than in other parts of the world. The inland fishery comprises important river basins, inland lakes, wetlands and small ponds, many of which are seasonal. At present, the continent does not have a significant aquaculture sub-sector, though it presents favourable conditions for pro-poor aquaculture development. Properly managed, Africa's inland capture fisheries and aquaculture can be key drivers of rural economic development.

Key characteristics and trends affecting Africa's inland fisheries include: poor data, lack of visibility and weak capacities; absent or inappropriate policies and/or lack of means to implement policy; changes in the fisheries due to the construction of dams and the diversion of water for irrigation; a break-down in traditional management systems largely because of population pressure, migration and changes in land-use; an increasing tendency to over-fish; a strong need for community-based management systems, anchored in the broader livelihood context of fishing communities; a need to re-think fisheries assessment and management tools for data-scarce environments that will inevitably suffer periodic pressure when other sources of revenue fail; robust and growing local markets but poor market access; growing interest in aquaculture, particularly around urban centres; and important transboundary fisheries that present additional challenges for management.

At present, USAID has few programs that provide specific support to inland fisheries, but has provided support in a number of areas as part of larger environmental or integrated water resource management planning processes. USAID has particularly relevant experience in supporting transboundary programs and integrated conservation and development programs, involving multiple partners.

The recommendations focus on the potential contribution of inland fisheries to the President's Initiative to End Hunger in Africa and its support of the New Partnership for Africa's Development/NEPAD's Comprehensive Africa Agricultural Development Plan. The latter includes an Action Plan for Fisheries and Aquaculture (including components on marine and inland fisheries), which provides an appropriate framework within which to situate seven recommendations. These concern: sustaining production through integrated water resource management; supporting transboundary management;

developing governance systems that protect the interests of the poor; supporting post-harvest development; improving market access; promoting enterprise development through support for appropriate institutions and policies; and integrating consideration of fish into food security policies. These recommendations are widely applicable. Nonetheless, preliminary suggestions are made on countries and river/lake basins where they would have particular relevance.

## I. Introduction and context

### Scope of the study on Africa freshwater fisheries

This report concerns Africa freshwater fisheries—one component of a global assessment of capture fisheries. The assessment seeks to identify and recommend specific opportunities for USAID investment in near-shore small-scale marine and freshwater capture fisheries that contribute to one or more of the Agency's major mandates, initiatives, or focal areas. These may include, for instance, improved freshwater and marine biodiversity conservation, ecosystem health and productivity, improved democracy and rule of law, enhanced economic growth and livelihoods, reduced fragility and resource degradation, and strengthened public-private alliances and corporate responsibility for sustainable resource use. A key emphasis in the assessment is to summarize issues concerning near-shore fisheries management globally, and how these can be matched to USAID interests in biodiversity conservation, poverty reduction, food security, democracy and good governance, and other development objectives.

The Africa Freshwater Fisheries Study is organised as follows:

- I Introduction
- II Biodiversity overview of freshwater water fishery systems in Africa
- III Freshwater fisheries in Africa: issues and trends
- IV Assessment of policies, good practice and USAID programs in Africa
- V Recommendations

This report covers the Africa Region as defined by USAID—so, it excludes North Africa but includes the Sudan and Madagascar. The authors were asked to give particular focus to the Rift Valley lakes. In addition, where possible, information is also presented on the Congo River Basin, the Niger River Basin, the Lake Chad Basin, Madagascar, Lake Kariba and the Sudd Swamp. A map showing Africa's major lakes and river basins is attached as Annex A. While the focus is clearly on fisheries resources, some of the important water bodies in Africa are an inherent part of ecosystems that support other important wildlife resources. Without detracting from the main focus of the report, where this relationship is deemed particularly critical, these resources are also mentioned in the text. When fisheries management is neglected, there is often much more at stake.

The assessment and its component studies have been undertaken through review of the literature and telephone interview (or email exchange) with key informants. Sections II and III provide an overview of the existing literature on biodiversity and fisheries in the major ecosystems of sub-Saharan Africa. The information available varies considerably between systems, reflecting the extent to which each system has been studied and when those studies were undertaken. The telephone interviews were guided by a standard set of questions used for all the component studies. The authors are extremely grateful to those people for the critical input and ideas they provided. A list of people contacted is attached as Annex B.

**Overview of the importance of freshwater fisheries in Africa**

Africa's freshwater fisheries are overwhelmingly small-scale and informal, supplying affordable protein to millions of people throughout Africa. Millions of men and women are involved in the fishery—the latter often in processing (drying or smoking) and trading activity.[1] Commercial freshwater fisheries, in the sense of a capitalized industry providing higher value products, are almost non-existent on the continent, with the notable exceptions of Nile Perch frozen fillets exported from Lake Victoria to Europe and the Lake Kariba fishery.

In Africa, inland fisheries have greater relative importance than in other continents. Africa's inland fisheries account for about 24% of global inland capture fisheries production. About 50% of the continent's fish supplies are of freshwater origin—much more than in other parts of the world. The inland fisheries comprise important river basins, inland lakes, wetlands and small ponds, many of which are seasonal. At present, the continent does not have a significant aquaculture sub-sector, though it is argued that Africa presents favourable conditions for pro-poor aquaculture development particularly around its growing urban centres (widespread land ownership, robust and growing domestic markets for fish products, and increased agricultural intensification with a shift towards higher value products). Properly managed, Africa's inland capture fisheries and aquaculture present an important opportunity for rural economic development.

With poverty in Africa still overwhelmingly concentrated in rural areas, increased focus on rural livelihoods has highlighted how rural households derive incomes and sustenance from multiple sources. In surveys, many fisherfolk do not record fishing as their main income source. Poor people, in particular, exploit seasonal opportunities and undertake activities that require minimal investment, such as fishing. Gear is traditional and low-cost, or borrowed from traders, who in return purchase fish at preferential prices. Trading activity is undertaken at different scales, but almost everywhere in Africa it includes low-income women, able to buy, process and sell accessibly small quantities of fish. Tragically, in some communities, women exchange sex in return for fish, contributing to the very high rates of HIV/AIDS associated with the fisheries sector.[2]

Given the important role of Africa's inland fisheries in livelihoods and consumption, it is ironic that this sector has such low visibility. Much of this activity takes place in poorly accessible places, sometimes in seasonal fishing camps where conditions are hard. The people for whom it is important are poor and dependent on informal trading channels, where transactions are largely unrecorded by the authorities. The trucks carrying dried fish cross African borders at night or otherwise manage to escape surveillance (and taxes), and no-one notes the number of cycle traders and head-loaders that earn a living at the important landings. (A significant exception to this was a series of studies commissioned by USAID in the late-90s on informal cross-border trade. Dried fish was an important commodity at several border points including Mozambique/Malawi,

[1] Neiland, Arthur, et al. 2006. *Inland Fisheries in Africa: Key Issues and Future Investment Opportunities for Sustainable Development.* Cairo, Egypt: WorldFish Center.
[2] Gordon, Ann. 2005. *HIV/AIDS in the fisheries sector in Africa.* Cairo, Egypt: WorldFish Center

Uganda/Kenya, and Uganda/Democratic Republic of Congo-DRC). The fisheries departments responsible for monitoring rarely have the means to go to the field.

The information presented here is based on the available official data (whatever its shortcomings), but supplemented by information obtained from the literature, from WorldFish Center's own research, and from the key informants noted above.

**Africa freshwater fisheries: key regional issues**

Although clearly inter-related, ten critical issues are identified that have trans-boundary dimensions and/or widespread relevance throughout the continent:

(1) in most of Africa, inland fisheries are characterized by a lack of data, a lack of visibility and a weak (sometimes non-existent) policy framework; in Government, the fisheries sector is particularly poorly resourced;

(2) where there is policy, there is often no means to implement it—so there is a disjuncture between policy and practice; for instance, where there is a legal framework for co-management, the means and capacity to support it may be lacking (and decentralized Government staff may not even be aware of its provisions);

(3) throughout rural Africa, traditional tenure and common pool resource management systems are breaking down, as a consequence of population pressure, migration, and market access; this is affecting access to fisheries resources directly and via changes in land tenure in riparian communities; fisheries resources and the populations who depend on them are threatened;

(4) the fisheries themselves are being affected by changes in water use—particularly when dams are constructed or water used for irrigation;

(5) as traditional systems break-down under pressure, without being replaced by alternative management regimes, there is a management vacuum and a tendency to overfish;

(6) the importance of fisheries in the diverse livelihood systems of Africa's rural poor, combined with the minimal Government presence in fishing communities, means that workable management models must be community-based and must be anchored in an understanding of the livelihood context;

(7) there is a need to re-think fisheries assessment because the present tool-box is unreliable and prohibitively expensive in data-scarce environments, whilst its objective (managing for maximum sustainable yield) is inappropriate in situations where communities will periodically and necessarily over-fish because of disruption in other livelihood revenues (e.g., crop failure); a framework that takes account of periodic vulnerability and critical thresholds in the fishery

(beyond which the fishery could not recover, even if subsequently 'rested') would be more appropriate to the vulnerability context in Africa and more amenable to community uptake and management;

(8) population growth, urbanization and rising incomes are associated with increased consumption of animal protein; Africa has robust and high volume markets for fish products, but is handicapped by poor market access, much of it associated with poor physical infrastructure (particularly roads); this is a critical issue for sustainable development of Africa's inland fisheries and realizing the economic growth potential of this sub-sector;

(9) there is widespread interest in aquaculture on the continent; extensive (low external input) systems offer considerable potential to sustain rural livelihoods and provide an important source of animal protein to growing urban populations, whilst reducing pressure on critical natural resources; and

(10) many of Africa's large lake and river fisheries have international dimensions; management of these resources tends to be particularly uneven, because even though there may be official agreement on what is needed, the capacity to implement those recommendations varies enormously between countries; the incentives associated with improved management may also be unequal.

This summary of key regional issues will be echoed in the more detailed and specific review that follows.

## II. Biodiversity overview of freshwater systems

### Continental overview

Aquatic ecosystems are highly complex and sensitive to change. They are intimately linked to the surrounding terrestrial ecosystems, and are also often connected with each other through a variety of ground and surface water systems. The impact of freshwater systems on near-shore coastal areas is significant due to the effect of nutrient flows in the water, and because of the spawning systems of diadromous[3] aquatic resources.

Although distinct, discrete systems rarely exist in practice, the inland aquatic ecosystems are described below at the watershed/basin level. Drainage basins often form distinct biogeographic areas, and are inhabited by flora and fauna adapted to the basin. The interrelationship of terrestrial and aquatic ecosystems also makes it important to look at integrated water basin dynamics holistically.

For consistency throughout this section, the definition of ecoregions and bioregions has been adopted from Abell et al (2000), as described in Thieme et al (2005). An ecoregion is described as 'a large area of land or water containing a distinct assemblage of natural communities and species, whose boundaries approximate the original extent of natural communities before major land use change.' The definition of a bioregion used here is 'a complex of ecoregions that share a similar biogeographic history and thus, often have strong affinities at higher taxonomic levels (e.g., genera, families).' [4]

Sub-Saharan Africa (SSA) encompasses a vast range of different types of terrain, from desert and dry sahel to moist tropical forests. Africa's 12 major lake and river basins and 70-80 smaller river basins exist within and across vastly different bioregions, and, in addition to the mainstream rivers, support lakes, wetlands, swamps and reservoirs, as well as smaller waterbodies such as seasonal ponds and streams.[5] These river and lake basins are distinctive for being amongst the oldest in the world, and consequently are immensely important as evolutionary 'information banks', and are notable for their outstanding biodiversity features. Africa is widely acknowledged as having 'more archaic… freshwater fishes than any other continent, and outstanding species radiation among a variety of taxa in both rivers and lakes.'[6] There are an estimated 4,300 species of vertebrates and invertebrates in Africa's freshwaters,[7] which include 2-3,000 species of freshwater fish.[8]

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[3] Fish that spawn in freshwater and migrate to marine habitats to mature, or vice versa.
[4] Thieme, Michele L., et al. 2005. *Freshwater ecoregions of Africa and Madagascar: a conservation assessment*. Washington: WWF, p. 22-3
[5] Senegal; Niger; Volta; Chad Basin; Congo-Zaire; Cubango-Okavango; Orange-Vaal; Limpopo; Zambezi-Shire-Malawi; Tanganyika; Victoria; Nile
[6] Roberts (1975), Lowe-McConnell (1987), and Brown (1994), cited in Thieme et al (2005). Taxa is plural of taxon, referring to taxanomic categories such as species and family.
[7] Thieme et al (2005), p. 1
[8] Neiland et al (2006), p. 69, estimates 2,000; Thieme et al (2005), p. 4, estimates 3,000.

The African continent contains about 9% of the world's freshwater resources,[9] but there is significant variation between countries. In general, more precipitation in West and Central Africa means that there are more freshwater resources in these regions than in the far north, south and east of the continent. With an average of 25% of the continent's renewable water sources, the Democratic Republic of Congo (DRC) is the wettest country, while Mauritania, with 0.01% of Africa's total renewable water, is driest.[10] This broad calculation hides the seasonal variation that occurs in most rivers systems, where flows decrease and can even dry up entirely at certain points in the year, and are replenished (usually annually or biannually) by flood pulses determined by rainfall.[11] It has been estimated that 57% of Africa's waterbodies are affected this way,[12] and the water levels of larger rivers may rise or fall by 20m seasonally.[13] In many rivers, flow patterns have changed radically over the past 50-100 years as a result of dams and water abstraction for agriculture and urban use, and there is concern that climate change may exacerbate these impacts. There is some evidence that instances of both drought and flooding have been increasing over the past 30 years.[14]

Changes to ecosystem health are measured in a variety of ways, most frequently through the water quality, water quantity, and level of biodiversity.[15] Measurement of inland freshwater systems in Africa has been infrequent, and efforts have not been targeted strategically, with the result that there are significant gaps in the data available. Over the past 5-10 years, a number of organizations have tried to obtain an overview of past research and make this available in a comprehensive way (e.g., World Wildlife Fund's/(WWF Global 200 ecoregion initiative, and the World Conservation Union's/(IUCN Species Survival Commission/SSC Biodiversity Assessment Programme). The recent WWF assessment 'Freshwater Ecoregions of Africa and Madagascar', which rated aquatic resources in Africa according to biological distinctiveness and conservation status, highlighted a number of priority areas, and determined that 'the majority of the nineteen ecoregions in most urgent need of conservation attention (Class 1) are in the Great Rift Valley, Madagascar, and the Guinean-Congolian region.'[16] It also indicated data quality for the 93 ecosystems identified as high (26 ecosystems), medium (31 ecosystems) or low (36 ecosystems).

