UNIVERSITY OF NAIROBI.

INTEGRATED COASTAL ZONE MANAGEMENT IN KENYA: A CASE STUDY OF THE NYALI-BAMBURI-SHANZU AREA.

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DECLARATION

This is my original work and has not been presented for award of a degree in any other University.

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DEDICATION

To my parents

for their inspiration and tireless support they have given me

throughout my academic life.

And

Mr. Maleche

who made it possible for the whole transition from

intellectual musing to thesis.

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ABSTRACT

The Nyali-Bamburi-Shanzu coastal area has some of the richest ecosystems characterized by extensive coral reefs, sandy beaches, and dense mangrove forests. Because of the economic benefits derived from them, the area teems with human population. Traditionally, the area's economy is dependent on fisheries, mangrove harvesting and agriculture. Today, these economic sectors have been overshadowed by the development of the tourism and visitor industry. Rapid growth of population spurred by tourism and other commercial and industrial activities has resulted in urbanization. While it is generally agreed that tourism development earns Kenya the much needed foreign exchange and creates employment opportunities, controversy centers on its impact on the environment. Despite the intensity of debate, there have been very few attempts to rigorously manage the unplanned development at the coast.

Integrated coastal management was studied to delineate the relevant land use patterns and attendant infrastructure, analyze key issues and institutional constraints with a view to advancing some recommendations to the stakeholders as to the way forward to balance economic development with environmental concerns. The study found that zone is subject to increasing population and economic pressure manifested by various activities, notably fishing, mariculture, waste disposal, residential development, tourism and industrialization. However, unisectoral overuse of some of resources has caused grave problems. This together with the lack of appropriate and well-coordinated control over the use of natural resources and pollution, has resulted in declined environmental quality, resource use conflicts, natural resource depletion and coastal erosion-related damages.

The well-intended efforts to develop and diversify economies has inadvertently resulted in declined environmental quality. Special concerns include loss of habitats, deterioration of coral reef ecosystems, and declined nearshore water quality due to point and non-point sources pollution. This has concomitantly led to increasing conflicts amongst different stakeholders. A major cause of the problems is the open access nature of many resources. Compounding this problem, jurisdiction over various parts of the coast and ocean areas generally falls under different levels of government. The overlapping

jurisdictions and gaps in sectoral responsibility and effort of government agencies with authority on the coast have resulted in vital resources being wasted through duplication as well as confusion and conflict. Given the current government policies, the government cannot address all development and environmental issues confronting the coastal zone.

A number of lessons emerge from the study. First, there is need for proper planning and coordination not only to manage and minimize the conflicts but also to take advantage of positive interaction between activities and maximize the overall benefits accruing from the coastal area. Second, there is need for reliable monitoring and evaluation to ensure timely flows of relevant management information. Third, is the need to undertake more research to quantify the relevant physical, social and economic components that go to compound the carrying capacity of the zone. Fourth, commensurate with increasing demand of shorefront land, regulations have to be developed and implemented as regards physical development and the technology used to tame the coastal erosion. Also required is strong public support to develop policies and plans, to implement these policies and plans, and to enforce regulations necessary to ensure compliance with these policies and plans. Finally, the management mechanism needs to fully consider alternative options such as cost-sharing, decentralization, etc., as well as an integral part of the management system. Such policy reform will offer the best opportunity to maximize the net flow of benefits from coastal resources to the investors, coastal community as well as the nation, while minimizing environmental costs.

Because of the multifaceted aspect of the coastal management issues and the multidisciplinary of the potential solutions, disciplinary and sectoral planning and management approach has failed. It has become clear that effective management must embody two essential mechanisms: integration and coordination; that is, the planning process must be multidisciplinary and integrate all relevant issues. However, exixting political and administrative realities make integrated management difficult, if not practically infeasible in some cases. Realistically, management actions will have to be carried by various sectoral agencies. Therefore, coordination of these sectorally oriented agencies is essential to maintain the overall integrity of coastal ecosystems.

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LIST OF ABBREVIATIONS

BOD	Biological Oxygen Demand
CBOs	Community Based Organizations
CBS	Central Bureau of Statistics
CDA	Coast Development Authority
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
FAO	Food and Agricultural Organization of the United Nations
GEMSAP	Group of Experts on the Scientific Aspects of Marine Environment
GoK	Government of Kenya
ICMP	Integrated Coastal Management Plan
ICZM	Integrated Coastal Zone Management
IPCC	Intergovernmental Panel on Climate Change
KAHC	Kenya Association of Hotel and Caterers
KMFRI	Kenya Marine and Fisheries Research Institute
KWS	Kenya Wildlife Service
MCM	Municipal Council of Mombasa
NBS	Nyali-Bamburi-Shanzu area
NGO	Non-governmental Organizations
NOSCS	National Oil Spill Contingency System
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Programme

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

The coastal zone of Kenya, comprising the waterfront land and offshore islands, extends over a distance of 630 Km (UNEP, 1998). The coastline has varied habitats, which, include deep waters comparatively close inshore, coral reefs, mangrove swamps, seagrass beds, sandy beaches, rocky shores, estuarine mudflats, and lowland coastal forests (UNEP, 1996). Underlying these resources and uses, which are of direct human interest, are the inherent ecological values which rank any stretch of Kenya coast among the most productive and valuable of natural ecosystems (McClanaham, 1993). In addition to their natural protective and defensive functions against coastal erosion and flooding, these natural systems provide valuable services in terms of recreation, coastal tourism and maritime transport and support a diversity of marine life.

