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Prospects for Integrated Coastal Resource Management in West Africa

ON THE COVER

(top left) Men and women carrying fish from boats in Tanji, The Gambia. November 21, 2019.
Dreamstime.com/Mariusz Prucszyk

(top right) Aerial view of a mangrove forest in The Gambia.
Dreamstime.com/Mariusz Prucszyk

(bottom) A mangrove forest in the Saloum River Delta, Senegal.
Dreamstime.com/Juan Vilata

Prospects for Integrated Coastal Resourse Management in West Africa

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Senior National Park Service staffer Rob Milne, whose work bridged the international conservation community and the agency, conceived of the project leading to this report. His work drew on the Service's expertise and tailored it to region–specific needs, along with policy and funding support for success.

The authors are the eminent Coastal Ecologist Sam S. Snedaker; John R. Clark, a widely acknowledged architect of the field of coastal zone management; and Scott T. McCreary, president of CONCUR, Inc., a nongovernmental partner for facilitation, strategic planning, and environmental policy analysis. Post–workshop synthesis and drafting by Clark and McCreary followed at John Clark's field station in Merida, Mexico in February 1988.

CONCUR updated the document in 2021–2022. Scott McCreary and Jasmin Muñoz, project associate at CONCUR, Inc. and Masters in City Planning candidate at the University of California Berkeley, reviewed and edited this report. Ron Rick, of Ron Rick Design, San Rafael, California digitized the original 1988 text and updated the report design, cover pages, map illustrations, and revised text.

About the Authors

The late **John R. Clark** is the lead author. When the Mbour workshop convened, he held a research appointment at the University of Miami Rosenstiel School of Marine Sciences and consulted internationally on coastal zone management. Previously, he was senior associate at the Conservation Foundation and senior coastal planner at the International Affairs Division of the U.S. National Park Service. Referred to as "the Grand Old Man of Integrated Coastal Management" by colleagues, John authored/edited many books including *Coastal Ecosystem Management* (1977) and *Coastal Zone Management Handbook* (1996)—characterized as "foundation stones" of coastal management.

During workshop convening, facilitation, and report drafting, **Scott T. McCreary** was completing his doctorate at Massachusetts Institute of Technology's Department of Urban Studies and Planning. His focus was on using mediation and joint fact–finding techniques to resolve coastal and ocean resource conflicts. He had joined John Clark at estuarine conservation initiatives on the east and Gulf coasts of the United States. In that same timeframe, coauthored Institutional Arrangement for Coastal Resources and Environments (first published 1984; revised 1990). Dr. McCreary is now president of CONCUR Inc., a California–based environmental policy firm where he leads teams in conflict analysis and mediation on coastal, ocean, and other natural resource issues.

The late **Dr. Sam C. Snedaker** was professor at the Miami Rosenstiel School of Marine and Atmospheric Sciences. He coauthored the foundational work *The Ecology of Mangroves,* chaired the Division of Marine Affairs in 1982, and was professor of Marine Biology and Fisheries and associate director of the Institute for Coastal Studies from 1988 to 1989. Dr. Snedaker was editor of the *Bulletin of Marine Science* from 1997 until 2003. His research spanned 45 nations and addressed sea level rise on marine fish populations, energy flows, and estuarine pollution.

Executive Summary

Prepared early in the development of the international practice of integrated coastal zone management, this report is a reconnaissance-level scan of opportunities and needs for sustainable use of coastal resources in West African nations from Mauritania in the north to Nigeria in the south. It builds on the findings of an international workshop convened in Mbour, Senegal in November 1987. The workshop brought together academics and practitioners from twelve nations, as well as international advisors from the U.S. National Park Service and colleagues from the International Union for the Conservation of Nature (IUCN) in Gland, Switzerland. A core concept articulated at the workshop and broadly endorsed by participants was the need to create governance arrangements to integrate planning for coastal resources across multiple sectors, institutions, and levels of government to yield the best opportunities for economic development and avoidance of unwanted environmental impacts.

In this report, we present findings from the coastal zone management workshop in relation to foundational principles of coastal area management and planning and characterize the natural resource base. We summarize key topics discussed by workshop participants. These include the adequacy of the natural resource information base, major issues and use conflicts, current management arrangements, the role of science, and the potential for regional pilots.

We summarize the status (as available in 1987) of coastal resources in West African nations in a series of short sections covering the region from Mauritania to Nigeria. Each section presents a characterization of coastal resources and an overview of coastal resource issues, illustrated by one or more maps. Next, we discuss coastal area planning and management mechanisms, with an emphasis on program structure and institutional arrangements. We explore specific tools of construction setbacks and mixed-use zones, critical habitat designation, and environmental impact assessment.

Key findings and recommendations from the workshop include:

- In each West African nation, responsibility for managing coastal resources is shared among several ministries. There is a critical need to improve coordination among sectors and create interagency councils to guide and control development in the coastal zone.
- Effective local participation is central to the decision-making process for coastal management.
  Membership of interagency councils should include local representatives.
- Each nation is encouraged to create a center to organize and promote the exchange of information on coastal uses, integrated into the framework of national conservation strategies.
- A mechanism should be created for regional exchange of information among West African nations; donor organizations should be approached for support.
- Local use traditions should be respected and reinforced by central government acceptance. Implementation of coastal policies should be based at the local level and local interests should have influence on central government policies.
- Multiple-use zoning should be encouraged for perpetuation of local traditions while maintaining important habitat values.
- Demonstration projects should be developed for possible funding support, illustrating principles of coastal area management and planning in action.
- Current resource uses exerting negative impacts on coastal resources should be identified, and priority problems meriting prompt attention should drive policy development to anticipate and avoid future conflicts.

- Recognize the central role of the coastal zone in national economic development planning, including the need to manage the coastal zone for the benefit of both local interests and the national interest as a whole.

A particular focus on coastal parks and reserves is highlighted, corresponding with a worldwide trend to integrate traditional uses into park planning. As a practical matter, at the time of workshop convening, participants acknowledged that given limitations on national funds and current priorities, turning to international donor organizations for assistance was a practical way forward. Specific suggestions included:

- Strengthen the focus of the U.S. Agency for International Development (USAID) and other donors to focus on intersectoral planning and to include impact avoidance and mitigation, particularly in development programs affecting estuaries.
- Work with local and international political bodies to define and develop conservation strategies, with a specific suggestion to focus on delta areas of Senegal and The Gambia.
- Improve the inventory and database for coastal resources, with a focus on arid/semi-arid nations that face immediate risk.
- Strengthen institutional capabilities, policy making, and technical skills, including teaming with nongovernmental organizations or private volunteer organizations for training.
- Work toward sustainable management and multiple use of mangrove forests to balance needs for development and ecological protection.
- Support applied research to fill information gaps on coastal resource productivity and susceptibility to impacts of development.
- Strengthen coastal protected area management.

Lastly, we emphasize the need for coastal zone management to incorporate a strong focus on linkage to uplands, with particular attention to hydrology of coastal rivers and their role in natural hazards management, water quality, and delivery of sediment to nourish beaches. Natural hazards are highlighted, with a particular focus on beach erosion and the importance of maintaining wetlands to buffer storm surge and sea level rise. References and supplemental references strive to link the 1987 report with more recent developments in the practice of ICZM. Attendees of the 1987 meeting, including their affiliations, are listed in the appendix.

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Introduction

The Coastal Resources Workshop

Recent advances in natural resources science and management have created new opportunities for developing countries. This is particularly true for coastal resources, which form an important economic base in West African coastal nations. In order to explore the potential for modern approaches to coastal resources management, a workshop was convened in Mbour, Senegal, in November 1987. The Coastal Zone Management workshop was held in conjunction with an international wetlands conference of the International Union for the Conservation of Nature (IUCN; Coastal Wetlands Conservation), Coastal Zone Planning: Their Contribution to Sustainable Development in West Africa, reported by Dugan (1988). The Coastal Zone Management workshop took place during the seminar period, November 9-13, with principal activities occurring in intensive sessions on November 11 and 12.

The objectives of the Coastal Zone Management workshop were based on the recognition that the resources of the estuaries, lagoons, and tidal rivers of West Africa play a critical economic role in supporting fish, wildlife, and wood production. Coastal fisheries are particularly dependent on mangrove forests and other contiguous wetlands. These areas provide special habitat for key life stages of several commercial fish species and a large supply of detrital materials for fish and shellfish. Mangrove forests directly support the major animal protein food supply of West Africa—its fisheries industry (worth in excess of US $100 million, annually). Coastal wetland resources and environments are increasingly jeopardized by unplanned land clearing for agriculture and aquaculture, unsustainable harvesting of mangrove forests, and changes in freshwater inflow to coastal waters caused in part by the Sahelian drought and by dams, weirs, and barrages constructed to capture diminishing freshwater runoff. Concern for coastal resources degradation has been raised as an issue in the U.S. Agency for Ineternational Development's (USAID) plan for supporting natural resource management in sub-Saharan Africa (Freeman 1986).

The results of the workshop provided a comprehensive review of West African coastal natural resources, priority conservation concerns, and the current level of scientific knowledge related to these topics. It also created an opportunity for coastal West African countries (Mauritania to Nigeria, see Figure 1), international organizations, donors, multilateral banks, and educational institutions to discuss future coastal-resource issues of mutual concern.

Workshop discussions focused on resource issues related to estuaries, mangrove forests, beach/coastline protection (erosion control), fisheries, and coastal agricultural land. Emphasis was placed on the resolution of conflicts between the long-term conservation of these resources and increasing demands for development projects—freshwater management schemes (dams and barrages), expansion of agriculture into marginal lowlands, development of port facilities, mangrove cutting, and oil/mineral extraction.

Examples of successful institutional alternatives to current approaches to coastal development were presented and discussed in the West African context. Particular attention was paid to centralized, integrated approaches in coastal zone management, which have recently attracted interest in Asia and Latin America. These discussions were led by individuals who have direct experience with the approaches used.

The major discussion topics at the workshop included: assessing and strengthening the natural resources information base, bolstering information on economic values, major issues and conflicts, current management arrangements, current planning arrangements, status of mechanisms for management, role of science, potential for integrated coastal zone management, and potential for regional pilots and demonstrations.

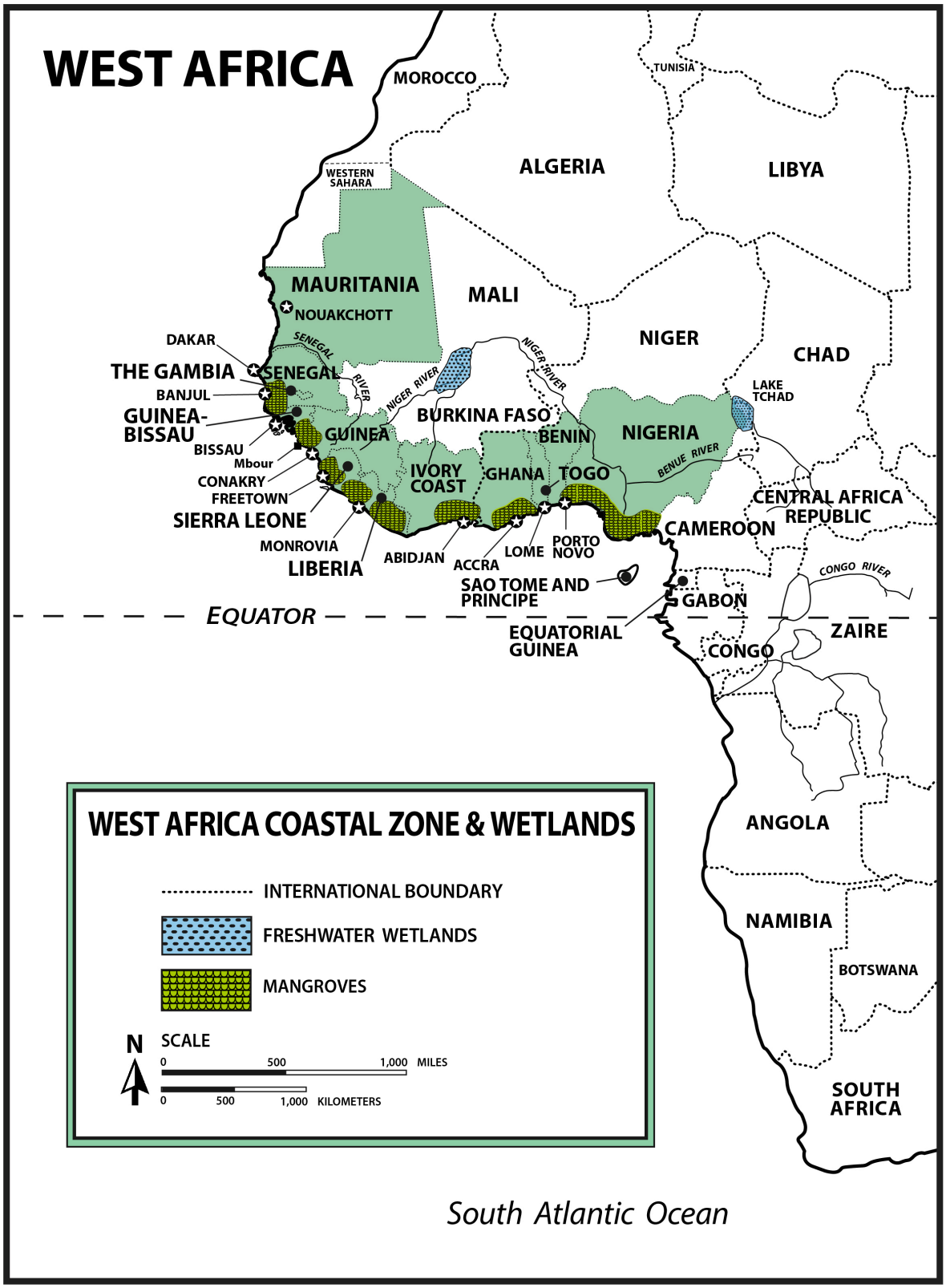

Figure 1. West coast of Africa showing countries and general location of wetlands.

A Reminder on the Context of the 1987 Workshop

This report presents the results and conclusions of the workshop and summarizes key contents of materials presented. At the time of the 1987 workshop, relatively little substantial literature existed on the resources of this coast, which was an important impetus for convening the workshop. Moreover, the workshop was among the very first efforts to address a setting with relative sparse data and systematically pool information in support of advancing coastal management in West Africa.

Much of the information in this report was generated by the workshop participants. Other material was contributed by project consultants (e.g., Shiyam and Smardon 1987) and the University of Miami Rosenstiel School of Marine and Atmospheric Sciences staff. Another information source was the array of previously published documents pertaining to the West African coast.

Accordingly, we acknowledge that the issue coverage by nation is variable. We believe that this report makes a useful contribution to the future of integrated resources management for the West African coastal zone.

Coastal Management

No nation or civil society can defer the task of conserving its coastal resources. These resources are too valuable to lose because of indifference, lack of information, or intention. We know, and accept, however, that some loss of potential fisheries production usually accompanies coastal development (e.g., harbors, cities, mining, agriculture, and even dams), and we know that each fisherman's share of the catch must decrease as more boats and nets join the fleet. But unsustainable use, leading to depletion, is not acceptable, nor is it necessary.

Development and conservation can and must coexist if today's civil societies are to prosper well into the coming decades. First, conservation is necessary to balance the pressures on natural resources so that they are not overexploited. Second, control of coastal development is necessary to protect resources from pollution and the destruction of essential habitats. Both needs must be met if we are to have resources for the future. The technology by which to guarantee sustainability of coastal resources exists, as well as the methodology for its application, which is a dominant subject of this report.

It is particularly appropriate for development assistance agencies (national and international) to increase their efforts to enhance coastal productivity and protect coastal resources from degradation. One reason for concern is that in some locations, well-intentioned but misapplied or inadequately coordinated assistance activities have resulted in decreased economic value or utilization potential (for example, excessive deforestation, dam construction, development in erosion-sensitive areas, and wetland reclamation activities). Also, an effective and productive use of assistance agency resources could be to apply more effort to the identification and development of the underutilized resources (which are many) of developing country coastal areas. The governments and people of many developing countries, influenced in part by the increased worldwide awareness of marine resources created by the extension of national marine jurisdictions and economic zones, now commonly express an increased desire to "turn towards the seas" and learn to use the coastal and open ocean resources that are available to them (National Academy of Science 1982).

Integrated Coastal Zone Management

Worldwide, sustainable management of ocean and coastal resources is one of the most pressing environmental policy challenges—one demanding a concerted intergovernmental response, multisectoral planning, robust information sharing, effective participation, networking, and continued innovation and refinement—an approach coined as Integrated Coastal Zone Management (ICZM).

The Mbour workshop was one of the first intentional international efforts to explicitly define and use the framework of Coastal Area Management and Planning (CAMP) or ICZM to catalyze program development. The workshop emphasized the critical need for cross-sectoral integration, creative institutional arrangements, rigorous impact assessment, and broad-based community engagement.