Most of the detailed studies have been undertaken on large waterbodies, but it is important to recognize that small water bodies (usually defined as less than 10km2), including ponds, streams and seasonal wetlands, also contain a range of important flora

[9] UNEP. 2002. *Africa Environment Outlook: Past, present and future perspectives*. Norway: UNEP. Available online at http://www.unep.org/dewa/Africa/publications/aeo-1/148.htm
[10] UNDP cited in UNEP (2002)
[11] Neiland et al (2006), p. 15
[12] Kapetsky (1995) cited in Kapetsky, J. M. and Barg U. *Land quality indicators from the viewpoint of inland fisheries and aquaculture.* Rome, Italy: Fishery Resources Division, FAO. Available online at http://www.fao.org/docrep/W4745E/w4745e0e.htm
[13] Neiland et al (2006), p. 70
[14] UNEP (2002)
[15] FAO. 2004b. *World Fisheries and Aquaculture Atlas CD-ROM*, Rome: FAO (E:\html\ecosys\inland\stattrends\default.htm)
[16] Thieme et al (2005), p. 91.

and fauna. While these may not be as important for biodiversity, their total area and widespread distribution means that they make an important contribution to Africa's total inland water resources. Verhaust (1998) estimated that there are between 50,000 and 100,000 of these water bodies in southern Africa alone, and they may support a yield of 1-3 million metric tonnes (t) of fish per year.[17]

**Rift Valley Lakes**

Africa's Rift valley stretches from the Red Sea in the north to Mozambique in the south. The Rift has two main branches: the eastern branch (the 'Great' Rift Valley), and the western branch (the Albertine Rift). The eastern rift is characterized by shallow lakes, which may be freshwater or saline-alkaline (e.g. Lake Turkana). The western rift is characterized by deep freshwater lakes (e.g. Lake Tanganyika).

With a great variety of lakes, rivers and wetlands, this bioregion supports unique flora and fauna. At least 1,500 freshwater fish species have been identified here, but according to Seehausen there may be as many again yet to be identified.[18] 15% of freshwater fish species globally are present in the Rift Valley lakes and rivers. Regional endemism is high (e.g. 82% of fish and 74% of mollusks are endemic[19]), indicating that species are well-adapted to their particular environments, and form essential ecological functions. Ninety percent of these fish belong to the perchlike cichlid family. In IUCN's Eastern Africa Biodiversity Assessment, it was estimated that 78% of fish identified in East Africa are either threatened or have now become extinct.

Each one of the three Great Lakes, Tanganyika, Malawi and Victoria, have more species of fish than the freshwater systems of Europe in their entirety.[20] Even excluding consideration of the Great Lakes, the Rift Valley region is extraordinarily rich in taxa and has high levels of endemism. Catchments worth noting in particular include the Lake basins of Lakes Edward, George, Turkana, Kivu, and associated Lakes Nabugabo and Kyoga, as well as a number of the river basins (Tana, Shire, Malagarasi, Pangani, Rufiji/Ruaha). Of these, most fish species are to be found in the Malagarasi river basin in Tanzania.

The Southern Eastern part of the Rift Valley system (the 'Gregory Rift Valley') stretches across an area of 3,800 $km^2$, spanning Kenya and Tanzania. An extensive series of small water bodies cover the region, which is also important for its saltpans and saline water as well as freshwater systems. The lakes of Natron, Nakuru, Bogoria and Manyara are globally important for their congregations of waterbirds, and the region contains the largest flocks of flamingos in the world.

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[17] Bernacsek (1984) cited in Tomi, Petr. [No date]. *Small waterbaodies*. [UN Atlas of the Oceans webpage]. Available online at http://www.oceansatlas.com/world_fisheries_and_aquaculture/html/ecosys/inland/modeco/small_water_bodies.htm

[18] Seehausen, Ole. 2005. 'The Cichlid Fish Radiations of East Africa: A Model for Understanding Origin and Loss of Biodiversity', in Thieme et al (2005), p. 48

[19] Darwall, W., et al. 2005. *The Status and Distribution of Freshwater Biodiversity in Eastern Africa. IUCN SSC Freshwater Biodiversity Assessment Programme*. Gland, Switzerland and Cambridge, UK: IUCN

[20] Seehausen (2005), p. 48

### *Lake Tanganyika*

Lake Tanganyika is the oldest of the three Great Lakes, and is the second oldest Lake in the world. It is also the second largest freshwater lake in the world, in terms of volume (after Baikal, in Siberia), and third largest in terms of surface area (after Baikal and Victoria). Situated in the Western branch of the Rift Valley, it is surrounded by four states: Burundi, Democratic Republic of Congo, Tanzania and Zambia.

The Lake and its catchment area contain an estimated 2,500 plant and animal species, 600 of which are endemic, including the 231 species of freshwater fish. The pelagic fish community of the Lake is unique,[21] and unlike the other Great Lakes, Tanganyika also hosts a number of species flocks of fish other than cichlids, though with 250 identified species, cichlids are predominant.[22]

Changes to the communities and composition of species within the lake have occurred over recent years in the wake of threats such as urban pollution (particularly around Bujumbura), pollution from boat discharges, sedimentation from deforestation, and overfishing. There are a number of smaller threats that are also disrupting the ecosystem, including pesticides, mineral exploitation, and atmospheric deposition.

Lake Tanganyika has been assessed as a globally outstanding biodiversity region by WWF. Part of Lake Tanganyika is a Ramsar site,[23] and a significant body of opinion is in favour of extending the area under protection to include the critical surrounding watersheds.

### *Lake Malawi*

Lake Malawi (Nyasa/Niassa)[24] has been designated as an international biosphere reserve under the United Nations Edcuational, Scientific, and Cultural Organization's (UNESCO) 'Man and the Biosphere' Programme, as well as being recognized by WWF as 'globally outstanding'. The lake is the 9th largest in the world, and is thought to contain more fish species than any other lake in the world. Lake Malawi is located in the Western Rift Valley, between Malawi, Tanzania and Mozambique.

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[21] Thieme et al (2005), p. 284

[22] West, K. 2001. *Lake Tanganyika: Results and experiences of the UNDP/GEF conservation initiative (RAF/92/G32) in Burundi, D. R. Congo, Tanzania, and Zambia*. GEF. p.18. Available online at www.iwlearn.net/publications/knowledge-products/

[23] 'The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 152 Contracting Parties to the Convention, with 1609 wetland sites, totalling 145.8 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.' Available online at http://www.ramsar.org

[24] Most commonly known as Lake Malawi, and referred to in the text by this name. Also known as Lake Nyasa/Niassa in Tanzania and Mozambique.

Estimates of fish numbers in Lake Malawi vary considerably. Ribbink (2001) has hypothesized that there could be up to 3,000 taxa (species and sub-populations). A more narrow consideration puts the number of fish species at about 800. Ninety percent of the lake's fish species are halpochromine cichlids, and the other 10 percent belong to just nine other fish families, including an endemic species flock of clariids. Of the cichlids, over 98% are endemic to Lake Malawi.[25] There are high levels of endemism amongst the lacustrine invertebrates as well. This species radiation is thought to be one of the highest globally (greater than the Galapagos islands), and the lake is therefore particularly important to the study of evolution.[26]

Biodiversity and ecosystem health are threatened by overfishing, sedimentation from deforestation, eutrophication, and pollution from agriculture. A Lake Malawi Workshop held in 2001 prioritised conservation action, noting particularly the urgent need to reduce eutrophication and maintain levels of river-breeding and cichlid stocks.[27]

***Lake Victoria***

Lake Victoria is an exception to the other Rift Valley lakes dealt with here, as it lies in a depression between the eastern and western portions of the rift, and does not lie in a rift trench.[28] It is situated between three nations: Kenya, Tanzania and Uganda. The catchment area of Lake Victoria basin is more than 193,000 $km^2$, while the lake itself has the largest surface area of any tropical lake (68,800 $km^2$), and is globally second only to Lake Baikal.

Estimates of fish species in Lake Victoria vary widely, but more than 600 endemic species have been identified.[29] There are 500 species of cichlids of which more than 300 are endemic.[30] Other taxa dependent on the Lake include amphibians, the Nile crocodile, otter species and a hippo. These all have an impact on the food chain and a role in modifying aquatic habitats, and are therefore critical to maintaining the ecosystem for fish.[31]

Lake Victoria is, however, also famous for being the site of the 'what is probably the largest mass extinction of contemporary vertebrates.'[32] Since the introduction of invasive alien species—the Nile Perch and Nile Tilapia—into Lake Victoria in the 1950s, there

[25] Ribbink (2001) cited in Thieme et al (2005), p. 94, 279
[26] Species richness is not limited to the lake itself, but extends across the lake basin, which contains an estimated 200 mammals, 650 birds, and 5,500 plant species. Brown (1994), cited in Thieme et al (2005), p. 96
[27] Chafota et al (2002) cited in Thieme et al (2005), p. 108
[28] Leveque (1997) cited in Thieme et al (2005), p. 287
[29] Thieme et al (2005), p. 289
[30] Thieme et al (2005), p. 94
[31] In Lake Edward for example, the reduction in hippos from poaching (down from nearly 30,000 in 1974 to less than 600 in 2005) has meant less hippo manure is entering the Lake and subsequently less microscopic plankton and worms and larvae to feed the lake's tilapia fish, according to WWF's Marc Languy (National Geographic News, Dec. 14 2005. Available online at http://news.nationalgeographic.com/news/2005/12/1214_051214_hippo_dung.htm)
[32] Seehausen et al (1997) cited in Thieme et al (2005), p. 290

have been considerable changes to the Lake's fish communities and population dynamics. However, it is possible that habitat degradation[33] may have had as much, or even more impact, than the introduction of alien species[34], and there remains considerable debate as to the exact cause of the changes in fish biodiversity. Whatever the cause or combination of causes, the result has been the extinction of an estimated 200 endemic cichlids, and many of the remainder are now endangered. Very recently, however, with Nile Perch overfishing, some endemic species thought to be extinct have been rediscovered, while others have been found in satellite lakes.[35] The introduction of invasive water hyacinth and water lettuce has also had an impact on the ecology of the lake.[36] Other threats include deforestation, dumping of industrial and agricultural wastes and population increases around the lake.

**The Sudd Swamp**

The Sudd is located in the Upper Nile region of southern Sudan, and is one of the largest and most biologically interesting wetlands in the world. The full extent of the ecoregion, and the effects of the swamp, is roughly 150,000 $km^2$, although the Sudd habitat area is between 30,000 and 40,000 $km^2$, and its size changes dramatically with fluctuations in seasonal rainfall. From 1960, increasing rainfall in the headwaters led to an increase in the inflow into the Sudd. Between 1960 and 1980, the wetland was increasing—but whether this expansion has continued is unknown.[37] The area is made up of open-water, river-lakes, flooded grasslands and wetlands, and woodlands.

The Sudd is reported to have 115 fish species, of which 16 are endemic.[38] These support an important artisanal fishery for the Dinka, Nuer and Shiluk tribes. The effects of fishing on fish populations is unknown, but pressure on fishing resources is likely to have grown over recent years with ongoing civil war contributing to breakdown of controls. This has been the case for other populations, which have been subject to poaching efforts, and seems likely to hold true for fishing.[39]

The productivity of the Sudd depends on the water regime and the ecosystem, and its fisheries are vulnerable to changes in the hydrological cycle, either as a result of direct human intervention or climate change. One longstanding threat is the possible construction of the Jonglei canal, which was designed to speed water flow through the Sudd and so reduce evaporation losses in the wetland system. The canal was started in 1978 and was intended to go from Bor in the South to Malakal in the north (linking two

[33] The decline in quality of a habitat resulting in an impaired capacity to support biological communities.
[34] Mumba, S and Howard, G. 2005. 'Invasive Alien Species in African Freshwater Ecosystems', in Thieme et al (2005), pp. 78-81
[35] Chapman et al (2003) and Balirwa et al (2003), cited in Thieme et al (2005), p. 290
[36] This invasive plant was bought from South America, but the process by which it came to spread across large areas of Africa, is poorly documented.
[37] Hughes and Hughes (1992), in WWF. 2001. *Saharan Flooded Grasslands AT0905*. Available online at http://www.worldwildlife.org/wildworld/profiles/terrestrial/at/at0905_full.html
[38] Thieme et al (2005), p. 95
[39] The white ear kob population, for example, declined by 74% between 1980 and 2001. Thieme et al (2005), p. 207

points in the curve of the White Nile river), but construction stopped in 1983 due to outbreak of conflict. If completed, the canal would result in a shrinkage of the flood plain (by an estimated 20% in the wet season and 10% in the dry season[40]), and so have a major impact on the fisheries of the Sudd. According to the Food and Agriculture Organization (FAO), 'A severe decrease in the discharge into the Sudd resulting from the Jonglei canal would bring about the total disappearance of many lakes in the papyrus zone and reduce others to the status of seasonal lagoons, with a serious loss of year-round fish and fishing potential.'[41]

**Congo River Basin**

Central Africa contains the second largest expanse of tropical rainforest in the world, which is contained in three river systems, the Congo, Ogooue, and Sanaga. The Congo River is by far the largest of these. Its watershed extends into Tanzania, and the basin area, covering between 3,730,000 $km^2$ and 4,100,000 $km^2$,[42] and encompasses the Republic of Congo, Democratic Republic of Congo, Central African Republic, Equatorial Guinea, Gabon,[43] Cameroon, Angola, Burundi, Rwanda, and Zambia. Due to the different habitats along the river (swamps, lakes, rapids, etc), it is usually divided into a number of ecoregions.

According to Tuegels and Thieme, 'the Congo Basin has the highest species richness of any river system on the African continent'[44], while Lowe-McConnell[45] estimates that up to 80% of the species in this ecoregion are endemic. The Congo River alone contains approximately 700 fish species, 500 of which are endemic to the region.[46] Even now, however, knowledge of biodiversity in this region is poor,[47] and many areas of the basin have still not been explored.

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[40] Ramsar. 2005. *The Annotated Ramsar List: Sudan*. Available online at http://www.ramsar.org/profile/profiles_sudan.htm

[41] FAO. 1997. *Irrigation potential in Africa: a basin approach*. Rome, Italy: FAO. Available online at http://www.fao.org/docrep/W4347E/w4347e11.htm

[42] Teugels, G., and Thieme, M. 2005. 'Freshwater Fish Biodiversity in the Congo Basin' in Thieme et al (2005)

[43] Different organizations and individuals identify different countries when alluding to the Congo River Basin. USAID for example works in six countries which form the 'key' Congo Basin countries for partnership purposes (Cameroon, Central Africa Republic, Democratic Republic of Congo, Equatorial Guinea, Gabon, and Republic of Congo. See http://www.usaid.gov/locations/sub-saharan_africa/initiatives/cbfp.html) even though some (Gabon, Equatorial Guinea) are not drained by the Congo River. Other definitions exclude these countries on the basis that they are not in the drainage basin, but do include further 'peripheral' countries which have some land in the drainage basin, such as Tanzania, Zambia, etc, e.g. Tuegels and Thieme (2005), p. 51

[44] Tuegels and Thieme (2005), p. 51

[45] Lowe-McConnell (1987) cited in Thieme et al (2005), p. 52

[46] Water Resources eAtlas: *Congo Watershed*. Available online at http://www.waterandnature.org/eatlas/html/af3.html; Shumway (2003), p. 9

[47] WCS. [No date]. *Central African Forests Factsheet*, p. 6. Available online at http://wcs.org/centralafrica/FactSheets/CenterOfBiodiversity.pdf

The need to protect these remote areas is increasingly recognized, and 35 national parks have been set up by Congo Basin countries, covering 4.7% of the area.[48] The interior of the basin remains relatively intact, and it is critical these areas of 'wilderness' are adequately protected. Due to political instability, the remote regions of the basin remain unexploited by licensed large-scale industrial enterprises, though informal extraction (e.g. logging) does take place to a limited extent. Lack of regulation means that fishing techniques can be destructive to fish communities (e.g. poisoning, small meshed nets).[49] Towards the coast, pollution from urban centers (Kinshasa, Brazzaville) is increasing, and will continue to do so as cities grow. Instability makes measuring populations difficult, but in Bas Congo province, for example, population density was 42 people/km$^2$ in 1990, and the growth rate between 1990 and 1995 was 2.5 %.[50] According to WWF, the population in the Congo Basin countries will double between 2005 and 2020.[51] There may be considerable future threats (once the political regime is more stable) in the form of increased commercial extraction of natural resources (timber, gold), industrial pollution, and the construction of dams. It is vital that research is conducted and policies adapted to manage these developments in advance.

