International Water Resources Association
Water International, Volume 25, Number 1, Pages 115–126, March 2000

Addressing the Global Water and Environment Crises through Integrated Approaches to the Management of Land, Water and Ecological Resources

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Abstract: *As the world approaches the 30-year anniversary of the Stockholm Conference on the Human Environment and prepares to review progress made in the decade since Dublin and Rio, we are confronted with results that are mostly disappointing. When it comes to addressing the water resources crisis, the 1990s may well be remembered as a decade of debate rather than action. Recent assessments suggest a doubling to almost two-thirds of the world's population experiencing some water stress by 2025 and increased demands to withdraw more water for a new "green revolution" for irrigated agriculture. Both of these will accelerate environmental degradation to a new crisis level while the existing degradation that resulted from the first "green revolution" still awaits remedial action both in the North as well as in the South. It is now clear that the global water crisis and the global environment crisis are linked and are being exacerbated by unprecedented global pressure resulting from over-consumption, population growth, globalization of economic systems and trade, reduction in development assistance, and failure to enact necessary policy, legal, and institutional reforms. This article makes the case that the traditional sector-by-sector approach to economic development is a key contributor to the two global crises. Lessons of experience are presented on policy, legal, and institutional reforms necessary to address the inter-linked crises through integrated approaches to managing land and water resources and their biological diversity. Water pricing reforms, reductions in damaging subsidies, land tenure reforms, community participation, and institutional reforms are necessary. There is a need to build upon the linkages and synergies among the three Rio conventions (climate, biodiversity, and desertification) in order to create new global driving forces for actions to address the crises holistically in the context of a country's national sustainable development strategy. The Global Environment Facility (GEF) and its implementing agencies stand ready with incremental cost grant financing to assist countries willing to undertake the reforms for integrated basin management of land, water and biological resources as they transition towards sustainable development.*

Keywords*: Global water crisis, integrated water management, global environment, policy reform, water policy, land tenure, biological diversity, globalization, river basin management, Global Environment Facility, sustainable development.*

Introduction

Since the beginning of time, water has been shaping the face of the earth, not only as a geologic agent, cutting valleys and canyons and sculpting rock formations, but also as a major factor in the rise and fall of great civilizations and as a source of conflict and tension between nations. The first great civilizations arose on the banks of great rivers, the Nile in Egypt, the Tigris-Euphrates of Mesopotamia, the Indus in Pakistan, and the Hwang Ho of China. All of these civilizations built large irrigation systems and made the land productive. By the same token, civilizations collapsed when water supplies failed or were improperly managed. The decline of the Sumerian civilization of Mesopotamia, for example, is believed to be due to poor irrigation practices resulting in saline soils (El-Ashry, 1998).

Today, the way we think about water goes to the very heart of the increasing worldwide concern about human health, the environment, and the path towards sustainable development. Of all the natural resources needed for economic development, water is one of the most essential, particularly in arid and semi-arid regions. At the dawn of the 21st century, we find ourselves facing formidable challenges: rapid population growth; increasing demands for water to satisfy people's needs, both in agriculture and in expanding urban centers; failing water quality, pollution, and associated health and environment impacts;

groundwater depletion; and international conflict over transboundary water resources.

However, solutions to water-related concerns can not be formulated in isolation. A wide variety of critical environmental threats with global implications also exist that have linkages to the water crisis: reduction of crop yields from soil degradation; catchment erosion and deforestation leading to cycles of drought and flood; loss of biological diversity and associated habitat; damaged wetlands, floodplains, and coastal ecosystems from water diversions, diking, and land conversion; overfishing; and fluctuating climate from global warming.

At the turn of the century, it is clear that growing concerns in water subsectors represent only one symptom of a much larger global crisis facing our social, economic, natural resource management, and environmental systems. This paper explores the nature and significance of these complex, closely linked crises. Sector-by-sector approaches to development have led to fragmentation rather than the integration sought by socially and environmentally sustainable development. Case studies of fragmentation and lessons of experience in integrated management are examined, and the lack of commitment to enact necessary policy and institutional reforms is highlighted as a key obstacle. Without such reforms, sector-by-sector projects and their competition for scarce land and water resources will not achieve their desired objectives, and no technical or engineering fix will be sustainable.

The social, economic, and environmental costs of inaction are potentially so high that governments will eventually need to embrace a comprehensive approach to land, water, and ecosystem management. This paper describes several initiatives underway through GEF assistance that operationalize a more comprehensive and integrated approach to sustainable development, river basin by river basin. While sectoral approaches will be necessary to address elements of the water crisis, results may be more sustainable if they are formulated within this integrated approach to land, water, and ecosystem management as part of a country's sustainable development strategy. We propose the thesis that the three Rio global environment conventions provide an holistic framework within which countries can pilot and test these opportunities to address both local and global environment concerns as well as linked aspects of the water crisis. These experiences will be valuable for both the North and the South.

Significance of the Global Water Crisis

While it took up to 1950 for humanity to accumulate 2.5 billion people, it took less than 40 years for that population to double and only 12 years to add another billion people, reaching six billion in October of 1999. With modest projections of two billion more people by 2025, and India joining China with a population of a billion people, it is easy to see why per capita water supplies are on a downward spiral. In addition, most of this population increase is projected to occur in developing countries.