Definitions of ICZM evolved. A definition provided by the European Commission (1999):

> *ICZM is a dynamic, continuous and iterative process designed to promote sustainable management of coastal zones. ICZM seeks… to balance the benefits from economic development and human uses of the Coastal Zone, the benefits from protecting, preserving, and restoring Coastal Zones, the benefits from minimizing loss of human life and property, and the benefits from public access to and enjoyment of the Coastal Zone, all within the limits set by natural dynamics and carrying capacity.*

The expanded frame emphasized alternatives to centralized planning, coastal and marine spatial planning, restoration of ecological functions, coastal adaptation and resilience, more authentic modes of stakeholder participation, and inclusion of social equity considerations. In recent decades, ICZM activity in West Africa has stepped up as shown in Table 1.

Table 1: Selected milestones in development and application of ICZM to West Africa.

Date	Event/Activity	Outcome(s)
1972	Initial Statutory Guidance	Coastal Zone Management Act, California Coastal Act
1985	U.S. NPS/USAID Coast Series of Publication	Coastal Resources Management Case Studies Institutional Arrangements book
1987	Mbour, Senegal Coastal Area and Management Planning Workshop	Characterization of coast resources, scan of issues, forward –looking recommendations
1988	Assessment Undertaken by Government of Finland/UNEP	Notable Progress: The Ghana Coastal Wetlands Project; The WACAG 11 Project on ICZM in The Gambia, Guinea; and Marine Ecosystem Project: Ivory Coast, Ghana, Benin and Nigeria
1992	Stockholm 1992 Earth Summit	Credited as source of woldwide awareness of ICZM concept
1998	Assessment by UNEP Priority Actions Program	Findings: success depends on political support, institutional mechanisms, participatory efforts, commitment of resources, and adaptive governance
2012	Maputo, Mozambique Meeting	ICZM Protocol to the Nairobi Convention
2018	World Bank–sponsored Initiative	Coastal Areas Management Program: From Shared Coastal Vision to Sustainable Reality
2021	USAID–sponsored planning effort on Climate Change Adaptation	West Africa Biodiversity and Climate Change Program (West Africa BiCC)

A main theme of the Coastal Zone Management workshop and of this report is that the sea coast is a distinct area with equally distinct resources. Furthermore, it is only by focusing attention on the coast as a special area that coastal resource values can be maximized. Conceptual approaches to coastal management available at the time of the 1987 Mbour workshop had not been in wide usage 10 or 20 years previously. This particularly true of the integrated approach coined as either Coastal Area Management and Planning (CAMP)* or Integrated Coastal Zone Management (ICZM). The concept explained by Clark (1988) was elaborated by several practitioners over subsequent decades.

In its broadest sense, ICZM is most often a central government program established for the purpose of using or conserving coastal resources and environments. The word "coastal" may be used differently by different users and managers. To some, it means fish and wildlife, to others it signifies beaches and dunes, to others, it still means broad reaches of land and water. However, coastal management spans the boundary area between land and sea called the coastal area or the coastal zone. This zone is meant to include both the part of land affected by proximity to the sea and the part of the ocean affected by its proximity to land. The core idea is to recognize the linkage between the "wet side" (the coastal sea) and the "dry side" (the coastal land) that is formed by biological, geological, and hydrological patterns and processes.

*We chose to apply the term ICZM throughout the text and to highlight the term in the report title, though CAMP was briefly in use in during the 1987-1990 period.

In this report, we include the planning aspects of coastal management along with the management of resources in the coastal area, and term the whole process ICZM. There is a system for the ICZM program that distinguishes it from other governmental resource management programs along with a special set of principles, premises, and practices (Clark 1988). Some of its distinguishing features are as follows (Sorensen et al. 1984):

- As distinct from a one-time project, it has continuity and is usually a response to a legislative or executive mandate.
- A geographic jurisdiction is specifiedwith an inland and ocean boundary; it is not only an ocean program.
- A specific set of goals is articulated, usually in response to some specifically identified issues or conflicts among coastal uses.
- A clear institutional identity is established—identifiable as either an independent organization or a network of organizations linked together by functions and management strategies.
- An ICZM program is based on a clear understanding of natural coastal systems and ecological functions and services, emphasizing linkages landward and seaward.
- A major focus is the intentional coordination of plans and development across multiple economic sectors (e.g., fisheries, ports, agriculture and silviculture, tourism).
- Mechanisms for implementation and enforcement are specified.

The Resource Base

The natural resources of the coastal areas are among the most important that exist in West African countries. These resources include mangrove forests that produce a great variety of economic goods and services; the associated estuaries, lagoons, and bays that produce fish and shellfish and support wildlife; the contiguous beaches and dunes that protect settlements and attract tourists; and the near-coast waters that sustain artisanal and industrial fisheries (Table 2).

Fisheries of West Africa can be categorized as: (l) inland, (2) coastal artisanal, (3) coastal/marine industrial, and (4) foreign offshore. Foreign industrial fishery operations are concentrated in the rich grounds off Mauritania and Morocco, and to a lesser extent in the region between Senegal and Sierra Leone. The USSR and Spain together accounted for 73% of the non-African landings of 1.65 million tons in 1981. Spain is the principal harvester of cephalapods and is the dominant participant in the sardine fishery. Spanish, Portuguese, and Soviet trawlers and the principal harvesters of hake and seam bream (Goodsen 1984).

Ghana and Senegal are the only countries with well established marine fisheries traditions. In the late 1970s, the largest African industrial fleets were found in Morocco, Ghana, Senegal, Nigeria, and Ivory Coast. African artisanal operations are responsible for a large percentage of total national landings in several countries. Goodson (1984) estimates this figure at being on the order of 75%. Sutinen and others (1981} estimated that roughly 100,000 canoes and 600,000 fishermen operate in the coastal nations, primarily in the southern zone. According to Goodson (1984}, Nigeria has the largest artisanal fishery. Sierra Leone, Ivory coast, Ghana, Cameroon, and Senegal have moderate sized fleets.

Interventions aimed at improving management of artisanal and other African nearshore fisheries could probably show positive terms in tens of jobs, foreign exchange, and food supply through a combination of training, institutional development, community support, and technical assistance aimed at reduction of post-harvest loss. According to available data, expansion of: (1) African inshore trawler activities in the Northern Zone; (2) inshore artisanal fisheries in the Northern Zone; (3) sardinella activities in the

Table 2. Overview of Coastal Resources in West Africa.

Nation	Coastline[1] (length in km)	Shelf Area[1] (*000 km²)	Fishery per Tonnage Landed[2]	Per Capita Consumption[2] (kg/yr)	Rank in Per Capita Consumption[2]
Mauritania	780	32.3	535,100	46.3	4
Senegal	500	30.0	275,300	89.3	1
The Gambia	80	5.2	11,000	30.0	7
Guinea-Bissau	350	52.5	65,800	NA[3]	NA[3]
Guinea	320	39.5	100,000	10.4	11
Sierra Leone	300	26.9	34,000	59.1	3
Liberia	560	17.4	9,000	45.9	5
Ivory Coast	600	11.6	65,000	45.6	6
Ghana	550	21.7	200,000	60.8	2
Togo	70	1. 7	10,000	25.4	8
Benin	100	2.6	5,000	25.1	9
Nigeria	860	37.0	216,000	23.4	10

[1]Source: Everet et al. 1980

[2]Source: E.I.U. 1988 and R.D.A. 1985

[3]Data not available

Southern Zone; and (4) mixed offshore demersal activities in the Southern Zone, appear feasible from a natural resource management point of view.

Sustaining fisheries production is essential to the continued well-being of many West African nations, which derive from their fisheries something near 50% of all their animal protein. The coastal artisanal fisheries include many species that are dependent upon lagoons, estuaries, mangroves, and submerged seagrass beds for important stages of their life cycles, and their abundance depends on optimum conditions of coastal habitats and coastal waters. In this regard, the Sahelian drought, accompanied by decreasing freshwater runoff, has the potential to seriously affect estuarine environments and their fishery resources through three principal mechanisms: (1) loss of mangrove forests through hypersalinization and a concomitant reduction in the export of organic detritus, (2) reduction in mineral nutrient runoff and thus the availability of nutrients to support nearshore productivity, and (3) changes in the temporal and spatial salinity patterns in estuaries that could result in significant changes in fishery species composition. Associated with the reduction in river runoff are an acceleration of both erosional processes on beach fronts and the siltation of coastal and inland channels. Thus, any coastal area management planning initiative must take into account, not only the current situation, but also planning in the context of future environmental/ecology changes. (See Table 3 for a listing of major river systems.)

Table 3. Major river systems of West Africa ranked in order of drainage and discharge areas. [Source: UNEP 1982]

River Drainage Basin	Size (km^2)	River Discharge	Flow Volume (m^3/sec)
Niger, Nigeria[1]	1,125,000	Niger, Nigeria	8,500
Senegal, Senegal	441,000	Cross, Nigeria	1,557
Volta, Ghana	398,371	Volta, Ghana	700
Bandama, Ivory Coast	100,000[2]	Senegal, Senegal	774
Sassandra, Ivory Coast	80,000[2]	Saloum Casamance, Senegal	695
Gambia, The Gambia	77,000	Gambia, The Gambia	200
Oueme, Benin	50,000	Konkoure, Guinea-Bissau	683[2]
Cross, Nigeria	48,000	Sassandra, Ivory Coast	360
Mono, Togo	22,000	Pra, Ghana	289[2]
Pra, Ghana	23,000[2]	Banadama, Ivory Coast	285
Konkoure, Guinea-Bissau	19,000[2]	Oueme, Benin	182
Tano, Ghana	16,000[2]	Tano, Ghana	146[2]

[1]Nations listed are those where river mouth is located.

[2]Partial discharge or drainage area at last gauging station.

Coastal Resources of West African Countries

This section briefly reviews the status of coastal resources in West African countries from Mauritania south to Nigeria. It is based mainly on materials available at the Mbour coastal zone management workshop. As noted, the summaries vary greatly in their coverage. Where we had information, we addressed the following subjects for each country: (1) character of the coast, (2) coastal resource uses, (3) watersheds and water resources, (4) parks and protected areas, and (5) coastal resource issues.

Mauritania

Character of the coast

The Mauritanian desert coast is characterized by a northern section with an irregular coast and poorly developed sand dunes and a southern section with a smooth, unbroken dune structure. ounes vary in width from 200 m in most sections of the coast to almost 2 km north of the Senegal River Delta. Urban centers include Port Etienne in the north, the colonial capital Nouakchatt in the center of Mauritania, and Rosso, the administrative center (Figure 2).

Coastal resource uses

The fishing sector is now one of the driving forces in the economy. It has averaged 11 percent growth a year since 1979. About 98 percent of fishing is done by industrial companies; however, they employ only an estimated 354 nationals. Some 2,000 people are employed in the artisanal fishing sector. Villagers from Rosso and Kaedi practice boat fishing on the Senegal River. Trawler fishing is based out of Cape Blanc, South of Port Etiene. Foreign fishing fleets are concentrated in the waters off Mauritania and Morocco. Major participants are Spanish, Soviet, and Portuguese fleets. Per capita fish consumption ranks fourth in the region.

Watersheds and water resources

The Senegal River, with a total watersheds of 441,000 km^2 drains portions of Mauritania. Although there are no major dams or irrigation canals, artisanal level irrigation activity is practiced along portions of the Senegal River. The Saloum-Casamance has an average discharge of 695 cusecs (cubic meters per second).

Parks and protected areas

Mauritania s principal coastal park is the Parc National du Banc d' Arguin, established in 1976 and in 1982, it was designated as a Ramsar site (Ramsar sites are designated by countries signatory to the Convention on Wetlands of International Importance Especially as Waterfowl Habitat, initiated in 1971 at a conference in Ramsar, Iran). The park is located on the coast between Cap d'Arguin and Cap Timiris and includes 1,173,000 ha of area, approximately half terrestrial and half marine waters.

Parc National du Banc d'Aguin is a model for the modern concept of multiple use coastal protected areas, designed to protect habitats and important species while at the same time encouraging sustainable resource uses, such as fisheries. The park was created primarily for conservation and tourism is of lesser importance because of the remoteness of the area from tourist facilities.

With six million migratory birds, "landscapes of dunes, fishermen and their sailboats which traverse the ocean's deeps in company with the dolphins" the Banc d'Arguin represents "one of the wonders of the world, a rare place where man still lives in peace with nature" (Anon. 1986:1). Scientific research shows that the Banc d'Arguin constitutes a zone of biological production essential for the production of coastal fisheries and for sustaining the fishing economy (Hayda and Compredon 1987). It is one of the greatest littoral zones of the eastern Atlantic that is virtually unspoiled. Under present consideration is the Diaouling Nature Reserve in the Senegal River delta which would include 13,000 ha of lowlands and water.

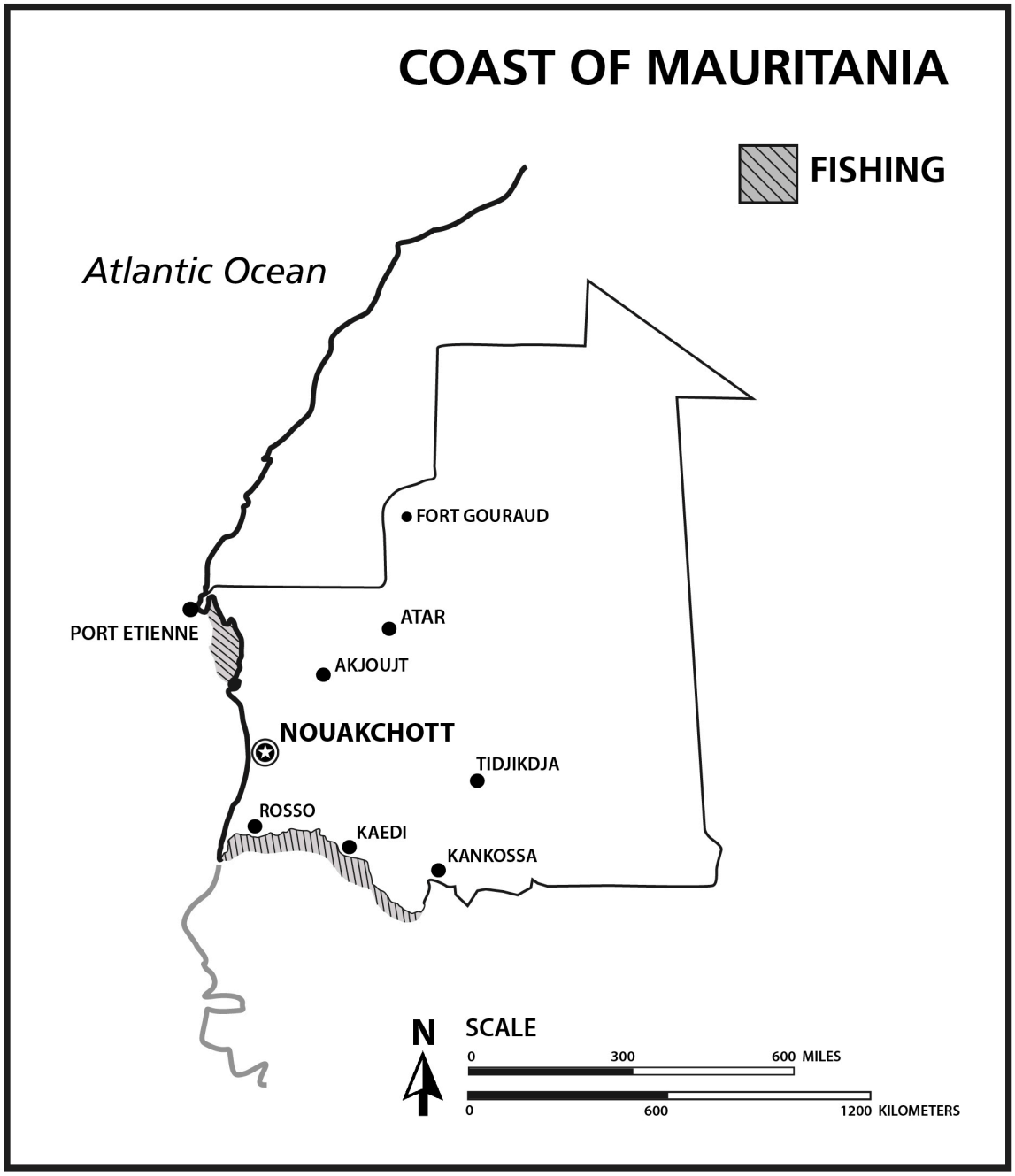

Figure 2. Coast of Mauritania, fishing areas.

Coastal resource issues

Beach erosion is a problem in parts of Mauritania. Sedimentation of coastal waters from wind blown desert sand in other parts. Marine pollution is an issue in Port Etienne, Noukachatt, and other places. A serious problem exists in the Senegal River lowlands due to the construction of a dam and resulting changes in the ecology of the wetlands/aquatic system.

