KENYA NATURAL RESOURCES MANAGEMENT ASSESSMENT

Volume 6

Sustainability of Coastal and Aquatic Resources

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ACRONYMS

ASAL	Aid and Semi-Arid Lands
CDA	Coast [Province] Development Authority
COBRA	Conservation of Biodiverse Resource Areas
CRMP	Coastal Resources Management Project
CRSP	Cooperative Research Support Program
CZM	Coastal Zone Management
EAWS	East African Wildlife Society
EIA	Environmental Impact Assessment
FAOUN	Food and Agriculture Organization
GEF	Global Environment Facility
ICRI	International Coral Reef Initiative
ICZM	Integrated Coastal Zone Management
ISPAN	Irrigation Support Project for Asia and the Near East
IUCN	International Union for the Conservation of Nature
JICA	Japanese Economic Cooperation Bureau
KENGO	Kenya Environment and Energy Organizations
KIFCON	Kenya Indigenous Forestry Conservation Programme
KMFRI	Kenya Marine Fisheries Research Institute
KWS	Kenya Wildlife Service
MOU	Memorandum of Understanding
NEAP	National Environmental Action Plan

PSTC	Program in Science and Technology Cooperation
REDSO/ESA	Regional Development Support Office for eastern and Southern Africa
TARDA	Tana and Athi River Basin Development Authority
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
WCS	Wildlife Conservation Society
WIOMSA	Western Indian Ocean Marine Sciences Association
WWF	Worldwide Fund for Nature / World Wildlife Fund

I. EXECUTIVE SUMMARY

BACKGROUND: The biophysical regions of Kenya are defined largely by the availability of water. Lakes, wetlands, and the coastal zone therefore concentrate great densities of humans and wildlife, as can be seen around Lake Victoria, Lake Nakuru, and the Coast Province, where annual population growth is around 20%. Competition for water resources is between three heterogeneous sectors, tourism and biodiversity, municipal and industrial uses, and agriculture and fisheries. Wasteful use and poor management in any one sector extracts costs of lost opportunities on the others.

The demand for fresh water in Kenya is indicated by the fact that over 60% of the nation's area water is lost only by evaporation. The bias in its distribution is indicated by the fact that the Lake Victoria catchment receives a greater volume of water than the Northern Ewaso Ngiro catchment, despite being less than one-fourth its size. Essentially all of Kenya's rivers major streams are dammed for power generation, municipal water, and irrigation. Per capita availability of freshwater is shrinking, and water projects on all scales threaten and displace traditional grazing and agriculture. Deforestation, over-grazing, and expansion of agriculture into marginal lands are causing increased evapotranspiration of water, increased sediment loads in some rivers (e.g., the Tana and Yala), decreased storage capacity in the watersheds, and hence more erratic flooding.

Along the 560 km Kenyan coast a highly productive coral shelf extends up to two km off shore before dropping into infertile deep waters. The shore consists largely of sand beaches in front of limestone terraces. Within 20 to 40 km of the coast there is a transition from subhumid grasslands and bush south of Malindi to subarid grasslands north of Lamu. Mangrove forests grow wherever rivers, streams, or shallow aquifers meet the sea.

Fully one-half of Kenya's tourism is coastal. This sub-sector of the economy and the infrastructure to support it, primarily beach hotels, is growing rapidly. Its sustainability is questionable. A system of marine parks and reserves that covers 8% of the coast is generally very well-run and increasingly well regarded by local people. Management in the other 92% is essentially non-existent. Wetlands are also important attractions because of their biodiversity. Lake Nakuru National Park was visited by about 150,000 of 400,000 "inland" tourists in 1990.

Subsistence fisheries are the dominant ecological force on the Kenyan coast. Population pressure is forcing fishermen to use more aggressive and less sustainable techniques, especially small mesh nets. The resulting degradation of the coral reefs threatens both the fishery and the tourism industry. Commercial aquaculture is increasing on the Kenyan coast, and is poorly regulated. There appears to be untapped potential for small-scale fish farming.

Ninety per cent of Kenya's commercial fish catch is based on Nile perch from stocks introduced to Lake Victoria in the 1960s. The fish is locally called "the savior" because of its economic value, but by displacing endemic species it has caused the largest extinction of vertebrate biodiversity in human history. The fishery is probably not sustainable at current levels because of over-fishing and high levels of urban and industrial pollution.

Water pollution from sewage and industrial effluents causes serious health risks in urban and peri-urban areas of Nairobi, Kisumu and other inland towns. Along the Kenyan coast, large tidal flushing has kept the problems localized, but explosive population growth could change this quickly.

CONSTRAINTS AND OPPORTUNITIES: Several common problems link the sub-sectors of aquatic and coastal resources in Kenya and all of East Africa. All are threatened by population pressures on living resources, municipal services, and fragile lands. No solution can succeed in isolation because (1) the sectors are in competition, and (2) migration will overwhelm programs working in niches that are too narrow.

The over-arching need in coastal and aquatic resources is less for technical responses (although these will be required) than it is for increasing institutional capacities in policy, planning, and management. Broad programs offer the greatest opportunities for long-term engagement with the full donor community and with the academic and NGO communities, across Kenya and throughout the region.

A broad spectrum of international conservation groups works for the conservation and management of Kenya's water resources, with increasingly close cooperation with the academic community. Of the Agencies involved, the Kenya Wildlife Service (KWS) is universally well-regarded, and the Coast [Province] Development Authority is young but promising. However, most relevant agencies (Water, Fisheries, Forestry, the municipalities, Tana and Athi River Development Authority) have reputations for low capacity and corruption. These organizations must be strengthened or replaced if KWS, the NGOs, the private sector, the universities, or any other group is to make durable progress toward sustainable use of Kenya's water resources.

Kenya has already agreed in principle to undertake major reforms in its management of coastal resources as part of a regional program. In 1993, Ministers from Kenya, Madagascar, Mauritius, Mozambique, the Seychelles, and Tanzania signed the "Arusha Resolution on Integrated Coastal Zone Management," which lays out why integrated management is needed in the region, and what legislative, political, economic, educational, and technical steps are necessary. A follow-up Ministerial meeting will be held in 1996. The resolution would form a useful framework for formulating national-level coastal policies. Sub-sectoral policies for coral reefs, mangroves, estuaries, and off-shore fisheries may eventually be articulated. The small-scale efforts currently supported by

USAID and others (e.g., the COBRA project, the REDSO planning exercise, and the Human Capacity Development training program, all in Mombasa) are essential to demonstrating the potential of integrated management, and deserve continued support. However, there is no national mandate for inter-agency and inter-sectoral collaboration. Without this imprimatur and guidance, the small and mid-sized exercises now underway can be only short-term successes.