The impending water crisis is not new; professionals have been warning of the coming scarcity since Mar del Plata in 1977 and New Delhi in 1980. The pace of international conferences has quickened in the 1990s, beginning with Dublin and Rio in 1992 and culminating with The World Water Forum in the Hague in March 2000, as water professionals call the coming crisis to the attention of the world community. The numbers are staggering: 1.4 billion people without access to safe drinking water, 2.3 billion lacking sanitation, seven million die yearly from disease linked to water, food shortages for 800 million people, and half the world's rivers and lakes seriously polluted (Serageldin, 1999).

Recent assessments conducted for the UN (World Meteorological Organization, 1998) and for the World Commission on Water (Seckler et al., 1999; Water Supply and Sanitation Collaborative Council, 1999) add a sense of urgency to these well-known numbers. Currently, almost half a billion people face shortages in 29 countries. By 2025, almost two-thirds of the people on our planet are forecast to experience some type of water stress, and for over a billion of them, the shortage will be severe and socially disruptive. Depending on the assumptions made, from 20 to 65 percent more water will need to be diverted for irrigation to feed the growing population.

Unfortunately, measures have yet to be taken to remedy the massive environmental degradation and social disruption that accompanied the first "Green Revolution" in irrigation 30 years ago. Wetland, floodplain, and coastal ecosystems may not be able to sustain additional withdrawals and loadings of polluted return flows without irreversible degradation. Yet, cities and industry also have a growing demand for water. In 1950, there were less than 100 cities with one million people; by 2025, the number is projected to increase to 650, as half the planet's populations reside in cities and 70 percent live within 90 kilometers of the oceans. With 87 percent of water consumption being utilized by agriculture, serious domestic and transboundary conflicts among agriculture, water supply, hydropower, and ecosystems are forecasted.

Significance of the Global Land and Environmental Crisis

The other, quiet crisis involving land degradation, especially in the drylands, and environmental damage is closely linked to the water crisis and may prove to be more intractable and politically sensitive. Loss of land productivity and loss of benefits provided by ecosystems in decline have enormous social consequences and fuel the migration of environmental refugees to overcrowded cities.

The earth's forest land is shrinking, deserts are expanding, soils are eroding, and irrigated land is becoming

waterlogged and saline. At the same time that the hungry planet needs more food to feed its rapidly expanding population, more land is going out of production from soil erosion (six to seven million ha/yr) and waterlogging/salinization (one to two million ha/yr) than is being placed into production (Umali, 1993). And downstream, the eroded topsoil fills in reservoirs, canals, and rivers, exacerbates flood damage, and leads to reduced hydropower production or irrigation potential.

In the drylands, in particular, severe consequences are suffered by the poverty-stricken population as a result of land conversion and degradation. Deforestation, degraded rangelands, depleted soils, salinized land, and depleted aquifers impair the lives of 100 million of our planet's poor and threaten another 900 million people. Figure 1 shows that dryland degradation is a moderate to serious concern on every continent, as evidenced by assessments conducted in 1977, 1984, and 1991 (UNEP, 1994). Desertification is estimated to directly affect about 3.6 billion hectares on 70 percent of our planet's drylands as a result of excessive livestock grazing, cropping methods, irrigation schemes, and fuelwood harvesting.

Unsustainable and wasteful use of irrigation water is a particularly significant problem with 25-30 million hectares of land estimated to be severely affected by water logging/salinization and an additional 60-80 million hectares with less serious yield reductions (Umali, 1993). Inadequate drainage deprives the downstream water environment of needed water, especially coastal areas, while water tables rise in irrigated areas. About 10-11 percent of irrigated land is affected in India and Mexico; 21-24 percent is affected in Pakistan, China, and Uzbekistan; 28 percent in the US; and 48 percent in Turkmenistan near the Aral Sea. This degradation of land and reduction in crop yields translates into tens of billions of dollars of economic loss each year.

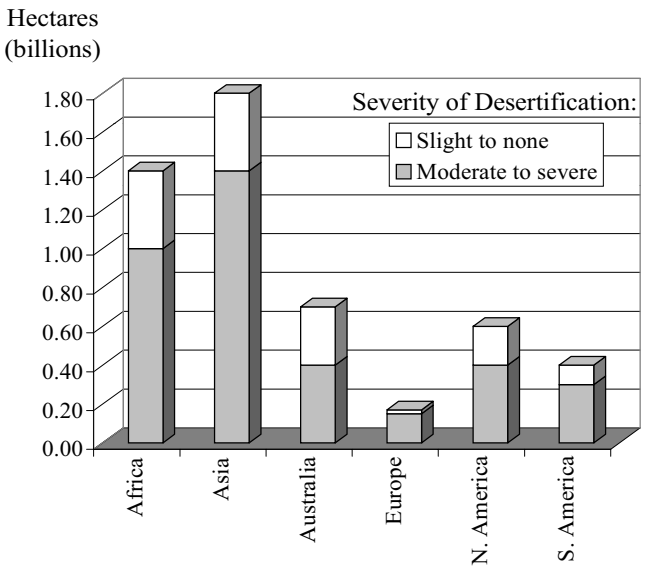

Figure 1. Extent of drylands and severity of desertification by continent (from UNEP, 1994).