Senegal

Character of the coast

A portion of Senegal lies north of its sister nation, The Gambia, and a portion lies to the south of it (Figure 3). The coast is generally dominated by series of low dune systems and spits. Major urban centers include Saint Louis in the north and Dakar, the capital, in the center of the country. The region south of The Gambia is largely rural. Between Saint Louis and Dakar, Acacia savannah reaches the coast. South of Dakar, and extending into The Gambia, a grass-dominated savannah predominates. In the southern portion of Senegal, deciduous forest and patches of swamp forest occur (Figure 4).

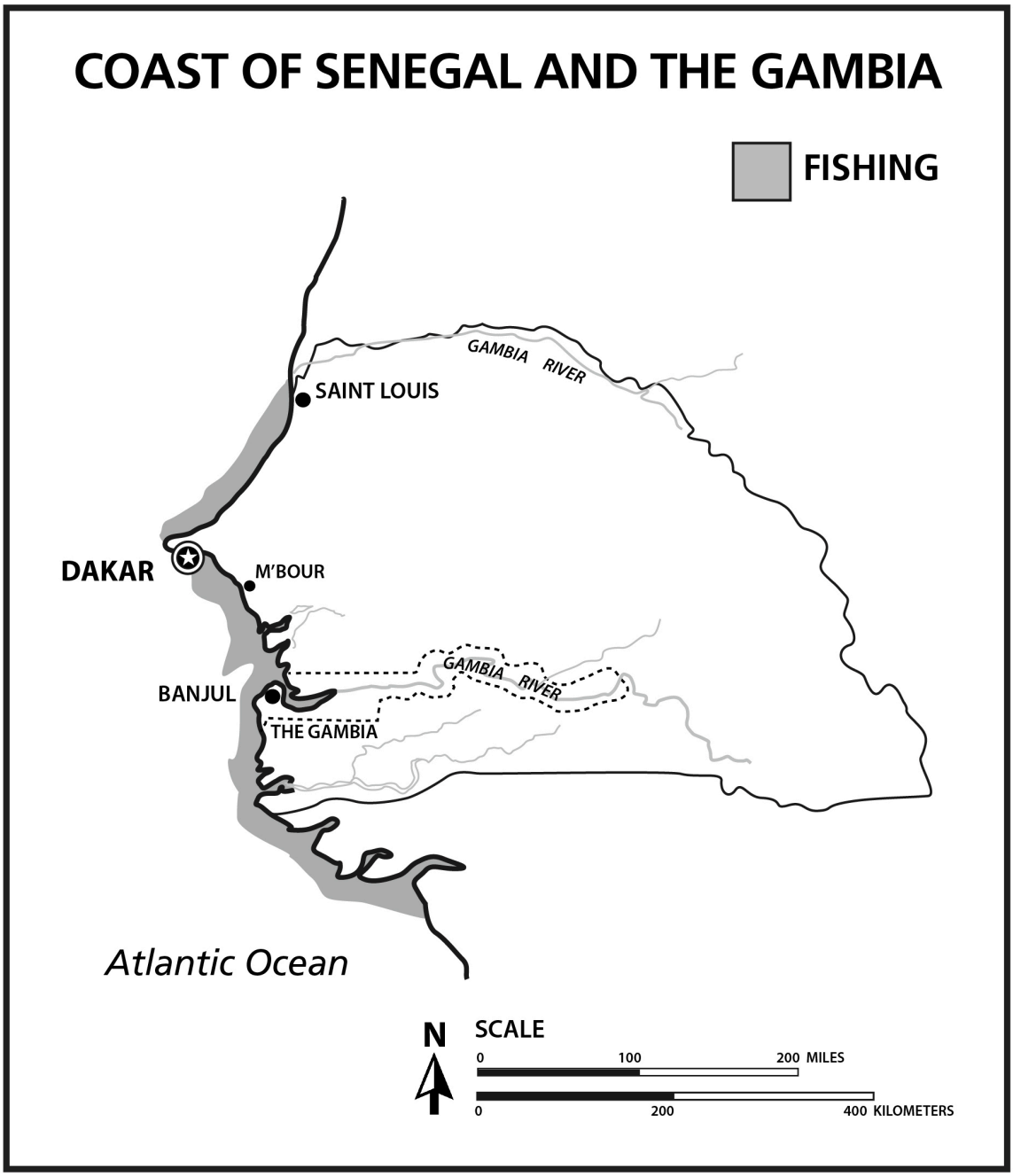

Figure 3. Coast of Senegal and The Gambia, fishing areas.

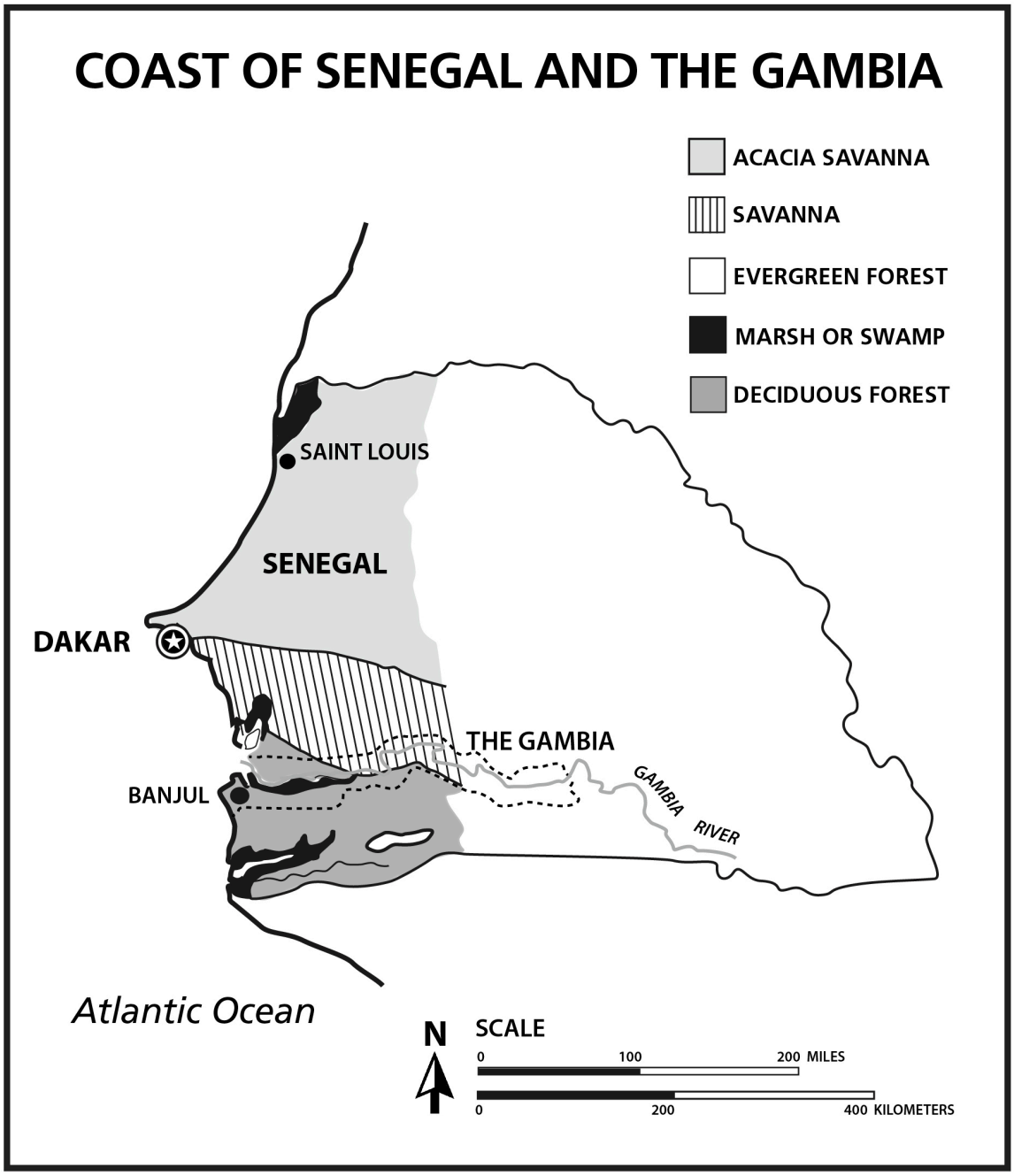

Figure 4. Coast of Senegal and The Gambia, ecological zones.

Coastal resource uses

Senegal has the highest per capita fish consumption in the region, and ranks second to Nigeria in tonnage landed. Senegal and Ghana are the two nations in the region with the most established marine fisheries traditions. Commercial fishing is practiced along the coast from Saint Louis through Dakar, and in the south. Artisanal fishermen in villages like Mbour (south of Dakar) make a substantial catch using fuel-powered canoes and boats. This traditional maritime sector, involving small scale operations by independent fishermen, provides direct regular employment for an estimated 29,000 people and, in common with inland fishing that employs an estimated 10,000 people, produces fish for the domestic market. Fish occupies an important role in the Senegalese diet.

The industrial sector, geared to exports and employing about 5,000 Senegalese, includes both Senegalese vessels (165 in 1983) and vessels of foreign enterprises operating under licence; foreign boats account for about 60 percent of the sector's catch. Including processing and marketing, as many as 130,000 Senegalese are estimated to be employed in the sector (E.I.U, 1988). Agricultural uses of coastal land include the production of millet, sorghum, and peanuts, and livestock grazing.

Watersheds and water resources

The Senegal River has the second-highest drainage area in West Africa (after the Niger). Average discharge is 774 cusecs, the fourth highest in region. At peak flow conditions, the Senegal River discharges between 2,500 and 3,700 cusecs. During flood conditions, the Senegal spreads into a series of lagoons behind the Mauritanian coastline. Since the Senegal has a very low gradient, tidal influence extends 273 mi (440 km) in land. At 37 mi (60 km) upstream, salt content reaches 10 ppt. As a result of hypersaline conditions, mangroves do not flourish. The Saloum Casamance river drains an area of 166,535 mi (268,000 km^2) and has an average discharge of 695 cusecs.

Parks and protected areas

Parc National de Iles La Madeleine, a wooded savannah, is located about 2.5 miles (4 km) West of Dakar on the coast. It rises from 0-115 ft (0-35 m) above sea level. The park contains 1.7 miles (450 ha) and the marine section includes a band of 164 ft (50 m) inland from the beach. The park, established as an ornithological reserve in 1949, has a small management staff.

Parc National de Basse Casamance was established in April, 1970, in the Casamance region in the southwest portion of country near the border with Guinea-Bissau. It consists of 12,355 acres (5000 ha) and rises 0-36 ft (0-11 m) above sea level.

Delta du Saloum National Park and Biosphere Reserve in the West African Woodland/Savannah is located 150 km from Dakar on the road to Banjul. The entire biosphere reserve spans 180,000 ha with a core zone of 73,000 ha (the national park). It comprises a 72,000 ha marine sector, 23,000 ha of flooded areas, and 85,000 ha of terrestrial land.

The Parc National de la Langue de Barbarie was designated in January 1976. It is located at the mouth of the Senegal River 25 km from Saint Louis and has an area of 2,000 ha.

The Foret Classe de Samba Dia Biosphere (woodland/savannah), was designated in 1936, and later as a biosphere reserve. It is located in the Fatick district in the Sine-Saloum region, 6 km from the Atlantic Ocean.

The creation of a joint Senegambia Park has been discussed between authorities in Senegal and the Wildlife and Conservation Department in The Gambia. However, plans have stalled, and communications between Senegal and The Gambia have been challenging.

Coastal resource issues

A massive low dam structure has been completed to control salinity intrusion at the mouth of the Senegal River. Compensatory mitigation has been proposed to offset lost marine fishery nursery functions below the dam, but the details have yet to be worked out. However, salt intrusion has caused massive degradation of mangroves and rendered large areas unproductive.

The rural natural resources base has become impoverished as a result of heavy demands for fuelwood gathering and cultivation. Yet, the coastal lagoons remain largely intact and serve as valuable bird habitats.

Oil pollution of coastal waters is a problem, arising from washing of storage tanks, minor spills in the vicinity of port oil transfer facilities, and oily waste from refinery operations.

Senegal shares with The Gambia much of its coastal wetland/system because of the central position of the Gambia River, and its delta, estuary, and mangrove forests (Baillon 1987). Therefore, conservation problems of one country are often shared with those of the other; for example, the controversial barrage proposed for the Gambia Estuary.

The Gambia

Character of the coast

The coastal zone of this very narrow country is dominated by the Gambia River Delta (Figure 4). Mangroves extend 250 km upstream. Hypersalinity is associated with a reduced forest height near the ocean. Forests near the upstream limit of salt water penetration grow along the river margin, reaching 30 m. Banjul (Bathurst), the capital, and major urban center, is located on the coast.

Coastal resource uses

Fishery production varies annually from 7,500 to 20,000 tons for commercial marine fishing (finfishes), and from 6,000 to 11,000 tons for the artisanal fishery (shrimp, oyster, crab, and various species of estuarine and riverine fishes; U. Michigan 1985). The artisanal fishery of the coast is conducted by about 3,000 fishermen using more than 600 canoes, two thirds of whom are Senegalese or other foreigners. The smaller estuarine fishery is conducted by about 1,800 fishermen; shrimp is a major product. Coastal rice culture is practiced along the River above the brackish zone. Irrigation agriculture is a recent innovation (for maize, etc.)

Watersheds and water resources

The Gambia River is the major watershed, with a drainage basin of about 77,000 km2, is the fifth largest among rivers in the region. At present there are no dams in The Gambia, but a controversial plan to control (and divert) the Gambia River has been completed, as discussed in the next section.

Coastal resource issues

The major coastal issue is a proposal, backed by the Government of The Gambia, to build a massive low barrage to reduce salinity intrusion. USAID commissioned a series of studies and impact assessments, discovered that the ecology of the Delta would be adversely affected, and recommended against funding and construction of the dam. The Government of Senegal, however, supports the project, as the dam would include a new road to provide more convenient transportation from northern Senegal to the south. Although the project would create a number or ecological problems, The Gambia has sought construction funding from United National Development Program and certain nations, including China and Iran.

Construction of barrages changes estuarine conditions in several ways. There is a reduced inflow of freshwater and nutrients which alter natural salinity regimes and support estuarine productivity. The loss of sustained sand replenishment is also translated into accelerated coastal erosion (losses are not offset by renewals of terrigenous sand). The result, as seen in many other parts of the world, is the loss of coastal habitats, fishery resources and beaches.

Coastal erosion is currently undermining coastal construction such as fish landing sites and hotels. Ill-planned sand mining for use in housing and highway construction exacerbates this problem (Barrow 1987). Although there is a law to control the removal of materials from beaches, bands and foreshores of the Gambia River and its tributaries, this law excludes the capital (Banjul). Causing problems, such as erosion at the Muslim Cemetery in Banjul has been worsened by extraction of sand for the Banjul-Serrekunda highway construction (Barrow 1987).

In response to the general problem of erosion, The Gambia formed the Subcommittee on Coastal Erosion, including members of the Department of Physical Planning, the Physical Planning Board, the Department of Technical Services, and the Environment Unit. The Subcommittee recommended several steps to cope with the problem including both immediate rehabilitation of some areas, employment of additional inspectors, and completion of a study to establish set-back lines for sand mining and development.

Guinea-Bissau

Character of the coast

The marshy Guinea-Bissau coastline is characterized by an intricate network of small streams and tidal channels, interrupted by a series of small cliffs. The saline portions of the marshy swamps support important mangrove stands (Figure 5).

Coastal resource uses

Both commercial trawler and artisanal fishing is active on the coast of Guinea-Bissau. Small fishing communities on the coast that depend on canoes and engine powered boats, smoke fish for local consumption. Most of the trawler catch is exported.

Rice culture in the saline intertidal zone dominated by mangrove forests is practiced by the Diola people of the Basse Casamance, the Balanta people in the Quinara, and the people of Northern Guinea-Bissau partly composed of the Manjacos. The Balanta use a system wherein families tend both high and low rice fields. This presents a hedge against the uncertainty of flooding and saltwater intrusion. Moreover, the Balanta traditionally conserve large areas of mangrove forests untouched, or limit their use to fuelwood, construction wood, and medicinal purposes. However, the Balanta now face social disintegration as many young people are choosing not to remain in rice culture. The Manjaca people, more hierarchical and less conservation-oriented, are more likely to abandon lowland rice fields for highland cultivation served by upstream dams (Slabbers 1987).

Watersheds and water resources

Guinea-Bissau has no extensive water control system. The Konkoure River with an annual discharge of 683 cusecs, is the country's largest. In the coastal lowlands, dams have been built to expand rice cultivation in mangrove areas.

Coastal resource issues

Although large lowland barrages, or dams, do offer the benefits of freshwater storage, prevention of salt water intrusion, and decreasing required labor for dike maintenance, they pose several problems enumerated by Slabbers (1987). Negative ecological effects include dramatic decreases in fish diversity; decline in water quality required for remaining fish species; loss of diversity of other terrestrial fauna and aquatic life; mortality of upstream mangroves; possible soil acidification and effects on adjacent mangroves; and appearance of human disease. Moreover, dam repair is much more difficult than the repair of traditional polders, and cannot solve national production problems unless other major social problems are also solved (e.g., it would be beneficial to decrease urbanization, increase surplus production, overcome labor shortages.)