There is a similar opportunity to develop a national strategy for wetlands and lakes, as the Kenyan government will soon review a National Wetlands Strategy being prepared by the Dutch. A wetlands working group convened in the National Museum has worked closely on this plan, and offers a good mechanism to achieve good donor coordination in developing essential tools such as accurate inventories of wetlands and their threats, community-based water management plans, and education for increased local capacity. More specific work is required in municipal and industrial waste management, pollution prevention, aquaculture, and Environmental Impact Assessment, consistent with recommendations of the NEAP.

RECOMMENDATION: USAID can best foster the conservation and sustainable use of coastal and aquatic resources through support for national and regional programs that will establish durable frameworks for cooperative management and increased capacity among Kenyan agencies, municipalities, NGOs, and research institutions.

II. BACKGROUND AND ANALYSIS

A. COASTAL AND MARINE RESOURCES

The Kenyan coast runs for 560 km between the Somali and Tanzanian borders. A highly productive coral shelf extends up to two km off shore before dropping into the relatively infertile waters of the Indian Ocean. The shore consists largely of sand beaches in front of limestone terraces. Within 20 to 40 km of the coast there is a transition from subhumid grasslands and bush south of Malindi to subarid grasslands north of Lamu. Mangrove forests grow wherever rivers, streams, or shallow aquifers meet the sea. This region, home to about 2.5 million people, is the Kenyan coastal zone.

1. Coral Reefs, Sea Grasses, and Beaches

Coral reef ecosystems dominate Kenya's coastal zone in terms of area, diversity, productivity, and economy. The calcareous skeletons of living corals provide a dense set of micro-habitats for fish, invertebrates, and algae, just as the tree canopy allows high diversity in a forest. Corals grow in warm, clear, shallow seawater, and therefore grow along most of the East African coast. These reefs and the diverse plants and animals they support provide Kenyans with protein, fisheries income, tourism income, and physical protection from storms. Construction of sea walls to replace coral reefs destroyed by pollution and over-harvesting is prohibitively expensive, giving fringing reefs a value of millions of dollars even before their productive worth is accounted. The importance of coral reefs is recognized in all six of Kenya's marine reserves, where only "traditional" fishing is permitted, and by marine parks within four of the reserves, where no extractive use is permitted. Together these areas cover roughly 8% of the shore line. The Kiunga Reserve, in the north, is an UNESCO Biosphere Reserve.

Coral reef ecosystems are threatened by many of the activities they attract. Destructive fishing methods break and topple living corals. Kenya has largely avoided or prevented the dynamite fishing that has reduced much of Tanzania's coral reef to rubble, but weighted nets and trawls cause severe damage. Boat anchors dropped by recreational divers also cause extensive damage in popular sites like marine parks, and shells collected for the souvenir trade have depleted certain species.

Fishing and discharge of pollutants on reefs are increasing in part because of the expanding tourism industry, but primarily because the coastal population is exploding at an estimated rate of ~20% per year. While these people are mostly immigrants from up-country looking for jobs in Mombasa or the tourism enclaves, surveys reveal that women in the Coast Province choose to have the largest families in Kenya, with 55% of women wanting families of 6 children or more.

Corals are literally smothered by excessive sedimentation or algal growth. Human activities that cause erosion (such as careless forestry or agriculture) or accelerate algal

growth (such as municipal pollution) therefore threaten coral reef ecosystems. Nutrient pollution does not seem to be a major problem in Kenya, in part due to effective flushing of the four-meter daily tides.

An oil spill at the port of Mombasa could devastate the reef community. Fish feed on filamentous algae that grow on corals, so over-fishing also promotes algal growth and degrades coral reefs.
Coral bleaching, in which corals expel symbiotic algae living within their tissue and cease to grow, has occurred in Kenya and around the world in the last decade. Corals recover from single incidents, but are damaged by repeated events. High sea-surface temperatures correlate strongly with bleaching, so links to global warming are widely suspected.

Sea grass beds grow in the protected waters behind coral reefs, where they provide habitat for adult or juvenile shrimp, oysters, fish, dugong, green sea turtles, and hawksbill turtles. They are susceptible to roughly the same suite of threats as coral reefs, including overgrazing by urchins.

Sand beaches are highly valued for tourism developments, which tend to be sited as close to the water as possible, and by fishermen, who need a safe place to haul out their boats. Inadequate or unenforced zoning regulations lead to conflicts between groups, and to beach erosion. Sea walls built to maintain sand around buildings exacerbate both problems. "Sun-Sea-Sand" tourism can also displace nesting sea turtles.

Fisheries stocks and harvests are poorly known for Kenya's coastal and oceanic waters. Food and Agriculture Organization (FAO) catch estimates from the mid- and late 1980's vary from 4,000 to 20,000 tons, and estimates of potential catch vary from 13,000 to 36,000 tons. The variation results from the importance of the informal artisanal fisheries, which take about 90% of the catch. For example, the fishermen at a density of about 12 per km of shore were overlooked by a UNEP study of a 10 km unit of coast near Mombasa. The total marine catch has steadily increased with population in the past 25 years. However, fishermen are forced to use unselective small-mesh nets that take fish before they reach full size, which is economically inefficient, or before they have reproduced, which is economically dangerous. Better stock assessments are clearly called for.

The FAO has estimated that there are 6,500 fishermen on the Kenyan coast, but the real number is probably twice that. Despite these relatively low numbers, fishermen are probably the most important force controlling the ecology of Kenya's coral reefs. Ninety-percent of the catch is taken with hand nets, simple traps, and hand lines in the sheltered near-shore waters. Those with larger boats go several km out to sea for larger fish and more valuable species such as shrimp, some of which are exported. After men return the catch to shore, women clean, cook, preserve and sell the catch.

The collection of aquarium fish has become an attractive alternative to traditional fishing in recent years. Collection practices can damage corals, kill large numbers of fish, and deplete stocks, but no trends have emerged in Kenya.

The Department of Fisheries issues permits, but makes only occasional attempts to control net size or catch. Although the kenya Wildlife Service (KWS) has effectively stopped fishing in marine parks, "traditional fishing methods" that are permitted in the much larger reserves include monofilament nets, metal traps, outboard motors, and all other technology short of trawlers.

Coastal Tourism accounts for fully one-half of all tourism in Kenya. Kenya's marine parks are visited by about 10% of its 1.2 million foreign tourists each year, although these have received far less publicity or support than the inland game parks. Many tourists use beach hotels as bases from which to tour inland wildlife parks such as Amboseli National Park, Tsavo National Parks, and the Shimba Hills National Reserve, but there is a concern that the development and promotion of coastal tourism is less interested in the Kenyan environment than the inland's ecotourism. Domestic tourism is also important, as illustrated by Malindi, where half of the 50,000 visitors in 1991 were Kenyans. About half of Kenya's registered hotels are already on the coast, and more than ten are being added per year. Over-capacity is already a problem in some sites.