Deforestation has become a globally significant phenomenon and has increased dramatically over the last 20 years in the moist tropics (Houghton, 1994). The converted land is being abandoned at a record pace as its short-lived productivity declines, and at current rates of deforestation, tropical forests may disappear from the earth in our children's lifetime (Houghton, 1994). Since 1970, the world has lost 10 percent of its forests, losing an area the equivalent of Bangladesh or Florida each year (WWF, 1999). Only one half of the world's original forest cover remains, and the earth's biological diversity is disappearing at unprecedented rates. While the US and Europe have lost over 90 percent of their original forest cover, Central America, Southeast Asia, and West African tropical forests share the same fate. Perhaps thousands of native species may have been lost and tens of thousands others threatened with the greatest rate of species extinction seen on earth in 80 million years. The Global Biodiversity Assessment (UNEP, 1996) describes the nature and significance of the loss. Once original forest is lost, areas of re-growth are less biologically diverse. Enormous potential economic value for food crops and pharmaceutical products are at risk.

Most directly linked to mismanagement of water resources and narrow sectoral approaches to water development is the loss of freshwater and coastal biodiversity and adverse impacts on local communities as a result of diversions of water, channelization, diking of floodplains, wetland drainage, dams, and agricultural pollution discharges. North America has experienced a major loss of freshwater biodiversity, with many species endangered, threatened, or already extinct (Abramovitz, 1996). Worldwide, the loss of important freshwater species is double the rate of loss of terrestrial species, with 51 percent of freshwater species declining in numbers (WWF, 1999). This has profound effects on people depending on fisheries and wetlands in many areas, and environmental degradation was identified as the top factor threatening freshwater fisheries, according to a recent global assessment by FAO (1999). Of even greater significance is the risk of economic loss from free services provided by nature when ecosystems like wetlands, floodplains, and coastal areas are degraded. Trillions of dollars of benefits are projected to accrue each year, and these free inputs to national economies are at risk from mismanagement (Costanza, 1997).

Lessons of Experience for Integrated Management

For the past 60 years, the concept of "integrated water management" has been evolving. During the 1930s, the move from single purpose to multi-purpose water projects that began in the Tennessee, Loire and Ganges

basins initiated this evolution. The papers compiled by Lundqvist et al. (1985), Mitchell (1990), and Tennessee Valley Authority (1989) describe the need for integrated, cross-disciplinary approaches to land and water resource management. While many papers have been written on integrated water or integrated basin management, it is a difficult concept to achieve in practice. At best, there might be tradeoffs among sectors, but consideration of land management or downstream biological diversity is often absent. Even in wealthy nations, a recent critique by the Organization for Economic Cooperation and Development (1998) identified lack of integration across sectors in managing water resources as a continuing problem and noted the need for improvement.

In addition to the Tennessee Basin and the French approach to basin management, the new Brazilian water law and the new South African water law show promise for improving the integration of ecological considerations into cross-sectoral management of water resources, basin by basin. Also of particular note is the initiative by the Australian government in the Murray-Darling river basin, which supplies three-fourths of the country's water. Ecological degradation, pollution, salinity, and water shortages created an impetus for action. As reported by Postel (1999), a special allocation of 25 percent of flow is being set aside for instream ecological uses at the same time that water charges are increased, water and salinity reduction markets are created, nutrient reduction measures are being implemented, and a cap on urban water use is established to achieve more effective water management

The failure to achieve integrated management has been attributed to the strength of sectoral ministries in opposing the concept, as well as institutional bottlenecks occurring in implementation (de Jong et al., 1994). Somlyody (1994) describes obstacles that impede the application of integrated water resource management, as sector-by-sector, fragmented approaches remain the norm even in the North. The availability of funding to "fix" problems caused by fragmentation and inter-organizational rivalries keeps conflicts at bay (Deyle, 1995). White (1998) characterizes the disappointment with integrated management quite well as he describes his 50-year "international search" for integrated water management.

The lack of application of this integrated approach to transboundary basins is becoming a serious international issue, since over 50 percent of the earth's land surface consists of multi-country river and lake basins. Notable exceptions of environmental and biodiversity considerations being integrated with water quality and quantity management are the Rhine Basin (Huisman, 1994) and the Great Lakes-St. Lawrence River basin of North America (Duda and La Roche, 1997). However, this occurred only in the context of restoration once the policy, institutional, and legal shortcomings were recognized, and these restoration efforts have been quite expensive.

The lessons of experience reveal that many cross-sectoral water conflicts stem from sector-by-sector, supply-side projects and that these fragmented actions contribute significantly to degradation of important ecosystems in the North and the South. The following case studies provide examples of the economic, social, and environmental damage associated with fragmented, sector-based development.

Aral Sea Basin

The Aral Sea is a large desert lake in south central Asia fed by two mountain rivers, the Amu Darya and Syr Darya. The Aral Sea and surrounding region are experiencing extensive environmental degradation with major economic consequences in the five republics that share the basin, Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan, and the Kyrgyz Republic. The area of the Aral has been reduced by 50 percent and its volume by 70 percent in 30 years. Total river runoff into the Sea has dropped almost to zero. Rapid development of irrigated agriculture to environmentally damaging levels, combined with high population growth rates, are the main reasons for the region's problems. Early in the 1960s, an ambitious single-sector plan for agricultural development of this semiarid region was put into effect by the Soviet central government. Irrigated land doubled to seven million ha. With the rapid expansion of irrigated lands, the total inflow of water to the Aral decreased sharply, and the Sea's level dropped. The exposed sea bottom of the Aral has become salt flats and a source of constant windblown silt, salts, and pesticides. As a consequence of the physical changes, the Aral Sea has also lost most of its productive fisheries. Increased salinity and dried-up spawning grounds have caused 20 of the 24 commercial fish species to disappear (El-Ashry, 1991).