In view of these problems, some analysts (Slabbers 1987) advocate small-scale interventions at the village level to assist production while maintaining ecological integrity. This requires analysis to determine how best to partition small hydrological units in response to topography, soil units, and water management. Selective damming might then be undertaken, but with more careful attention to allowing periodic saline intrusion and sustaining productive adjacent fishwaters. Assistance in restoring damaged polders would be another useful technical intervention. Support in marketing, literacy and education, and broader participation in decision making are complementary steps advocated by Slabbers (1987).

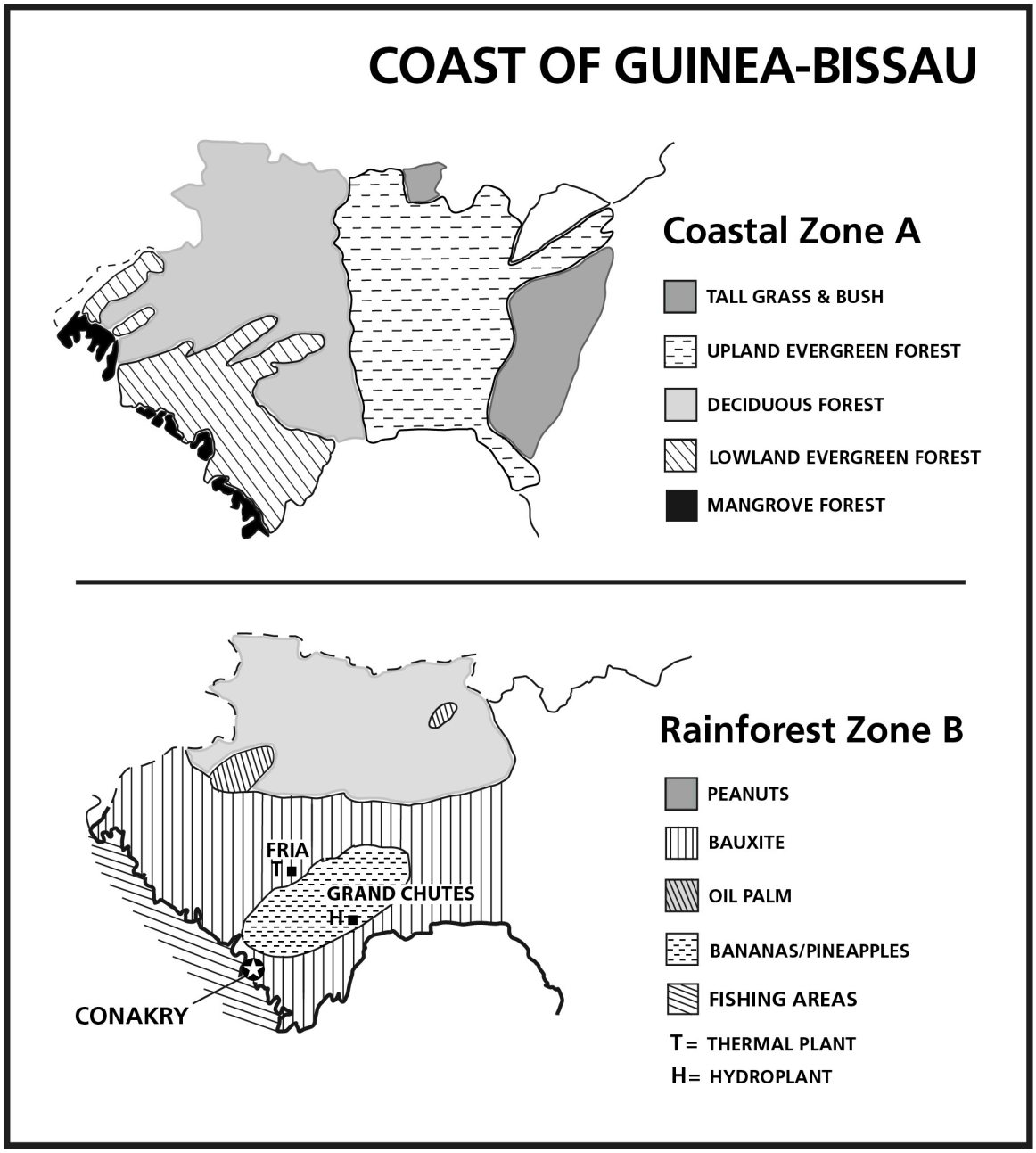

Figure 5. Coast of Guinea-Bissau, major ecological zones (A) and economic production locations (B).

Guinea

Character of the coast

The coastal zone of Guinea is part of the Rivieres du Sud region, which extends 1,000 km from The Gambia to Sierra Leone and extends from several to 100 km in width at its maximum (Cheneau-Loquay and Usselman 1987). The coast consists of low, partially submerged alluvial plains. Mangrove vegetation forms the dominant vegetation along the edge of the Guinean coast (Figure 6). Conakry, the capital, is the main urban center.

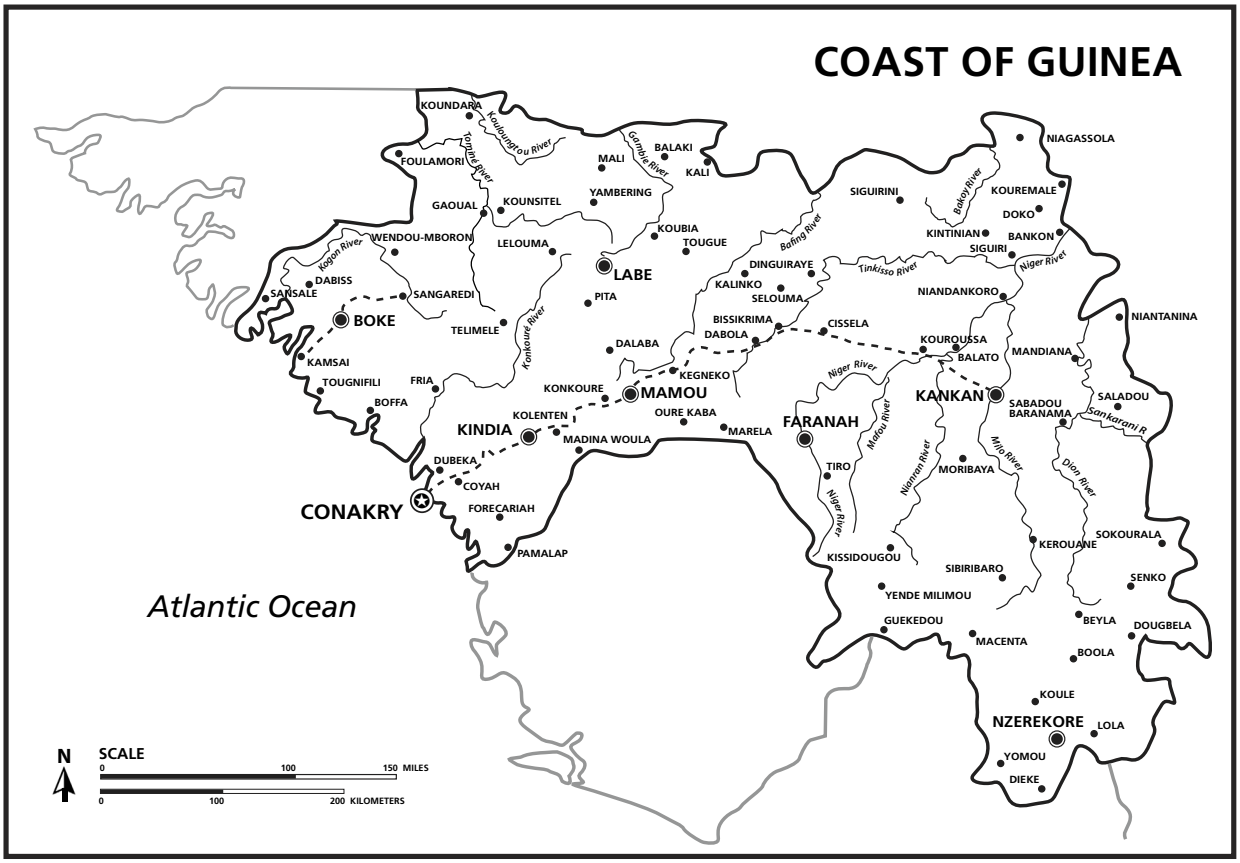

Figure 6. Coast of Guinea.

Coastal resource uses

Both commercial trawler and artisanal fishing are practiced along the Guinean coast, with boat and canoe fishing confined to the calmer waters around the shores, and trawlers venturing further out to sea. Production is estimated to be near 100,000 tons per year.

Historically, the Guinean coast has been populated by people who knew the value of polders for growing rice, the major food resource of this region. Other agricultural practices near the coast include both natural and cultivated palm products, and bananas and pineapples in the rainforest zone (Figure 6). Peanuts are grown in the inland savannah.

Industrial uses of the coast include an aluminum processing plant and chemical facilities. In addition to Conakry, there are two other small ports: Kassa, where ore is shipped, and Banty, which is a banana port.

Watersheds and water resources

Guinea's major river is the Corubal. There is a hydroelectric generating plant at Fria, but there are no navigation or irrigation facilities. The effect of the dam at Fria on coastal resources is not recorded.

Coastal resource issues

The major coastal issues in Guinea revolve around the possible repair and expansion of traditional hydrologic control works to increase rice production, and the related impacts on the coastal lowlands. Many of the earlier hydrologic projects were created purposefully to increase rice production. After independence, the dikes were abandoned. The United Nations, and then China, reconditioned two large dikes while others degraded rapidly and were abandoned. Few of the dikes function properly. There is a widespread hope among Guineans that these dikes will be repaired, yet such action faces serious physical, political and economic constraints.

Lack of a coherent agricultural policy is a major uncertainty that impacts the coast. Some analysts (Cheneau-Loguay and Usselmann 1987) have questioned whether it makes sense to augment local rice in the context of cheap imports. Community members still use traditional, fairly inefficient methods. Although the new regime has set food self-sufficiency as a major priority, Guinea continues to import rice in an amount equal to 20% of its annual production with most of it destined for consumption in Conakry.

As much as 150,000 ha have agronomic characteristics favorable to rice culture, of which 50,000 to 75,000 are considered manageable at acceptable costs (Cheneau-Loquay and Usselmann 1987). Currently, the actual production area is 35,000 to 40,000 ha. These areas are cultivated by local people using simple methods which yield a harvest barely above subsistence levels.

Many obstacles confront a serious effort to augment domestic rice production in the coastal lowlands. An elaborate system of canals, dikes, drains and barriers would have to be constructed, and must withstand saline intrusion and coastal erosion. Supplies of agricultural seeds, fertilizers, and special herbicides would have to be provided. Additionally, exceptional coordination among farmers of adjacent plots would be required. Moreover, the need to keep prices low to serve the needs of urban consumers works against repairing damaged dikes. Near the capital, cash crops, and salt extraction have been favored over subsistence-level rice production.

Sierra Leone

Character of the coast

The Sierra Leone coast is characterized by mountainous cliffs (in the Freetown Peninsula) and low cliffs and spits. Mangrove forests occur in sheltered areas around the mouths of rivers, such as the Scarcies and Rokel River estuaries, and the Shenge Peninsula (Figure 7). Major urban settlements include Freetown, Bonthe in the center of the nation, and Sulima in the south. Other communities include Hastings and Shenge.

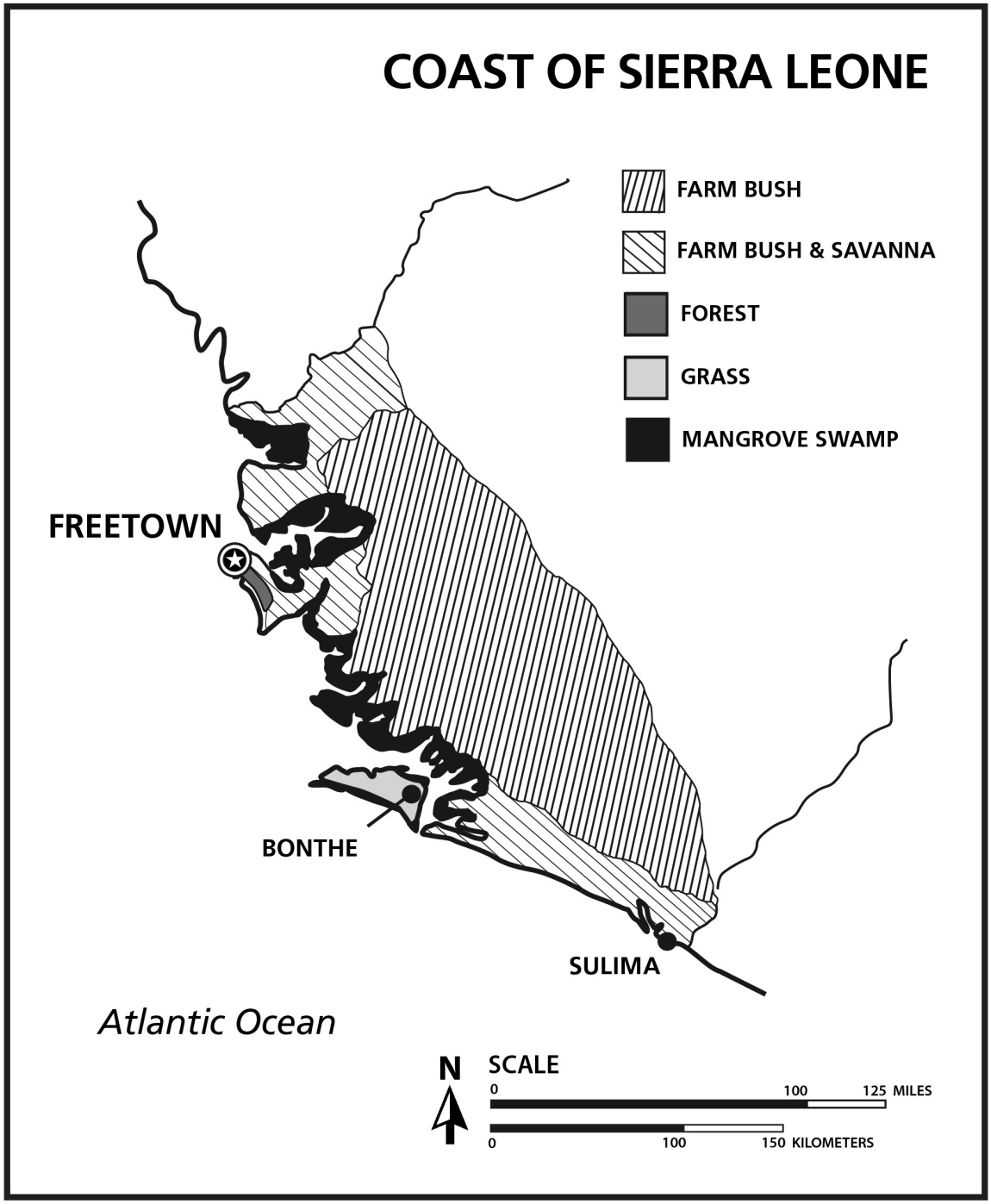

Figure 7. Coast of Sierra Leone, major ecological zones.

Coastal resource uses

Both trawler and boat fishing are practiced, with settlements concentrated at the Freetown Peninsula, the Shenge area, and the Sherbro estuary. The largest catch is by Soviet trawlers offshore, average 70,000 tons annually. Still Sierra Leone ranks third in the region in per capita fish consumption. Two coastal lagoons, Lake Mape and Lake Mabesi, are the subject of aquaculture trials (UNESCO 1981).

A total of 30,000 ac of former mangrove-forest area have been placed in rice production, including portions of the estuaries of the Scarcies River and Sierra Leone River. Most of the tropical rainforest on the Freetown peninsula has been logged or cleared for urban development. Mangroves are also in heavy demand for fuel and for conversion to agricultural food production.

Ports include Freetown international port, the ore port at Pepel Island, and regional ports at Bonthe and Sublima.

Watersheds and water resources

Ten of rivers in Sierra Leone drain into the Atlantic; among the most important rivers are the Sierra Leone, the Kolente, and the Hoa.

Coastal resources issues

The effective management of mangrove forests is complicated by uncertain ownership, divided jurisdictions, and lack of information. The Forestry Department would like to spearhead integrated management of mangroves, but mangroves outside established forest zones do not fall under the Forestry Department's jurisdiction.

Erosion is a common problem. Sewage and waste disposal are problems in the urban centers, such as Freetown. Oil pollution results from tank and bilge pumping by passing tankers. To help address issues related to mangrove forest utilization, the Sierra Leone government sought assistance from USAID. A Malaysian forester completed an assessment, and helped to launch a pilot replanting program which was accepted by the local villagers.