Beyond these values, and perhaps more important, 17% of the country's population live in the coastal area or not far inland (World Bank, 1995). While large areas are almost unpopulated, such as in Lamu, certain areas such as Mombasa, Kilifi and Malindi are indeed densely populated with several hundred persons per square kilometer. The lives and reasonable aspirations for economic advancement of these coastal residents is inextricably linked to the productivity of the coastal resources. Equally important, the coastal area is the gateway for the greater part of Kenyan imports and exports, is often the focus for industrial development and, increasingly, it is being promoted as a tourist zone and potentially, the key to further prosperity if petroleum deposits are discovered offshore as expected (UNEP, 1998). These multiple demands on coastal resources require the best management strategies to ensure sustainability.

Until recently, the Kenya coast retained its predominantly trade-oriented focus. But in the last three decades, there has been a distinct shift to the service-oriented activities focused on tourism (Sincliar. 1990). Much of the tourism growth has concentrated in three major zones - Diani in the south, Mombasa in the middle, and Malindi in the north. The economic opportunities presented by this, act as magnets for a large number of people who migrate to the coast to work in the tourist industry and its allied service sectors. This transformation has in turn led to economic growth, a rapid increase in population and the establishment of other industrial activities (Mwanje, 1993). Clearly, the tendency forever greater number of people to migrate to the coast, and the associated industrial and tourism development place heavy demands on coastal habitats and ecological resources often result in natural resource depletion, environmental degradation and conflicts over use of these valuable but vulnerable resources (Ngoile and Horril, 1993).

More than the coastal areas of Kenya, those in Nyali-Bamburi-Shanzu (NBS) area, located north of Mombasa Island, illustrates in microscom the depletion and degradation of natural resources resulting from the explosive building brought by the tourist boom. The coastline along this zone has many hotels and shopping areas, reflecting substantial investments by developers. This largely unmanaged growth of tourism industry has eroded the shoreline's natural beauty. The main problems include the decline in near-shore water quality, coastal erosion, and the rapidly increasing decline in habitat and natural resources. These problems being encountered have resulted from the unsustainable use and unrestricted development of the coastal area and resources. Unless policymakers take more affirmative action to protect this coastal environment, the reality will be that great environmental and economic potential become degraded and could pose significant risks to public health.

Simply stated the NBS coastal zone has grown economically but at a cost of major losses in environmental quality. Because the zone has never before faced rapid growth, it lacks sufficient land-use control, regulatory, and enforcement capability. The rapid economic growth has degraded the natural resources at an increasing rate. New economic activities have created urbanization and changed the way people use resources. More economic activities have resulted not only in increased income, but in intensified use conflicts and pressure on the resources. In addition, growth has exceeded earlier expectations, so that roads, sewers and other infrastructure are now inadequate to meet the present demands. Furthermore, planning for future infrastructure needs are not keeping pace with population and tourism growth. There are no mechanisms effective in controlling the development process. The overlapping jurisdictions and gaps in sectoral responsibility and effort of government agencies with authority on the coast have resulted in vital resources being wasted through duplication as well as confusion and conflict, and environmental degradation.