Consultation with local communities by hotel developers is minimal, and consideration of environmental standards for siting and sewage disposal is optional. Hotel facilities and the auxiliary businesses that they support are a primary draw to poor immigrants from up-country, engendering group conflicts. "Beach boys" and girls move in among tourists quickly, selling souvenirs but also harassing tourists or engaging in petty theft or vice. Tourism is expanding despite these problems because visitors spend around $65,000,000 in the coastal zone per year on food and lodging alone.

Tourists visiting Kenya's marine parks are expected to pay visitor fees, but the lack of gates makes collection difficult. A simple solution was tried in Mombasa, where beach hotels charged guests $2 per night for use of the park did not comply with regulations in the Ministry of Tourism, and was apparently criticized in the European press. The "Report of the Special Probe Committee on the Kenya Wildlife Service" (February, 1994) recognized that the program was installed in good faith, but nonetheless recommended that it cease. After a hiatus, hotels are again collecting the visitor fees. The story is an example of the problems that will result from the necessary experimentation and innovation that more integrated coastal zone management will produce.

Biodiversity conservation must be viewed differently in marine waters than on land. The Convention on Biodiversity recognizes three levels of variation, within species (genetic diversity), between species (the number of species), and at the ecosystem level (the complexity of living communities). Endangered species, in the middle level, are most familiar to the public. On the coast of Kenya dugong have been hunted to near

extinction, and three species of sea turtles (Olive Ridley, Hawksbill, and Green) are reduced to a few hundred nests because of egg collection and beach development. An IUCN turtle program has worked fairly well in which KWS pays residents three times, for being shown a nest, a hatch, and hatched eggs. Most true reef organisms are more resistant and resilient to exploitation because their widely dispersed larvae effectively re-colonize potential habitats. Local populations of the most visible invertebrates, especially giant clams and other large or decorative mollusks, face local extinction along parts of the Kenyan coast (a loss of genetic and species biodiversity).

The more pervasive and immediate threat to marine biodiversity is at the level of the ecosystem. Biological and geochemical processes at the coast suffer such comprehensive degradation that entire productive systems are collapsing. A simple example is the depauparate fauna of Tanzanian reefs blasted with dynamite. Less obvious but potentially as important is the long-term replacement of economically valuable and over-exploited reef fish by sea urchins that eat the same foods. The priority in marine conservation is therefore broad-based and integrated management rather than targeted or sectoral programs.

Non-traditional exports offer certain alternative livelihoods in the coastal zone. Brown algae is being cultivated by women along wide areas of the Kenyan and Tanzanian coast. Carageenan is extracted from the seaweeds for cosmetics, auger, and processed foods. Cultivation appears to be an environmentally friendly and low-tech operation. More processing in the villages would add value to the export and create new employment.

Colorful reef fish are collected and exported for aquarium hobbyists. As discussed above, a variety of damaging practices are involved, but there is no firm information on the extent of any problem. Other countries (e.g., Sri Lanka) have developed successful small-scale aquaculture operations for this market, and such operations may be viable in Kenya as well.

A Belgian research and economic development project on cultivation of oysters has operated for several years in the Tana River Delta. Besides export to Europe, local hotels and restaurants serve oysters to foreign tourists. The project is usually described with cheerful skepticism for its growth potential, but the enterprise may be environmentally and socially preferable to large-scale shrimp aquaculture or rice farming. Contamination by fecal coliform bacteria has often hampered oyster culture in other developing countries.

2. Mangroves, Estuaries, and Coastal Forests

Mangrove forests, those growing in brackish waters where creeks, rivers, or aquifers meet the sea, cover roughly 62,000 ha in Kenya. Seventy percent of the world's fisheries are estimated to depend on the shelter of these highly productive wetlands for

reproduction, and non-commercial species are equally reliant upon this habitat. Mangroves trap sediments that can be detrimental to coral reefs, provide essential physical protection against the sea to coastal communities, and limit the intrusion of salt water into coastal aquifers. All eight species of mangroves in the eastern Indian Ocean grow in Kenya, despite that the Tana and the Sabaki Rivers form Kenya's only significant marine estuaries. Extensive mangrove forests grow on seepage areas near Lamu and at Mida Creek, near Malindi.

In principle, all of Kenya's forests between the high and low water lines have been designated as Forest Reserves since 1932, but are managed very little. In practice, mangroves are de-gazetted for salt ponds and aquaculture developments by the same opaque processes that are used in other forests. Mangroves are cut primarily for building poles, furniture, and charcoal. These are potentially viable uses of the resource, but clearance of the forests today is unsustainable. Large areas of mangrove have also been cleared for rice, mariculture, and salt ponds. These activities need not be incompatible with sound coastal zone development; rice was grown in the Tana River Delta hundreds of years before European colonization. However, these agro-industries represent important risks because of the large areas of habitat destroyed, the modest economic returns to local communities, and the frequency with which mariculture operations around the world are abandoned after about five years of high profits. Moreover, the resource-users who suffer the loss of the wetlands are not usually those who benefit from the new economic activity. For example, erosion from deforested mangrove swamps degrades coral reefs used by artisanal fishermen. The FAO and other international donors remain interested in developing this industry in Kenya and East Africa.

The Tana River Delta is a large and complex ecosystem of grasslands, mangroves, lakes, dunes and forests that depend upon the timing, duration, and extent of flooding. Traditional agriculture, pastoralism, fishing, and related activities have continued there for thousands of years. They are now being displaced by potentially more lucrative activities, such as rice and shrimp farming and salt pans, and by up-stream hydro-power and irrigation developments. It is not clear that these are sustainable or compatible activities. A 2,000 ha aquaculture development affecting 15 villages was initiated without public consultation. A major publicity campaign by the East Africa Wildlife Society (EAWS), with the technical support of IUCN, has indefinitely delayed the project by forcing the government to develop a complete zoning plan for the delta, including EIA provisions. A large Japanese-financed rice project in the delta is reported to be vindicating the results of a Dutch feasibility study recommending against such a program.

Inland coastal forests previously grew along much of the East African coast. This habitat survives today primarily in Tanzania's Pugu Hills and in the Arabuko-Sokoke Forest, a 41,000 ha Forest Reserve near Kilifi. Along with 372,000 ha of adjacent ungazetted land, this area comprises perhaps 10% to 15% of all remaining coastal forest. Smaller patches in Kenya are preserved in reserves at Shiba Hills (18,000 ha) and Witou (6,000 ha) under the management of KWS and the Forestry Department. The Arabuko-

Sokoke is habitat to fifteen rare and threatened birds, including the endemic Scops Owl and Clarke's weaver, five rare or endangered mammals, including a duiker and a mongoose, several rare fish, and one third of Kenya's species of butterflies.