Liberia

Character of the coast

Liberia has a coastline of about 560 km where wave action has formed long stretches of spectacular beaches and lagoons. Coastal savannas and mangrove forests are extensive (Figure 8). Tropical high forest is limited to inland areas because of exploitation in the coastal area. Rainfall is around 2,000 mm (80 in) per year.

There are a few urban centers on the coast (e.g., Harper, Greenville, Buchanan), and the capital, Monrovia, which holds about one-third of the population in Liberia. Features of recreational importance are the spectacular beaches, sand dunes, spits, sand bars and cliffs.

Coastal resource uses

Fishing is a major occupation in Liberia. All along the 560 km stretch of the Liberian Coast are fishing villages of artisanal fishermen. Hook-and-line-fishing from two-person canoes is the traditional form of fishing. The species most commonly caught are mackerel, barracuda, snapper, grouper and cavalla. Recently, the fishing sector has started to utilize outboard motors and drag nets. Beach-seine fishing is still a principal practice in the estuaries. Offshore trawler fishing with sophisticated equipment account for higher catches than the traditional sector, about 15,000 tons per year. This practice is forcing the artisanal fishermen to modernize their equipment to remain economically competitive. Fish farming is becoming important in the coastal communities.

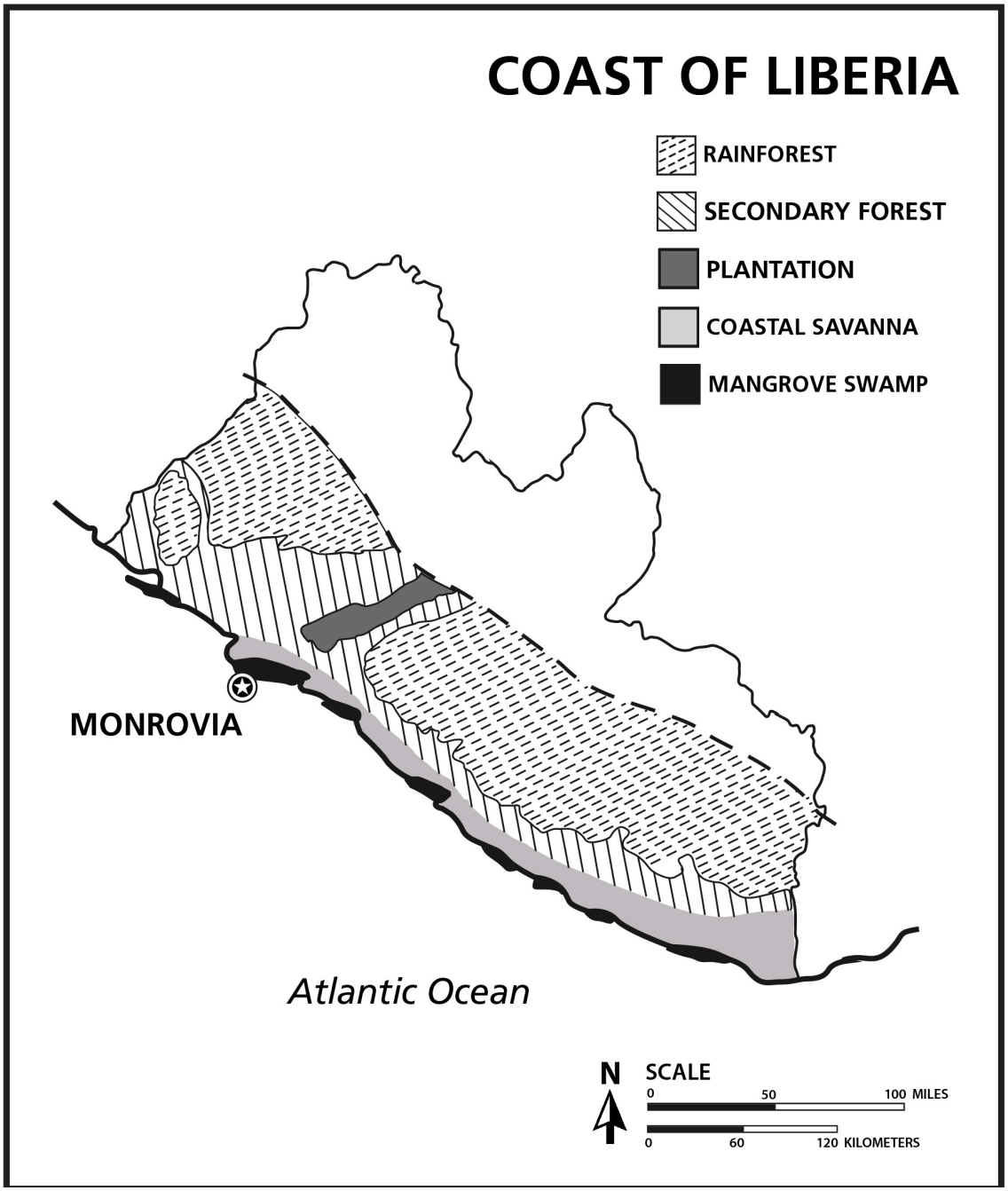

Figure 8. Coast of Liberia, major ecological zones.

Agriculture is a major coastal land use. The major food crops are cassava, yams, and sweet potatoes. Cash crops for export include coffee, cocoa, and there are large government-operated rubber and forest plantations. Logging, a major activity in the rainforest, is managed on a sustained yield basis by large timber corporations. Mangrove logging is not documented. Coastal industries include ore mining and processing, rubber manufacturing, chemical industries, cement works, food processing, and oil refining.

Watersheds and water resources: Liberian rivers include the Mano, Loffa, St. Paul, St. John, Cestos, Senghuene, and Cavalla. Liberia has hydroelectric facilities on the Farmington River at Habel (4,200 kw) and on the Saint Paul River 40 km from Monrovia (potential capacity of 100,000 kw). Irrigation is very limited. The rivers (e.g., Saint Paul) are navigable for only a few kilometers inland.

Parks and protected areas

Liberia presently has no coastal or marine parks, but there is a proposal pending for the Cape Mount Reserve at the western end of the coast. The reserve would comprise 10,000 ac of which 3,000 ac are in mangrove forest and would provide protection for fisheries, most migratory waterbirds, and the various habitats of this ecosystem.

Coastal resources issues

Erosion is a threatening problem on the coast and it appears that sewage and waste disposal problems exist in and around parts of Monrovia. Liberia has neither onshore nor offshore oil production, but it is confronted with oil spill problems in the form of oil/tar balls on beaches and oily wastes from refinery operations. There are effluent discharges from chemical industries that affect coastal environments. Waste materials generated by iron and mining companies, and dumped as overburdens on mountain slopes, also find their way into streams and rivers during the heavy tropical rains; from here they are transported up along the coastline. This, coupled with the high sediment load of the rivers, contributes to the low coastal water quality. It appears that the mangrove forests are being destroyed by clearing and draining for rice cultivation.

There is no organized coastal management program, but with coordination among the various government agencies, it is believed that an integrated coastal management plan could be achieved. A nationwide habitat protection scheme is presently evolving.

Ivory Coast

Character of the coast

The Ivory Coast littoral zone consists of two major sections. The area from the frontier with Ghana to Fresco in the center of the country is characterized by a series of lagoons separated from the ocean by barrier beaches, these lagoons range in length to over 100 km and each has a connection with the ocean. The other section of the Ivory Coast, from Fresco to Bieron, is characterized by more irregular relief. Smaller lagoons occur in this area. Moreover, they have only intermittent connections to the ocean due to the processes of sedimentation and littoral drift. Coastal vegetation is dominated by mangroves which play an essential role in contributing to ecological productivity and buffering the coast from erosion.

Although the coastal zone of the Ivory Coast comprises just one percent of the country's land area, its supports 20% of the population of 2.2 million (1985 data), most of whom live in the region of the capital, Abidjan (Figure 9). Other major settlements include Grand Bassam and Dabou. Population is unequally distributed around Bandama river. Two towns, Cissandra and San Pedro, concentrate population in the west. To the east, villages occur along riverine corridors and lagoons, and there are eight towns with populations over 10,000.

Coastal resource use

The Ivory Coast's complex network of lagoons is exploited by both trawler and artisanal fishermen. Among the West African nations, the Ivory Coast ranks sixth in per capita fish consumption.

In 1982, decline in average size of most harvested species led to restrictions on fishing in the lagoons. The government has prepared a plan for rational management of lagoons and there is development of a commercial fishery for crab. Another innovation is the installation of *acadjas*, which are underwater thickets of dead trees built to aggregate crustaceans and fish that then can be harvested at will.

Lagoonal fishing is more important in the east, where the coastal zone supports about 100 species of estuarine fish. Catches in these eastern lagoons range from 12,000 to 15,000 tons per year, or about 10-15% of total production of seafood, and 6% of the national consumption of fish. This industry

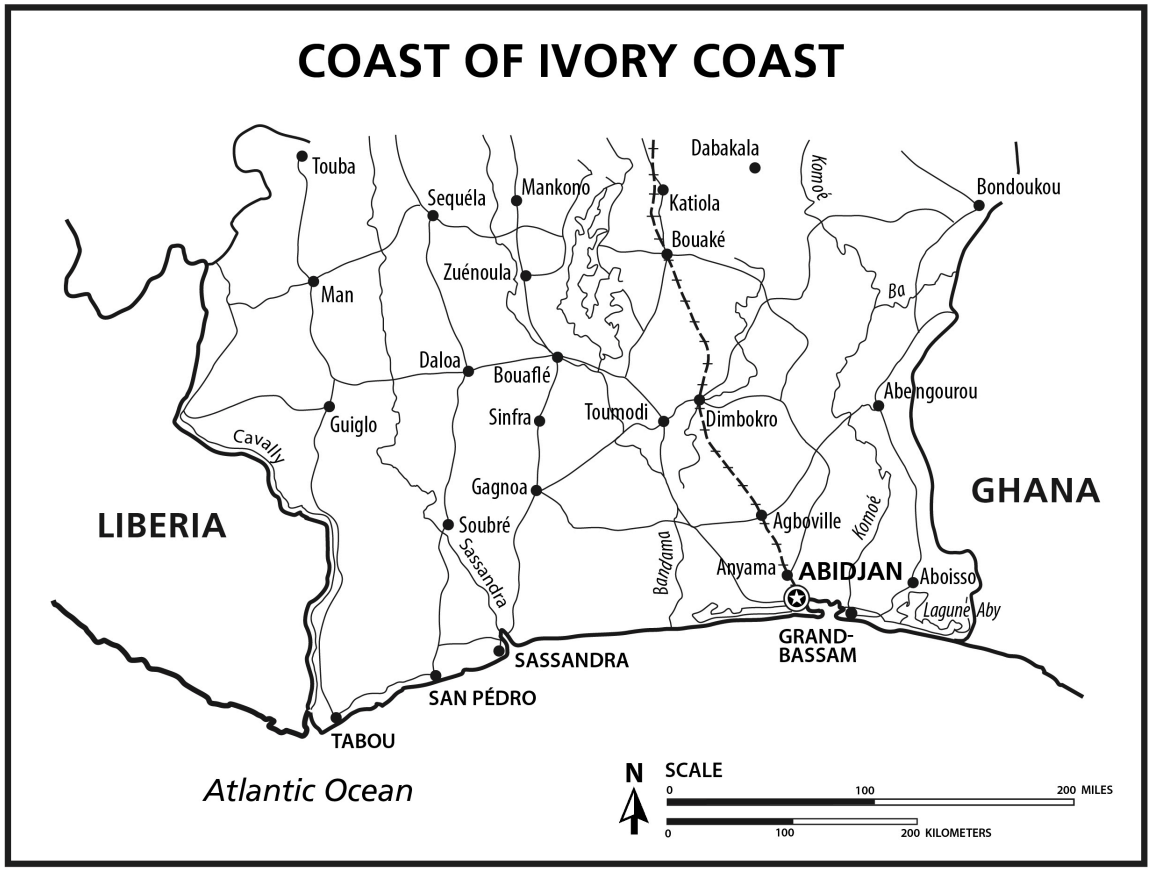

Figure 9. Coast of the Ivory Coast, major rivers, estuaries, and other features.

supports about 12,000 people, half in fishing and the other half engaged in the smoking of fish. The principal agricultural crops in the coastal zone are bananas and pineapples which are grown in the Comoe River basin west of Abidjan.

Watersheds and water resources

Two of the largest rivers in the West African region meet the sea in the Ivory Coast, the Bandama with a drainage basin of over 100,000 km^2. The Sassandra has a drainage basin of over 80,000 km^2 and an average discharge of 360 cusecs. Two other important rivers are the Davo and the Comoe.

Parks and protected areas

Six percent of the area of the Ivory Coast is dedicated to national parks. The motivation for creating parks include the protection of migratory species and special vegetation, and preventing severe erosion.

Parc National d'Azgny, located 100 km from Abidjan, includes a 19,000 ha littoral zone. For many years, the marshy character of the area made it inaccessible. After World War II, Azgny was made a hunting territory for the privileged residents of Abidjan. Creation of a partial reserve was initiated in 1960 by the Forestry Department, and official designation of the area as a national park followed in 1973. The area includes 30 vegetation types, and supports numerous species of birds, mammals, and reptiles. A survey of national parks undertaken in 1981 concluded that Azyny deserved top priority for its international tourism potential, prompting the creation of extensive tourism facilities.

Parc National Du Banco was established in 1953. It is located on the North Bank of the Ebri Lagoon around the mouth of the Banco River about 10 km west of Abidjan. It has 30,000 ha rising from sea

level to 110 m in elevation. The park is managed for both wildlife and ecosystem diversity. Currently, management of parks and protected areas is hampered by inadequate funds. For example, extensive tourism facilities were built at Azgny (including staff offices and overnight lodging for 100 visitors) yet the program is failing because there are insufficient personnel to staff these facilities. Also, for proper management, more agents are needed to prevent poaching.

Coastal resources issues

The most pressing coastal issues in the Ivory Coast are related to the degradation of lagoons and loss of mangrove-dominated habitats. In the west, planters and land clearers pose threats to the functions of natural systems, while in the east, some fishermen have damaged fisheries by using poison or cutting mangroves.

Particularly within 60 km of Abidjan, pressure on natural areas is especially intense; i.e. wood cutting for fuel to smoke lagoon-caught fish. Cutting is not selective, and damage caused by cutting is particularly acute in mangrove forests. Near Abidjan, many areas are almost completely cultivated. Up to 60% of the area to the east is under cultivation for the production of rice, corn, manioc and other crops. Some wetlands (such as Tanoe and La May located just 20 km from Abidjan) remain intact as a result of difficult conditions of access rather than because of any organized, formal protection.

The lagoons at Ebrie and Aby have become degraded as a result of the combination of overfishing and destruction of mangrove forest.

Decisions related to human settlement and food self-sufficiency are the biggest potential sources of ecological problems, and the consequent clearing of mangroves worsens erosion. Other coastal problems include poaching and overexploitation of forest resources. Solutions might include pisciculture and aquaculture, regeneration of mangroves and silviculture. It would also be useful to undertake studies of areas that are still pristine, as a source of baseline data.

Ghana

Character of the coast

The extreme eastern and western portions of Ghana's coast are sandy, while the middle portion consists of beach terraces and rocky shore. Mangroves are not an important vegetation type on Ghana's coast. There are coastal swamps made up of herbaceous vegetation and patches of broadleaf evergreen forest. Major urban centers include Accra (the capital), Tema (the industrial city), Cape Coast, Takoradi, and Sekondi.

Coastal resource uses

Ghana's coast supports sea fishing, lagoon fishing, and river fishing. Although fisheries in Ghana's coastal lagoons are mainly at a subsistence level, Ghana ranks second in per capita consumption of fish and third in tonnage landed among West African nations. Total catch from marine and estuarine waters is 200,000 tons annually. Fishermen use cast nets, long lines, and traps. Most of the fish caught in lagoons is sold fresh. Tilapia, grey mullet, and blue crab are among the species taken. Based on an effort of 70 man hours per day over a square kilometer of lagoon area, Yaa (1987) calculated an annual catch of 140 kg/ha/yr.

Recent studies show that lagoon fishermen can earn up to 1000-1500 cidis ($10) for a half-day of work, or ten times the government minimum wage (Yaa 1987). Another occupation is collection of shell from the lagoon for building materials, from which workers can earn 1000 to 1125 cidis per day.

Traditional fish culture has been practiced in some coastal lagoons. The practice of *achidja* involves dumping twigs and branches with attached foliage into shallow lagoons and demarcating the area with sticks. Usually an area in the range of 150 to 300 m^2 is used. Fish are attracted to these areas to feed on

the decomposing vegetation and attached algae. Then, after three or four months, the fish are harvested (Manu 1987). Although some analysts have suggested that the aquaculture potential of coastal lagoons could be expanded (Denyoh 1979), no organized initiatives have been launched in response.

Agricultural uses include both subsistence farming and plantation agriculture of rubber and fast-growing exotics.