Associated with this environmental and land disaster are water logging and salinization of over 50 percent of irrigated land, causing about $2 billion in economic losses annually (World Bank, 1998). In addition, measures to fix the poor irrigation practices may cost over $50 billion, with billions more for fixing the environmental damage (World Bank, 1998). Single-sector irrigation development, with government subsidies, lack of water legislation, and lack of pricing policies to encourage conservation has permanently destroyed the downstream Aral Sea ecosystem and has disrupted communities, people, and national economies. While this is a worst-case scenario, many other cases of salinity/water logging and environmental damage are described by El-Ashry and Duda (1999). Excessive irrigation diversions have created similar, but less severe problems in the Colorado River, the Ganges, Tarim Lake in China, the Yellow River, and others (World Bank, 1993).

Colorado River Basin

Unsustainable irrigation practices, excessive diversions of water, and water subsidies not only create down-

stream environmental problems in former socialist countries like the Aral Sea basin states or in developing countries, but also in developed nations. The Colorado River basin in the US provides a good example of massive government subsidies for irrigation water and land development, low prices for water encouraging waste, significant salinity problems, and major environmental and social impacts in the coastal areas as a result of very little inflow of freshwater.

El-Ashry et al. (1985) describe the legal and institutional deficiencies that led to the existing, fragmented approach to land and water management in the basin. With perhaps four million hectares in the basin suffering from salinization and with difficulty in meeting treaty requirements for flows and salinity with Mexico, an urgent need exists for proper policy reforms with regard to pricing and removal of government subsidies to encourage irrigation efficiency. In addition, implementation of on-farm management practices for salinity management and groundwater recharge area protection from saline irrigation water that were identified 20 years ago are still needed to remedy salinity (El-Ashry, 1980) and toxic trace metal discharges that have degraded biodiversity.

The lack of policy and pricing reforms leaves only a trickle of water to reach the Colorado delta in Mexico following consumptive use in the US and Mexico. Postel et al. (1998) describe the nature of the environmental and social degradation in the Colorado River delta and pending collapse of the fishery in the Sea of Cortez. Water must be reallocated to the delta as part of a more comprehensive approach to land and water resources. A mix of policy reforms, economic incentives, and efficiency investments are feasible (Postel et al., 1998) and would free up substantial amounts of water for ecosystem restoration to mitigate these adverse impacts of the unchecked spread of subsidized, irrigated agriculture.

Coastal Ecosystem Eutrophication

In addition to the disruption of flow regimes in river deltas from channel alterations, wetland drainage, excessive irrigation diversions, and dam discharges, communities that depend on these delta and coastal ecosystems for food, shelter, and livelihoods have encountered another adverse impact from the "Green Revolution": over fertilization or eutrophication from excessive application of nitrogen fertilizers. Nuisance algae blooms, fish diseases, oxygen depletion, and other problems result in fish mortality, ecosystem degradation, and reduced income to fishing communities. Examples range from the Danube and Black Sea basin (Mee, 1999) to the Baltic Sea (Kindler and Lintner, 1993), the North Sea, the Adriatic Sea, Chesapeake Bay, Albemarle/Pamlico sounds of North Carolina (Duda, 1982), and the Gulf of Mexico (Rabalais et al., 1999). Three- to five-fold increases in nitrogen loading from fertilizers have been recorded in most of the rivers draining to these areas, including up to seven-fold increases in the Mississippi River basin that create the "Dead Zone" in the Gulf of Mexico. Clearly, policy reforms are necessary to move toward comprehensive land and water resources management to reverse these devastating coastal problems from agricultural intensification, especially in the North.

Africa Dryland Basins and Floodplains

The drylands of Africa have faced more environmental deterioration than most regions, and their people are more dependent on fluctuating water resources than on other continents. Recent droughts have brought the complex problems of population increase, overgrazing, desertification, lack of institutions, and poor water management to the forefront. Water scarcity and fluctuating climate are natural features and constitute barriers to development. By 2025, almost one billion people will inhabit the continent and one-third of them are projected to face water scarcity. In addition, over 80 percent of Sub-Sahara Africa lies in transboundary basins (see Figures 2a and 2b). Water stress is serious in some of these international basins already and will expand by 2025 (Figure 2b). Major land- and water-related reforms and commitments to action are clearly necessary for development to proceed in Africa.

Water development projects in Africa have severely impacted floodplains, the downstream environment, and people depending on floodplain ecosystems for survival. Often developed to provide irrigation or power to cities, dams and subsequent reduction of floods have caused desertification in downstream areas. A good assessment of the complexity of these related land, water, ecosystem, and social problems is presented by the World Bank (1996). Retrospective analyses have documented that economic receipts for African farmers from the traditional systems (floodplain recession, herding, fishing) over the course of a year actually exceed receipts from irrigation. Examples include the Senegal River floodplains (Salem-Murdock, 1996), the Hadeijia - Jama'ore wetland downstream of dams in Nigeria (Barbier and Thompson, 1998), and the Togone floodplain in Cameroon (Wesseling et al., 1996).