Management of the Arabuko-Sokoke Forest Reserve was improved under Kenya Indigenous Forestry Conservation Programme (KIFCON), but the termination of that work leaves the situation unresolved. Two NGOs, the Peregrine Fund and the Pan African Raptor Conservation Programme run conservation and education programs in the reserve, and there is some research for pharmaceuticals. Major threats to the forest are encroachment for settlement (as was done through the Presidency for 8000 settlers last year), and legal and illegal removal of wood. Individual and commercial operators annually remove over 30,000 poles for building, and 610 tons of fuel wood. This rate of removal, ~15 kg per ha, would seem to be compatible with conservation goals so long as it is managed, but relations with the nearby communities are not good. A proposed pipeline is also of some concern.

3. Lakes, Streams, and Wetlands

Eight thousand years ago surface waters in Kenya flowed either into Lake Victoria, or into the Indian Ocean. In today's drier climate, waters from 60% of Kenyan territory leave the country by evaporation alone, either from the alkaline lakes of the Rift Valley, or from the Lorian Swamp north of Garissa. Rainfall varies enormously across Kenya, and is the primary determinant of agricultural potential. The disparity of Kenya's climatic zones is illustrated by the fact that the Lake Victoria catchment receives a greater volume of water than the Northern Ewaso Ngiro catchment, despite being less than one-fourth its size.

As with all of Kenya's natural resource base, per capita availability of water is shrinking. Deforestation, over-grazing, and expansion of agriculture into marginal lands are causing increased evapotranspiration of water, increased sediment loads in some rivers (e.g., the Tana and Yala), decreased storage capacity in the watersheds, and hence more erratic flooding (greater "flashiness").

In most arid climates irrigated agriculture places the greatest demands on water supplies. Irrigation in Kenya can be viewed as either a small element of agriculture, used on less than 10% of cultivated lands, or as a major element of water use, affecting virtually all surface waters in the country. Falling levels in Lake Turkana (below) are an example of such resource conflict. Although water conflicts may be expected to be most intense in Kenya's ASAL zone, the drainage of wetlands for conversion to agriculture poses dilemmas for land management across the country. These lands have traditionally been used for communal grazing in the dry season, but increasing population pressures are putting pressure on the authorities to support the conversion of ~50,000 ha of wetland and river-bottom for cultivation.

The diversion of water can enormously increase crop yields, but there are trade-offs in environmental, hydrological, and socio-economic impacts. For example, biodiversity in the form of bird life brings thousands of tourists to Kenya's wetlands every year.

The creation of river basin authorities has divested great powers to allocate and distribute water. The Tana and Athi River Development Authority (TARDA) has perhaps taken greatest advantage of this license and obtained Japanese support for the Grand Falls Dam on the Tarda River. Opinions are mixed as to whether this can be an environmentally sound program, but the recent decision to build in mechanisms for substantial flood and sediment release give some cause for hope.

Global climate change could have severe consequences for water resources in Kenya. Models generally indicate that a doubling of atmospheric CO_2 will cause greater precipitation and greater evapotranspiration in the region. Even if these predictions are accepted, however, there are no reliable indications of which will be the greater change. There could be more available soil and surface water (as there was 8,000 years ago) or there could be much, much less (as was the case 14,000 years ago). The only rationale adaptation in the face of this uncertainty is greater efficiency in using whatever water is available. This conservative strategy has the particular value of being profitable whether the world is undergoing anthropogenic climate change or not. In addition, planners and financing organizations should recognize that the risk of global climate change increases the uncertainty in returns on large capital investments, such as the water programs around Great Falls, Naivasha, and Mombasa that are described elsewhere in this report.

Aquaculture in Kenya is based on Nile perch, but includes sport fish, tilapia, trout, carp, and other cyprinids. It is confined to the western and Rift Valley areas of high relief and relatively high precipitation. Aquaculture is of modest importance, comparable in total yield to the harvest from Lake Turkana. Production is for both sales and subsistence use, but is rarely a full-time occupation. Production has lagged some 800% behind early expectations, despite Peace Corps support for some of this work. The FAO blames much of the deficit to extension efforts that were driven by technical potential rather than farmer's needs.

The USAID Cooperative Research Support Program in Pond Dynamics, which is directed by the Global Bureau's Office of Agriculture and implemented by Auburn University, was forced to flee Rwanda during the war and riots there last summer. The project hopes to resume work in a new location, and may be able to play a valuable role in Kenya.

4. Principal Lakes and Wetlands

Kenya's water resources include freshwater lakes, alkaline lakes, diverse wetlands, rivers and streams, aquifers, mangrove woodlands, coral reefs, and coastal resources. This

section highlights a few of the most prominent. Estuaries and mangroves are described in the section on coastal resources.

Lake Victoria is the second largest lake in the world. In 1970 it was estimated to have 250 endemic cichlids among 400 fish species. About 100 cichlids remain. They have been exterminated by pollution and by predation from the Nile Perch and Nile Tilapia introduced three decades ago to develop an industrial export fishery. In the short term the effort has succeeded, as total fish production increased five-fold in the 1980's due to these species. The perch is locally called "The Savior." However, the fishery shows no signs of approaching any kind of equilibrium, and it is highly doubtful that present catches are sustainable. Ichthyologists refer to the perch as the cause of the single largest extinction of vertebrate animals in history. Local issues of population increases, fuel demands, and displacement of subsistence fishers have arisen. While all three riparian nations of Lake Victoria have increased their national catches, Kenya has steadily increased its percentage of the three-nation total.

Winam Gulf, comprising about half of Kenya's waters in Lake Victoria, suffers severe nutrient pollution from agricultural, industrial, and municipal waste. Pollution directly threatens the fishery, and may be encouraging the spread of water hyacinth. This aquatic weed so impedes commercial and environmental processes that Uganda has begun experiments with harvesters to remove the plants.

Despite great concern for the future, the perch and associated fisheries still account for about 90% of Kenya's fish harvest and 95% of the harvest from freshwater lakes, and employ some 30,000 commercial and artisanal fishermen. Thousands more, including a high percentage of women, are engaged in fish processing and trade. There is some hope that fishing for small dagaa, used primarily for fish meal, will off-set decreases of the perch, but there will be a loss of value in this exchange. It is not clear whether the introduction of the Nile perch was a doomed experiment that is now failing, or if deteriorating water quality is a more fundamental problem. These are not exclusive hypotheses. It is only clear that Lake Victoria's physical and biological environments are both highly unstable.