Salt winning and mining are practiced at Keta, Ada, Accra, Winneba, and Cape Coast/Elmina. Both artisanal uses and operations by companies such as Panbrose Limited are expected to expand in response to growing demand for salt in Ghana and for export markets in West Africa such as Mali and Burkina Faso. In addition, use of sea salt for production of caustic soda is expected to expand (Manu 1987).

Watershed and water resources

Six major rivers meet the coast in Ghana (Figure 10). The Volta is among west Africa's three largest river systems with a drainage basin of 398,370 km^2 and an average discharge of 700 cusecs. It drains Lake Volta, one of the largest man-made lakes, occupying 8,500 km^2 and extending for 400 km. A vast dam and hydroelectric facility at Akosombo generates power for Ghana and for export.

The Pra (drainage basin of 23,000 km^2) meets the Gulf sea at Shama, while the Ankobra discharges its waters directly into the sea at Shama. The Tano (drainage over 16,000 km^2 and average discharge of 146 cusecs) feeds Aby Lagoon at Half Assini. The Densu flows into Sakumo lagoon No.1, lying 11 km west of Accra, and the Kakwa feeds Nakwa lagoon situated between Winneba and Cape Coast.

Parks and protected areas

Following a 1974 survey by the Department of Game and Wildlife, two sites were recommended for designation as national parks: Cape Three Points near Axim and Songaw Lagoon near Ada. Subsequent studies of the avifauna led to the signing of a cooperative agreement between the Ghana Government, the Royal Society for the Preservation of Birds, and the International Council for Bird Preservation to create the Save the Seabird Project (Yaa 1987). The aim of the project, as discussed below, is to promote compatible multiple use of the designated areas (Figure 11).

Coastal resources issues

Water diversion has adversely affected traditional oyster fisheries in Keta lagoon. Reduced inflow into Keta lagoon caused hypersaline conditions beyond what oysters can tolerate.

Efforts are underway to achieve compatible multiple use of Densu Delta lagoon (also known as Sakumo) for fishing, salt production, water works, and shorebird protection. A consortium composed of the government of Ghana, the University of Accra, the International Council for Bird Preservation, and the Royal Society for the Preservation of Birds, is at work on a management plan. Some 1,500 people live and work at the lagoon, which also supports major salt production and nationally important populations of 15 species of waders, herons, and terns. The key will be to create a water management regime that meets the requirements of all users.

A parallel effort is being mounted for Sakumo lagoon, 25 km east of Accra. There, fishing depends solely on lagoon waters, which also supports some 100 species of birds, including 23 types of shorebirds. Modest tourism facilities are planned for the northeast, which could pose threats from solid waste dumping and pollution. Moreover, there is some evidence that fishing disturbs shorebird roosting. At Sakumo lagoon, a workable plan must pay close attention to the avoidance of disturbances and organizing adjacent uses in a compatible fashion.

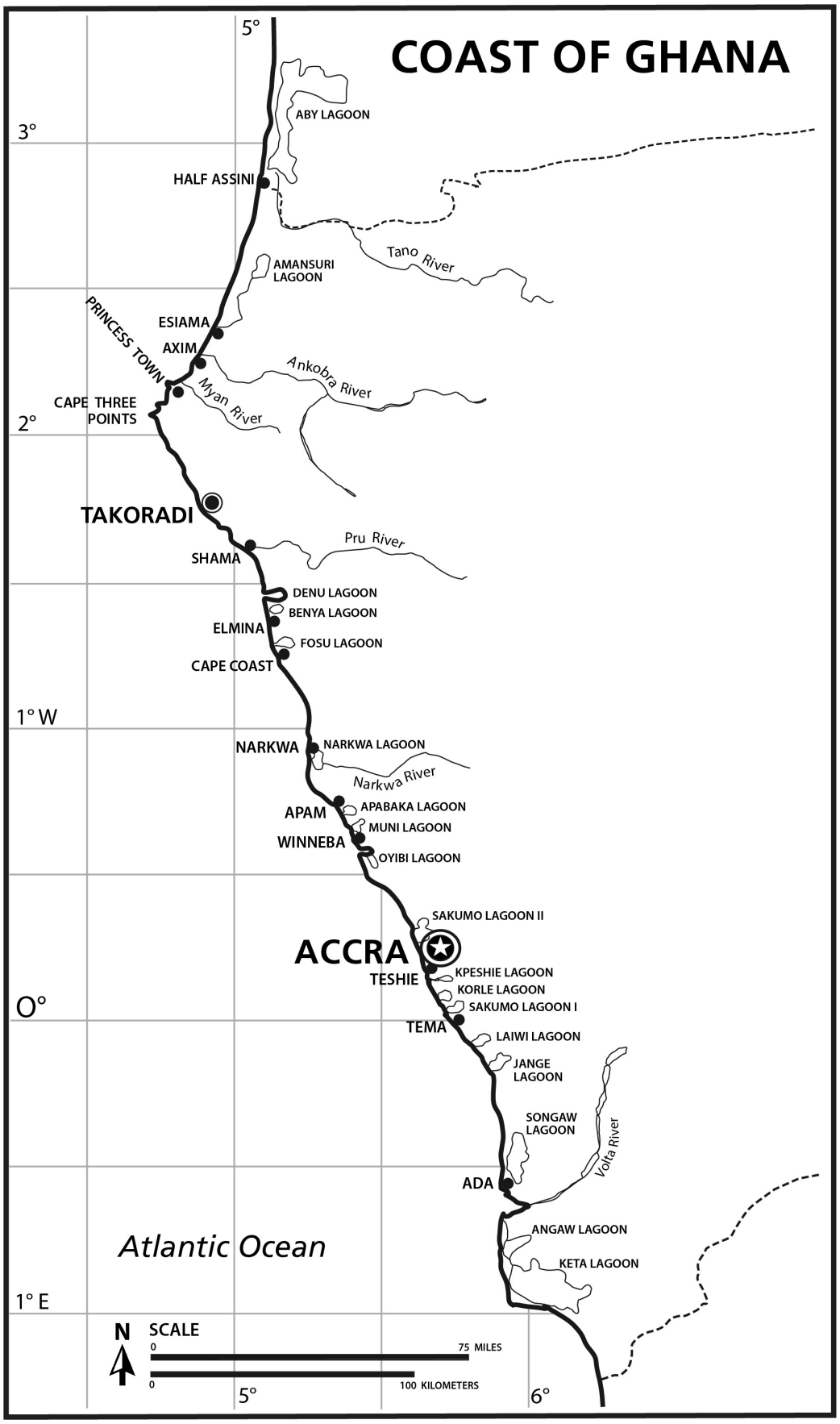

Figure 10. Coast of Ghana, major rivers and lagoons.

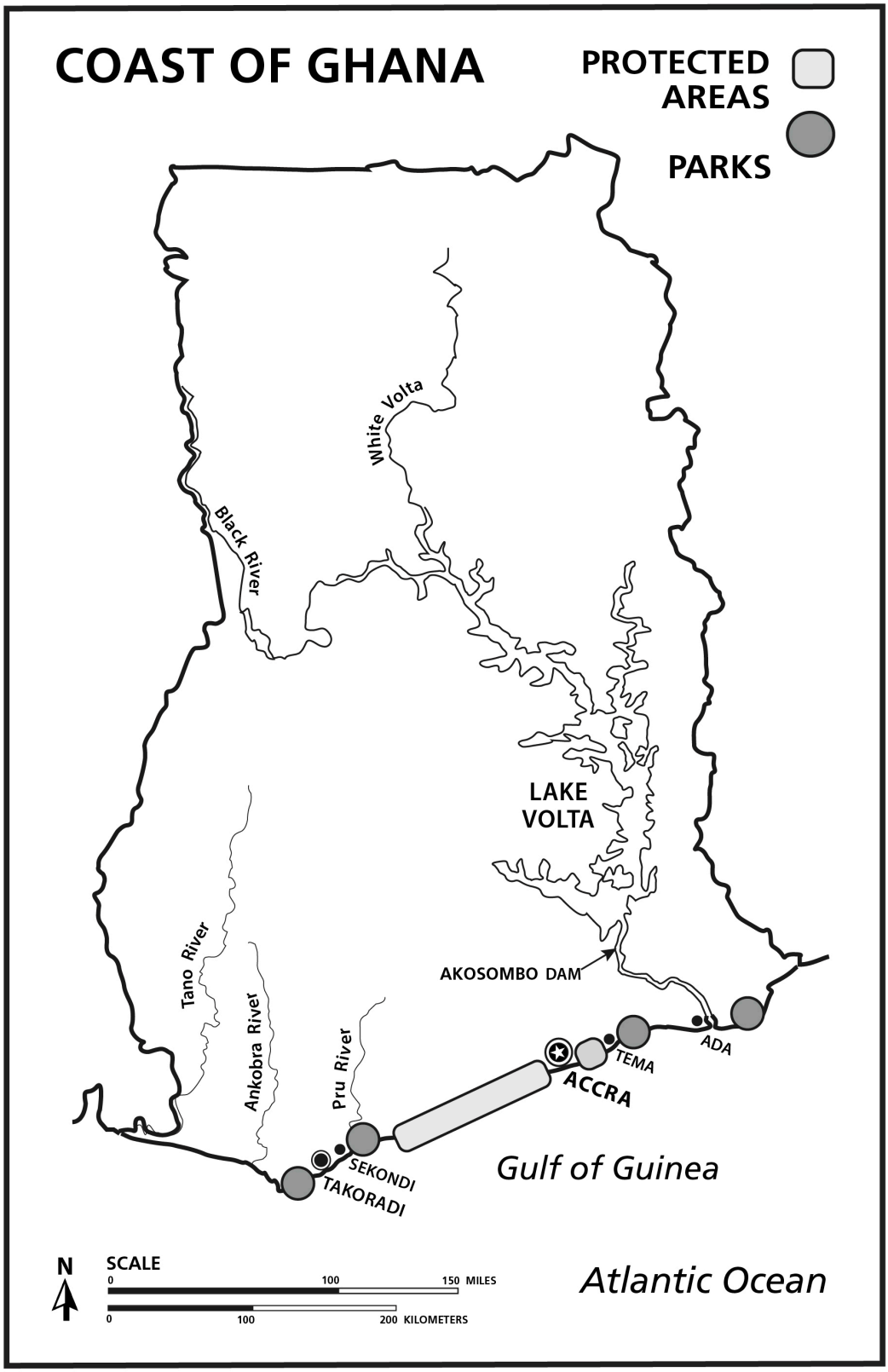

Figure 11. Coast of Ghana, proposed parks and protected areas.

A variety of coastal pollutants have been identified (Abrokwa-Ampadu 1986). These include untreated or partly treated sewage from the urban settlements of Accra, Cape Coast/Elmina and Terna; sediments from the Volta, Pra, and Tano Rivers: and heavy metals from the Ankobra River (Figure 12). Tank washing residues result in oil and tar balls that accumulate on Ghana's beaches. Coastal erosion is also a serious problem in Ghana and a task force has been set up to review the status of beaches and possible remedies for erosion control.

Ghana is among the first nations in West Africa to explicitly recognize the need for greater intergovernmental coordination to manage its coast. Ten ministries or subministries have jurisdiction relevant to coastal management. In his national report presented at the coastal workshop, C. K. Manu (1987:4) observed:

> *The research and management activities of the various organizations dealing with coastal wetland resources in Ghana do not seem to be sufficiently coordinated. The organizations have different priorities ... Some organizations are making individual and seemingly competitive efforts through their respective ministries to achieve their targets in development projects, but whether these attempts are compatible and complementary for sound environmental management is an entirely different question.*

Currently, mechanisms for local involvement in coastal decision making are not well-established. As most land is in private ownership, it appears that compensation must be paid if the government wishes to halt uses which degrade the coastal environment. However, funds for this purpose are in short supply. Cooperation from local dwellers is essential if coastal land uses are to be adjusted to sustain and protect natural systems; Manu (1987:6) further observed:

> *Attempts to translate some good plans from paper into action have failed in Ghana because affected local dwellers have not accepted projects wholeheartedly ... Highly punitive laws are often ineffective when they tend to preclude or restrict excessively the use of natural resources. While public education and research activities are in progress, management and development plans for coastal wetlands should aim at multiple, judicious and sustainable utilizations.*

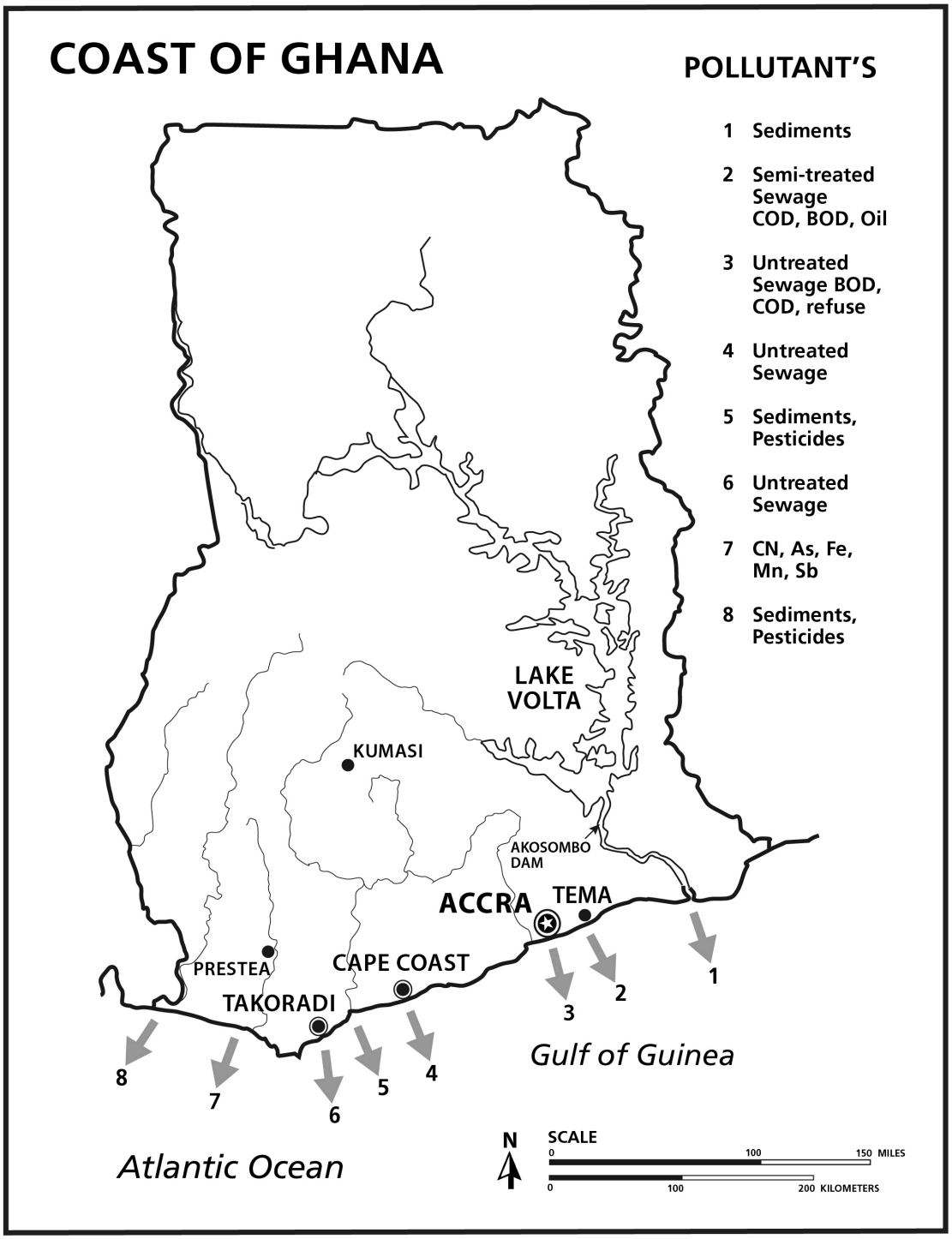

Figure 12. Coast of Ghana, potential pollutant inputs.

Togo

Character of the coast

The coastline of Togo is under strong influence of littoral currents and surf. Sandy materials that form the beach on the coast are supplied by the Volta River in Ghana; the beach materials are transported eastward by the surf which breaks obliquely to the coast. There are barrier islands and several parallel beach ridges on the coast, and in between the barrier islands and coastal plateau, lagoons and marshes are present.

Mangrove forests are not abundant on the coast of Togo. Inland, patches of forest exist but the majority of them have been removed for cocoa and coffee plantations. There is little or no documentation on the state and condition the forests, especially those of mangrove.

The coastal area receives a low amount of rainfall. Coastal waters in lagoons and river estuaries are muddy with a substantial increase in salinity when ocean tides are high. River discharge and hence sediment load is high in the rainy season.

Coastal resource uses

Fishing is conducted along the coast by artisanal fishermen mainly for domestic consumption. Ocean fishing by large trawlers was limited until a special fishing wharf was constructed in the new port of Lomè which may increase landing capacity and facilitate boat handling. Trawler fishing is by licensed foreign vessels and the fish catch is mainly for export. Fish export is a notable foreign exchange earner in Togo, although total annual production is only about 10,000 tons.