Water withdrawals for growing African cities also threaten globally significant biological diversity, as has been noted for the Okavango River basin (Ramberg, 1997). A clear case for enacting policy reforms involves the environmental and social costs of the Zambezi River dams, where even after 30 years, projected beneficiaries have yet to receive the planned benefits from the projects (Masundire, 1996). Remedial actions are needed to correct problems so that sustainable land and water resource management needs of communities residing downstream of these water projects can be met and the quality of life can be improved for those people who have been forced to relocate and then to migrate to periurban areas of growing cities. Furthermore, LeMarquand (1991) identifies the

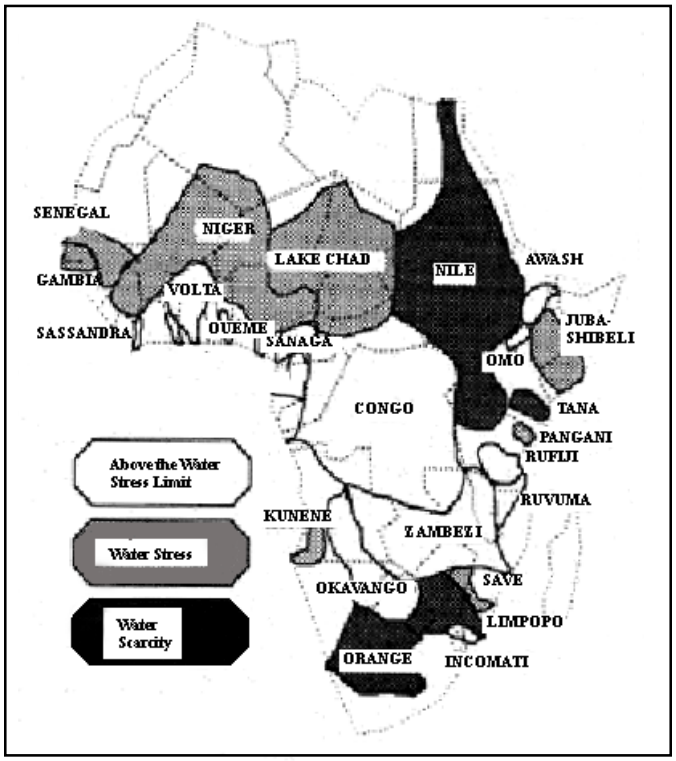

Figure 2a. Transboundary river basins in Africa and existing water scarcity in 1995 (from World Bank, 1996).

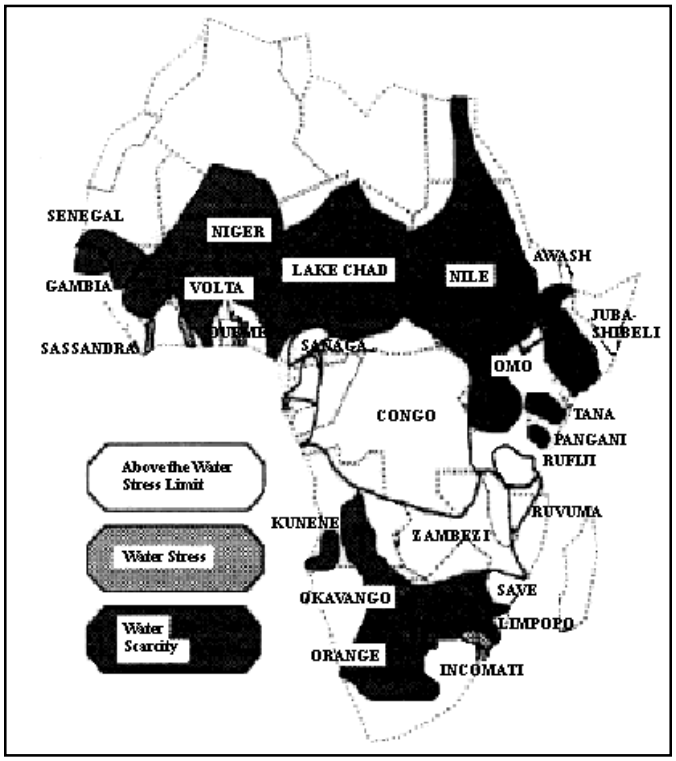

Figure 2b. Transboundary river basins in Africa and projected water scarcity for 2025 (from World Bank, 1996).

need to examine the roles that other driving forces play, such as investment interests from outside and the pressure to produce foreign exchange.

Important lessons of experience suggest that environmental, social, land, and water crises are closely linked and that single-sector interventions related to water can make matters worse for people and for the biodiversity they depend on for survival. The crisis is exacerbated by the delay in making the transition to sustainable development. The World Bank (1996) notes that the situation is deteriorating in Africa, with weak institutions, fragmented and ineffective policies and programs, and continued reliance on piecemeal, sector-based development approaches without considering upstream and downstream needs of biodiversity, people, and institutional reforms. As Ali (1999) discusses for Sub-Saharan Africa, urgent action is needed now on policy reforms. Given the projections of global warming that will make Africa's fluctuating climate even worse, the adoption of more comprehensive approaches that integrate needs and opportunities for land, water, and ecosystem management with the capabilities of communities, basin by basin, constitutes a critical linchpin for sustainable development. More than any continent, effective management of land and water resources and their ecosystems in Africa constitutes a necessary condition for food security, poverty reduction, human health, and economic progress.

Global Driving Forces for a Comprehensive Approach

These lessons of experience are not new, and every international water conference in the last 20 years has ended with the call for water sector reforms. What is new is that the continued lack of action has resulted in water and environment problems getting worse and consequently resulting in transboundary environmental degradation. With decades of inadequate domestic action, water problems that were once local in scope have now crossed borders and have become "international" in nature.