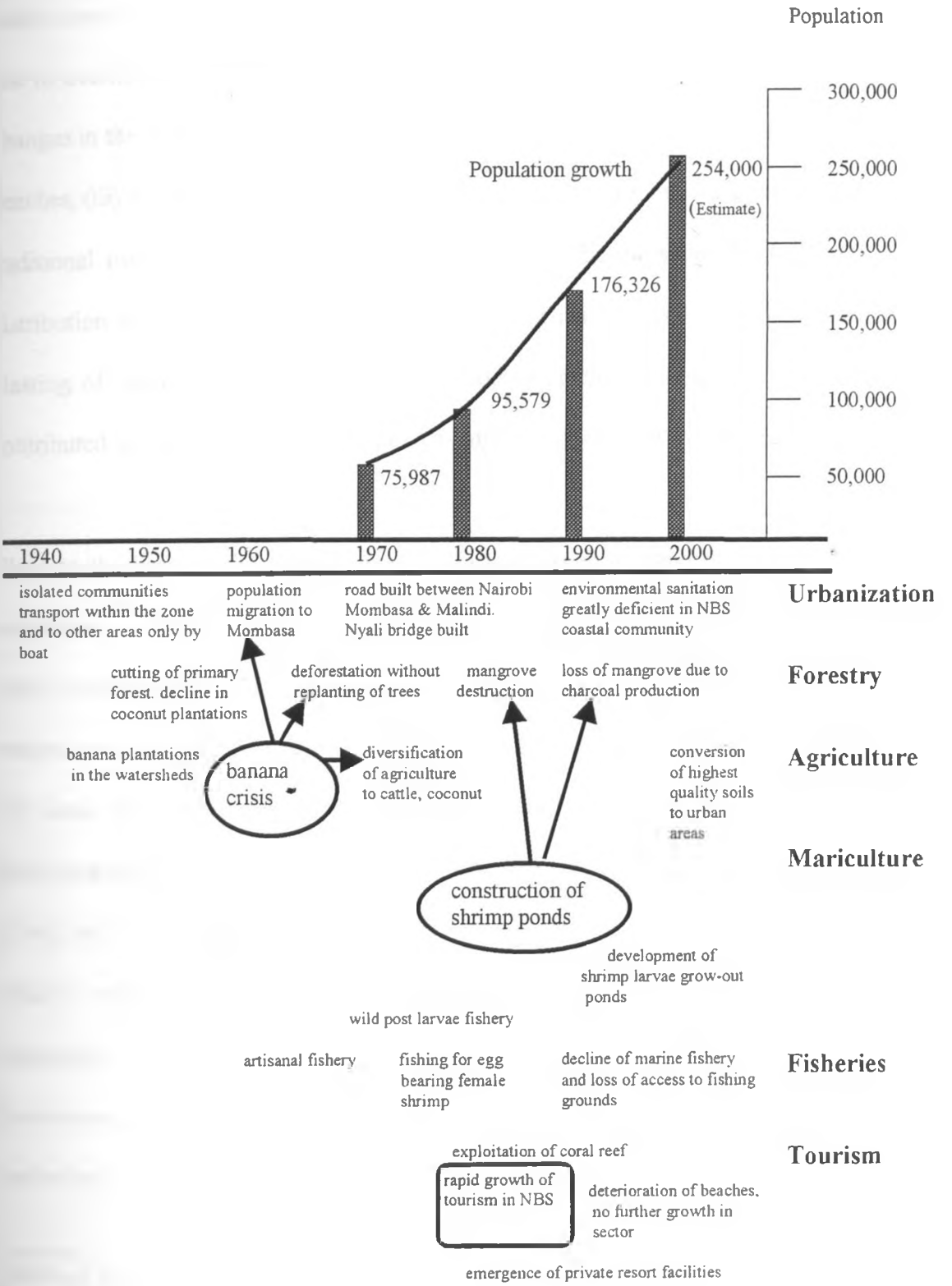
The dilemma that faces the coast today is that while a significant number of people are depending more and more on the ocean for their livelihood and well-being, the natural habitats and ecosystems which sustain these resources are being destroyed or stressed through pollution, various developments and other impacts. The purpose of this study is to clearly analyze key coastal issues affecting the area and to outline basic management strategies that can be employed to stem the pressures from rapid population growth, industrialization, and the growth of tourism industry, which are now threatening the capacity of the zone to provide its enormous and varied benefits. This will help create a balance between the many conflicting demands being made on the coastal environment, ensuring that its limits to tolerance and its capacity for sustainability are not exceeded.

1.2 Statement of the Problem

The Nyali-Bamburi-Shanzu area has changed dramatically since the 1940s, when the region was isolated and the economy was based primarily on subsistence agriculture and fishing and conflicts between these uses were few and far between (Bryceson, et al, 1990). Figure 1.1 illustrates the pattern of accumulation of resource uses followed by problems in the zone. Primary forests were cut in the 1950s and 1960s. The subsequent development of banana plantations created a temporary spurt of prosperity that was cut short during the banana crisis of the 1960s. The economic decline forced farmers attempted to diversify their activities into cattle, cotton, and coconut. Deforestation continued. The construction of Nyali Bridge in the 1980s opened the area north of Mombasa. Human population grew considerably during this period. New uses of coastal resources emerged, including tourism, mangrove cutting, shrimp mariculture, and intensive fisheries for post-larval shrimp. These activities are capable of affecting another and do so with regular frequency.

With the build-up of the modern time's infrastructure and concentration of economic and social investment in this zone, a development magnet was created. The zone has many tourist hotels, shopping and recreational areas, which have made it very popular. The tourist boom has brought great wealth to landowners and jobs to the working class. The economic opportunities presented by this, act as a magnet for large number of people who migrate to the zone to work in the tourism industry and its allied service sectors. Unfortunately, widespread poverty, together with population growth and inappropriate or poorly planned development, has resulted in environmental degradation and resource depletion of the coastal area. This has concomitantly led to increasing conflicts amongst different stakeholders.

Figure 1.1 Relationship between economic development and use of natural resources in the Nyali-Bamburi-Shanzu coastal zone



Source: Field survey, 1999.

The rapid development of the coastal area has given rise to competing demands for coastal space and resources. The result has been the progressive degradation of environmental resources which have left residents vulnerable to the following problems: (i) collapse of near-shore fisheries due to overfishing and destruction of habitat for species of commercial importance, (ii) negative changes in the public image of tourist beaches due to disposal of waste into the sea and littering of beaches, (iii) epidemics such as waterborne diseases, and (iv) limited access to the resources from traditional users who have been displaced by outside business people, furthering the uneven distribution of goods. Large scale harvesting of mangroves, over-exploitation of fisheries, blasting of corals, and inadequate economic development planning and management have all contributed to declining resource productivity and decline in environmental quality.