The coast is fertile to the south and is intensively and systematically farmed. It produces large food crops and rich commercial crops consisting of oil palm, cocoa, coffee, and cotton. The logging of the forests is a minor activity and aquaculture is not documented. Coastal industries focus mainly on food processing but there are also textile and consumer industries. Shipping is active along the coast. Tourism is not well developed, in spite of the good beaches.

Watershed and water resources

There is a dam at Adjaralla on the Mono River, a thermal plant at Lomè with a capacity of 3,600 kw, and a hydraulic station at Palime with a capacity of 1,600 kw. The effects of these facilities are unknown. Four dams have been proposed on the Mono River along the Benin border to provide irrigation water for 16,000 ha in Togo and 26,000 ha in Benin.

Coastal resources issues

Sewage and industrial waste disposal may be a problem in Lomè, the capital and only significant urban center on the coast. Discharges from the iron, chromium and phosphate plants and mines find their way into the coastal environments and waters. Togo has no oil resources, but has oil spill problems with oil/tar balls on beaches resulting from tank washing residue or similar discharges from passing tankers.

Erosion is a major problem for the beaches along the coast. Shoreline erosion in Togo (and Benin) was so acute in 1979 that the United Nations Environmental Program was asked to initiate a study of the problem. The major source of the problem was found to be construction of a deep-water ports at Lomè, Togo, in 1966 (and one in Cotonou, Benin in 1963). The jetties of the port interrupted the longshore transport of sand, one of the strongest in the world (greater than 1,000,000 m^3/yr). Transport is from west to east almost every day of the year due to the influence of waves arriving at an oblique angle to the shore. No sand-bypass systems had been installed at either harbor entrance, so erosion had become a serious problem downdrift of both harbors. The jetties at Lomè provided a classic case study of man's impact on beaches. The shoreline updrift (west) of the jetties was building out in excess of 50 m/yr,

whereas downdrift, the beaches were receding at rates up to 8 m/yr. Local outcrops of beachrock slowed the erosion rate on the downdrift side. In the erosion zone, many fishing villages were abandoned and a major tourist hotel was threatened. The major solutions considered were sand transfer (bypass) systems, set backs, small groins, and beach sand replacement (Figure 13).

Figure 13. Coast of Togo.

Benin

Character of the coast

Benin has broad coastal lagoons and relatively flat terrain. The coastal plain is dominated by sand and alluvial sediments carried by the rivers, and is dotted with lakes and edged to the south by a lagoonal shoreline and barrier islands. The coastal lagoons are about one mile wide except where they are proximate to a river. Behind the coastal lagoons, are extensive wetlands which have been exploited for salt production resulting in numerous ponds of water and extensive cutting of the mangrove for firewood. The mangrove vegetation has become scarce and replaced by a bare marshy zone. There are a few urban centers on the coast. Chief among them are Cotonou, the economic capital, with a population of about 120,000; Port Novo, the administrative capital, with a population of about 80,000; and Ouidah with a population of about 20,000 (Figure 14).

Coastal resource uses

Fishing from canoes and small power boats by artisanal fishermen is the major fishery. The network of lagoons, lakes and estuaries provides suitable fishery habitat as breeding and feeding grounds and is the principal locus of fisheries. Annual production from inland and coastal waters is about 25,000 tons. Trawler fishing is done by both foreign and local companies with the catch mostly for export. For both inland and coastal the total catch is near 25,000 tons per year, of which 5,000 may be from the coast.

Some cocoa is grown along the coast, but the most important cash crops are the Indian butter tree, tobacco, cotton, coffee, and oil palm, all intermixed with subsistence farming and grazing. Primary industries exist for the processing of agricultural produce, e.g., oil palm mills, Indian butter tree processing, peanut shelling, food processing industries, cotton ginning and assembly plants.

Watersheds and water resources

Benin has one major dam which is at Adjaralla on the Mono River. There appears to be little systematic irrigation for agriculture.

Coastal resources issues

The coastal forest has been mostly removed for settlement and agriculture. Mangrove vegetation is no longer common in the coastal wetlands because of salt production which uses mangrove as the major fuel wood for the evaporation of sea water to produce concentrate or rocksalt.

Sewage and waste disposal appear to be a problem around the coastal cities (e.g., Cotonou and Port Novo) because of the high population and industrial concentration. Salt extraction from the coastal wetland has degraded the flora and fauna of these ecosystems. The artisanal fishing sector has seen a rapid fall in production in recent years because of salination of the lagoons and from the construction of the port at Cotonou. Oil spills are also common as are oil residues from offshore tanker traffic which accumulate on the beaches. The effects of the one dam at Adjaralla on the Mono River (shared with Togo) are unknown. The sandy shoreline, which is subjected to strong littoral drift, has presented serious problems of erosion and stability for the outlets of the river (Mono) and lagoon (Cotonou channel) system (see also Togo section).

Figure 14. Coast of Benin.

Nigeria

Character of the coast

Nigeria has 800 km of coastline. The whole coastal zone consists of a low-lying depositional plain characterized by expansive estuarine lagoons and mangrove swamps fronted by beach-ridge barriers. The central portion of the coast is dominated by the large Niger Delta and its productive coastal lagoons, mud flats and mangrove swamps. Brackish water influence extends as far inland as Onitsha, about 20 km from the coast.

Mangrove forests are found all along the coastal areas of Nigeria in estuaries and lagoons; the dominant species is *Rhizophora racemosa*. On the drier outer margins, the mangrove trees can attain heights of about 50 m and girth of 2.7 m. Freshwater swamp forests occur extensively in the Niger Delta. Inland there is the moist lowland evergreen forest, a region of extensive timber harvesting (Figure 15).

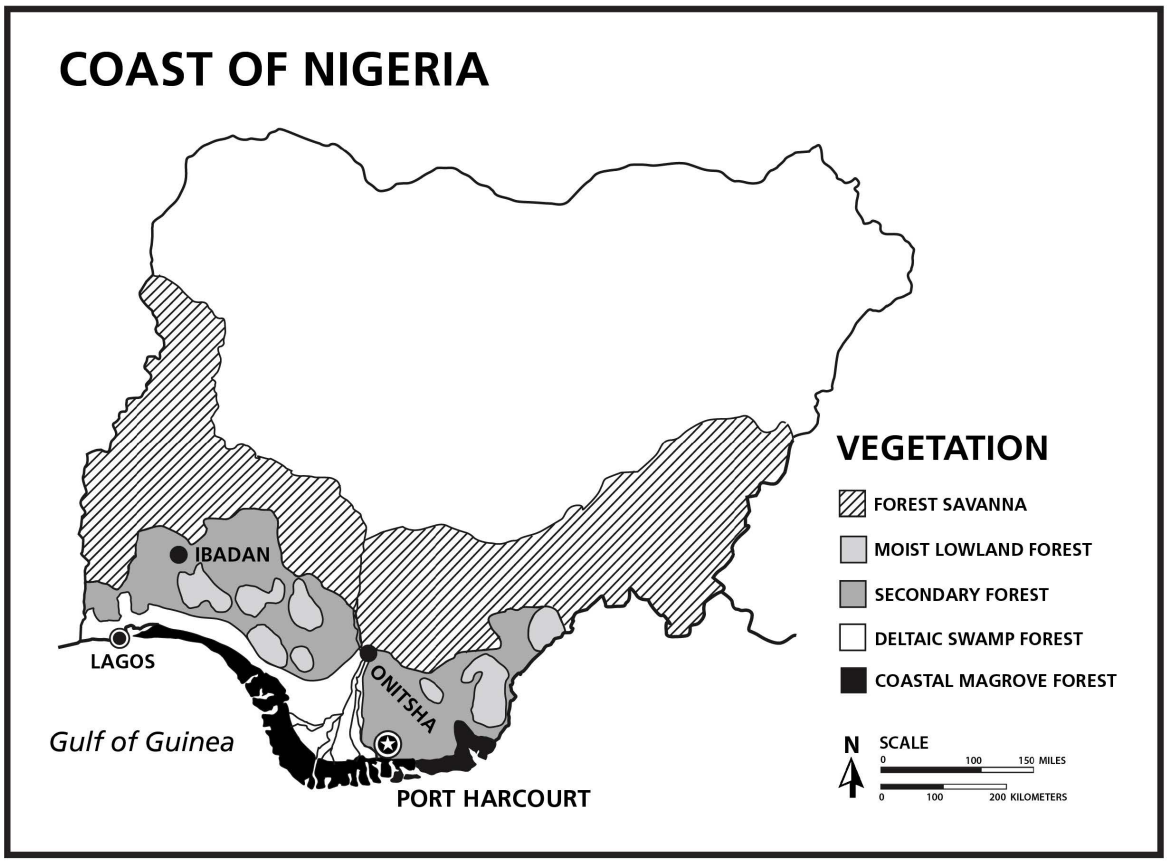

Figure 15. Coast of Nigeria, major ecological zones.

West of the delta, the coast has a well developed barrier beach-lagoon complex. East of the delta, the coastal landscape is typically that of beach ridges. Rainfall along the coast is abundant (about 3,500 mm) and temperatures range between 20° to 30° C. The coastal zone of Nigeria is heavily populated from Lagos to Calabar; rural settlements, hamlets and fishing camps lie between large modern cities, including Lagos (the federal capital) with 7,000,000 inhabitants.

Coastal resources uses

Fishing is a way of life for most coastal communities in Nigeria from Badagri in the west to Calabar in the east. Artisanal fishing is undertaken by canoe. Ocean fishing is conducted by foreign trawlers from

Russia, Japan, Poland, and other countries. Frozen fish is landed at Lagos, Port Harcourt, and Koko from where the fish is distributed, including some for export. Shrimp are especially abundant around the Cross River estuary and east of Calabar. Fish farming and aquaculture are new activities in the coastal region. Large fishponds have been constructed by the government and some private organizations for the purpose of producing fish for internal consumption. There are also family fishponds under traditional management.

Fish production has been hampered by shortages of nets, boats and the cancellation of industrial fishing licenses. The artisanal coastal fish catch fell from an estimated 370,000 tons in 1983 to only 160,000 tons in 1985. The industrial catch was 17,000 tons in 1985.

In coastal agriculture, both subsistence and cash crops are grown. Major subsistence crops are yams, cassava, rice, plantain and maize, while the cash crops include kola nuts, cocoa, rubber and oil palm which grow in large extensive plantations. Logging occurs throughout the mangrove and rain forests for export, canoe building, residential building materials, and domestic fuel wood supply. Wood-using industries include plywood and papermills which utilize both native and plantation-grown trees. Sawmills and large wood-using industries are increasing.

Industries are concentrated in the coastal region. The chief industries are food processing, beverages, tobacco, textiles, rubber, wood, and plastics. Consumer-oriented chemical groups produce toiletries and household detergents. Other types include meat packing, fruit canning, soap making, tanning of hides, sugar refining, and vegetable oil milling from ground nuts and palm oil fruits. All these industries are concentrated in port cities and main urban centers. Petroleum refining and chemical industries are also heavily concentrated on the coast with Lagos alone having about 2/3 of the chemical industries. Major seaports are Lagos, Sapele, Warri, Port Harcourt, and Calabar.

Watersheds and water resources

Nigeria has one major dam at Kainji that generates the country's power; nothing is known so far about the effects of changes in the river's hydroperiod caused by the dam (Figure 16). There is a proposal to construct a water storage dam at Jebba and Makurdi. The river Niger is navigable year round to Kainji Lake and the river Benue to Makurdi. Irrigation is practiced on rivers Ogun, Anambra, Kaduna, Sokoto and Gongola.

Parks and protected areas

Nigeria has not established coastal parks or protected areas to the present time but some of the states are trying to establish coastal mangrove preserves.

Coastal resource issues

Water quality along the Nigerian coast is generally poor. The high human concentration, especially in the coastal cities, generates a high level of domestic wastes that are disposed of in creeks and lagoons polluting the water and endangering aquatic life. This, coupled with a high concentration of industries (e.g., chemical industries, oil refining and breweries) send all their wastes untreated into coastal waters. Numerous rivers carry a high level of sediment from upland erosion which is deposited into coastal waters causing sedimentation and turbidity. Beach erosion problems are typical of the whole Nigerian coast. Mangrove cutting is also serious and is as yet uncontrolled; also Nipa palm invasion in previous mangrove areas has been noticed.

While sewage and waste disposal problems are paramount in Lagos (the capital) and the situation is the same with all other cities along the coast, the major environmental problem is oil pollution. Oil pollution problems include: contamination of beaches and structures around oil ports, oily wastes from refinery operations, oil spills from production facilities, and biological disturbance due to oil spills.

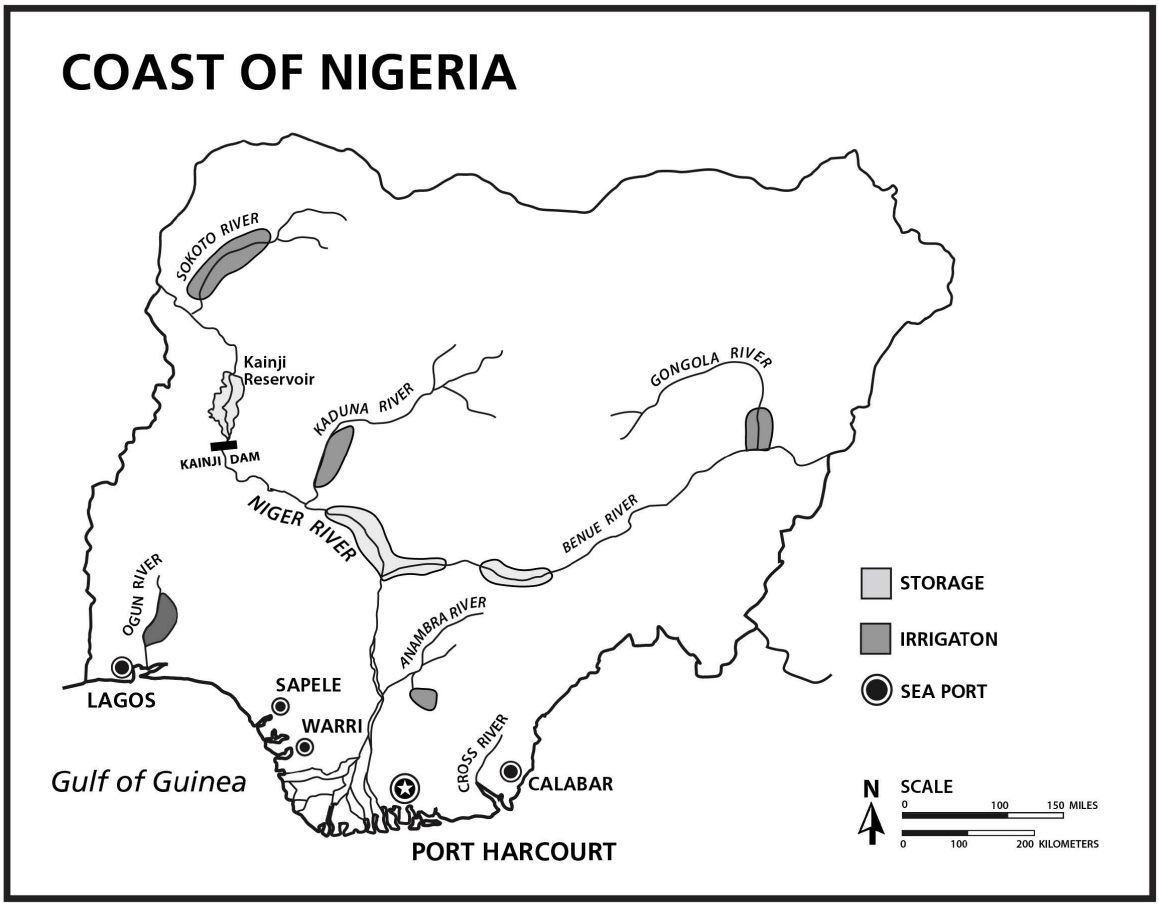

Figure 16. Coast of Nigeria, major water resource zones.

Major research programs are underway to aid in resolving coastal issues, including remote sensing of the whole coast and special mangrove surveys. While there is no central coastal agency, the concerned ministries (e.g., environment and agriculture) try to coordinate informally on important coastal matters.

Coastal Area Management and Planning Mechanisms

The best approach to coastal resource management is to use an integrated approach such as the Integrated Coastal Zone Management (ICZM) system. The reason is that any major management initiative in a coastal region involves the central government, local authorities, the military, fisherman and other resource users, local people, scientific and technical experts, business interests, and many other interests. Other complications factors are that an unusual number of government agencies interests are involved and the problems faced are often quite different from those in inland areas. The ICZM system is organized to resolve many of the problems by invoking policy formulation, coordination mechanisms, technical review of projects, and the application of scientific knowledge. ICZM provides a mechanism for searching out the best socioeconomic solution to each coastal development problem (Figure 15).