**Zambezi Basin and Lake Kariba**

The Zambezi river bdasin is Southern Africa's largest freshwater system. It stretches from Zambia in the west to the sea in Mozambique. It covers a number of habitat types, from floodplains to savanna, and there are a number of ecoregions within the basin. The three most important ecoregions, following the course of the main riverbed, are the Upper Zambezi (upstream of the Victoria Falls), Middle Zambezi (from the Victoria falls to Cahora Bassa) and the Lower Zambezi (from Cahora Falls to the Indian Ocean). The ichthyofauna are different in each ecoregion, with barriers to fish migration formed by the Victoria Falls and by dams in the Middle Zambezi. The Upper Zambezi particularly has extensive floodplains (the ecologically important Barotse floodplains, the Chobe swamps, and Caprivi wetlands).

Surveys conducted by the African Wildlife Foundation (AWF) in 2002 and 2003, with the support of USAID, improved knowledge of biodiversity along the Zambezi considerably, and suggested that about 20 new species need to be described. Previous estimates[52], excluding Lake Malawi, identified 239 species of fish in the Zambezi basin, 122 in the main Zambezi river, and 117 in satellite water bodies.[53] There is rich familial

[48] Water Resources eAtlas: Congo Watershed. Available online at http://www.waterandnature.org/eatlas/html/af3.html
[49] Democratic Republic of Congo (1998) cited in Thieme et al (2005), p. 221
[50] DRC (1998) cited in Thieme et al (2005), p. 221
[51] From 60 million to 120 million. WWF. *Population growth in the Congo River Basin* [webpage]. Available online at http://www.panda.org/about_wwf/where_we_work/africa/what_we_do/central_africa/congo_basin_forests/problems/population_growth/index.cfm
[52] Skelton (2001) cited in Mwima, H and Mandima, J. 2005. 'African Wildlife Foundation Experience in the Management of Fishery Resources in Two Southern African Landscapes' in Thieme et al (2005), p. 127
[53] Mandima, J and Mwima, H. 2005. 'Baseline Fish Biodiversity Surveys: African Wildlife Foundation Experiences form the Zambezi River, Southern Africa' in Thieme et al (2005), p. 53

diversity among fish in the Zambezi basin. Tigerfish (*Hydrocynus vittatus*), lungfish (*Protopterus annectens brieni*), cichlid and cyprinid species are most common.

The Kariba dam, on the border between Zambia and Zimbabwe, is one of the largest dams in the world. The manmade reservoir, Lake Kariba, is located in the former Gwembe valley and has a catchment size of 663,848 $km^2$. It provides one of the few successful examples of introducing alien species into lakes. After the creation of the lake, it became apparent that the native lacustrine species were utilizing only 38% of the lake habitat. A pelagic clupeid from Lake Tanganyika, the Kapenta or *Limnothrissa miodon* was introduced, along with other cichlid species from Kafue.[54] The successful offshore pelagic sardine fishery exploits Kapenta stocks, and seems to have had little negative biological effect on indigenous species.[55] There are 40 species of fish present in the Lake. Hippos and crocodiles are also dependent on the lake, and other mammals such as elephant, buffalo and rhinocerus frequent the lakeside.

Cahora Bassa, further downstream, was left relatively untouched by commercial fishing until the end of the Mozambiquan civil war in 1992. The damming of the Cahora Bassa, in 1975, produced a reservoir of 2,665 $km^2$ (surface area)—the second largest on the Zambezi, and the second largest lake (after Lake Malawi) in Mozambique. Below the Cahorra Bassa, the river crosses a mountainous area, before dropping to the delta. The water system of the delta region is more affected by the water flow of the Shire River than by the upstream of the Zambezi.

The AWF survey highlighted the threats from falling water table, and siltation and eutrophication, which occur largely as a result of dams and manmade barriers changing the river flow regime. Other threats include urban pollution, deforestation, overgrazing, and unsustainable tourism activities.[56]

**Lake Chad Basin**

In terms of biodiversity, Lake Chad is nationally rather than regionally or globally important. However, given its location in an otherwise dry region, the number of people dependent on lake resources, and its endangered conservation status, it warrants closer attention. The lake is situated at the southern limit of the Sahara desert, at the border between Niger, Nigeria, Chad and Cameroon. The size of the lake varies enormously within any given year, but also between years (see below). Floodplains around the lake also expand and contract dramatically, reaching up to 90,000 $km^2$ during the wet season of a rainy year.[57]

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[54] Magadza, C. 'Kariba Reservoir: Experience and Lessons Learned Brief' in ILEC. 2006. *Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders*. Kusatsu, Japan: International Lake Environment Committee Foundation, p. 208. Available online at http://www.ilec.or.jp/lbmi2/index.htm

[55] LakeNet Profile: Kariba. Available online at http://www.worldlakes.org/lakedetails.asp?lakeid=8360

[56] Mandima and Wwima (2005), p.126

[57] Thieme et al (2005), p. 192

The ichthyofauna of the basin are adapted to the flooding regime. Fish migrate between the lake, rivers and floodplains at different points in their lifecycle. Changes to the flood cycle therefore have a big impact on which species are prevalent. Following drought in the 1970s, for example, lacustrine fish that depend on migration suffered high mortality rates, but marshy species, such as lungfish were less affected.[58] The lake contains 25 mollusk and 36 frog species, and is a resting stop for 65 species of birds across different parts of the year.[59]

The major threat to the lake is the changing water level. This has been particularly significant over the past 40 years. In 1964, the total size of the Lake was 25,000 $km^2$. During the drought of 1972-1975, it was just one tenth of that size, at 2,500 $km^2$. The United States National Aeronautics and Space Administration's (NASA) satellite imagery in 2001 shows that the Lake may now have shrunk even further, and could be as little as one twentieth of its 1964 size.[60] This reduction is caused partly by lower rainfall and changed climatic conditions, and partly by increased use of water for irrigation in the catchment. Future threats come from proposed large-scale irrigation and water transfer proposals.

**Niger River**

The Niger River and its tributaries flow through more countries than any other river in Africa, traversing through Guinea, Mali, Niger, Nigeria, Cote D'Ivoire, Burkina Faso, Benin, Chad and Cameroon between its headwaters in Guinea and where it forms a delta before flowing into the Atlantic Ocean on the coast of Nigeria. The main body of the river extends across 4,200 km. The river as a whole is notable for its biodiversity, with the Malian Inner Niger Delta (deemed continentally outstanding by WWF), and the Nigerian Niger Delta near the coast (globally outstanding), being worthy of particular attention.

Located in central Mali, in the semi-arid Sahel, the Inner Niger Delta is flooded each year when the Niger and Bani rivers swell due to rainfall. Depending on rainfall and river discharge, the flooded area varies between 9,500 $km^2$ and 44,000 $km^2$.[61] There are 130 species of fish in the delta, two of which are endemic. All are highly adapted to the flood system, either migrating with the receding flood, or surviving in small pools left behind.[62]

The Lower Niger-Benue contains 202 fish species, including 17 endemics, the majority of which are adapted to flooding patterns. In the past, researchers believe, during wet periods the river may have been connected to other river basins in the region, including the Chad basin.[63]

[58] Thieme et al (2005), p. 193
[59] Thieme et al (2005), p. 193
[60] Thieme et al (2005), p. 194
[61] Thieme et al (2005), p. 186
[62] Thieme et al (2005), p. 188
[63] Thieme et al (2005), p. 306

The Niger Delta, an ancient area of freshwater swamps, mangrove forests, rainforest and floodplains, covers an area of more than 10,000 $km^2$, and is mostly freshwater. Blackwater (e.g. New Calabar) and whitewater (e.g. Niger) river systems converge in this area, each with distinctive biodiversity characteristics. The delta is Africa's largest wetland and also contains the largest area of mangrove forest in Africa (5,000 $km^2$), and the highest concentration of monotypic fish families in the world. Many fish species have yet to be identified, but fish fauna include Nilo-Sudanian, Upper Guinean, and Lower Guinean species, a number of which are endemic to the region. Identified by WWF as a Class 1 priority conservation ecoregion, with globally outstanding biological distinctiveness and high levels of taxonomic endemism, it faces severe threats, particularly pollution from extractive industry and the related developments (settlements, road construction). There are no protected areas in the delta.[64]

**Madagascar**

Madagascar is the fourth largest island in the world, and is situated in the western part of the Indian Ocean. The whole island has been recognized as important for its freshwater and terrestrial biodiversity. Its geographical isolation from other major land masses, and varied micro-climates, means that it supports important endemic biodiversity.

Although Madagascar has important and famous coral reefs, 65% of Madagascar's fisheries come from inland waters.[65] In 1990, the country had an estimated 530 lacustrine water bodies greater than 0.2 $km^2$, and a floodplain area of between 918 and 2,000 $km^2$.[66] Freshwater biodiversity is particularly important in the east and north of Madagascar. The country has 101 species of endemic freshwater fish, as well as endemic mollusks and crustaceans and one endemic turtle species. Most of Madagascar's endemic freshwater species occur in rivers and streams in the eastern and northeastern areas of the island. Many of Madagascar's fish are primitive, and reveal important information about the evolution of advanced fish in the cichlid, catfish and herring families amongst others.[67] Similarly, the absence of a number of fish families that are found in both Africa and India, as well as the absence of any large predatory fish, make the island of particular ecological interest.[68]

Aquatic biota in Madagascar are under severe threat from environmental degradation, including deforestation, erosion, and sedimentation, as well as pollution and the introduction of non-native species. These developments have had an impact on fish

[64] Thieme et al (2005), p. 91.
[65] Brainard et al (1992) in Shumway, C. 1999. *Forgotten Waters: Freshwater and Marine Ecosystems in Africa: Strategies for Biodiversity Conservation and Sustainable Development*. Boston, USA: Boston University.
[66] Vanden Bossche, J.-P.; Bernacsek, G.M. 1990. 'Source book for the inland fishery resources of Africa: 1'. *CIFA Technical Paper*. No. 18.1. Rome, FAO.
[67] Shumway (1999), p. 23.
[68] Sparks, J and Stiassny, M. 'Madagascar's Freshwater Fishes: An Imperiled Treasure' in Thieme et al (2005), p. 63.

stocks, some of which have collapsed. Freshwater fish are the most threatened of the island's vertebrates.[69]

The Alaotra wetlands are the largest in the country. They support a wide range of aquatic species, and are also very valuable to the human population. For these reasons, the wetlands warrant particular mention. Six endemic fish species have been recorded from the area in the past, but none has been seen since 2001.[70] The fish community has been disrupted by the introduction of non-native species, and catches are now dominated by Tilapia.[71] Another non-native species that is causing disruption to the ecosystem is the carnivorous *Channa striata*, which, according to local observers, preys on endemic bird species.[72]

The Alaotra Lake and wetlands are a Ramsar site, and there are plans for 8,900 ha to become a protected area with no extractive use.[73]

[69] Shumway (1999), p. 58
[70] Andrianandrasana, H. et al. 2005. 'Participatory ecological monitoring of the Alaotra wetlands in Madagascar', *Biodiversity and Conservation* 14: 2757-2774, p.2758 cf. p. 2766
[71] Andrianandrasana (2005), p. 2766
[72] Andrianandrasana (2005), p. 2758
[73] Andrianandrasana (2005), p. 2760

## III. Freshwater fisheries in Africa – issues and trends

### Socio-economic importance of freshwater fisheries in Africa

The majority of freshwater fish production in Africa is caught by informal and artisanal fishers rather than industrial and commercial concerns. 99% of fisherfolk in Africa are involved in small-scale fisheries, of one kind or another.[74] Many small-scale farmers and herders fish intermittently, and full-time fishing as an occupation is an exception rather than the rule. Much small-scale fishery activity takes place in rural areas with poor infrastructure, and plays a vital livelihood role in regions where other employment options are limited, employing millions of Africans.[75] Likewise, fish contributes essential animal protein to diets, which might otherwise be protein deficient. (Marine and inland fish combined supply an estimated 22% of animal protein in SSA as a whole, and in at least seven African countries fish accounts for over 60% of animal protein consumed.[76])

Fish which is harvested as a 'wild food' or caught by small-scale fishers and exchanged for other goods or services, or traded informally, is usually under-reported in national statistics. Reporting by species is also weak. Of reported inland capture statistics, 45% of fish species are unidentified.[77] Consequently it is hard to gauge accurately the role of inland fisheries in supporting livelihoods and food security, and contributing to the economy. It is even more difficult to ascertain which fish species are providing this variety of services at what level (i.e. which fish are commercially important, and which have a greater role in local consumption).

Despite the data limitations, it is clear that the inland fishery sector in Africa, even by official figures, is dynamic. According to FAO, in 2002, 24% of global inland capture fisheries production was in Africa.[78] Over the 12 year period 1984-1996, African inland capture fisheries production increased by 2% per year, while in the period 1951 – 1999, inland fisheries increased from less than 25% of total capture fisheries production to over 50%.[79] Tanzania and Uganda are ranked among the top ten inland capture fishery countries in the world, with reported catches of 274,000 t (3.1% of total) and 222,000 t (2.5% of total) respectively.[80] In the countries where there is large-scale commercial inland fishery activity, in particular those bordering the Great Lakes, it is apparent that

[74] WorldFish Center. 2005a. *Fisheries and the Millennium Development Goals: Solutions for Africa*. Cairo, Egypt: WorldFish Center
[75] An estimated 35 million for small-scale inland and marine combined. WorldFish Center. 2005b. *Supporting the Contribution of Small-scale Fisheries to Africa's Economic Development*. Cairo, Egypt: WorldFish Center
[76] Comoros, Equatorial Guinea, Gambia, Ghana, Guinea, Sao Tome and Principe, Sierra Leone (Source: Anon, cited in WorldFish Center. 2005c. *Fish and Food Security in Africa*. Cairo, Egypt: WorldFish Center)
[77] FAO (2004b), E:\html\resources\capture\swir\default.htm.
[78] FAO. 2004a. *The State of World Fisheries and Aquaculture 2004*. Rome, Italy: FAO, p. 12
[79] Neiland et al (2006), p. 18
[80] FAO (2004), p. 12

reported inland catches are substantial and may even exceed marine catches (e.g. Tanzania).