Close to the heart of the problem are two factors largely beyond the control of governmental authorities. One is the sharp increase of the country's population in the recent years. The other is the rush to Mombasa by thousands of people from rural areas. Third, jurisdiction over various parts of the coast and ocean areas generally falls to different levels of government. The local government control use of the shoreline down to the water edge, the provincial administration has jurisdiction over the terrestrial sea (typically extending 12 nautical miles from shore), while the national government has control over the Exclusive Economic Zone (EEZ). Equally important, public institutions have not acted effectively to confront the continual degradation of environmental quality or accelerated progress towards social and economic development to match the needs of the growing population. Moreover, there are several institutions[1] including government departments, regional development agencies, the municipal

[1] Some of the organizations that play an important role in the manegement of the coastal zone include CDA, KMFRI. KWS and the MCM. Appendix II provides a consice summary in their role in the management, development and protection of the coastal ecosystem.

council of Mombasa, and private interests involved in managing the coast. This fragmentation of responsibility within and between sectoral agencies, planning functions and government levels lead to a very confusing and conflicting governance arrangements (Cicin-Sain and Knecht, 1998) and waste of resources and environmental degradation. Moreover, these resource management institutions do not have the personnel, financial assistance or administrative means to organize an effective field presence. Without this continuos presence in the coastal area, these institutions cannot properly evaluate the use of resources or counteract illegal actions.

Compounding these problems, is a weak system of environmental regulation (see Appendix II) to offset environmental consequences of urbanization.[2] The pre-existing national policies and procedures applicable to coastal management have been very general and, in many cases, not very helpful in guiding the solution of specific coastal problems (OECD, 1993a, UNEP, 1998). The lack of coordinated policies and ineffective coastal management policies compound land-use conflicts among the various interested parties (OECD, 1993b) increasing levels of environmental degradation and loss. Less than stringent enforcement of existing laws and traditional resource usage rights has had negative implications for the management and conservation of fisheries and mangrove forests. These resources have come under the increasingly ineffectual legal jurisdiction of local or central government, which treat them as open access resources (Berry, 1989). Subsequently, the traditional user rights and licensing schemes which have historically controlled access to these resources have been put under severe strain by high population growth, urbanization, unemployment and in-migration trends in the zone (Ostorm, 1990).

[2] The statutes that impinge directly or indirectly on the coastal and marine environment, and its management include: The Water Act, Forestry Act, Agriculture Act, Fisheries Protection Act, Merchant Shipping Act, Wildlife Conservation and Management Act, Maritime Zones Act, Coast Development Authority Act, the Local Authority Act and the Physical Planning Act among others. Appendix III gives a summary of these acts.

Although the problems that coastal resource users face differ depending on which part of the ecosystem is important to them, there are at least three common elements that must be considered in the search for viable solutions: (i) most problems are tied to one another to a certain degree, consequently the solution to one requires actions that will affect the others; (ii) groups of users can learn better ways to handle planning and organizational problems; and (iii) resource users and communities can act jointly through the planning process to attract the political support, financial resources and technical assistance they need to reach environmental quality goals. This will offer the best opportunity to maximize the net flow of benefits from coastal resources to the individual and the nation, while minimizing environmental costs.

1.3 Research Questions

The development of the NBS coastal zone to date has mostly been haphazard, there being a misbalance between urban and tourism development, and the possibilities of natural systems to sustain it. While much research has been devoted to the study of tourism and its attendant marketing institutions, less has been done to explore on how best to manage the many development interests in the zone. We use a conceptual model to investigate the following:

1. What changes have taken place in the area regarding urbanization, human settlement, tourism development and resource use?
2. What major environmental and resource use problems need to be managed?
3. What institutional constraints hamper sustainable development in the coast?
4. Can land use planning, management and other development control measures as well as institutional changes ensure that coastal and marine resource are developed to provide desired products and services to meet human needs, while maintaining the resilience of coastal systems?

1.4 Objectives of the Study

There are a number of pressures on the NBS coastal zone that are now threatening the capacity of the zone to provide its enormous and varied benefits. Unless effective steps to manage this zone are taken soon, loss of considerable consequence will occur and inevitably, it is the poor who suffer most. The main objective of the study is to develop an integrated management plan that will ensure sustainable use, development and protection of coastal and marine resources. Specifically, the study aims to fulfill the following:

1. To describe the main changes and development trends taking place in the area and factors that brings this a bout.
2. To identify and analyze the main environmental and resource use issues of these developments and changes in respect of population growth, urbanization, tourism and other land use activities.
3. To identify the main institutional constraints which hamper the systematic and coordinated efforts towards sustainable development of the coastal zone.
4. To suggest land use planning, development control and management measures to achieve sustainable development planning and environmental conservation of the coastal zone.