Kenya, Tanzania, and Uganda have agreed not to pump water from Lake Victoria, but pressure to extract the water may become irresistible, especially for Tanzania, which is geographically best situated to use the water. There is a large GEF project underway to build capacities of and linkages among the various governmental research and regulatory bodies around the lake. NGOs in the area, including WWF and the National Museums of Kenya, are working with KWS to protect important habitat for crowned cranes and other species, and to preserve stands of fringing papyrus, especially in the large Yala Swamp (~100 km^2). Activities include conservation awareness groups in communities, training, research, and formulation of policy.

Local Recommendation: In view of the political complexity of the area, previous experience of USAID/REDSO, and the large investment undertaken by the GEF, direct involvement in management of Lake Victoria is not recommended.

Lake Turkana crosses Kenya's northern border into Ethiopia. In the recent decades it produced twice the combined fish harvest of all other Kenyan lakes combined, outside of Lake Victoria. Turkana's fishery and its waters have been subjected to greatly varied exploitation but essentially no management, so that it is unclear whether there is potential for a larger fishery or not. Diversion of water in the Omo River Basin for irrigation has reduced lake-levels in recent years, entirely eliminating Ferguson's Gulf and significant tilapia breeding areas. Catches have fallen about 75% from peaks in the late 1970's. However, fishing pressure decreased along with water levels, as members of the Luo tribe moved to the Lake Victoria basin as Nile perch catches improved there. The FAO describes collection of statistics as "quite systematic but with fluctuating reliability."

Local Recommendation: A stock assessment and hydrological estimates are sorely needed to prevent the permanent degradation of a valuable resource, although without an institutional authority capable of using this information there is no immediate value in producing it.

Lake Nakuru is a National Park and the sometime home of four million flamingos. This is the greatest density of primary consumers ever recorded in a lake; they consume over 100 tons of blue-green algae per day at peak productivity. Tourists spent 20,000,000 shillings in the park in 1990. It is Kenya's sole wetland protected under the aegis of the 1971 Ramsar Convention for wetlands of international importance. (The Convention provides guidelines and technical advice to members, and facilitates communication on shared or inter-related wetland systems, including migratory flyways.) Lake Nakuru is highly alkaline (pH 10.5), and receives moderate amounts of agricultural, industrial, and municipal waste. Trash flows in during floods. The greatest threat to the lake and surrounding wetlands may be the improvement of water supplies and sanitation in Nakuru town, because greater freshwater inputs may alter the lake's unusual chemistry enough to eliminate the flamingos' food source.

The WWF, Wildlife Clubs of Kenya, the National Museums, KENGO, UNEP, and other groups work on watershed management, agricultural and domestic extension, and community-based conservation of birds, rhinos, and other fauna. In addition, these partners maintain an education center for teachers and youth groups, community outreach, international outreach, and ornithological research.

Local Recommendation: At present management of Lake Nakuru does not seem to require direct USAID support. The Mission is advised to strongly consider short-term technical assistance should an urgent situation present itself (e.g., in choosing between alternative plans for the municipality's water needs). The site should also be loosely

monitored as an indicator of how seriously the government of Kenya regards its international commitment to conservation.

Lake Baringo is another important wetland for birds, tourists, and a significant number of fishermen. It has lost one-half of its volume to siltation and evaporation since the 1940s. The Baringo Fuel and Fodder Project, described elsewhere in this report, greatly reduced erosion and sheet-flow. This site exemplifies the rule that freshwater protection must work beyond the shoreline, in the watersheds.

Lake Naivasha is a lake in the Rift Valley that has no surface outlet, yet maintains fresh water. There are both inflows and outflows underground. Water levels seem to correlate to high-elevation rainfall, and have generally decreased in this century. In the mid-1800's, however, the basin was essentially dry. Major natural resources issues concern municipal pollution from the town of Naivasha, pesticide and fertilizer run-off from horticulturalists around the lake, and a complex mix of indigenous and introduced animals, but by far the most controversial issue is the sustainability of extractions of lake water for irrigation. Those using the resource include small farmers in the watershed, fishermen, large corporate horticultural operations along the lake shore, hoteliers and their clients, private home owners, a geothermal power plant producing 12% of Kenya's electricity, and the town of Nakuru. A water diversion scheme proposed by the Japanese Economic Cooperation Bureau (JICA) would have removed much more water for municipal and agricultural use. Monitoring of the lake does not even include regular measurements of lake level, but approximate calculations of the water balance indicate that agricultural irrigation is contributing to the lake's retreat by extracting about 30% of inflow.

Native species at the lake include hippopotamus, reedbuck, water buffalo, and a wide diversity of wading birds. Buffalo attacks lead to the destruction of papyrus by motivating fearful fishermen to burn the reeds. Coypu have lived around the lake since escaping from a fur ranch many years ago, as have pythons introduced to control the coypu. An introduced weevil is successfully controlling an introduced aquatic weed (Salvinia), although water hyacinth has more than replaced it.

Introduced fish play a major role in Lake Naivasha's ecology. Prior to 1925 there was one species of a small carp in the lake. Bass, tilapia, trout, Nile perch, and a variety of minnows were introduced for sport fishing, food fishing, and mosquito control over the years. The most abundant fish today, a tilapia, was introduced by accident. Pelicans, cormorants, divers, and darters were shot in the 1930's to protect the fish. Introduced Louisiana crayfish are commercially important, 50 tons per year being caught, and about 60 licensed fishermen and about 250 unauthorized fishermen work the lake with gill nets.

The Lake Naivasha Riparian Owners Association is a group of individuals and companies owning land on the lake shore that is attempting to mediate water conflicts. The Association convened in 1929 to resolve land claims arising from falling lake levels. It currently has 97 members, including the town of Naivasha and the largest producer of

carnations in the world. Recently they were effective opponents of a scheme to dam the Malewa River above Lake Naivasha. The Owner's Association encourages environmentally sound practices on the lake shore, and is reviewing drafts of a management plan that calls for comprehensive monitoring and for designation of Lake Naivasha as Kenya's second Ramsar site. It would be the only site under community management, albeit a rather select community.

Lakes Chala, Jipe, and Amboseli are in the Coast Province, on the Tanzanian border. Chala and Jipe are of modest importance for fisheries and tourism, but are being considered by the Coast Province Development Authority (CDA) as part of an ambitious plan to obtain additional water for Mombasa. All three lakes and Amboseli's lakes and wetlands (the Lengurruahanga Swamp) are fed by aquifers draining from Mt. Kilimanjaro. The entire system drains into Tanzania. Thus the CDA water plan seems ill-advised for inter-related political, economic, and environmental reasons.

Local Recommendation: It is likely that Mombasa's water needs could be better met by proper management of resources already available. USAID should consider offering support for this work as an alternative to such a diversion.