A summary of some of the current indicators of inland fisheries are given below. This provides something of a benchmark for observing future trends.[81]

| **The importance of inland fisheries in Africa – a statistical overview** | |
|---|---|
| PRODUCTION | |
| • Total inland production (% of global total) | 2.1 million t (24%) |
| • Total inland production as proportion of total fisheries production | 49% |
| • Annual rate of increase of inland fisheries production | 2% |
| • Total no. of African countries with inland production >100,000t/year | 7 |
| VALUE | |
| • Total first sale value of inland fisheries production (% of global value) | US$1.82 billion (2%) |
| • Total economic value of inland fisheries production | Not known |
| EXPORTS | |
| • Total value of inland fisheries exports (international) (% of global total) | c. US$650 million (1%) |
| • Total volume/value of inland fisheries exports (regional) | Not known |
| FISH SUPPLY | |
| • No. African countries with inland fish supply >4kg/capita | 13 |
| • GDP contribution of inland fisheries (mean) | <1% |
| • Total no. African countries with GDP contribution >1% | 5 |
| EMPLOYMENT | |
| • Total employment in African fisheries (% of global total) | 2.6 million (7%) |
| • Total employment in African inland fisheries | Not known |
| • No. part-time fishers | Significant |
| NUTRITION | |
| • Fish protein supply in Africa, average (global average) | 2.4g/capita/day (4.4g) |
| • No. African countries where fish represent >50% total animal protein supply | 7 |
| • No. African countries where inland fisheries represent >50% per capita fish supply | 16 |
| Source: Neiland et al (2006) | |

[81] Neiland et al (2006), p. 29

## Threats facing Africa's inland fisheries

### *Environmental change*

Environmental change and overfishing are the two major threats facing Africa's inland fisheries. The principal environmental threats concern changes in the water regime in rivers and lakes, primarily due to the construction of hydro-dams and the abstraction of water for agriculture. In some cases, this threat is exacerbated by catchment degradation, soil erosion and siltation, while in others there is physical loss of fish habitats as a result of poldering of floodplains, and pollution, which can be locally important. However, these issues are generally minor in comparison to the more widespread and more serious threats arising from water management practices. In the absence of action to address these threats to inland fisheries, investment in efforts to improve fisheries management or enhance the development value of the fishery through processing and trade will almost certainly be of limited long-term value. Much greater attention, therefore, needs to be given to addressing these environmental threats.

### *Overfishing*

There are indications of overfishing in many of Africa's waterbodies. While in several cases it has been shown that biological production has not declined significantly, the overall value of the catch has declined as the larger predators have been overfished. In others, notably in some of the lake fisheries, there has been a significant decline in total catch. These experiences raise important questions about how these fisheries can be managed to optimize their economic and social value. It is clear that the current management weaknesses in Africa's fisheries need to be addressed if these resources are to realise their full potential contribution to social and economic development in the region.

In inland fisheries in Africa, many problems arise from the fact that fisheries are de facto 'open access', without management in place to regulate pressure on resources. The problems related to overfishing can vary considerably depending on three variables: 'system variability, susceptibility of species to fishing, and selectivity and scale of operation of fishing patterns.'[82] Some fish are more 'susceptible' to overfishing than others, or may be particularly vulnerable at certain stages in their migration cycles. This can impact the type of remedy that would be best in any given instance, i.e. net size, protected area or closed season. Small-scale fishing—by targeting a broader range of fish species—is more likely to result in 'an overall unselective fishing pattern… that appears to be ecosystem conserving.'[83] However, an increase in fishing effort and changes in gear can, nonetheless, result in pressure on fish resources.

[82] FAO (2004a), p. 134
[83] FAO (2004a), p. 136

### *Climate change*

Climate change is predicted to have a big impact on inland fishing communities in Africa. Water bodies will be affected as precipitation and evapotranspiration rates alter their hydrology. Research has shown that if risk exposure, sensitivity and adaptive capacity are combined to predict vulnerability 'it is African countries whose fisheries sectors and fishing people are most vulnerable to climate change… and it is those semi-arid countries with significant coastal or inland fisheries that will be most vulnerable.'[84] Using two different climate change scenarios, of the top 15 countries with highest vulnerability of fisheries, African countries ranked numbers 13 and 14 respectively. Water systems that will be particularly vulnerable are shallow lakes and wetlands, where precipitation will impact water hydrology and the geographical extent of water. The rift valley lakes, and Lakes Chad, Chilwa and Kyoga were singled out as being climate-sensitive.

## Other major trends of importance for Africa's inland fisheries

### *Population growth*

With a projected growth rate of 2.2% between 2003 and 2015, (medium variant)[85] population increases across Africa will have a big impact on fisheries in a number of ways. According to the United Nations Population Fund (UNFPA), between 1995 and 2050, the population of Africa will have tripled.[86] There will be direct effects, probably including increasing numbers of fishers entering the fisheries sector, declining catch per unit effort, and increasing demand for fish products. There will also be substantial indirect effects on fisheries arising from changing use of water resources: dam construction, irrigation systems, industrial pollution, deforestation, and urban withdrawals all alter the status of the ecosystem.

### *Health*

HIV and AIDS, and other diseases of poverty, affect fisherfolk disproportionately. HIV/AIDS rates in fishing communities are much higher than in surrounding non-fishing populations. A study by Kissling et al (2005)[87] revealed prevalence rates in fisherfolk in three African countries that were between 4 and 6 times higher than amongst the general population. This impacts the health of the communities concerned, capacity to earn income, the provision of fish to local diets, and export earnings. It also has consequences for the long-term conservation of biodiversity, as loss of skills and knowledge in the

[84] Allison, Edward H., et al. 2005. *Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisherfolk living in poverty: Summary Report*. London, UK: Fisheries Management Science Programme, DFID, p. [5]
[85] UNDP. 2005. *Human Development Report 2005*, p. 235
[86] Cited in Thieme et al (2005), p. 5
[87] Gordon (2005), p. 2

fishery sector (communities and supporting institutions such as Fishery Departments) may lead to unsustainable and destructive fishing practices.[88]

### *Species introduction*

The introduction of non-native species into aquatic environments can pose a threat. Despite the well-known introduction of Nile Perch into Lake Victoria, there are only 430 recorded cases of exotic fish being introduced into African waters, which is relatively low in comparison with other parts of the world.[89] Increasing aquaculture production may result in the unintentional introduction of more species into freshwater environments. Safeguards are needed to ensure this does not happen.

### *Fisheries management capacity*

Much of the foregoing depends on effective fisheries management. The competing, and sometimes contradictory, demands on fisheries departments and regional organisations means that a strong set of priorities is critical. Most of Africa's rivers, and all large lakes, with the exception of Lake Tana, straddle international borders. As demands on resources increase, effective basin-level initiatives are important to forestall international conflict over water use. Fisheries policies at governmental and regional levels are beginning to change to take account of new research in sustainable development and participatory management. Although capacity is often weak, and new policies difficult to implement, the foundation is being built for future change away from maximum sustainable yield and top-down management.

## Rift Valley Lakes

### *Lake Tanganyika*

Lake Tanganyika is situated between Burundi, DRC, Tanzania and Zambia (which have 9%, 43%, 36% and 12% of the Lake's shoreline respectively).[90] These four countries harvest 165-200,000 t/yr of fish from the lake (though potential has been estimated at 380-460,000 t/yr)[91], supporting approximately 45,000 fishers[92] and roughly 1 million people in some form or another when related livelihoods (processing, marketing) are taken into consideration.

Approximately 10 million people live in the lake catchment area. Most of these farm, fish, or practice a combination of both, and are dependent on the ecosystem and its services whether for fishing or for irrigation. Extreme poverty characterizes the riparian

[88] Seeley, Janet and Edward Allison. 2006. 'HIV and AIDS among Fisherfolk: What is at stake?' in WorldFish Center. 2006. *Proceedings of the International Workshop: Responding to HIV and AIDS in the Fishery Sector in Africa.* Cairo, Egypt: WorldFish Center, p. 28
[89] Neiland et al (2006), p. 16
[90] West (2001), p. 17
[91] West (2001), p. 16
[92] FAO (2004b), E:\html\ecosys\inland\nateco\lake_tanganyika.htm, and Reynolds et al (2002) cited in Neiland (2006), p. 43

nations of Lake Tanganyika. The percentage of the population below the poverty line ranges from 36% to 86%, and life expectancy varies between 41 and 52 years. The population is increasing steadily, with growth rates of 2-3.2%.[93] The role of fishing in supporting livelihoods is critical.

The lake as a whole produces a catch of 54-66 kg/hectare/yr. Commercial fishers work off-shore in the predominantly pelagic area. Tanzania and DRC waters represent 86% of the lake, but have lower production than Burundi and Zambia, where fishing pressure is more intense.[94] So while Lake Tanganyika as a whole probably has the potential to be exploited more fully, the northern and southern tips of the Lake are probably overfished. Evidence to support this (from the mid 1990s) comes from the decline in catch per unit effort (CPUE) for commercial purse seine fishing in Burundi and Zambia.[95] In the Zambian area of Lake Tanganyika, catches have been declining since 1985, and the species caught have altered (from 50% sardines, 50% *Lates* in 1970 to up to 92% *Lates* by 1986), revealing that fishing techniques have changed the community structure within the lake, with a greater level of impact on populations of sardines than *Lates*.[96]

Artisanal fishers also target sardines and *Lates*, but in addition target many other species, both intentionally and as by-catch. With little effective management, their fishing practices are frequently destructive. Small mesh nets, and even mosquito nets, are used for fishing,[97] with a consequently large catch of juvenile fish. In total, more than 50 types of fishing gear have been identified on Lake Tanganyika.[98] Juvenile fish are caught, and the population is disrupted. The harvest of ornamental fish, which targets rare and valuable species in high numbers, is also a major concern. Tanzania, DRC, Burundi and Zambia all have export markets for ornamental fish.[99]

Over the past decade, war and refugee migrations have affected Burundi and DRC, and by their proximity, Tanzania and Zambia. Lake Tanganyika has always been used as a transport and communication link between the littoral countries, but the population movements driven by the conflicts in the region have strained the relationship between the countries and poor regulation of the lake has exacerbated this.[100]

Mechanisms for the management of the lake have not yet been implemented, but concerted efforts are being made to address the problem. A meeting of partners in June 2003 proposed the establishment of an Interim Tanganyika Management Authority. It has been recognized that there is a need to harmonise regulations with regard to control of sedimentation and pollution, and to reduce fishing pressure through more effective regulation (technical and policy measures). The FAO Committee for Inland Fisheries for Africa (CIFA) has set up a Sub-Committee for Lake Tanganyika. From 1992 to 1999

[93] UNDP, World Bank (2000) cited West (2001), p. 16
[94] Jorgensen, S., et al. 'Lake Tanganyika: Experience and Lessons Learned Brief' in ILEC (2006), p. 367
[95] Jorgensen (2005), p. 367
[96] Coulter (1970), Pearce (1995) cited in West (2001), p. 22
[97] West (2001), p. 21
[98] Lindley (2000) in West (2001), p. 21
[99] West (2001), p. 21
[100] West (2001), p.18-19

there was a FAO/FINNIDA funded research project (LTRP), which developed a Framework Fisheries Management Plan. The United Nations Development Programme/Global Environment Facility (UNDP/GEF) conducted the Lake Tanganyika Biodiversity Project (LTBP) from 1995-2000, which encompassed socio-political as well as ecological aspects, for example preparing a draft legal convention, and undertaking a biodiversity survey (BIOSS).

Organisations who have worked in this catchment area in the past include the (MRAG), CEH, NRI, the United Nations Office for Project Services/UNOPS, GEF, UNDP, UNEP, FAO, the Africa Development Bank (AfDB) and IUCN.

***Lake Malawi***

Lake Malawi is shared by Malawi, Mozambique and Tanzania. By far the largest stretch of shoreline is in Malawi, and human population along this stretch is much denser. In Tanzania and Mozambique, the lakeshore is remote from large urban centers. In Malawi, a number of towns (Karonga, Nkhata Bay, Nkhotakota, Senga Bay, and Monkey Bay) abut the shore, but there are no very large urban developments. Fisheries are the most important economic activity on the lake, but water is also used for irrigation, and generation of hydroelectricity.

Malawi, Tanzania and Mozambique are amongst the poorest countries in the world (with Human Development Index rankings of respectively 165, 164 and 168 out of 177).[101] Fisheries supply important protein to the populations of all these countries, and are an important source of gross domestic product (GDP), particularly in Malawi. Malawi's annual production from the lake is an estimated 30-50,000 tons,[102] and employment in the fishery sector is about 300,000 through direct and indirect activities.[103]

In Lake Malawi, as in Lake Tanganyika, a variety of fishing activities are practiced. The majority of fishers are artisanal, but there are also commercial fishing companies in operation, and specialist companies targeting the ornamental fish trade (composed of nearshore cichlids and species raised in tanks near Senga Bay).[104] There are some possibilities for further aquaculture development in the lake, through the cultivation of tilapiine cichlids.[105] Overfishing is of more concern along the Malawian shoreline than on the Tanzanian and Mozambiquan shores. Fishing trawlers cause much of the damage through small mesh sizes, and the growing number of vessels fishing in the southeastern part of the lake is a cause for concern.[106] Decline has been particularly marked in the economically more valuable and larger fish species (e.g. chambo, catfish). This probably has an impact on the regional economy and on the nutrition of the local populace. A Malawi State of the Environment report in 2002 stated that fish consumption had

[101] UNDP (2005), p. 235
[102] Thomson estimated 30,000 in 1995, Lewis and Tweddle estimated 50,000 in 1990. Cited in Bootsma, H. and Jorgensen, S. 'Lake Malawi/Nyasa: Experience and Lessons Learned Brief' in ILEC (2006), p. 261
[103] Bootsma and Jorgensen (2005), p. 261
[104] Bootsma and Jorgensen (2005), p. 264
[105] Shumway (1999), p. 116
[106] Shumway (1999), p. 117

declined between the mid 1970s and 2002 from 14 kg/person/year to 6 kg/person/year.[107] Nevertheless, there are still underexploited fish stocks in the lake, which have not yet been developed due to difficulties in accessing deepwater pelagic stocks.[108]

Increasingly intensive cultivation of land in the catchment area has dramatically increased the incidents of soil erosion, and pesticide and fertilizer use could also become problematic. Changing land use in Tanzania could lead to problems in the north of the lake, as rainfall in this area is highest, and 20% of the annual inflow into the lake comes from Tanzania's Ruhuhu River.[109] Given that the border between Tanzania and Malawi is currently disputed (where in the lake the border should fall), this might add pressure to a potentially contentious issue.

To address this range of threats to Lake Malawi, there is need for an ecosystem-wide transboundary approach. To date, most attention has been focused on management in the context of researching Basic Catch per Unit (CPUE) data in order to set regulations. However, individual governments are now recognizing the need for a more holistic approach, and are bringing in policies to support this. These include Malawi's National Environmental Policy (1996), Tanzania's National Conservation Strategy for Sustainable Development (2004) and Mozambique's National Environmental Management Programme (2003). [110] The practical impact of these policies has been limited, but getting the framework in place is a good start. In 2003, FAO supported the three countries in the drafting of an initial policy document for a basin-wide commission. Some donor support (e.g. the GEF-Southern African Development Community/SADC Lake Malawi/Nyasa Biodiversity Conservation Project 1995-1999) has helped prioritise these aims, but the short-term and narrowly sectoral nature of many development projects has meant this is the exception rather than the rule. USAID was involved in the Malawi Environmental Monitoring Program between 1993 and 1999. Lake Malawi has a national park, but it only covers a small portion of the lake.

Decentralisation of national resource management has been occurring around Lake Malawi, with the establishment of numerous Beach Village Committees (BVCs). This was initiated by a program funded by the German Technical Cooperation/GTZ. However, the success of the committees has been limited and the delineation of authority between central government and local communities remains unclear.

Other organizations that have been involved in Lake Malawi include UNDP, DfID, World Bank, GTZ, African Development Bank, the United Nations University/International Network on Water, Environment and Health (UNU/INWEH), and numerous universities.