1.5 Assumption of the Study

The main assumption is that increasing population and expansion of its associated economic activities, particularly tourism development, along the coastline is not planned. This has largely led to environmental degradation, natural resource depletion and resource use conflicts between competing land uses and resource users.

1.6 Justification of the Study

The Kenya coast has been the focus of much development. The main economic activities are tourism, industrial and fishing. Most of these activities, particularly fishing, tourism and recreation are dependent on the quality of land and near-shore waters. The resulting conflicts borne of competition between users is is both inevitable and often detrimental to sustainable development. Some of these human activities subject the coastal environment with increasing pressure on the resource use, conflicts and environmental degradation. Given that it is not possible to meet land and water demand by these various sectoral activities, a broader framework than is now provided is required to guide the allocation of development of the coastal resources. With increasing pressures upon scarce land and marine resources, the integration of compatible land-use activities and the segregation of non-compatible uses will help solve potential conflicts, safeguard the natural resources and increase their productivity.

The importance of the coastal zone in terms of social and economic values is widely recognized. The coastal and marine resources contribute substantially to the economy via fisheries, tourism, and other numerous non-consumptive uses. Of these, tourism has brought many benefits to Kenya. National gross receipts from tourism in 1999 amounted to Kshs 21 billion (GoK, 1999). Coastal tourism accounts for 60-70% of the tourism industry earnings for the country (Schoorl and Visser, 1993) and is now the second foreign exchange aerner after agriculture. Tourism in the NBS zone represents 24% of the total tourism earnings in the coastal region (Mwanje, 1993). The decline in tourism due to destruction of scenery, and the pollution of beaches and the sea is of major concern. Sustained economic development of the area will depend heavily on maintaining a high level of environmental quality (DeGeorges, 1990).

While the need to conserve the coastal area as an element of natural heritage and as an essential base for economic and social development has long been recognized, the quality of the environment and of natural resources continue to deteriorate. This situation is largely due to the absence of mechanisms allowing the complex relationships between human activities and the natural environment appropriately to be taken into account on the decision making process. Rising population pressure, migration and rapid urbanization have increased the need to address the area's environmental problems which are affecting the ability of the people to meet their own basic needs and seriously threatening the area's economic development (Kiflemariam, 1989a). Further is the need to reconcile the many uses and institutional conflicts, and to optimize economic development and public use of the coastal area whilst ensuring environmental protection. This will offer the best opportunity to maximize the net flow of benefits from coastal resources to the individuals as well as society, while minimizing environmental costs.

Despite the apparent resource-related problems and widespread concern for threats to sustainable utilization of coastal resources, the information necessary for proper resource management has remained exceedingly patchy and inadequate, and the competing human uses have remained unrelated and unplanned. In the task of improving environmental quality, agencies frequently have to concentrate on the individual firms causing it. This requires micro-data, which is lacking, and when available, is largely aggregate and of suspect quality. The poor database on the state of the environment therefore provided a further motivation for this study. It is envisaged that these data will meet the demands of the policymakers, planners, developers, and the general public for synthesised and harmonised development in the coastal zone. Better planning and more soundly based decisions will be an important step towards the use and sustainable development of the coast.

Findings of this study consequently are expected to be useful to the sectoral management agencies, but also to the CDA, an initiative whose main objective is to facilitate sustainable development in the Coast. The real beneficiaries of this research, however, will be the resource users who in the face of development must make hard decisions affecting the coastal environment and resources. Implementation of the findings is expected to result into better management of their source of livelihood --- the ocean. It would lead to reduction of conflicts, generate direct development benefits to the local community, and ensure protection of the marine ecosystems.

1.7 Scope and Limitations of the Study

Integrated coastal management involves not only the analysis of physical and environmental factors but requires that a larger set of issues and the potential adverse effects be factored into the decision-making process. Since this study is not an attempt to produce a land-use plan, it is thus limited to environmental examination in which case, socioeconomic factors are considered in general context. It largely addresses a small set of issues, namely protection and management of coastal and marine resources, water quality, improvement of public access, and promotion of tourism development. The other was a general lack of detailed data on coastal land and marine resources. Most resource inventory reports were too generalized, outdated and covered larger areas. This was, however, supplemented by fieldwork to provide a baseline information necessary for balanced development in the zone.

1.8 Structure of the Study

This study is divided into six chapters. Chapter one provides a brief background and problem statement, the objectives of the study and the methodology used. Chapter two briefly reviews the concept of coastal zone management. This includes an examination of

coastal and marine resources, development activities and their impacts, as well as the issues critical in coastal zone management. Chapter three provides a brief overview of the coastal environment and resource utilization as well as relevant socioeconomic information for the study area. It pays a special attention to the development trends that evidently affect sustainable development. Chapter four analyzes key issues affecting the zone given the current situation and the areas' future development path. Chapter five synthesis the study's findings and their implications and suggests various policy measures to mitigate and resolve the issues. Chapter six gives a summary of the major findings and provides a conclusion to the study.