III. CONSTRAINTS AND OPPORTUNITIES

A. Fishing and Marine Conservation

The economy of Kenya's coastal zone is strong enough to encourage 20% annual population growth. Marine parks are well managed, and the marine reserves are passably well managed. However, the coral reefs and related ecosystems on which the coastal zone is socially, economically, and environmentally based are deteriorating and may be approaching collapse. A primary cause is that however well the protected areas are managed, about 90% of the coast is essentially unregulated.

It is likely that coastal and pelagic fishing can be maintained or can slightly expanded in Kenya, and profitability may be increased, if the resource is carefully managed. This is an especially attractive option because marine species grow and colonize quickly, so the benefits of protection become visible after just one or a few years. Marine protected areas can be expanded through careful community development processes. The Mombasa park is beginning to win community approval because of profits being realized by boatmen serving snorkelers and by fishermen taking advantage of the sanctuary or reservoir effect of the park. The park was introduced and enforced in a blunt and authoritarian manner before the importance of community participation had been accepted throughout KWS.

Fishermen are a naturally mobile group, and word of successful maintenance or recovery of fish stocks through enforcement of harvest regimes in managed reserves has spread along the coast. The fishermen of Diani actually took the initiative to approach KWS and

request establishment of a reserve. The IUCN will soon begin an experiment in which village elders from the Tanga River Delta in Tanzania will travel to communities in southern Kenya to discuss their generally successful experience with integrated coastal zone management.

A higher priority than gazetting new protected areas must be to develop management plans fishing and other activities for the other 90% of the coast that will not fall within the jurisdiction of parks or reserves.

The Mombasa Tourism Association has expressed great support for working with the Coast Province Development Authority (CDA) to resolve coastal management issues because most owners and managers recognize the importance of environmental quality to their clients. The CDA is a newly-formed development authority with a mandate to bridge sectoral obstacles to sustainable development in the entire Coast Province and the 200 mile Exclusive Economic Zone (EEZ). The quality of their disposal practices and other environmentally important activities apparently varies widely, but are not reported to be immediate problems. This may change as hotel densities continue to increase. There will be more hotels built on the coast, and it is in the interest of all parties to have them designed, located, and operated with the support of the established community, i.e., in a sensitive and sustainable manner. The tourism industry is a natural ally in work toward integrated coastal resources management.

B. Forestry

The legal and illegal clearing of mangroves for wood and commercial developments threatens to degrade the Kenyan coastal zone in the overlapping areas of fisheries, coral reefs, biodiversity, drinking water, and storm safety. Mangroves are a fast-growing, renewable resource, and extractive uses important to local economies should be managed rather than prevented. However, mangroves are very poor colonizers, and cleared areas typically become wastelands without labor-intensive replanting programs. Poor communities around Media Creek have recognized their losses due to deforestation, and have taken on re-planting essentially of their own initiative. Potential models of community involvement in coastal resources management like this one will benefit from technical support and political backing in dealings with other resource users.

C. Urban and Industrial

This report emphasizes the proximate origins of coastal resource degradation, such as over-fishing and land clearance, although these processes must be recognized as products of the coastal zone's 20% annual population growth. This explosion threatens the sustainability of literally every natural environment in the area. If nutrient pollution and solid wastes are not critical problems in waters near Mombasa now, they are likely to

become a problem if or when the city's population quadruples in the next decade. Issues of environmental quality are inextricable from environmental health, municipal management, sanitation, and institutional capacity for urban planning.

As Mombasa's shipping petroleum industries continue to grow, pollution prevention and disaster preparedness will become increasingly important to comprehensive coastal zone planning.

D. Government Agencies

The major government agencies involved in the Kenyan coastal zone are listed below. They present a classic dilemma in development: their professionalism is the most important limiting factor in the management of water resources, but their very reliability is the greatest assumption in implementing work in this sector. Demonstration projects and local capacity-building efforts can and do work through NGOs, but these efforts will fall short of integrated planning and management.

- Coast Province Development Authority (CDA): The CDA has been singled out by USAID/REDSO, the Dutch, and IUCN as a promising young organization with good technical strengths and a clear appreciation of development issues The CDA has a mandate and an interest in facilitating, convening, and catalyzing development in a large area of southern and eastern Kenya, including the entire 200 mile Economic Exclusion Zone. They are mandated to implement management plans and to enforce compliance, which will be facilitated by staff seconded from other agencies. They do not have a great deal of experience.

- Kenya Wildlife Service (KWS): In this sector as in others, KWS appears to be a well-trained, well-equipped, and committed group. They are the first choice of donors. The Senior Warden in Mombasa (Ali Kaka) seems strong and competent, and the new Director of Research (Nyawira Muthiga) has taken on her position with remarkable enthusiasm, focus, and technical skill.

- Kenya Marine Fisheries Research Institute (KMFRI): KMFRI is an institution of about 75 staff with headquarters in Mombasa and several field stations along the coast and at inland lakes. They are reasonably well equipped, but fund mostly salaries rather than research and policy. They are benefitting from an active research program by an American scientist, Tim McClanahan, who is working with partial USAID support.

- Kenya Department of Fisheries: This is not a strong group. They do issue fishing permits, and could enforce regulations concerning mesh size of nets, etc., but lack the capacity and perhaps the motivation to do so.

• Kenya Department of Forestry: This is not a strong group, as discussed elsewhere in this report.

• Town of Mombasa: An important but unknown quantity. It is unlikely that they are prepared to cope with a projected doubling of population in less than five years and a quadrupling in less than ten.

• Merchant Marine: This and other commercially-focused users of marine resources are important but unknown quantities.

There is an explosion of MOUs between these groups, primed by KWS and CDA. The KWS appreciates the importance of good and collaborative relationships with its colleagues, and understands that its capacity is limited. Donors are understandably more anxious to work with the more motivated and professional individuals in KWS, but it is short-sighted to ignore other agencies or to pretend that fundamental improvements in the aquatic resources sector can come about without the involvement of the Fisheries Department.

Several common problems link all of the case studies presented above. Foremost is that all are engendered by population pressures on municipal services, fragile lands, and finite resources. All are illustrative of similar cases on smaller scales occurring throughout Kenya and throughout east Africa. Therefore no solution can succeed in isolation; for example, an alternative livelihood project for fishermen at Lake Victoria will draw new people to the region, either to take advantage of the same opportunities or to fill the niche that the fishermen left (whether it is a sustainable niche or not). The common need in all these areas is not for technical solutions so much as it is for policy, planning, and management. These broad programs offer the greatest opportunities for long-term engagement with the full donor community and with the academic and NGO communities, across Kenya and throughout the region. The following recommendations are intended to take advantage of such possible synergisims.