In this section are discussions of coastal management structure and institutional arrangements. The section also discusses several management tools available to West African nations, including environmental assessment, critical habitats, multiple use management and zoning, and shoreline setback zones, which take into account functional features of the coastal zone.

ICZM Program Structure

As it can be very flexibly structured, the ICZM system is adaptable to the specific circumstances of any country. Minimum requirements for an ICZM program include (Clark 1988):

1. Official declaration of policy and goals for conservation of coastal resources by the central government.
2. Designation of a coordinator or coordinating office in a "lead agency" to facilitate information exchange and cooperation among the various governmental agencies.
3. Articulation of a written set of conservation guidelines for critical habitat protection, coastal construction setbacks, pollution control, and efforts to mitigate environmental impacts

Institutional Arrangements

As recognized by participants in the coastal workshops, in each West African nation, several government ministries share responsibility for managing coastal resources, emphasizing the need for coordination among agencies and economic sectors. In most countries there are agencies for fisheries, wildlife, parks, pollution control, water resources, planning, oceanography, Navy, etc., but none with a singular mandate for coastal zone management. Therefore, some special entity has to be created to assume responsibility for coastal resources.

In solving this problem, West African nations have several choices to consider (Sorensen et al. 1984):

- create an interagency network to coordinate policy making, land use allocation, or development through an interministerial council or regional board;
- concentrate authority within a single existing unit of government;
- concentrate authority within a new unit of government;
- concentrate authority within a new or existing unit of government; and
- create an interagency council to advise the unit of government.

If a nation decides to create a new ICZM agency or to add this function to an existing ministry, additional choices are available. For example, responsibility for coastal management could reside in a

particular ministry, such as fisheries, or within a national economic planning entity, or within a newly created ministry. Alternately, coastal management could be the responsibility of regional subagencies or provincial authorities. Any of these options could be then be used in combination with an interagency advisory committee. The key to success in ICZM is to have a strong mechanism for inter-agency coordination and cooperation, however this may be accomplished.

Each of these arrangements has advantages and disadvantages. Szekely (1987) recently reviewed institutional arrangements for environmental policy in several Latin American countries. He identified nine features which might be used to evaluate or to design an institutional arrangement for environmental management: geographic coverage; type of functions to be performed (policy setting versus regulation); influence over natural economic resource allocation; capacity to coordinate with other sectors of the economy; influence of the agency over national planning; ability to resolve intersectoral disputes over land, water, and resource utilization; ability to work at the local level; and size of budget provided to the institution according to responsibilities to be performed. Each of these are useful considerations in designing an institutional arrangement to manage the coast.

Some West African nations have recently taken initial steps towards improved institutional arrangements for coastal management. For example, Ghana has called upon its ten ministries and subministries involved in managing aspects of the coast to function in a more cooperative fashion (Manu 1987). There is also a proposal to convene a national conference on coastal issues to consider the creation of a national committee to function as an ongoing coordinating mechanism (Yaa 1987). The Gambia created the Subcommittee on Coastal Erosion, which included members of the Department of Physical Planning, the Physical Planning Board, the Department of Technical Services, and the Environment Unit. The Subcommittee has met and produced a series of recommendations.

The boundaries set for the coastal area, or coastal zone, will have a strong bearing on the institutional arrangement for implementing ICZM because the distance that the boundary is set both seaward and landward will dictate the number of agencies involved and their levels of involvement (both boundaries are usually set parallel to the coast, defining a band of land and adjacent water). For example, if the inland boundary is set far back from the coast, agriculture, forestry, and urban agencies may become heavily involved. If set at the extreme (storm) high tide line fewer agencies would have direct interest. On the other hand, if the seaward boundary is set far offshore, the Navy, oil industry, and industrial fishery agencies may be much more involved than if it is set only short distance from shore. But the important factor in determining how broad or narrow the zone should be depends upon the answer to the question: What is to be accomplished by the ICZM Program?

Construction Setbacks and Mixed-Use Zones

A traditional approach to protection of the shoreline has been the use of a setback zone. Here the idea is to prevent development from encroaching into highly erodible areas or areas perceived to be ecologically sensitive. The Gambia's Subcommittee on Coastal Erosion has recommended completion of a study to establish set-back lines for sand mining and development purposes. In a review of ecological impacts of rice growing in Guinea, Cheneau-Loquay and Usselmann (1987) recommended protection of a "curtain of mangroves" of some 500-600 m to preserve their ecological functions. However, from the perspective of maintaining the regional pattern of biological diversity, this may not be the best approach if important types are left unprotected inland of the boundary. It is possible that certain habitat zones might be fully protected while others of similar or greater importance might be totally lost. For example, the value of mangroves for marine and estuarine populations is now being focused on dissolved organic matter (as opposed to the whole leaf or particulate form) which emanates from wetland areas that are inland from the coastal band (Camilieri and Ribi 1986, Alongi 1987, Lahmann et al. 1987).

Shoreline setback or exclusion zones refer to regulatory programs that specifically limit certain uses within a strip or bank in the coastal zone. Areas subject to shoreline setback or restriction are usually landward of the high water mark. In the past, there have been two types of shoreline setback zones: those that have fixed upland and offshore dimensions, and those defined on the basis of natural boundaries of shoreline habitats. The latter is preferable because it allows for the inclusion of all habitat types that constitute units of the coastal ecosystem. In addition, the inclusion of all critical habitats will provide for the maintenance of surface water flows and the materials they transport, that link critical habitats in the coastal zone.

Several countries have enacted shoreline setback and exclusion zones. Four major issues are addressed by these zones: avoidance of erosion hazards, protection of mangroves, preservation of public access, and view protection. In Indonesia, a mangrove setback zone of 100 or 500 m width (depending on which agency has jurisdiction) excludes uses that would consume or alter the mangroves. Sri Lanka and Barbados have both enacted shoreline exclusion zones to avoid extreme erosion. In Costa Rica, a 1977 law defined the first 50 m above mean high water as a protected Public Zone, devoted to public use and free transit. Planning guidelines created in the Bahamas in 1976 created setbacks to protect coastal views. However, as mentioned above arbitrary setbacks which slice through coastal wetlands, such as mangroves, may have deleterious consequences in terms of a reduction in the tidal export of dissolved organic matter and reduction of biological diversity.

In West Africa, a difficult challenge is to enable the continuation of traditional uses while protecting ecological functions of direct and indirect economic benefit. Standard parks and protected areas could in some cases be so restrictive as to provoke resentment from local people who are excluded from traditional fishing grounds or salt winning areas. The concept of multiple use areas or use zoning can be useful in this instance. This can be most simply accomplished by zoning the subject area for different uses in different parts of the area according to resource sensitivity or need to minimize conflicting uses in certain high-use parts. This has become a common practice in parks and nature reserves in many parts of the world and reflects the obvious benefit of designating zones for different uses according to their characteristics (rather than insisting on a uniform use pattern over the whole area). This is the basis of the UNESCO program of Biosphere Reserves in which "core zones" are strictly protected while other zones are available for a variety of economic uses and for settlements.

Ghana's Save the Seabird Project, carried out in cooperation with the Royal Society for the Protection of Birds and the International Waterbird Census, is built on the concept of creating scientifically sound management to enable multiple uses of productive coastal lagoons. The intent is to encourage the continuation of traditional local fisheries and other uses in a fashion that also enables wildlife to flourish (Yaa 1987). In other areas, the enactment of local bylaws has been suggested to prevent intrusive development while perpetuating local uses (Yaa 1987).

Critical Habitats

There are three approaches to the designation and protection of critical habitats. The first is to identify a class of habitats by physical or biological description, such as, all mangrove forests, sand dunes, seagrass beds, etc., and require that they be protected wherever they exist. The second is to map out the particular areas where these habitats are found in good condition and require particularly stringent rules for development in these critical areas. The third is to map out the most important complexes of critical coastal areas such as national reserves, parks, or wildlife refuges.

Decisions as to which of the coastal resources should be identified as critical habitats for birds, fishes, shellfishes, and others, should not be difficult because the resource values of various kinds of coastal habitats are rather well known to science. However, care should be taken to protect all representative

habitat units to preserve regional biological diversity (Wilson and Peter 1988). Mapping the critical habitats is a simple process for an experienced cartographer with access to the requisite data. The most difficult part of the job is obtaining reliable data in a systematic manner for long stretches of coastline. Here, aerial photography or satellite imagery (available for most coastal areas upon request from the United States, France and other countries) can simplify the project. Technical assistance and training in survey and mapping techniques is available from the foreign assistance agencies of many countries. For much of West Africa, the most experienced organization is the Institut de la Carte Internationale de la Vegetation, University Paul Sabatier, Toulouse, France.

Coastal resources survey and mapping is underway or is being planned in some West Africa countries. For example, at the November 1987 workshop in Mbour, Nigeria indicated that a top coastal management priority for this nation will be to undertake a survey of coastal wetlands and other important coastal features. This survey will document the current status of resources and threats to these resources in order to lay the foundation for a constructive management plan (Ogunyoye 1987).

Environmental Impact Assessment

A major conclusion of the November 1987 Coastal Zone Management workshop was that "there is a critical need . . . to review major new projects with the aim of controlling development in the coastal zone."

One management tool that is suited to meeting this goal is the environmental impact assessment, or EIA. Environmental impact assessment includes both a governmental procedure and an analytic method. As a process, EIA is usually imposed by government to require public agencies and in some cases, private interests, to examine potential environmental impacts, to coordinate aspects of planning, and to submit development proposals for review. As an analytic method, EIA involves describing the biological and physical character of the environment for the project and predicting the impacts of the project on various features of the environment.

A comprehensive EIA process also requires that alternatives to the proposed project be identified and comparatively assessed, and measures to avoid or reduce impacts be provided in detail.

The analytic phase of EIA must be combined with an administrative process to be effective. This usually requires that a document be prepared and a hearing held in order to describe environmental impacts and strategies to reduce them. A specific ministry or bureau must be designated as the focal point for the EIA process. Such lead agencies would then be responsible for coordinating the collection of information, preparation of an EIA document, communicating the findings, and ensuring that the project under review responds to the recommended measures to reduce impacts.

Three alternative standards for selection of a development project for review may be used to decide whether an EIA is needed: (1) for all projects in the coastal zone; (2) for any project that is likely to create a significant environmental impact; and (3) for any specific type of project, for example, major water diversion projects, major roadworks, and industrial and oil-related public facilities.

Developing nations with EIA requirements include Brazil, Thailand, the Philippines, Indonesia, and India. Sri Lanka requires an environmental impact statement for all major development (Amarsinghe and Wickremeratne 1983). In addition, many Caribbean nations are now contemplating creation of more formal EIA procedures.

There is little formal literature on the development and use of EIA in West Africa. However, it is clear that if EIA is to become a feature of coastal management, several obstacles must be overcome and gaps filled as illustrated in the following list (after Gamman and McCreary 1988):

- Enactment of clear enabling legislation
- Sufficient staff funding
- A lead or consistently responsible ministry
- Robust staff capacity
- Stepped up regional cooperation
- Broaden funding beyond dependency on donor agencies for support
- Intragovernmental coordination and genuine public participation

An EIA does not have to be complicated to be effective. For example, Gamman and McCreary (1988) present a simple EIA procedure which responds to the major obstacles listed above. Simplification is important to West African nations in pursuing their coastal management objectives.

Results of the Coastal Zone Management Workshop

In the two days of the workshops devoted to ICZM (November 11 and 12), participants engaged in lively, productive facilitated discussions in separate English and French sessions. The results are reported in this section; other findings are reported elsewhere in this document.

Conclusions and Recommendations

The following are the overarching policy-level conclusions generated at the workshops. More specific conclusions and recommendations (see Dugan 1988).

In each West African nation, several government ministries share responsibility for managing coastal resources. There remains a critical need to improve coordination among sectors and to investigate the creation of national committees or interagency councils to coordinate policy for the coast and to review major new projects with the aim of controlling development in the coastal zone, as is done in organized ICZM programs.

1. Effective local participation should be part of the decision process for coastal management. For instance, membership of interagency councils (proposed in 1, above) should include local representatives.

2. Each nation should create a special center to organize and promote the exchange of information on coastal resources, uses and conflicts. Where possible, the center should be integrated into the framework of national conservation strategies and serve as a networking agent.

3. A mechanism should be created for regional exchange of information on coastal zone management among West African nations; donor agencies should be asked for financial help.

4. Traditions of local use of the coast should be aided by central government acceptance of local bylaws that reinforce beneficial local traditions. Implementation of coastal policies should be based at the local level or have continuing influence on the process.

5. Multiple use zoning should be encouraged for perpetuation of traditional uses while sustaining important habitat values. Mechanisms that protect traditional uses while excluding noncompatible development should be pursued.

6. Demonstration projects should be developed for possible funding support to illustrate the principles of integrated ICZM programs in action.

7. Current resource uses and activities which are now exerting adverse impacts on coastal resources should be identified. Identify priority problems that deserve prompt attention, and develop policy which responds to significant continuing conflicts.

8. The important economic role of the coastal zone should be recognized in overall national economic development plans, including the need to properly manage the coastal zone both for local community interests and greater national interests.

Coastal Parks and Reserves

An extended discussion concerning coastal parks and other protected areas led delegates to the strong conclusion that for coastal areas, any new reserves or other type areas should include multiple use provisions. This corresponds to a worldwide trend to broaden the concept of parks and other protected areas to allow traditional uses to continue. The current concept is to zone the reserve area into subareas corresponding to different uses, from strict protection of core subareas to allowance in other subareas for traditional fishing, farming, and agroforestry, among others. In coastal areas it might be particularly important to encourage tourist resort facilities in specific places. Many successful waterbird preserves allow artisanal fishing with no apparent significant negative impact on feeding, nesting, or roosting; others permit controlled access to birdwatchers.

Sources of Support

At the time of the workshop, participants expressed the view that most West African nations do not possess nor choose to prioritize the financial resources to initiate simple ICZM programs, even if a compelling case can be made for their value, given the competing imperative to improve economic conditions.

Therefore, participants noted that the most promising strategy to achieve a more rational integrated approach for coastal resources in the near to medium term is through financial assistance from more developed nations and from international donor organizations.

1. Strengthening of AID and other donor agencies' intersectorial planing to include both the assessment of, and mitigation measures for, the maintenance of coastal and estuarine resources. This is particularly needed in coastal and agricultural development, and in sector resource management in the arid and semi-arid subregion.

2. Work with national and international political bodies to define and develop coastal resource conservation strategies for West African coastal areas beginning with the delta areas of the Senegal, The Gambia and, in East Africa, the Zambezi rivers.

3. Improve the inventory and data base for coastal resources of the African coastal areas start ing with those of the arid/semi-arid West African coastal countries, including Guinea-Bissau. These areas are of highest international significance and face the most immediate risk. It is important to their development, management and long-term productivity.

4. Strengthen institutional capabilities, policy and technical skills of coastal countries in coastal resource management particularly in semi-arid/arid subregions. This would include working with NGO/PVO groups for training programs and workshops.

5. Work towards the concept of sustained management and multiple use of mangrove forests to balance environmental and developmental needs. Their value is multi-faceted, their risk of loss is high.

6. Support applied research to fill in the general information gaps existing on coastal resource productivity and their susceptibility to development.

7. Strengthen coastal protected area management for areas of international significance (Ramsar sites, World Heritages sites, for example).

Linkage to Uplands

The subject of the linkage of the coastal zone to the uplands was discussed at considerable length. There was a strong recognition among participants that any effort to devise an integrated coastal program would have to address the issue of water discharge from rivers. The productivity of the true estuarine system is controlled by the amount of fresh water discharge; in many estuaries the "hydroperiod" as well as total amount of discharge has been or soon will be, greatly altered by dams. Also, the quality of water in the coastal lagoons and estuaries is seriously degraded by pollutants which enter upstream (from agriculture and other sources) and carried by rivers to the coast. Other effects include the reduction in delivery of sandy sediments to the coast to maintain the beaches and the blockage of access to migratory fish by dams built in the coastal lowlands. The solution to many of these problems is to ensure that each government has a special reviewer to consider the coastal effects of each new river development project.

Natural Hazards

Erosion problems appear to be the major natural hazards concern for many West African states. Most countries are experiencing some erosion of their shorelines, and some are suffering very serious effects, including Togo, Benin, Ghana, and The Gambia. The reasons are several: (1) the reduction of sand delivery to the coast by rivers; (2) the unwise construction of certain control structures such as groins and jetties (Hayes 1985); and (3) rising global sea level (Clark 1983). While this is not a biological problem, it is a resource problem (sand being the resource) and should be included in any ICZM program if erosion is a problem in the subject country.

A major corrective measure for beach erosion is to substitute "soft engineering" approaches for the typical armored beach, rock groin, or similar hard structure. The soft engineering approach works with nature's forces rather than working against them (Hayes 1985) to stabilize the beach. Also, the soft engineering approach is usually a lower cost option. Other measures include restriction of mining sand from the beach or removing sand dunes (Clark et al. 1980) and discouraging projects which will result in depriving the beach of sand. These problems can be addressed in an integrated coastal management program.

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Appendix

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