[107] Bootsma and Jorgensen (2005), p. 264
[108] Bootsma and Jorgensen (2005), p. 264
[109] Bootsma and Jorgensen (2005), p. 261
[110] Bootsma and Jorgensen (2005), p. 267

### *Lake Victoria*

Lake Victoria sustains the largest inland commercial fishery in Africa, which contributes significantly to the export earnings of its three littoral countries: Kenya, with 17% of the shoreline, Tanzania (33%) and Uganda (50%).[111] Twenty-five percent of Africa's reported total inland fishery catch comes from Lake Victoria.

The lake basin has a population of 30 million (one third of the combined population of the three countries). Population growth rate is high, and many migrants settle in the lake basin area because of the economic opportunities offered, both in the fishery sector and in the agricultural sector, which supports 70% of people in the region.[112]

Nile perch and Nile tilapia, both alien species introduced in the 1950s, form the basis of the large-scale commercial fishing industry. Initially, the stocks of these non-native species did not have a big impact, but from the 1970s onwards their numbers increased dramatically. Between 1970 and the late 1980s, annual catch from the lake increased from 100,000 t/yr to 400,000 t/yr.[113] However, this fishing intensity is believed to be unsustainable, and much of the catch today consists of juveniles. Since 1999, it seems as though numbers of Nile perch may be decreasing, and eventually there will probably be a more dramatic 'crash' in the industry due to overfishing and when the Nile perch has depleted its prey to such an extent that the food chain no longer functions.[114] Prior to the introduction of these two non-native species, the lake had a diverse fishery, which caught fish from across the species range and was, therefore, more ecologically sound. The decline in non-native species has been accompanied by the rediscovery of a number of indigenous species that had been thought extinct, and also by a massive increase in the number of small pelagic fish being caught (increased from 350,000t in 1999 to 1,200,000t in 2001).[115]

Artisanal fishers also fish in Lake Victoria, but find it difficult to compete with commercial businesses. The local fishers cannot afford the nets and other fishing equipment necessary to obtain maximum catch from the lake. Before the Nile perch industry took off in 1979, small operators constituted the majority of boat owners. A 1973 study counted 50,000 fishermen using 12,000 fishing boats.[116] Processing and trade was conducted in lakeside communities, usually by women. With the expansion of the Nile perch fishing industry, more people were engaged in fishing, but fishermen are now predominantly crew members, and fishing boat owners from further afield do not go out onto the water. A decline in sun-drying/smoking and the establishment of factories with

[111] Kayambo, S. and Jorgensen, S. 'Lake Victoria: Experience and Lessons Learned Brief' in ILEC (2006), p. 433
[112] Kayambo and Jorgensen (2005), p. 433
[113] Shumway (1999), p. 163
[114] Shumway (1999), p. 164
[115] Kayambo and Jorgensen (2005), p. 433
[116] Butcher and Colaris (1973) in Jansen, Eirik G. 1997. *Rich fisheries, poor fisherfolk: Some Preliminary Observations about the Effects of Trade and Aid in the Lake Victoria Fisheries.* Regional Office for Eastern Africa: IUCN, p. [5]. Available online at http://app.iucn.org/dbtw-wpd/edocs/1997-081.pdf

freezing facilities, has caused a dramatic reduction in the number of women involved in processing, although some have found employment in the factories.[117]

Water hyacinth has had both positive and negative impacts. It causes economic losses including control expenditures. One study valued these at $9,660,000 per year, whilst another estimated fisheries losses of $200,000.[118] Water hyacinth reduces the levels of oxygen reaching the lake. However, it also protects some areas from overfishing. Greater threats to the lake's ecosystem come from eutrophication due to agricultural and industrial pollution, and urban waste; increased biomass and algae; deoxygenation; and reduced area of papyrus swamps.[119]

Uganda, Kenya and Tanzania do not have a transboundary system of ecological management in place in Lake Victoria, although some cooperation in the fisheries sector specifically has been developed, partly due to pressure from export markets for quality control. Regional arrangements do not extend to environmental management (e.g. water quality monitoring, agreements on deforestation activity). Despite the lack of a formal governmental level lake basin commission, there are many other communication links open to Lake Victoria countries. The East African Community (EAC), which was set up in 2001, is one of the main forums for discussing mutual issues that relate to the lake, and has been supported by a range of donors from Sweden, France, Norway, the World Bank, and the East African Development Bank. The EAC-Lake Victoria Partnership promotes consultation in relation to lake-wide issues, and is promoting a Protocol for the sustainable development of the lake which will include a basin commission. The EAC has also identified the lake as a priority Economic Growth Zone.

The Lake Victoria Fisheries Organisation (LVFO), established under the aegis of the EAC, has the task of promoting partnerships and collaboration across the lake for the effective management of fishery resources, maintaining ecosystem services, and socio-economic development of lakeside communities. LVFO was conceived by the three riparian countries, FAO, the European Union (EU)and through the Lake Victoria Fisheries Research Project (LVFRP) and the Lake Victoria Environment Management Programme (LVEMP). LVFRP, established in 1997, has conducted research and informed policy on issues related to fisheries management in the lake, including (but not limited to) surveys of fish stocks and species, market surveys, and local fishing community issues. LVEMP is a GEF-funded project, which addresses ecosystem health, investigating how sustainable development of resources can reverse environmental degradation and improve biodiversity while also generating food and income. These tentative steps towards mutual decision-making and prioritization, involving all three countries from central government to local community level are a positive progression towards the development of a lake basin commission. While not always successful in every aspect, these ambitious goals at least bring up the issues which have to be addressed and provide a sound base for further collaboration.

[117] Jansen (1997), p. [9-10]
[118] Respectively Joffe and Cook (1997) and Kasuloo (1999) in Thieme et al (2005), p. 79
[119] Shumway (1999), p. 165

**The Sudd Swamp**

Sudan is the largest country in Africa, and covers a vast region with varying biogeographical characteristics. The Sudd is, however, one of the country's most productive regions and has a population density of 20 people/km$^2$, compared to 14 people/km$^2$ across the country [120]

For centuries, people in the Sudd swamp region have combined fishing, farming and nomadic lifestyles adapted to the seasonal flooding movements of the swamp. The Dinka, Nuer and Shiluk tribes are well known for combining fishing activities with grazing. The vast majority of communities live in poverty, and are totally dependent on the ecosystem services of the swamp, including fishing. Alternative livelihood options have declined, both due to unrest and to changing government policy—e.g., with the liberalization of the economy since 1995, services such as government support for irrigation have been withdrawn. This means that the fishery resources of the Sudd are more critical now than ever before.[121]

However, mass population movements in the wake of war have had a disruptive effect on traditional lifestyle patterns, and on the traditional management systems on which the ecosystem depends. In addition, a parallel war between the Dinka and Nuer tribes has added to disruption in the region. Government capacity to oversee resources has also been undermined. One impact has been the decline in regulation. Although in theory there are nature reserves in this area (five national parks and 14 reserves), patrolling is rare or non-existent, with the result that poaching and overfishing have had a disruptive effect on the swamp's resources. The exact impact on fishing resources is not known. IUCN/SSC research in the mid- 1990s revealed that there was no effective management or protection whatsoever in at least two of the National Parks.[122]

Since 1983, with the outbreak of the second civil war, there has been limited development of sustainable fisheries or ecosystem conservation by local or international organizations. Some degree of autonomy for Southern Sudan was agreed in 2005, and USAID is supporting the development of a regional capital in Juba.

**Congo River Basin**

The Congo River Basin waterways account for 30% of Africa's river flow, despite covering just 13% of the continent's surface.[123] Population density varies enormously across the Congo Basin, and is clustered in coastal areas and the north and east of the area. Central forest areas are far more sparsely populated—10% of the basin contains a

[120] Thieme et al (2005), p. 207, and FAO Aquastat. 2005. *Sudan Country Profile* [webpage] (available online at http://www.fao.org/ag/agl/aglw/aquastat/countries/sudan/index.stm)
[121] FAO Aquastat (2005)
[122] Thieme et al (2005), p. 207
[123] Thieme et al (2005), p. 4

population density of less than 1/km$^2$, compared to an average across the basin of 15/km$^2$ [124], and road density is just 0.07km per km$^2$ (1/20$^{th}$ of the density in Europe).[125]

In 1984, the potential catch of the Congo River was estimated at 90,000-120,000 t/yr.[126] Although current production is unknown, Shumway et al estimate that it is probably about half this figure.

Freshwater fish play an important role in contributing to the diets of people in the Congo Basin. In the report from CREDP (Congo River Environment and Development Project) financed by USAID, Shumway et al pointed out that more effective use of fisheries could also be used to counter the widespread consumption of bushmeat.[127] In each of the areas surveyed (the provinces of Bandundu, Bas-Congo, and Equateur), important conservation actions were identified as net exchange (to prevent destructive fishing practices), mapping of spawning areas (for possible protected areas), and further monitoring. It seems that currently overfishing is a medium or low threat in areas where research has been conducted to date, as evidenced by diversity and size of fish in the markets. There is also potential within the fishery sector to expand into ornamentals and into sport fishing.[128]

CREDP recommends that the ecoregion be managed as one unit, but failing this, smaller sub-catchment basins should be managed holistically as a 'second best' alternative. The importance of riparian mammals, particularly hippopotomuses and birds such as herons, was noted, and their role in modifying the river (e.g. by wallowing in pools and consuming aquatic animals, thereby adding to nutrient cycling).

USAID's current Central Africa Regional Program for the Environment takes a landscape-based approach to management and conservation of natural resources in the Congo River Basin. This model is described in more detail in Section IV.

**The Zambezi Basin and Lake Kariba**

The Zambezi basin, extending over the DRC, Angola, Zambia, Malawi, Tanzania, Namibia, Botswana, Zimbabwe and Mozambique, is one of the most important freshwater systems in Southern Africa. The basin has a population of roughly 38.4

[124] Water Resources eAtlas: *Congo Watershed*. Available online at http://www.waterandnature.org/eatlas/html/af3.html
[125] WCS. [No date]. *From the Mountains of the Moon to the Ocean: A conservation atlas of the forests of Central Africa*. WCS, p. [5]. Available online at http://wcs.org/centralafrica/Atlas/ConservationAtlas.pdf
[126] Shumway, C., et al. 2003. *Biodiversity Survey: Systematics, ecology, and conservation along the Congo River*. Boston, USA: New England Aquarium, p. 85
[127] Earth Institute Projects Database. *Freshwater Fishes of the Lower Congo: biodiversity, systematics, and conservation* [webpage]. Available online at http://directory.ei.columbia.edu/displayproject.php?projectid=212
[128] Shumway (2002), p. 86

million people, and a growth rate of 2.9%. Population density is 28 people/km$^2$, with greater density in the wetlands and floodplains, and less in dry areas.[129]

Most of the riparian communities are poor, depending on fish from the river and floodplains for income and food security. For example, the diets of the majority of the population of 225,000 living on the Upper Zambezi floodplain in Zambia consists of maize meal and fish.[130]

The man-made Lake Kariba (completed 1958) has both artisanal and commercial fisheries. The commercial fishery is based around a freshwater sardine, commonly known as Kapenta (*Limnothrissa miodon,* a Lake Tanganyika clupeid introduced in 1969, when it was noted that the newly constructed reservoir had no species adapted to off-shore environments).[131] Kapenta fishery yield peaked in about 1990, with a yield of over 30,000 t. In 2000, this had declined to about 20,000 t.[132] The commercial sector has historically been dominated by white entrepreneurs who established fishery companies in the colonial and post-colonial period. The large nets and submerged lighting necessary for off-shore fishing are capital-intensive, and entering this sector is difficult for local communities.

The artisanal fishery sector produced approximately 9-10,000 t in 1990, based on cichlid species introduced from the Kafue fishery.[133] Artisanal fishing in Lake Kariba has a chequered history. The local Tonga tribe, who were relocated involuntarily when the lake was created, had livelihood strategies adapted to seasonal flood fishing in the Zambezi Gwembe valley. They did not have the technology and skills to take advantage of the new fishery opportunities in Lake Kariba, and other ethnic groups moved into this niche. Attempts have now been made to build capacity and transfer management to local communities, including the Tonga, but conflict between the Tonga and other ethnic groups remain. In Zambia and Zimbabwe the Tonga communities remain the least developed and are disproportionately dependent on food aid.[134]

Kolding et al have compared fisheries management and methods on the Zambian and Zimbabwean sides of Lake Kariba. They conclude that despite the fact that the Zimbabwean side is highly regulated and government controlled, while the Zambian side is de facto open-access (and therefore has higher fishing intensity) and under the jurisdiction of local chiefs, catch rates are not as dramatically different as would be expected (2.8 kg/net compared with 1.8 kg/net). This supports the argument that the Lake is not overfished, and that high fishing pressure does not necessarily have negative impacts.[135]

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[129] WorldFish Center. 2004. *Proceedings of the International Workshop on the Fisheries of the Zambezi Basin.* WorldFish Center, forthcoming, p. 32
[130] WorldFish Center (2004), p. 13
[131] WorldFish Center (2004), p. 14, Magadza (2005), p. 208
[132] Magadza (2005), p. 208
[133] Magadza (2005), p. 208
[134] Magadza (2005), p. 208, 213, 219.
[135] WorldFish Center (2004), p. 61

The Cahora Bassa fisheries consist of large-scale commercial, artisanal and recreational fishery activities. Artisanal fisheries production consists predominantly of 13 species of fish, of which six are important commercially.[136] The large-scale commercial fishery depends almost exclusively on Kapenta. Estimates from 2002 for fish production were 12,000 t for commercial fisheries[137] and 7,600 t for artisanal fisheries.[138] Sustainable fish yield estimates vary enormously, but are generally lower than current fishing production.[139] Recreational fishing is still in early stages of development.

Although the largest single areas of production are the Kariba and Cahorra Bassa reservoirs, other fisheries in the basin are also important. The Kafue basin sub-catchment has an annual fish production of 9,600 t.[140] Fisheries production in the Lower Shire has historically ranged between 2,000 and 11,000 t/yr. Due to periods of drought and overfishing, current yield is about 2,000 t/yr[141], of which 75% is consumed locally.[142] A study of four wetland areas in the Zambezi basin revealed that 'fisheries contributed 16-26% of household income (including subsistence values).'[143]

One of the main threats is pollution, particularly from mining industries. The Luangwa River, for example, deposits 8 million t of silt into the Zambezi every year. Less serious, but growing, is the problem of untreated pollution from cities (e.g Livingstone, pop. 100,000). This will increase as riparian populations grow. Another serious threat is the proposed construction of further dams, including the proposed Batoka Gorge dam, Devil's Gorge Dam, and Mupata Gorge dam on the Zambezi River. Changes to flooding seasons in the delta from upstream modification have had a big impact on fish ecology, and contributed to the decline of the once lucrative prawn industry. The option of controlled flooding may help reverse some of this damage. Climate change, and the introduction of more non-native species are other possible threats. Poor organization of accommodation for construction workers near Kariba dam, and isolated fishing camps, has led to high levels of prostitution in the area and subsequently the area around the lake has high rates of HIV.[144]

Governance and institutional partnership around the Zambezi basin include: the SADC Zambezi River Action Plan (ZACPLAN), which has put forward recommendations to the riparian nations; the SADC Protocol on Shared Water Courses; and the Zambezi River Authority (ZRA), whose jurisdiction is limited to the river where it forms the border between Zambia and Zimbabwe, and not the surrounding land area. There are currently proposals calling for a Zambezi River Commission (ZAMCOM) to be established.