The world community recognized this situation at the Earth Summit in 1992 and charted a course toward addressing more comprehensively the root causes of the linked crises rather than just treating symptoms. Beginning with Chapter 18 of Agenda 21 and extending to the three Rio global environment conventions (climate, biodiversity, and desertification), the World Bank's 1993 Water Resources Management Policy, and the Global Environment Facility, opportunities exist for countries to reverse these trends as they learn to operationalize the concept of sustainable development.

Chapter 18 of Agenda 21 argues that the way ahead toward sustainable development involves integrated management of land, water, and ecosystems on a basin or subbasin scale. Integrated water resources management is based on the perception of water as an integral part of the

ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization. To this end, water resources have to be protected, taking into account the functioning of aquatic ecosystems and the perenniality of the resource, in order to satisfy and reconcile needs for water in human activities. In developing and using water resources, priority has to be given to the satisfaction of basic needs and safeguarding of ecosystems. Beyond these requirements, however, water uses should be charged appropriately. Integrated water resources management, including the integrated of land- and water-related aspects, should be carried out at the level of the catchment basin or sub-basin.

The three Rio conventions and the Law of the Sea constitute a commitment on behalf of countries to begin reversing the course of degradation. When taken together with Chapter 18 of Agenda 21, a transition to sustainable development can be followed in the North, and the South is able to participate in their implementation with assistance of the Global Environment Facility.

The three global environment conventions that emerged from the Earth Summit provide a new driving force for country-based action to restore and protect our planet's environment by hastening the transition to sustainable development. The Convention on Biological Diversity focuses on the integration of biodiversity concerns into development decision making through the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits stemming from their utilization. The UN Framework Convention on Climate Change has as its objective the stabilization of greenhouse gases at levels that would prevent dangerous anthropogenic interference with climate. While both of these clearly have linkages to floods, droughts, aquatic ecosystems, and carbon sinks, the third instrument, the UN Convention to Combat Desertification, clearly has water and land management at its heart since its provisions are aimed at combating desertification and mitigating the effects of drought and desertification.

A fourth global environment convention, known as the UN Convention on the Law of the Sea (UNCLOS), establishes a broad framework for protecting the marine environment. UNCLOS calls on states to prevent, reduce, and control pollution from land-based sources, the atmosphere, dumping, vessels, and installations used in exploring and mining the sea bed. UNCLOS outlines the general obligation of all states to take measures against pollution of the marine environment, including the establishment of national rules, standards, recommended practices, and procedures to achieve its objectives. States are also required to cooperate with neighboring nations to harmonize policies and programs at the appropriate regional level and to monitor, evaluate, and analyze effects of marine pollution.

While land-based sources of marine pollution from river basins are specifically mentioned in two sections of UNCLOS (Articles 207 and 213), the lack of consensus and hesitancy over costs of commitments resulted in very general wording. Following a series of preparatory meetings, the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA) was adopted in 1995 by governments in the "Washington Declaration." The GPA mandates sound river basin management as a means of reducing adverse impacts in coastal waters from pollution, nitrogen enrichment of marine waters, and excessive diversions of water threatening important delta areas.

Global Environment Facility

Two years before the Earth Summit, the Global Environment Facility (GEF) was established as a pilot program to test new approaches and innovative ways to respond to global environmental challenges in its four focal areas of climate change, biodiversity conservation, ozone depletion, and international waters. In March 1994, after 18 months of intergovernmental negotiations, agreement was reached in Geneva to transform the GEF from its pilot phase into a permanent financial mechanism. The restructured facility, which has so far committed more than $2.5 billion in grant funding, is open to universal participation (currently 165 countries) and builds upon the partnership between the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank, which are its implementing agencies. In addition to the four focal areas, activities to address land degradation are also eligible for funding insofar as they relate to one or more of the four focal areas.

According to its Operational Strategy (GEF, 1996), the GEF will fund projects and programs that are country-driven and based on national priorities designed to support sustainable development. In the international waters area, GEF's objective is to contribute primarily as a catalyst to the implementation of a more comprehensive, ecosystem-based approach to managing international waters and their drainage basins as a means of achieving global environmental benefits. The GEF implementing agencies assist countries to find means of collaborating with neighboring countries in order to change the ways human activities are undertaken in different economic sectors so that transboundary conflicts and problems can be resolved. The goal is to help groups of countries use the full range of technical, economic, financial, regulatory, and institutional measures needed to operationalize sustainable development strategies for transboundary water bodies and their contributing drainage basins.

The GEF Operational Strategy also advocates a comprehensive approach aimed at policy/institutional/regulatory reforms and priority investments needed to address top priority transboundary issues. Typically, projects begin with GEF implementing agencies assisting the cooperating nations in undertaking strategic work in setting

priorities for problems as well as opportunities. This is often done by collaborating nations each establishing an inter-ministerial committee to analyze information on the water- and land-related environmental problems/conflicts and then jointly sharing this information with colleagues from the other nations. In this way, a transboundary water resources analysis can lead to the identification of opportunities and needs for integrated basin-wide management of land and water resources and their biodiversity. It also allows very complex basin problems to be divided into smaller, more manageable ones, each with a specific action program for resolution.

As part of the process, the countries determine what actions, policy reforms, regulatory developments, and sectoral programmes are needed to resolve the priority problems, threats, or conflicts. These steps allow for harmonization of actions among nations so that economic disadvantages are not created. The follow-on GEF project provides an opportunity for the collaborating countries to formulate and adopt action programs to operationalize the needs and inter-linkages that have been identified by different ministries to ensure a sustainable, collective approach to development needs. Implementing agencies through their regular programs undertake complementary activities to address purely domestic needs, and the donor community may assist with both types of initiatives.