1.9 Research Methodology

Many studies related to development-environment relationships have been criticized for concentrating on a single discipline, while issues being studied are often inherently interdisciplinary. Moreover, some of these problems are commonly analyzed with narrow discipline frameworks, which predetermine the nature of conclusions and their professionally biased proposals. The approach adopted for this study recognizes that it is not possible to establish the nature and basic causes of declined environmental quality and resource use conflict in the coast and generate integrative strategies within a monolithic framework. It uses a "multi-data approach". This has been called the triangulation approach for collecting and analyzing data (Anderson, 1990). Triangulation is a methodological approach calling for application of multiple data sources (through use of multiple indicators) all of which "home in" or triangulate on the central interest.

1.9.1 Data collection

Data was collected on land characteristics, resource use trends, and environmental issues through direct observation, interviews, and group discussion. First, substantial data was extracted from various reports of the government departments. Second, a structured questionnaire (see Appendix I) was used to collect information from the community members. Third, informal in-depth discussions were held with selected government officials and other experts to supplement the findings.

1.9.1.1 Secondary data collection

Secondary data was collected from both government and private sources. Government sources included publications of the Central Bureau of Statistics (CBS), reports of various Government departments (e.g., Agriculture, Forestry, Fisheries, Tourism, etc.), regional development agencies (KWS, CDA and KMFRI) and the municipal council of Mombasa (MCM). These sources provided details on historical and physiographic factors of the area, types of habitats, human statistics, economic activities, infrastructure, land use, and general environment. This information has been reduced into maps, figures and tables for analysis of the pattern of land use, environmental degradation and resource use conflicts in the zone.

1.9.1.2 Survey of government officials and other experts

Discussions were held with officials in various departments of the central government and the MCM, CDA, KWS, and KEMFRI. The selection of the agencies was based on their direct involvement with coastal issues. The focus of the discussion was the process involved in environmental degradation and resource use conflict and the assessment of the alternative management and policy responses.

1.9.1.3 Field data collection

Field survey was done between September and October, 1999. Two methods were employed in collecting field data. One was a household survey. The other was case scenarios and informal interviews with older members of the community in the study area. Unstructured interviews, Focused Group Discussions (FGD), direct observation and photography were used to gather qualitative information.

1.9.1.3.1 Household survey

Intensive fieldwork concentrated in three zones (Nyali, Bamburi and Shanzu) selected purposively with two important preconditions; (i) representativeness of zones of different management needs (e.g., tourism, residential, agriculture) and (ii) availability of local assistants to help in data collection. The latter was a logistic requirement (imposed on the nature of the study) to gain confidence and enhance participation of local people. The household survey questionnaire was translated into *Kiswahili* and a two-day seminar held to familiarize the research assistants with the intent and meaning of the questions. The sample frame consisted of 67,549 households including fishermen, tourism industry operators and other interested parties. The sample population consisted of 50 households from each of the three zones. Both stratified and random sampling approaches were used to collect primary data on the major ecological and socioeconomic causes of coastal environment degradation. Administration of the household questionnaire provided information on current land use and trends, land tenure, land use conflicts, and other issues. The collection of the household data was carried with the assistance of three research assistants one from each of the zones. The principal researcher in most cases attended during the interview sessions.

1.9.1.3.2 Anecdotal information

Oral histories were conducted with three older people. They were selected on the basis of their age, experience and advice from the KEMFRI, CDA and KWS, as well as from the local people. The purpose was to collect a narrative explanation of the historical evolution of the study area focusing on the relationship between tourism and local communities. These interviews were taped with the respondent's permission.

1.9.2 Data treatment, processing and analysis

During the fieldwork, qualitative and quantitative data were collected. Salient points from recorded interviews are presented as quotes. Qualitative responses were coded and entered into QUATTRO-PRO (a computer spreadsheet package) and then transferred to SPSS (a statistical package). To prepare data for further analysis, percentage variables were *arc sine* transformed to compensate for non-normality near the extremes (0 and 100%). For questions on management issues, relative frequency are presented based upon the number experiencing the specific problem rather than upon the number of people surveyed. As regards all other questions, relative frequencies are based on the total number of people surveyed.

1.9.2.1 Data analysis

One way frequency (univariate) distributions and descriptive statistics for the responses were generated. Responses were first stratified into three zones and later into one pool. Other techniques include resource inventories, profiles and mapping. The latter were useful when spatial locations and relationships of particular resources, activities or programmes were considered to be important.

1.10 Definition of Terms and Concepts

1. **Conservation** refers to the management of human use of the zone's natural resources to supply the most sustainable benefits to the community as well as tourists while maintaining its potential to supply these needs in future.

2. **Institution** refers to government establishments such as agencies and non-governmental organizations including private conservation associations. The term also encompasses government laws, policies and cultural or moral standards.

3. **Management plan** is a coherent set of decisions about the use of the coastal zone and the ways to achieve the desired use. Integrated planning is a systematic assessment of potentials, constraints and alternative patterns of land use on physical, social, economic, cultural and political conditions inorder to select and adopt use options which achieve specific goals.

4. **Sustainable coastal management** refers to a process by which exploitation of resources (marine fish, mangroves, etc.), the direction of investments (hotels, industry, etc), the orientation of technological development, and institutional change are made consistent with the needs of future generations as well as those of present generations.