E. Priorities in the coastal zone

There are many small and medium-sized projects in Kenya's coastal zone and wetlands, working on community development and support for KWS. These pilot projects are playing an important role, but one that one more sponsored by USAID would not be especially valuable. The more strategic target for technical work to slow or reverse the degradation of the economic, scientific, and aesthetic value of Kenya's coastal and aquatic resources would be to advance a broader national or regional program.

East Africa is the last region of the world to move toward integrated coastal resources management. Donors and Kenyan agencies are clearly interested in the prospects. To

date there has been no effort to create a national policy giving at least a political mandate for inter-agency and inter-sectoral collaboration. Without this imprimatur and guidance, the many small and mid-sized exercises now underway can be only short-term successes. Priorities for developing an integrated strategy include:

- Building regional ties among a strong young group of trained and equipped CZM practitioners; regional work offers economies of scale in training and dissemination, catalyzes momentum, and offers many more lessons learned. (The IUCN would be a good vehicle for this work.)

- Organizing groups in local communities to make resource management and zoning decisions through joint planning and review. (An adaptation of the COBRA project and the REDSO project in Bamburi would be good vehicles for this work.)

- Promoting experimentation in fisheries management regimes, within and especially outside of permanent marine reserves. (The KMFRI and Wildlife Conservation Society (WCS) researchers in Mombasa (McClanahan and Muthia) would be excellent researchers for this work.)

- Establishing a regional center of excellence for training, monitoring, research, and policy in coastal zone management, and or supporting such a center in Tanzania or another country. (The IUCN would be a good vehicle for this work.)

Kenya has already agreed in principle to undertake major reforms in its management of coastal resources as part of a regional program. In April, 1993, Ministers from Kenya, Madagascar, Mauritius, Mozambique, the Seychelles, and Tanzania signed the "Arusha Resolution on Integrated Coastal Zone Management in Eastern Africa including Island States." This document lays out in four pages why integrated management is needed in the region, and what legislative, political, economic, educational, and technical steps are necessary. The Seychelles has offered to host a follow-up Ministerial meeting in 1996 to review progress toward the objectives. Many within the Kenyan government appear to be aware of this commitment to action, and to take it seriously. This document would form a useful framework for formulating national-level coastal policies. Sub-sectoral national policy for coral reefs, mangroves, estuaries, and off-shore fisheries may eventually be articulated.

A concise programmatic objective for USAID could be to implement the Arusha Resolution and the Action Plan to be produced by the Seychelles meeting. Key points include:

"developing and implementing Integrated Coastal Zone Management programmes,"

"coordination among sectoral agencies,"

"clarifying jurisdictional mandates,"

"implementing and rigorously enforcing legislative instruments,"

"promoting...multilateral training" (and other capacity-building efforts).

Following these priorities would require that programming proceed on two tracks, the local and the national. This strategy has produced good results in previous USAID programs in coastal and other natural resource management sectors such as forestry. At the local level, integration requires a forum that can bring together the diverse sectors of coastal resources development. Partners would include KWS, KMFRI, Forestry, Fisheries, CDA, Mombasa and other municipalities, the tourism industry (at several levels), and resource users, especially fishermen and women involved in marketing fish.

Poor and artisanal resource-users will need to be organized into cooperatives, women's associations, and similar groups if they are to have a voice in management of a resource with such concentrated value as the coastal zone. Supporting and creating these and other NGOs should be a priority whether or not they will serve on a Coastal Zone Management CZM committee.

The CDA is the obvious focal point for such a committee. They have recently (February 27, 1995) produced a draft management plan for Bamburi through consultation with stakeholders. Should this group be unworkable for any reason, successful committees in other countries have been established for the express purpose of integrated coastal zone management when supported by a national mandate. This process would work as directly on issues of community organization, democratization, and transparency of governance as on marine ecology. Integration within USAID's broader programs should therefore be made explicit.

Performance indicators in the first years would be, on the local level, the completion of training exercises at various levels, the establishment of working groups and full committees (including NGO representation), completion of coastal profiles of needs and opportunities, completion of action plans, and initiation of experiments in fisheries management. At the national level, a national strategy and action plan for coastal zone management should be ratified. Goals for the implementation phase might be measured in numbers of square km in which fisheries, mangroves, or other resources are reasonably managed.

F. Priorities for lakes and wetlands

Much of the previous section on coastal zone management applies equally to lakes, streams, and wetlands. The Government of Kenya will soon begin to review a National Wetlands Strategy being prepared by the Dutch. Important advantages in donor coordination would accelerate progress toward sustainable use if USAID could (a) provide political support and technical guidance for ratification of the Strategy, backed up by (b) strategic support for implementation of certain elements.

For example, the Strategy is likely to call for improved watershed management. USAID's experience in this field through the Irrigation Support Project for Asia and Near East (ISPAN) would give the Agency a comparative advantage in essential areas such as:

- conducting accurate inventories;
- working with communities to develop clear and fully accepted statements of water policy;
- fostering and strengthening water user groups and related NGOs.

A Wetlands Working Group has formed in the National Museum. They are working closely with the Dutch on the National Strategy, and offer a simple mechanism for increasing USAID attention to this sector, especially if broader support for the Museum is undertaken in accord with other options presented in this report.

The enormous interest in conservation and biodiversity in Kenya makes it easy to overlook the overwhelming difficulties facing urban water, wastewater, and sanitation systems. Although USAID cannot supply the municipal infrastructure that will ultimately be needed, the Agency can support improved municipal management for water efficiency and safe disposal practices. Such capacity-building programs alleviate short-term problems, buy time, and eventually become essential elements in the planning and operation of improved facilities. Mombasa's plans to divert water that now flows to the wetlands of Amboseli, illustrates that this management is actually an integral part of a national wetlands or water strategy.

As industrialization proceeds in Kenya's urban areas, every effort must be made to assure that its environmental costs do not exceed its economic values. Programs offering training and evaluation in "best practices" for pollution prevention in industrial processes are beneficial both economically and ecologically.

Beyond coordination, there should be unanimity among donors to require strict and thorough Environmental Impact Assessment (EIA) review before any water project is undertaken. This rule should be especially true of activities proposed in sensitive intertidal and estuarine areas. As an element of this policy, support for "best practices"

of both economical and environmental value could be supported through pollution prevention programs. The donors would thus be offering something as well as demanding something in a regime of strict EIAs. This option is in keeping with several recommendations of the National Environment Action Plan (NEAP).