[136] WorldFish Center (2004), p. 23
[137] Mafuca (2002) in WorldFish Center (2004), p. 24
[138] Barnes et al (2002) in WorldFish Center (2004), p. 24
[139] WorldFish Center (2004), p. 24
[140] WorldFish Center (2004), p. 15
[141] WorldFish Center (2004), p. 26
[142] WorldFish Center (2004), p. 48
[143] WorldFish Center (2004), p. 49
[144] Magadza (2005), p. 214

**The Lake Chad Basin**

The Lake Chad basin is extensive, the drainage area encompassing eight percentage of total African land surface, an estimated 2,434,000 $km^2$.[145] This extends across Algeria, Libya, Niger, Chad, Sudan, Nigeria, Cameroon and Central African Republic. The Lake itself is situated at the borders between Niger, Chad, Nigeria and Cameroon, and these countries also form the original Lake Chad Basin Commission (since then CAR joined in 1994 and Sudan joined in 2000, but have yet to ratify the Convention of the Lake Chad Basin Commission).

Lake Chad, and the surrounding lake basin, play a very important part in the lives of the surrounding populations. In a semi-arid area, this expanse of wetland, riverine systems, and lake, is a critical lifeline for those living in the surrounding area. Official statistics for the area are limited, and data are unreliable. UNEP (2004) estimates that there may be about 37 million people in the drainage basin, with a growth rate of about 2.5%.[146] Poverty levels are extremely high, and drainage basin countries rate poorly on most Human Development Indicators.

Shrinkage of the lake, detailed in Section II above, means that old data cannot be used with any degree of similarity assumed. One estimate suggests that levels of fish production in 2000 were about the same as levels in 1977, at 60-85,000 t/yr, roughly half the production of the years prior to 1970 (130-140,000 t/yr).[147] It has been declining still further in the years since. The majority of Lake Chad's fish production is consumed locally. 'The commercial value of fisheries in the area of the Lake Chad basin is highest in Nigeria (US$26 million and 48 percent of the total value), followed by the Niger (US$15 million and 27 percent), Cameroon (US$8 million and 15 percent), Chad (US$15 million and 10 percent) and the Central African Republic (US$254 000 and 1 percent).'[148]

It is apparent that shrinkage in the lake size had a huge socio-economic impact, altering livelihoods and natural resource governance, as well as the ecological features of the lake. A recent socio-economic survey (1999-2000) was conducted in three areas around Lake Chad (the Western Shore, Nigeria, the Chari delta, Chad, and the Yaere floodplain, Cameroon), looking at the role of fishing in local livelihoods.[149] The results of the survey indicated that, of the localities surveyed, seasonal ponds and channels were the most frequently fished areas, revealing a highly adapted livelihood strategy which was tailored

[145] UNEP (2004) cited in Odada, Eric O., et al. 2006. 'Lake Chad: Experience and Lessons Learned Brief' in ILEC (2006), p. 75
[146] Odada et al (2006), p. 77
[147] Jolley et al (2000) in Odata et al (2006), p. 77
[148] FAO. 2006. *Contribution of fisheries to national economies in West and Central Africa: Policies to increase the wealth generated by small-scale fisheries.* New Directions in Fisheries – A Series of Policy Briefs on Development Issues, No. 03. Rome, p. [5]. Available online at http://www.sflp.org/briefs/eng/03.pdf
[149] Bene, C and Neiland, A. 2003. 'Contribution of Inland Fisheries to Rural Livelihoods in Africa: An Overview from the Lake Chad Basin Areas' in *Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries.* Bangkok, Thailand: FAO

to seasonal opportunities. Verbal accounts report that people who previously fished are now turning to farming, relying on land exposed by the receding lake.

Fishing is one of a portfolio of livelihood options, and co-exists with farming and cattle herding. The role of fishing varies according to the status of individuals and families within the community; in some areas privileged access to fishery resources is accorded to richer households, while in other areas more equitable access arrangements are in place. Resource conflict in the region is common between communities at the lakeshore. Migration around the basin occurs with little regard for political borders, and there is no agreement at a higher level on water resource allocations. With regard to fisheries specifically, overfishing (including by fishing vessels from non-Lake Chad Basin Commission/LCBC countries such as Mali[150]), destructive fishing practices, and contaminated and diseased stock have all impacted negatively.

Managing Lake Chad's decline, and the drop in fisheries production, is a challenge that is exacerbated by poor coordination and weak capacity amongst riparian nations. While plans have been mooted to build dams and to pump water from the Congo River into one of Lake Chad's tributaries, the ecological consequences of this are potentially disastrous if not managed properly. The Inter-Basin Water Transfer Project nonetheless has received significant support in many areas, and may have potential as a solution for Lake Chad's declining resources. Many feasibility studies still need to be carried out, and the LCBC is hoping for contributions of $5 million to undertake these.[151]

Other projects ongoing in the basin include: an LCBC/GEF project assessing social and environmental impacts of water and land degradation; a WWF Living Waters campaign to survey surrounding wetlands; the Hadejia-Nguru Wetlands Conservation Project (run by numerous donors until being taken over by the Nigerian Conservation Foundation) which considered the integrated management of water resources; and the Mega Chad (UNEP/Belgium) and Protected Area (UNDP/GEF) initiatives.

The Lake Chad Basin Commission is currently working with a range of partners and organizations, including UN organizations, GTZ, World Bank, AfDB, Ramsar, Economic Community of West African States/ ECOWAS, EU, the African Union/AU, IUCN, GEF and WWF.

**Niger River**

As it runs through the Sahel, the River Niger provides a critical source of water for countries that are otherwise predominantly arid and semi-arid. As it descends into the more humid Guinean climate, it remains a critical resource as it passes through some of the most densely populated parts of Africa.[152]

[150] Odada et al (2006), p. 84
[151] Odada et al (2006), p. 87
[152] Thieme et al (2005), p. 308

Population growth in Mali is projected to be 2.9% between 2003 and 2015, suggesting that the population will increase from 12.7 to 18.1 million in this timeframe. Adult illiteracy is 81%, and 72% of the population live on less than $1 per day.[153] The Inner Niger Delta accounts for 90% of Mali's capture fisheries.[154] Since 1969, however, yield has been decreasing, and the size of fish that are caught has been getting smaller, indicating, among other things, that the resource may be biologically overfished. One factor believed to have contributed to this is the opening of fisheries access and transition from traditional to central government management that occurred in the 1960s. One estimate indicates that the fishing population in the Inner Niger Delta doubled between 1977 and 1997.[155] Other threats to the fishery include land degradation and deforestation, much of this due to movements of livestock herds which are thought to be more concentrated here than anywhere else in Africa.[156] Construction of dams, and climatic events such as drought, also have an impact on the river.

In the Lower Niger-Benue region between the two deltas, the river flows in broad channels through a savanna landscape, punctuated by floodplains. In Nigeria and Niger, overfishing and intensive agriculture have had an impact on the river's ecosystem.[157] The greatest threat, however, is the modification of the river from man- made constructions such as dams. The Kainji dam, the largest on the river, has had the most impact. In a study of 200km downstream of the Kainji dam, it was found that fish catches had declined by 50%, and similar effects were reported further downstream.[158] There are currently plans for two more dams, one in Niger, and one between Niger, Mali and Burkina Faso.

The (coastal) Niger Delta, which covers part or all of six Nigerian states, supports a population of between 10-20 million people. Fishing and its associated activities (processing and trading) are the main source of income-generating activity for the vast majority of people in the region. The area is one of the poorest in Nigeria. Life expectancy at birth is thought to be lower than the average of 43 years, and access to services (electricity, clean water, healthcare) is lower than most other areas of the country. The population growth rate is 3%.[159]

Pollution is a big problem in the delta. Oil extraction is one of the predominant reasons. There are more than thirty oil fields in the area,[160] and according to UNEP small spills (accidental and sabotage) release up to 2,300$m^3$ of crude oil into the delta every year (though some estimates put it at ten times this amount).[161] Another consequence of the oil industry is the construction of roads and pipelines, which also have a negative impact on the environment, and undermine fisheries. This has led to loss of fishing opportunities and

[153] UNDP (2005), p. 229
[154] Thieme et al (2005), p. 189
[155] Lae (1997) in Thieme et al (2005), p. 189
[156] Heringa (1990) in Thieme et al (2005), p. 189
[157] Thieme et al (2005), p. 308
[158] Scudder, T. Mar 1989. 'Conservation v. Development: River Basin Projects in Africa', *Environment*, Vol 31, no. 2, p. 27
[159] UNDP (2005)
[160] Hughes and Hughes (1992) cited in Thieme et al (2005), p. 293
[161] UNEP (1999), cited in Thieme et al (2005), p. 293

livelihoods. Tension between oil companies, local communities, and government institutions is widespread. There have been environmental impacts too from growing human settlements, including increased pollution, overfishing, logging and agriculture.

A wide range of organizations are active along the length of the Niger River. The Niger Basin Initiative was set up in 2001 between the Niger Basin Authority and several key organizations (Nigerian Conservation Foundation, Wetlands International, and WWF, followed by Birdlife International and IUCN in 2003).[162] They are collaborating to ensure that conservation issues are considered when development plans for the basin are being drawn up.

**Madagascar**

Data on trends in Madagascar's inland fisheries are inadequate. The available data suggest that inland fisheries production increased from 35,100t in 1970 to 45,806t in 1987, although due to increasing population (current growth rate is 2.5%), per capita consumption dropped.[163] The island as a whole has a potential yield of approximately 77,000 t of fresh and brackishwater fish.[164] Fishing is a relatively lucrative occupation. Fishers earn over $2 per day,[165] while 61% of people in Madagascar live on less than $1 per day.[166]

According to Rabelahatra,[167] Alaotra, the largest lake on the island (200km$^2$), and Itasy, the fourth largest (34km$^2$), are both overfished. Around Lake Alaotra and its wetlands, efforts are being made to address issues through both biodiversity conservation and the fisheries sector. A USAID-funded participatory ecological monitoring project has been in place since 2001, and initial results seem to indicate that it is having a positive impact.

According to Pidgeon (1996) and Razanadrakoto (2004), fish production in the lake has dropped from a peak in 1960 of 4,000 t/yr to 2,000 t/yr in 2004, while in the same period has increased from 1,000 to 4,000.[168] The population in the watershed increased from 109,000 to 550,000 between 1960 and 2004. Fishing techniques have become more destructive over the intervening years: marshland is being burnt to create new fishing areas, seine nets are commonly used, and mesh size is as little as 1mm.[169]

By involving local communities in monitoring, and implementing new fishing by-laws (introduced in 2002) there has been much wider adherence to the regional fishing regulations. A two-month closed fishing season (15 October to 15 December), and other practices such as minimum net sizes and a ban on marsh burning and constructing fences to control fish, seem to be having an impact on stocks. However, given that this has only

[162] Thieme et al (2005), p. 105
[163] Vanden Bossche and Bernacsek (1990)
[164] Vanden Bossche and Bernacsek (1990)
[165] Andrianandrasana (2005), p. 2761
[166] UNDP (2005), p. 234
[167] Vanden Bossche and Bernacsek (1990)
[168] Andrianandrasana (2005), p. 2759
[169] Andrianandrasana (2005), p. 2759

been monitored over a two-year period, it is not yet possible to reach any long-term conclusions.

## IV. Assessment of policies, good practice and USAID programs in Africa

### Overview of inland fisheries policy in sub-Saharan Africa

Africa's inland fisheries have received relatively little concerted attention from national governments or regional bodies. Although enormously important to millions of poor men and women who depend on inland fisheries as a source of livelihood and affordable animal protein, they are often assumed to be insignificant relative to the continent's marine fisheries and largely neglected by policy-makers. As a result, many African countries lack policies on inland fisheries *per se*, though fisheries may be mentioned in the context of water use policies, environmental policy or the agricultural sector (broad definition). In this wider development context, the fisheries sector has generally been unable to articulate its concerns and requirements, with the result that fisheries are dealt with marginally at best and often completely ineffectively.

Explicit concern and effective action on freshwater fisheries management tends to arise only in the context of highly visible fisheries (such as Nile Perch in Lake Victoria or the fishery of Lake Malawi whose decline threatens the livelihoods of thousands of people), and even here fisheries have only recently begun to be fully integrated into national policies on food security and poverty reduction. As a result of this relative neglect of inland fisheries, most government fisheries departments are extremely poorly resourced with limited capacity to research, develop and implement appropriate policy—a pattern that in turn perpetuates relative neglect. Moreover, where concerted action is needed among a number of countries (for example, to manage the fisheries in all of Africa's Great Lakes), it has proved difficult to translate the intent and resolutions of international meetings and committees into national policies and action.

However, there are signs of gradual change and the emergence of conditions in which inland fisheries may receive more attention. The importance of the Lake Victoria and Lake Malawi fisheries to livelihoods and poverty reduction is beginning to be reflected in national and regional considerations of economic development, trade, food security, and environmental conservation. More broadly, the international focus on poverty reduction in Africa has increasingly included scrutiny of poor people's livelihoods, particularly in rural areas, and therefore begun increasingly to highlight the role of diverse activities, including fisheries, in the economies of rural Africa.

At the pan-African level, the most important new initiative is the development and adoption of the NEPAD-CAADP Action Plan for Fisheries and Aquaculture that gives prominent place to the importance of inland fisheries. This Action Plan is now being used by NEPAD and the African Union as a framework for investment in the continent's fisheries and as a guide to where investments can be made effectively at national, sub-regional and continental level. At the sub-regional level, SADC has also now adopted a number of fisheries investment priorities to support implementation of the Action Plan in that sub-region whilst the NEPAD secretariat and the African Union are now working to promote similar action by other regional economic communities. Similarly, individual governments are developing national actions, including in Malawi and Nigeria. At the

international level, FAO and the WorldFish Center are providing technical support to NEPAD in the implementation of its plan. The Action Plan recommendations are discussed further in Section V.

**Successful models and lessons from USAID programs on inland fisheries**

Where USAID has supported inland fisheries development in Africa, this has mostly been a single component of a larger environmental program or an integrated water resource management plan.

The Central Africa Regional Program for the Environment (CARPE) is a three-phase, 15-year program focused ultimately on the conservation of Africa's largest area of rainforest in the Congo River Basin. USAID supports consortia of development partners to develop and implement appropriate management plans in 12 "landscapes"—areas selected for their critical conservation value. CARPE has succeeded in marshalling funds from other donors too, with the development consortia encouraged to find "match" for the USAID funds (approximately $50 million per five-year phase). During the first phase (2001-2006), fisheries received relatively little attention, but will be accorded more emphasis in Phase II. The CARPE experience has highlighted a number of useful lessons and priorities[170], including:

- conservation and livelihoods issues must be tackled in tandem; separate treatment is unlikely to be effective given their intrinsic inter-relatedness;
- meaningful involvement of communities and other stakeholders is essential;
- for the development consortia to operate effectively, the partners managing these landscapes must have mutually-reinforcing, if not identical, objectives;
- in inland fisheries in Central Africa, it is difficult to envisage commercial membership of these partnerships because, although important, the fishing activity is artisanal and largely serves under-capitalised, low-value domestic or regional markets; (this contrasts with the logging industry, for instance);
- the present priority for work on fisheries is better information on the resource, how it is harvested and how it is used and marketed; only once that information is available will it be possible to be more prescriptive; and
- assistance from USAID Washington would be welcomed in respect to the provision of (or facilitation of access to) specific areas of technical expertise.