1.11 Summary

This chapter has presented the general background to the research problems which, the study ought to investigate. It has been shown that the rapid urbanization and tourism growth without proper and coordinated planning result into numerous problems including overcrowding, environmental degradation, and resource use conflicts. The most affected are the traditional resource users (i.e., fishermen) and those who directly depend on marine resources and activities for their livelihoods.

CHAPTER TWO

2.0 LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 The Coastal Zone

There is no precise definition of a "coastal zone". Most definitions (LOICZ, 1996; World Bank, 1995; OECD, 1993) seek to include coastal waters, marine and estuaries, and some portion of land along the coast in which human activities and natural processes both affect and are affected by those in the waters. While one might include the entire land area of the watershed which drain to the sea and the entire water area out to the continental shelf, in practice the coastal zone is a relatively narrow band of water and land along the shoreline (Cendrero, 1989). Though the coastal zone forms the interface between land and sea, "the concern and interest are concentrated on that area in which human activities are inter-linked with both land-water environment (Scura, *et al*, 1992). Accordingly, the seaward limit of the coastal zone can be the edge of the continental shelf but it is for practical reasons defined as 200 miles Exclusive Economic Zone (World Bank, 1995).

The economic significance of the coastal zone is vast. It is home to ports and harbors, which link the country with the rest of the world for international trade (Goldberg, 1994). Scientists have established that it is in the coastal zone where greatest life is found. The coastal zone has for long been used for fishing and recreation, but tourism is now big business (Sincliar, 1990). Less obvious, but also economically important, are services the natural features of the coastal zone perform without cost: shoreline stabilization, beach replenishment, protection from storms, floods control, and waste treatment (UNEP, 1994).

2.2 Coastal Zone Ecosystems

The coastal zone, particularly that of Kenya is an area of great physical beauty, with many different ecosystems, a high biological diversity and wealth of living resources (Visser and Schoorl, 1991). The zone is essential to marine life and supports a large part of the country's living marine resources, certainly more than the open sea (Njuguna, *et al* 1992). The coastal ecosystems (natural habitats) are nursery or feeding areas for most coastal and many oceanic species (IUCN/UNEP, 1985). The critical ecosystems comprise mangrove forests, coral reefs, beach and dune systems, seagrass beds, and lagoons/estuaries (including embayments) known to be especially valuable (Chua, 1993). While it is useful and practical to focus on individual habitat types, one must not forget they exist only as components of wider coastal systems, therefore, they should be managed as parts of a greater system.

2.2.1 Mangroves

Mangrove forests are a significant and distinctive coastal resource. They are basically estuarine, thriving in areas where seawater and freshwater from the land merge and mix, and where the impact from strong oceanic waves is minimal (Kigomo, 1991). Mangrove swamps along the Kenya coast cover approximately 53,000 ha with the largest systems occurring in the Lamu area and the Vanga-Funzi coastal system near the Kenya-Tanzanian border (Table 2.1). The mangrove systems in Mombasa area along the Kenya coast cover an area of 1700 km^2 (KWS, 1999). This is, however much lower coverage relative to other zones and is correlated with the comparative absence of large river systems emptying into this coast which supply the sediments and cover the coastal indentations required for mangrove establishment and growth. These conditions are best met at Tana delta, which has mangrove system covering an area of 335km^2 (UNEP, 1996).