In its first eight years, 118 countries have asked GEF for assistance in addressing the coupled land, water, and environmental crises in transboundary basins. Table 1 lists GEF transboundary projects underway or in preparation to demonstrate the variety of requests for assistance that have been received. Approximately $330 million in GEF funding (with $715 million in cost share) has been allocated to international water projects over the period 1992-1999. Marine-focused projects are not listed in Table 1, but are included along with project descriptions in GEF (1999).

Table 1. Transboundary Water Resource Projects Under Implementation or Preparation with GEF Funding (GEF, 1999)

Transboundary Basins	*Linked Basins and Coastal Waters*
Danube River Basin	Black Sea
Dnieper River Basin	Gulf of Guinea
Mekong River Basin	East Asian Seas
Lake Ohrid	Plata Maritime Front
Lake Manzala	Red Sea
Lake Victoria	Gulf of Aqaba
Lake Tanganyika	South China Sea
Lake Malawi	Yellow Sea
Lake Titicaca	Baltic Sea
Lake Chad Basin	Tumen River and Coastal Area
Upper Paraguay River Basin	San Juan River and Coastal Area
Bemejo Binational Basin	Sao Francisco Basin
Caspian	Caribbean Bays Nutrient Reduction
Aral Sea Basin	Poland Nutrient Reduction
Okavango River Basin	Georgia Nutrient Reduction
Niger River Basin	Caribbean Pesticide Runoff Reduction
Volta River Basin	Pacific Small Island States
Senegal River Basin	Caribbean Small Island States

World Bank's Water Resources Management Policy

In response to Dublin, Rio, and Agenda 21, the World Bank has called attention to mismanagement of surface and groundwater resources and the water environment as a significant impediment towards poverty reduction and sustainable development. The Bank's Water Resources Management Policy, adopted by the Bank's Board in 1993 after a lengthy process of consultation with NGOs, governments, and international organizations, calls attention to the need for countries and development organizations to adopt a more comprehensive approach to water resources management (World Bank, 1993). This new approach represents a quantum shift from sector-by-sector projects to a more holistic approach recognizing the river basin as the appropriate unit for managing not only water quality, quantity, and ecosystems but also sectoral development initiatives.

Economic sectors are now asked to take full responsibility for preventing the degradation of water resources by modifying existing activities, using pollution prevention strategies in new activities, and coordinating across sectors so that the water environment can be sustained for its multiple purpose uses. Interaction among different but interrelated sectors is also mandated so that sustainable development goals can be achieved. A whole host of financial management, economic, policy reform, technological, and participatory tools are also recommended, including use of market-based instruments. Under the policy, the Bank is to provide assistance to member countries in developing a comprehensive approach (or framework) to water resources management suitable for the country's needs, resources, and capabilities. An emphasis is placed on building effective institutions to protect, enhance, and restore water quality and aquatic ecosystems that have been damaged by pollution or past development projects. Legal and regulatory reforms, emphasis on economic incentives, improved pricing policies, decentralization of water service deliveries, and action participation of beneficiaries, stakeholders, and the poor in water-resources management activities are stressed.

As noted by Olem and Duda (1994), the Bank's policy paper recommends operationalizing this comprehensive approach by providing assistance so that countries may conduct cross-sectoral assessments basin-by-basin and, based on priorities to prepare water resources management strategies within a comprehensive framework to find opportunities among complementary actions in basins, set priorities for collaborative action by different sectors to meet specific basin development needs, identify needed policy reforms at the national level such as pricing for water services, and build partnerships with stakeholders and external support agencies to implement the strategy.

The Tennessee Valley Authority (TVA) referred to this cross-disciplinary, cross-sectoral, systematic thinking as a "unified" approach to development of the Tennessee Valley in 1936 that operationalized the "proper use, conservation, and development of the Tennessee River basin" that was contained in the 1933 law creating TVA. Perhaps better than many organizations, as noted in TVA (1989), TVA operationalized this cross-sectoral, systematic thinking so that all disciplines collaborated to produce collective benefits for all sectors in the basin rather than induce competition among sectors.

Piloting Cross-sectoral Collaboration

The GEF Operational Strategy is providing the opportunity for nations to collaborate with their neighbors and to work with different sectors domestically in testing more comprehensive approaches that achieve integrated land, water, and ecosystem management on a basin scale. Policy, institutional, and legal reforms as well as priority investments are being implemented with assistance of the three GEF implementing agencies. One example involves the Aral Sea basin GEF project in which the World Bank is assisting the five Central Asian republics to reform the irrigation sub-sector so that additional water may be released for downstream ecosystems and salinity may be reduced to improve water supplies. As noted by the World Bank (1998), an objective of 15 percent of irrigation water is to be released for environmental purposes through reforms, investments, and demonstrations. Water charges are being introduced, subsidies are being eliminated, land policies are being reformed, and investments in irrigation efficiency are being cofinanced by GEF and World Bank loans to save water.

In the Bermejo basin of Bolivia and Argentina, the countries are determining their sustainable future for development in the semi-arid basin by addressing problems and opportunities related to land, water, biodiversity, rural development, irrigation, and reforestation of degraded lands for carbon sequestration. Also in South America, Brazil is involved in two projects that help operationalize its new water law. One project in the Upper Paraguay River basin addresses mining and agricultural threats to the world's largest transboundary wetland, the Pantanal. In the other, the 640,000 km^2 Sao Francisco basin draining five Brazilian states, GEF assistance is helping to implement water pricing reforms, water quality and quantity markets, stakeholder participation, flow regulation improvements, and integrated management through a basin committee to reduce environmental stress in the downstream coastal zone.