Two USAID transboundary programs in southern Africa (natural resources management in the Four Corners area and integrated water resource management in the Okavango Basin) also provide some useful lessons:

- transboundary initiatives are challenging, not least because of uneven capacity amongst country partners to implement recommendations; donors should not underestimate the resources and time required to achieve management goals;

[170] Personal communication, John Flynn, CARPE Program Manager, Kinshasa

- individual countries often derive different benefits from shared resources and hence face different incentives to participate in transboundary programs; donors need to anticipate this; where necessary, they should seek to redress this by also supporting activities that have national (not regional) benefits, even if the main focus of the program is regional;
- so-called "peace parks", straddling several countries, are gaining popularity in southern Africa, but much of the momentum is driven by conservationists; these initiatives will face difficulties unless they also work to meaningfully involve local communities and address critical livelihoods issues; USAID can support this by funding this element of larger multi-donor projects;
- planning of natural resource management projects should include a realistic estimate of the timeframe needed to assess fisheries and develop sustainable community-based management systems; and
- opportunities for public-private partnerships in inland fisheries are most likely to arise at the local-level, e.g., at the nexus of interests between sports fishing, tourist camp development, and community-livelihoods including fishing.

**Inland fisheries initiatives of other organisations in Africa**

Although the following list is not exhaustive, it provides an overview of the larger or umbrella programs focused on (or including a significant component of) Africa's freshwater fisheries. As such, they all have an international dimension.

Sustainable Fisheries Livelihoods Program (SFLP). This DFID(United Kingdom's Department for International Development) /FAO program uses a holistic multi-disciplinary approach to reduce poverty in fishing communities in West and Central Africa. Based on the sustainable livelihoods approach, it supports the development of social and human capital in communities, seeks to enhance the natural assets of those communities and strengthen the appropriate policy and institutional environments. This approach is people-centered, responsive and participatory, multi-level, conducted in partnership and dynamic. It helps different actors understand that fisheries management is a process that does not just impact on, but is influenced by, their livelihoods and livelihood strategies. Now at the end of its first phase (1999 – 2007), SFLP has attracted a lot of attention, because of the way in which it has stepped outside the traditional boundaries of fisheries to engage the wider policy and institutional processes needed to effect change in fisheries livelihoods. Working with marine and inland fisheries, it has played an important role in raising the domestic profile of freshwater fisheries in West and Central Africa.

*The Challenge Program for Water and Food.* This is a CGIAR (Consultative Group on International Agricultural Research) mechanism focused on selected river basins including (in Africa), the Volta, the Nile, the Limpopo and the Niger. At its heart is a concern with how more food can be produced, and rural livelihoods improved, using less water, in a manner that is socially acceptable and environmentally sustainable. Aquatic ecosystems and fisheries are one of its five themes. Only operational since 2005, it is too soon to assess its impact, but the criteria it uses are intended to promote poverty-focused,

interdisciplinary research, with the involvement of multiple partners and associated capacity-development. Each call for proposals has a different focus. Topics of relevance to fisheries include the appropriate valuation of (all) uses of water resources in the context of multiple-use systems and the development of innovative tools for the assessment and management of small-scale fisheries (2nd call for proposals, 2006).

WorldFish Center: Research programs focused on small-scale fisheries and aquaculture. In Africa, the WorldFish Center conducts research for development in partnership with other research and development organizations. With its mandate to undertake international public goods research, its projects are multi-country or address issues of widespread relevance. Recent work on inland capture fisheries in Africa addresses policy development (in support of the NEPAD-CAADP Action Plan for Fisheries and Aquaculture), valuation and governance of small-scale fisheries, domestic and regional marketing of fish products, fisheries producer organizations, health (including HIV/ AIDS) in fisheries communities, and rapid participatory methodologies for fisheries assessment and management. The WorldFish Center also conducts applied research on aquaculture—focusing particularly on local markets and low input technology that uses on-farm resources. This work includes participatory technology development with vulnerable households, including those affected by HIV/AIDS.

Great Lakes research and management initiatives. Section III describes the Lake Victoria Fisheries Organization (LVFO) and the other multi-country fisheries research, management and livelihoods programs of the Great Lakes.

**Opportunities for USAID**

This review, including information gained through key informant interviews, suggests that although USAID has not made inland fisheries a key focus in Africa, together with its partners, it does has considerable experience and arguably comparative advantage in:

- transboundary programs, supported through regional funding mechanisms
- multi-country, basin-wide integrated water resource management programs
- integrated development and conservation programs
- the promotion of public-private partnerships around development and conservation, and
- marshalling research resources to address development issues (from both its own academic institutes/museums and from other countries).

In many of its existing landscape management and environmental programs, USAID staff and other stakeholders argue that fisheries should be accorded higher priority. This is because whilst there are strong indications of resource depletion in many of the capture fisheries, the information base is weak, and much research is needed to fill this gap and develop appropriate workable community-based resource management systems. Moreover, the critical livelihoods role of fisheries means that it offers an important entry point for poverty reduction and economic development. Key informants, again both within USAID and in partner organizations, stress the importance of improving market

access—in particular, creating income opportunities for both men and women through value-addition and trade. USAID and its partners recognize the important role of women in selected fish capture activities, but particularly in processing and trade. Whilst there is some existing work (particularly around co-management) intended to increase women's decision-making in fisheries, there is widespread recognition of the need to do more work that directly addresses women's needs and priorities in fisheries and the associated marketing chain.

A clear message emerging from this review is that fisheries in Africa are part of a larger jigsaw, encompassing important livelihood and wider ecosystem considerations. The recommendations in Section V explore the opportunities offered to develop fisheries in the context of the President's Initiative to End Hunger in Africa and its focus on support to NEPAD's Comprehensive Africa Agriculture Development Program (CAADP).

**Current alliances and communities of practice for inland fisheries in Africa**

Six initiatives have been identified that have a significant focus on inland fisheries and serve as focal points for organizations working in this field in Africa:

- FAO has established a "Committee on Inland Fisheries for Africa"; this operates mainly at Government-level, but nonetheless engages key national players;

- the Sustainable Fisheries Livelihood Program has been highly instrumental in bringing together a community of practice (in governments, NGOs and communities) around poverty reduction in fishing communities;

- NEPAD, with support from the WorldFish Center, engages with African governments, the regional economic communities and donors, to promote the policies and conditions for development of fisheries and aquaculture in Africa;

- the SADC Protocol on Fisheries enshrines a regional approach for development and integration of the SADC fishery sector, as well as providing a regionally contextualised translation of the United Nations Code of Conduct for Responsible Fisheries (CCRF); the SADC Secretariat is drafting a strategy for implementation of the Protocol on Fisheries for consideration by members of the High Level Committee on Fisheries (HLC); the protocol includes articles on aquaculture; management of shared resources; trade and investment; law enforcement; and harmonisation of legislation;

- the WorldFish Center, through its research for development in Africa, engages an informal coalition that includes governments, the regional economic communities, research expertise (northern and southern), NGOs (operating at different levels), international organisations and donors; and

- the Lake Victoria Fisheries Organisation, although operating only on one lake, nonetheless provides an example of a multi-country initiative with a broad remit

relating to maintaining ecosystem services, fostering partnerships for fisheries management and promoting improved livelihoods of lakeside communities.

**Identification of potential partners**

There are relatively few organizations working in Africa that focus exclusively on fisheries, but there are a number of organizations present whose work includes fisheries. The following list is not exhaustive, but it includes many of the government, research and not-for-profit organizations with current activities on inland fisheries in Africa:

- government departments responsible for fisheries in the African states
- universities, research institutes and research networks in the African states
- regional economic communities in Africa (notably SADC, the Common Market of Eastern and Southern Africa/COMESA, ECOWAS, the Economic Community of Central African States/ECCAS)
- the Africa Wildlife Foundation (AWF)
- the World Conservation Union (IUCN)
- the Worldwide Fund for Nature (WWF)
- Wetlands International
- the New England Aquarium
- the Africa Museum, Tervuren (Belgium)
- Innovative Resource Management
- the Sustainable Fisheries Livelihoods Program (SFLP)
- the New Partnership for Africa's Development (NEPAD)
- the World Bank and the Global Environmental Facility (GEF)
- the Food and Agricultural Organisation of the United Nations (FAO)
- LVFO and the other research, management and development organizations of the Great Lakes:
  - the multi-country river basin authorities or initiatives (e.g., Nile Basin Initiative) or river management authorities (e.g., those in West Africa managing irrigation waters)
  - the transboundary parks
  - the Challenge Program for Water and Food (CGIAR), focusing on the Nile, Volta, Niger and Limpopo basins
  - Institut pour la Recherche et le Development (IRD), France, and
  - the WorldFish Center.

## V. Recommendations

### Comprehensive Africa Agriculture Development Programme (CAADP): the framework for assistance to inland fisheries in Africa

In formulating the following recommendations, the authors have looked for areas of convergence between: (a) the learning from the present review, (b) USAID's comparative advantage in development and conservation in Africa, (c) existing priorities for USAID assistance in Africa, and (d) ongoing policy and investment trends in African fisheries.

The President's Initiative to End Hunger in Africa, launched in 2002, sets out the framework within which USAID provides support to agriculture (including fisheries). Its work is structured around four themes:

- economic governance and global partnerships to foster agricultural development
- the development of markets, especially regional markets, and agribusiness
- harnessing science and technology for agricultural development, and
- focusing on the vulnerable, especially the persistently poor.

The Initiative to End Hunger supports NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) as a key instrument for the pursuit of these objectives. NEPAD, moreover, through its CAADP Action Plan for the Development of Fisheries and Aquaculture, provides clear pointers for investment in inland fisheries in Africa[171]. These represent the collective priorities of the African governments and fisheries/development experts, as distilled through a widely consultative process during 2004/2005 that culminated in the *Fish for All* summit in Abuja in August 2005 (NEPAD, 2005a).

Where USAID is able to use its resources and comparative advantage in support of the Action Plan for Fisheries, it can have an important strategic impact on fisheries and the livelihoods of those who depend on the sector.

The recommendations that follow include suggestions on specific actions for USAID. Although these recommendations have widespread relevance throughout Africa, some suggestions are made on places where such work would be particularly relevant.

### Recommendation 1. Sustain production through integrated water resource management

The long-term productivity of Africa's inland fisheries is dependent on maintaining the ecosystems on which these fisheries depend. These are, however, under widespread pressure from land and water management practices that are steadily reducing the

[171] The Action Plan covers marine fisheries too (NEPAD, 2005b). It provides a useful framework for the prioritization of donor activities relating to fisheries and aquaculture in Africa, irrespective of any implementation link to NEPAD.

availability and productivity of these systems. If Africa's inland fisheries are to be sustained over the coming decades, fisheries stakeholders will in particular need to engage with other water-users at all levels of decision-making, especially with regard to interactions with irrigated agriculture and hydro-power sectors. Investments in land and water management that sustain aquatic resources (including inland fisheries) are urgently needed, together with water governance that provides for full integration of inland fisheries priorities in water resource management. These investments will need to be rooted in a better appreciation of the fisheries resources and their specific contribution to economic development in different river basins.

*USAID actions:*

- Support the development of capacity amongst planners and managers at sub-regional and national levels to integrate fisheries priorities into integrated water resource planning and management.

- Support the development and implementation of decision support tools for land and water management that include the needs of fisheries and the freshwater ecosystems that sustain them, and strengthen the capacity of decision-makers to implement them. These should include the development of environmental flow assessment methodologies that incorporate the needs of river fisheries.

- Support the development of capacity to undertake assessments and valuations of major inland fisheries and contribute this information on an on-going basis in support of improved water management.

- Support efforts to strengthen the capacity of tertiary education and research institutes in Africa to provide science and training services required for better water resource planning and management.

- Support actions that pursue agreed priorities for biodiversity conservation in Africa's inland waters.

Target basins and sub-basins could include the Zambezi (including Lake Kariba once political considerations permit), Niger, Congo, Volta, Lake Chad, Lake Malawi and the important lake fisheries of Madagascar.

**Recommendation 2. Support transboundary management**

Many of Africa's inland fisheries are transboundary resources. The long-term sustainability of these fisheries is dependent on maintaining the freshwater ecosystems on which they depend. These sustainable management plans, however, require collaboration across national and state or provincial boundaries. Capacity to initiate or pursue such approaches needs to be developed and institutions that can foster this supported.

*USAID actions:*

- Support regional and basin-wide fisheries bodies to manage shared resources.

- Support basin-wide monitoring and information systems and promote establishment of compatible legislative frameworks across basins and between sectoral management agencies.

Target basins could include the Volta and Niger River basins, the Congo River Basin and sub-basins, and southern Africa river basins.

**Recommendation 3. Support improved fisheries governance in order to improve resource access and benefits for the poor**

The social and environmental sustainability of most of Africa's inland fisheries, and the realisation of their full development value, will only be achieved through more effective and equitable governance arrangements. Of particular concern is the general under-representation of fishing communities in the decision-making process in both local and national political arenas. In order to address this requirement, governance mechanisms and processes need to be strengthened at all levels. Simultaneously, the capacity of all stakeholders needs to be strengthened, in particular that of rural fishing communities. Effective participatory planning processes involving all legitimate stakeholders (including local communities and the private sector), leading to sustainable co-management frameworks, need to be established and supported with appropriate legislation.

*USAID actions:*

- Invest in fisheries management programs that address the issues of governance at multiple scales, including water management at the catchment scale, and co-management of individual fisheries at the local scale.

- At country-level, support programs that improve governance of fisheries, and integrate fisheries concerns into wider issues of water management, catchment management, and food security.

- Support the implementation of fisheries co-management plans that include all fisheries key-stakeholders. These should include the establishment of accountable governance structures at the decentralised level to supervise the fisheries management operations characterised by transparent mechanisms of control and audit.

Target countries should be those where there has been some progress with decentralisation and where there is some recognition of the role of fisheries in poverty reduction. This could include Uganda, Tanzania, Mozambique, Ghana, Nigeria, Senegal, Mali and DRC.

**Recommendation 4. Enhancing productivity through post harvest management**

The productivity of African inland fisheries can be increased substantially by improving post harvest management. Africa's inland fisheries are characterized by a very high rate of post-harvest losses that particularly affect small-scale operators (fishers and traders). Often, simple and cheap post-harvest technologies exist which could dramatically reduce the quantities of fish-product lost. Further development and widespread application of these technologies would have a major impact on the livelihoods of hundreds of thousands of producers and millions of consumers. Similarly, improvements in post-harvest handling are constrained by the very limited number of decent landing sites. Investments to rehabilitate the infrastructure of the existing sites and to develop additional ones are required. Private and public investments are urgently needed in those domains to increase the productivity of inland fisheries across Africa. In addition, the majority of small-scale processors are unable to develop their business and adopt improved processing techniques simply because they lack access to financial systems and investment funds. Providing, and facilitating the establishment of formal and informal financial support for the post-harvest sector is a priority for Africa's inland fisheries.

*USAID actions:*

- Support investments (public and private) in post-harvest (processing and trading) infrastructure, including the development of technologies for improved processing in specific fisheries and development of capacity through public private partnerships to disseminate and use these technologies.

- Invest in road and transport systems to improve accesses between major fishing areas and urban centres.

Such investments have widespread relevance throughout Africa and, as such, it seems inappropriate to single out particular fisheries. However, investments such as this are likely to have the largest impacts in places where there are large fisheries, with poor market access and infrastructure, despite proximity to significant local markets. This could include, for instance, the lake fisheries of eastern Congo (DRC), the fisheries of the River Congo, the Zambezi in Zambia and Madagascar's lake fisheries.