The Lake Naivasha Riparian Owners Association is a strong group that may represent a model for local control of a common water resource. Their effective application of enlightened self-interest to oppose potentially disastrous water diversion plans in the past is in itself reason to regard them as valuable allies in any movement to widely improve freshwater management in Kenya. USAID should support the concept of making Lake Naivasha a Ramsar site, as this will add a new layer of protection to this remarkable habitat. Other indirect support might be provided through the Wetlands Working Group, which could support the establishment of a consistent monitoring program and related hydrological research. Moreover, any program in municipal management of water, sanitation, or solid waste should make an effort to include the town of Naivasha.

As part of Kenya's planning for water use, the apparently unrealized potential for inland aquaculture should be explored. The Mission should closely examine the benefits of moving the Pond Dynamics CRSP to Kenya.

G. Budget

The budgets of previous USAID projects that made progress toward integrated water and coastal resources management have been in the range of $300,000 to $1,000,000 per year for five to ten years (including host and other non-USAID contributions). Details may be found in the final evaluations of the Coastal Resources Management Project (CRMP; 1994) and the Irrigation Support Project for Asia and the Near East (ISPAN; 1993).

H. Related USAID Programs

Such programs would build on three USAID activities already underway in Kenya. First, the Malindi and Mombasa marine parks are an Area of Special Interest under the COBRA project. The project is working with boatmen to improve their equipment and services to tourists visiting the marine park, with fishermen to emphasize the need for conservative fishing methods, and with the "Beach Boys" to organize them to police their ranks before the hotels have them barred from the area. This could be an excellent model for constituency-building all along the coast.

Second, a small pilot project in policy and planning is funded by USAID/REDSO/ESA in Mombasa and Zanzibar. The CDA is preparing, with public participation, a profile of needs and opportunities in the Bamburi area. They hope to have the plan approved locally within a few months, and to offer it as a national model of the planning process

in the fall. Collaboration with programs that may develop in Tanzania offer greater energy and economy as noted above. This could be a model for planning processes all along the coast.

Third, USAID's Human Capacity and Development Office has been involved in a small but very nice program through a Program in Science and Technology Cooperation (PSTC) grant which is bringing Master's-level students from the region to learn coral reef ecology and survey techniques in an intensive program of field research directed by Dr. Tim McClanahan, in association with KMFRI.

Regarding global ties, USAID is leading several elements of the International Coral Reef Initiative, along with the Department of State, the National Oceanic and Atmospheric Administration (NOAA), the National Science Foundation (NSF) and others. International partners include Japan, Britain, France, Sweden, Britain, Australia, Jamaica, the Philippines, the World Bank, IDB, UNEP, IUCN, and others. The purpose is to focus attention on the stewardship of coral reefs and related ecosystems for the next five years. The Global Bureau is leading the international component of the initiative on the basis of its leadership in coastal zone management over the last decade.

The next major activity of the Initiative will be a workshop in late May at which managers from developing countries will be trained in the design and implementation of national action plans for integrated coral reef management. Kenya has been invited to send representatives. This invitation is one indication of USAID's commitment to coastal resources (although it is not yet clear which donor will support the Kenyan delegation).

SUMMARY OF RECOMMENDATIONS

1. USAID can best foster the conservation and sustainable use of coastal and aquatic resources through support for national and regional programs that will establish durable frameworks for cooperative management and increased capacity among Kenyan agencies, municipalities, NGOs, and research institutions. Two working documents exist for these efforts, the Arusha Resolution for Integrated Coastal Zone Management, and the Dutch-backed wetlands management plan.

2. Progress will inevitably require capacity-building in the Kenyan agencies, and across the region, to develop a cadre of managers with the knowledge, skills, and attitudes necessary for ecosystem management. In the short term this will be difficult, but the example of KWS proves that it is possible. The effectiveness of CDA as a healthy catalyst should be explored.

3. The strength and visibility of NGOs will also have to be improved if traditional and artisanal resource users are to have a voice against large development plans, e.g., for irrigation, tourism, or mariculture.

4. Management of Kenya's marine parks is good and improving. Attention needs to be directed to new management regimes for fisheries, water quality, and land use in the other 92% of the coast. Marine protected areas can play an important part in these programs, but they are not sufficient. Urban areas and the management of water needs, solid waste, and sewerage will require particular attention.

ANNEX 1

Other donor programs

Other donor programs in coastal development and management include the following. Essentially all of them are potential partners.

Netherlands:

- GIS mapping of all mangroves at 1:10,000 and 1:25000;
- Community development in mangrove forests;
- Support for KWS activities by training of trainers for community work, upgrading boats, computers, and other facilities;
- Printing brochures and posting signs;
- Aquaculture and outreach in the Tana Delta;
- At least considering support for the marine reserve in Kiunga.

Japan:

- Tourism master plan for Kenya;
- Rice culture in the Tana Delta;

Belgium:

- Working with KMFRI on oyster culture, mangrove ecology, and scientific exchange under RECOSCIX;

Sweden:

- Many regional activities, based in Tanzania, including support for the Arusha Resolution and process;

Canada and Norway:

- Possible work in mangrove conservation;

UNEP:

- Directing, in collaboration with FAO, the Regional Seas Programme for East Africa, which includes capacity-building for various sub-sectors of coastal zone management (cooperating with the USAID/REDSO program and the International Oceanographic Commission (IOC));

- Preparing GIS maps at 1:50,000 to 1:250,000 scale with Belgian support;

Western Indian Ocean Marine Science Association (WIOMSA):

- Coordinating applied scientific activities in pelagic fisheries, coastal zone management, sea turtles, marine mammals, and coral reefs, for which a meeting will be held in Mombasa in the fall; presently directed from Tanzania by a Kenyan (M.A.K. Ngoily);

IUCN:

- Provide technical support and assistance with project design to donors and NGOs (including the Dutch project with KWS);

- Beginning implementation of a community-based coral reef project in Tanga, 150 km south of the Kenya border;

- Trying to launch a regionally coordinated coastal program, including a significant GIS component;

- Distributes a small newsletter for East African marine affairs;

WWF:

- Implementing the sole functioning project in community-based reef and fisheries management in the region, in Mafia Island, Tanzania;
- Examining feasibility of a similar program at the Marine Reserve/Biosphere Reserve at Kiunga;
- Conducted best regional reviews of the sector to date;

International Wildlife Society:

- Supporting applied research at KMFRI, through Tim McClanahan;

East African Wildlife Society (EAWS):

- Conservation in the Tana Delta, where they publicized the dangers of a large mariculture project and had it indefinitely delayed;

Peregrine Fund & Pan African Raptor Conservation Programme:

- Protection of forest and endangered species in Arabuko-Sokoke Forest Reserve;

New England Aquarium:

- Broad support for Western Indian Ocean Marine Science Association (WIOMSA) programs, especially coral reefs.

- Possible support for a public aquarium in Mombasa.

Annex 2

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