Many countries have requested GEF assistance in order to address land-based activities that affect coastal waters. The Brazil project is one of these. Others involve the Plata estuary in Argentina and Uruguay, the East Asian Seas, a Poland agricultural nutrient abatement project for the Baltic Sea, and a series of Danube River and Black Sea projects focused on nutrient reduction from agriculture. In fact, the Danube and Black Sea countries are considering a policy of a nutrient cap at 1997 discharge levels and possible nutrient reduction credit banking and trading systems nationally and among nations to reverse the serious nutrient over-enrichment of the Black Sea.

In Africa, the World Bank is assisting Tanzania, Uganda, and Kenya with GEF funding to build capacity for joint management of land and water resources around Lake Victoria and to demonstrate measures for addressing land degradation, pollution releases, fisheries management, and biological controls for water hyacinth control. Lake Chad basin countries have prepared a project for sustainable management of groundwater, wetlands, and land resources in the basin, and the three countries draining to the globally significant Okavango delta have prepared a GEF project with UNDP assistance to address proposed upstream irrigation and water supply diversions so that sufficient low flow and flood pulses are provided to sustain the wetland's biodiversity. While many of these GEF supported projects are just in the early stages of implementation, they should add a large body of experience in several years to lessons related to cross-sectoral, basin management and to the critical issue of transboundary waters.

Integrated Land, Water, and Ecosystem Management - The Way Ahead

There is no denying the existence of a global water crisis. The root causes of the crisis are complex. At the same time, our planet and its residents are experiencing a global crisis in land management, environmental management, and governance that is closely linked to the water crisis and is made worse by over-consumption of the North, population growth in the South, and rapid globalization of trade and economic systems. Solutions to these crises cannot be formulated in isolation. "Water sector" investments aimed at ameliorating the water crisis may just make matters worse for ecosystems, their biodiversity, and people depending on these systems for their livelihoods. In addition, both in the North and South, a large backlog of remedial measures await action to reverse existing environmental degradation and restore biodiversity lost from past development.

Lessons of experience reveal a water crisis caused by inadequate pricing and allocation policies, over-reliance on government to provide water service delivery, fragmentation of water management between sectors and institutions, neglect of health and environment concerns, and policy/legal/institutional failures in both land and water resources management. Water resource policies, institutions, and practices are not sustainable in some countries from any perspective, social, economic, or environmental.

Local, national, and global environmental problems

have the same underlying causes, inadequate economic policies, inadequate development policies and practices, and inadequate polices concerning natural resources and the environment. The challenge in dealing with the complex nexus of global environment, development, and water resources is to reform these policies, reduce damaging subsidies, and bring environment considerations into the mainstream of economic decision making.

Lessons of experience demonstrate that no technological or infrastructure investments in themselves will do without the necessary policy, institutional, and legal reforms. Experience clearly shows that uses of land and water resources are closely linked, and they must be managed together with full consideration of biodiversity and with community participation basin-by-basin because opportunities, problems, social institutions, and environmental requirements can be different in different basins or in different parts of basins. The term "integrated water management" was coined to provide a solution, but results have been disappointing, since not all sectors, land use considerations, or biodiversity have become "integrated" with "water sector activities." However, as this paper has shown, a more comprehensive approach is needed on the national level and the basin level to achieve a more strategic sequencing of policy reforms, programs for integrated basin management, and projects supportive of the collective response to global conventions that may contribute solutions to the water crisis.

The challenge of integrated land, water, and ecosystem management on a basin scale can only be met by management at the lowest possible levels. The national management level has certain responsibilities, the basin level has other responsibilities, and the local level has its contribution as well, be it community-based catchment management, irrigation users organizations, or urban water utilities. Reforms on the national level are needed to empower management at the other lower levels, including full cost pricing for all water service delivery. Interministerial collaboration at the national level in terms of a standing interministerial committee for integrated management represents a first step forward. There must also be created the subnational, basin-specific interministerial committees to ensure that sectoral ministries collaborate among subnational political jurisdictions for basin management.

At the basin level is where the diagnosis of interlinkages must occur to take into consideration characteristics of the basin, its ecosystems, and its communities. This systematic framework for land and water management (termed a "comprehensive framework" in the World Bank's water policy) can foster intersectoral dialogue among stakeholders to produce collective benefits for all sectors in the basin, taking into account upstream and downstream biodiversity, rather than inducing competition among sectors. Imports of food in basins with shortages provide "virtual water" that can help reduce competition among different water uses. This comprehensive approach that systematically considers the whole within basins in an integrated fashion can then be broken down into manageable components of sector-specific actions that can produce development synergies and can simplify the complexity facing governments. While it is still too early for results, this comprehensive approach being supported through the Global Environment Facility may add a wealth of experience for the world community to learn from as it operationalizes the concept of sustainable development.

More than ever before, domestic policies and actions must go hand in hand with international policies and relations among sovereign states as globalization proceeds. Effectively addressing the linked considerations of water, land use, ecosystems, and poverty reduction in a more comprehensive framework may facilitate the transition to a new development paradigm, one that will allow steady improvement in welfare and living standards without destroying the world's ecosystems upon which all our economies and our lives rest.

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Discussions open until September 30, 2000.

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