**Recommendation 5. Support improved market access, in particular for small-scale producers, processors and traders**

The full potential of Africa's inland fisheries will only be realized when artisanal fishers and small-scale traders have much improved access to markets for their produce. In order to improve this, multiple investments are required to develop market information systems at both national and regional levels and build capacity to understand and adapt to those market dynamics. Investments are also necessary to improve market infrastructures and

communication and transport networks. These interventions need to be supported by increased promotion of fish and fisheries products in international, regional and local markets, and the development of policies and regulations that can help foster this trade, including the currently significant informal regional trade[172]. In addition, the reduction of transaction costs at all levels including the removal of tariff barriers and elimination of all forms of illegal (informal) taxations systems need to be implemented. Finally, to ensure that the benefits of markets and trade are shared, more accountable and transparent institutions will be needed that allow operators of all sizes to benefit from their support and services.

*USAID actions:*

- Support the development of market information systems and strengthen market research and development capacities.

- Support an assessment of regional fish trade in order to identify current and potential internal African market opportunities, and support policies and regulations to encourage formalization of informal regional trade.

- Support programs that strengthen capacity of artisanal fish processors and traders, in particular women entrepreneurs, to further develop their enterprises.

- Support the development of capacity to reduce barriers to trade of inland fisheries products, including through activities such as development of guidelines for eco-labeling, development of capacity in testing laboratories and quality control authorities, and development of legal / institutional frameworks to support certification processes.

As with recommendation 4, such actions would have widespread relevance. Obvious priorities include areas where there is significant informal cross-border trade in fish products, including many of the Rift Valley country borders. In these countries, but also in other parts of DRC, West Africa and in Mozambique, there is a large amount of fish processing and trade, in which women play a very significant role.

**Recommendation 6. Support enterprise development through assistance with the development of enabling institutions and policy frameworks**

[172] Although the main focus, because of market size and accessibility must be markets in Africa, there is potential for market development in more specialized areas, e.g. high quality products targeted at export markets. One growth area in future might be the sale of ornamental aquarium fish. These have higher value than fish for sale for consumption, and are present in large quantities in rainforest rivers, such as those of the Guinean rainforest. According to Brummett, globally developing countries produce 63% of this trade, which was worth approximately $206 mn in 1996 and has increased since. Brummett, Randall E. July 2005. 'Ornamental fishes: a sustainable livelihoods option for rainforest communities' in FAO Aquaculture Newsletter No. 33, Rome, Italy: FAO.

If the economic opportunities offered by African fish trade are to be realized fully, training for enterprise management, marketing strategies and organizational capacities will need to be provided for both fishers and the full range of operators along the marketing chain. In addition, a specific effort is needed to facilitate access to financial institutions, in particular for the small-scale operators and the local grass-root organizations that support them. As part of the improvement of access to credit and financial support, special attention needs to be given to addressing the 'remoteness' of financial institutions that are often located hours or days away from rural fish-farmers or fisher communities. Finally, provision of facilities such as electricity and water to remote fishing communities will bring direct health benefits but also indirect benefits through the improvement of the economic performance of micro and larger-scale enterprises.

*USAID actions:*

- Support training for enterprise management and marketing strategies along the marketing chain.

- Support activities to strengthen the organizational and institutional capacities of producers' organizations.

- Support fisher and trader associations and professional organizations to access and manage credit, including through the introduction of mobile financial services, and develop appropriate financial services for different enterprises along the marketing chain.

These actions, focused particularly on capacities for value-added activities and marketing, would have particular relevance in the same areas suggested for recommendations on 5 and 6, i.e., the Rift Valley countries, parts of River Congo fishery, the Zambezi, Mozambique and Ghana, Nigeria and Mali.

**Recommendation 7. Support consideration of inland fisheries in national and regional policies and actions on food security**

The role of fish as a major source of animal protein and micronutrient is now increasingly well documented internationally. Yet, this has so far not been reflected in the integration of fisheries into Africa's national food policy frameworks. To achieve this, the contribution of fish to food and nutritional security needs to be better appreciated by senior decision-makers and planners at the national level and supported through more adequate and coherent policies at both national and regional levels. These need to address how Africa's fish resources can best contribute to food security through better processing and marketing of locally produced fish, while also seizing opportunities to generate income through export of higher value species to international markets. In addition, the role of imports of low-value fish needs to be considered.

*USAID actions:*

- Support activities that document and communicate the real contribution of inland fisheries to regional, national and local food security.

- Support implementation of national and regional policies that promote better management of inland fisheries as a contribution to enhanced local and national food security, e.g. the SADC fisheries protocol.

- Support efforts to promote fish consumption in areas where it can provide a source of cheap protein.

These actions would have widespread relevance throughout Africa and be particularly suitable for inclusion in programs aimed at improving food security in those places where there is particularly high malnutrition.

**Conclusion**

There is growing recognition of the importance of fisheries, particularly inland fisheries, in Africa's economic development—as a source of livelihoods and potential growth, and as an important source of affordable animal protein. As Sections II and III have shown, these fisheries are also very important from a biodiversity and conservation perspective. The conservation issues can only be addressed effectively within a framework and approach that takes due account of the livelihoods role of inland fisheries and substantively involves fishing communities in their management.

USAID is well placed to support work in this area. It has strong experience in integrated conservation and development programs, involving multiple stakeholders and partners. Moreover it has experience and mechanisms to support important transboundary initiatives that are particularly relevant to some of Africa's largest lake and river fisheries. Where these issues are not addressed, there will be important consequences for the fisheries and for the other environmental resources that are part of the same ecosystems.

The sector also presents rare and much-needed potential for rural economic growth in Africa, not least because of robust and growing local markets for fish products. Such opportunities for private sector and market development are well matched to the experience and interests of USAID and its partners in development.

**References**

Allison, Edward H. et al. 2005. Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisherfolk living in poverty: Summary Report. London, UK: Fisheries Management Science Programme, DFID

Andrianandrasana, H. et al. 2005. 'Participatory ecological monitoring of the Alaotra wetlands in Madagascar', Biodiversity and Conservation 14: 2757-2774

Bene, C., and Neiland, A. 2003. 'Contribution of Inland Fisheries to Rural Livelihoods in Africa: An Overview from the Lake Chad Basin Areas' in Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries. Bangkok, Thailand: FAO

Bennun, L.A., et al (eds). 1992. Conservation of Biodiversity in Africa: Local Initiatives and Institutional Roles. Nairobi, Kenya: Centre for Biodiversity.

Bootsma, H. and Jorgensen, S. 'Lake Malawi/Nyasa: Experience and Lessons Learned Brief' in ILEC. 2005. Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders. Kusatsu, Japan: International Lake Environment Committee Foundation

Brummett, Randall E. July 2005. 'Ornamental fishes: a sustainable livelihoods option for rainforest communities' in FAO Aquaculture Newsletter No. 33, Rome, Italy: FAO.

Darwall, W., et al. 2005. The Status and Distribution of Freshwater Biodiversity in Eastern Africa. IUCN SSC Freshwater Biodiversity Assessment Programme. Gland, Switzerland and Cambridge, UK: IUCN

Delgado, Christopher L.. 2003. Fish to 2020: supply and demand in changing global markets. Penang, Malaysia: WorldFish Center

Earth Institute Projects Database. Freshwater Fishes of the Lower Congo: biodiversity, systematics, and conservation [webpage]. Available online at http://directory.ei.columbia.edu/displayproject.php?projectid=212

FAO. 1997. Irrigation potential in Africa: a basin approach. Rome, Italy: FAO. Available online at http://www.fao.org/docrep/W4347E/w4347e11.htm

FAO. 2004a. The State of World Fisheries and Aquaculture 2004. Rome, Italy: FAO.

FAO. 2004b. World Fisheries and Aquaculture Atlas CD-ROM. Rome, Italy: FAO

FAO Aquastat. 2005. Sudan Country Profile [webpage] (available online at http://www.fao.org/ag/agl/aglw/aquastat/countries/sudan/index.stm)

FAO. 2006. Contribution of fisheries to national economies in West and Central Africa: Policies to increase the wealth generated by small-scale fisheries. New Directions in Fisheries – A Series of Policy Briefs on Development Issues, No. 03. Rome. Available online at http://www.sflp.org/briefs/eng/03.pdf

Gordon, Ann. 2005. HIV/AIDS in the fisheries sector in Africa. Cairo, Egypt: WorldFish Center

Gupta, M.V. et al (eds). 2004. Use of Genetically Improved and Alien Species for Aquaculture and Conservation of Aquatic Biodiversity in Africa. Penang, Malaysia: WorldFish Center

Hirji, R. et al (eds). 2002. Defining and Mainstreaming Environmental Sustainability in Water Resources Management in Southern Africa. Lesotho: SADC.

ILEC. 2005. Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders. Kusatsu, Japan: International Lake Environment Committee Foundation

Jansen, Eirik G. 1997. Rich fisheries, poor fisherfolk: Some Preliminary Observations about the Effects of Trade and Aid in the Lake Victoria Fisheries. Regional Office for Eastern Africa: IUCN. Available online at http://app.iucn.org/dbtw-wpd/edocs/1997-081.pdf

Jorgensen, S., et al. 'Lake Tanganyika: Experience and Lessons Learned Brief' in ILEC. 2005. Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders. Kusatsu, Japan: International Lake Environment Committee Foundation

Kapetsky, J. M. and Barg U. Land quality indicators from the viewpoint of inland fisheries and aquaculture. Rome, Italy: Fishery Resources Division, FAO. http://www.fao.org/docrep/W4745E/w4745e0e.htm

Kayambo, S. and Jorgensen, S. 'Lake Victoria: Experience and Lessons Learned Brief' in ILEC. 2005. Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders. Kusatsu, Japan: International Lake Environment Committee Foundation.

LakeNet. [No date]. LakeNet Profile: Kariba. Available online at http://www.worldlakes.org/lakedetails.asp?lakeid=8360

Lovgren, Stefan. December 14 2005. 'Hippos – and precious dung – vanishing from African lake', in National Geographic News. Available online at http://news.nationalgeographic.com/news/2005/12/1214_051214_hippo_dung_2.html

Magadza, C. ‘Kariba Reservoir: Experience and Lessons Learned Brief’ in ILEC. 2005. Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders. Kusatsu, Japan: International Lake Environment Committee Foundation

Mandima, J and Mwima, H. 2005. ‘Baseline Fish Biodiversity Surveys: African Wildlife Foundation Experiences form the Zambezi River, Southern Africa’ in Thieme et al (2005)

Mwima, H and Mandima, J. 2005. ‘African Wildlife Foundation Experience in the Management of Fishery Resources in Two Southern African Landscapes’ in Thieme et al (2005)

Mumba, S and Howard, G. 2005. ‘Invasive Alien Species in African Freshwater Ecosystems’, in Thieme et al (2005)

Neiland, Arthur, et al. 2006. Inland Fisheries in Africa: Key Issues and Future Investment Opportunities for Sustainable Development. Cairo, Egypt: WorldFish Center.

NEPAD, 2005a, Proceedings of the NEPA-Fish for All Summit, 22-25 August 2005, Abuja, Nigeria. Pretoria, South Africa: NEPAD.

NEPAD, 2005b, The NEPAD Action Plan for the Development of African Fisheries and Aquaculture, Pretoria, South Africa: NEPAD.

Odada, Eric O., et al. 2006. ‘Lake Chad: Experience and Lessons Learned Brief’ in ILEC (2006)

Ramsar. 2005. The Annotated Ramsar List: Sudan. Available online at http://www.ramsar.org/profile/profiles_sudan.htm

Scudder, T. Mar 1989. ‘Conservation v. Development: River Basin Projects in Africa’, Environment, Vol 31, no. 2

Seehausen Ole. 2005. ‘The Cichlid Fish Radiations of East Africa: A Model for Understanding Origin and Loss of Biodiversity’, in Thieme et al (2005)

Shumway, C. 1999. Forgotten Waters: Freshwater and Marine Ecosystems in Africa: Strategies for Biodiversity Conservation and Sustainable Development. Boston, USA: Boston University.

Shumway, C., et al. 2003. Biodiversity Survey: Systematics, ecology, and conservation along the Congo River. Boston, USA: New England Aquarium.

Sparks, J and Stiassny, M. ‘Madagascar’s Freshwater Fishes: An Imperiled Treasure’ in Thieme (2005)

Teugels, G and Thieme M. 2005. 'Freshwater Fish Biodiversity in the Congo Basin' in Thieme et al (2005)

Thieme, Michele L.. et al. 2005. Freshwater ecoregions of Africa and Madagascar: a conservation assessment. Washington, USA: WWF

Tomi, Petr. [No date]. Small waterbaodies. [UN Atlas of the Oceans webpage]. Available online at http://www.oceansatlas.com/world_fisheries_and_aquaculture/html/ecosys/inland/modeco/small_water_bodies.htm

Vanden Bossche, J.-P.; Bernacsek, G.M. 1990. 'Source book for the inland fishery resources of Africa: 1'. CIFA Technical Paper. No. 18.1. Rome, Italy: FAO.

Welcomme, R. L. 2001. Inland Fisheries: Ecology and Management. Paris, France: FAO

West, K. 2001. Lake Tanganyika: Results and experiences of the UNDP/GEF conservation initiative (RAF/92/G32) in Burundi, D. R. Congo, Tanzania, and Zambia. GEF

WorldFish Center. 2004. Proceedings of the International Workshop on the Fisheries of the Zambezi Basin. WorldFish Center, forthcoming.

WorldFish Center. 2005a. Fisheries and the Millennium Development Goals: Solutions for Africa. Cairo, Egypt: WorldFish Center

WorldFish Center. 2005b. Supporting the Contribution of Small-scale Fisheries to Africa's Economic Development. Cairo, Egypt: WorldFish Center

WorldFish Center. 2005c. Fish and Food Security in Africa. Cairo, Egypt: WorldFish Center

WorldFish Center. 2006. Proceedings of the International Workshop: Responding to HIV and AIDS in the Fishery Sector in Africa. Cairo, Egypt: WorldFish Center

WRI. [No date]. Water Resources eAtlas: Congo Watershed. Available online at http://www.waterandnature.org/eatlas/html/af3.html

WCS. [No date]. Central African Forests Factsheet. Available online at http://wcs.org/centralafrica/FactSheets/CenterOfBiodiversity.pdf

WCS. [No date]. From the Mountains of the Moon to the Ocean: A conservation atlas of the forests of Central Africa. WCS, p. [5]. Available online at http://wcs.org/centralafrica/Atlas/ConservationAtlas.pdf

WWF. 2001. Saharan Flooded Grasslands AT0905. Available online at http://www.worldwildlife.org/wildworld/profiles/terrestrial/at/at0905_full.html

WWF. [No date]. Population growth in the Congo River Basin [webpage]. Available online at http://www.panda.org/about_wwf/where_we_work/africa/what_we_do/central_africa/congo_basin_forests/problems/population_growth/index.cfm

UNDP. 2005. Human Development Report 2005. New York, USA: UNDP

UNEP. 2002. Africa Environment Outlook: Past, present and future perspectives. Norway: UNEP. Available online at http://www.unep.org/dewa/Africa/publications/aeo-1/148.htm

**Annex A: Map of Africa showing major lakes and river basins**

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