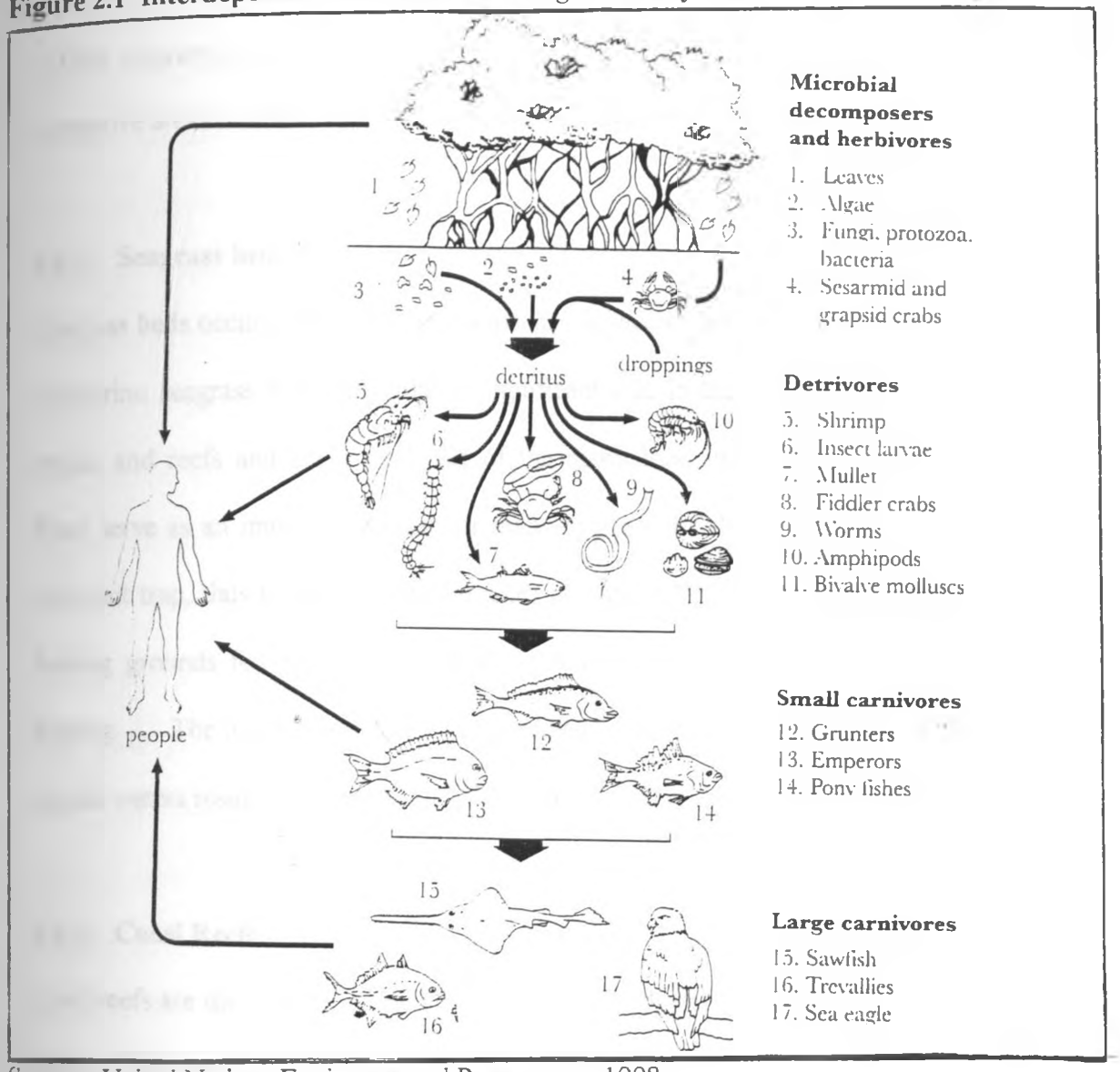
Table 2.1 Areas of Mangroves on the Kenyan coast

Locality	District	Area (ha)
Kiunga	Lamu	3,025
Lamu	Lamu	30,475
Kipini (Witu)	Tana River	1,595
Mto Tana (Witu)	Tana River	250
Mto Kilifi (Witu)	Kilifi and Tana River	2,335
Mto Fundisha (Ungwana Bay)	Kilifi	330
Ngomeni	Kilifi	1,815
Mida Creek	Kilifi	1,600
Takaunga	Kilifi	30
Kilifi Creek	Kilifi	360
Mtwapa Creek	Kilifi and Mombasa	525
Tudor Creek	Mombasa	1,465
Port Rietz	Mombasa and Kwale	1,575
Maftaha Bay (Gazi)	Kwale	615
Ras Mwachema	Kwale	5
Funzi Bay	Kwale	2,715
Vanga	Kwale	4,265
Total		**52,980**

Source. United Nations Environmental Programme, 1998.

Mangrove forests are an important, habitat for a variety of terrestrial and aquatic plants and animals, many of which in turn play an important role in coastal economics (Kokwaro, 1985). Mangroves yield large amounts of fish, crabs, prawns and oysters (Rasawo, 1993). They are valuable source of fuelwood, timber, tannin and other natural products (Ruwa, 1993). They are also very important as an indispensable nursery ground for numerous marine species of commercial and touristic value. Figure 2.1 shows that inhabitants of the coastal ecosystems utilize organic matter (leaf litter and detritus matter) from mangrove habitats in one form or another. Furthermore, mangrove forests reduce tidal currents and cause considerable deposition of sand and silt, thus forming a stabilizing complex along the shoreline. Unfortunately, the experience throughout the world is that where the protective cover of mangroves has been removed, there is considerable coastal erosion (Visser and Schoorl, 1991).

Figure 2.1 Interdependencies within the mangrove ecosystem



Source: United Nations Environmental Programme, 1998.

Kenyans have traditionally harvested mangrove trees or parts thereof for building poles, firewood, and making fish traps. Mangrove vegetation has also been cleared for solar salt works and prawn farms. Accordingly, loss of mangrove since the pre-agricultural times is thought to amount to 70% (UNEP, 1998). Despite extensive subsistence and small market use, estimates of the area under mangroves in remote shores have remained constant over the past 20 years (Kigomo, 1991). On the contrary, mangrove forests near urban areas such as the Nyali-Bamburi-Shanzu area, north

of Mombasa Island, have been overharvested. However, the greatest threat to mangrove forests is their conversion into brackish-water fishponds for culture prawns and man's desire to convert mangrove areas to residential, industrial, and real estate by land filling (World Bank, 1995).

2.2.2 Seagrass beds

Seagrass beds occur along the coastline usually adjacent to or associated with coral reefs. The submarine seagrass frequently play a significant role in the transfer of energy in the lagoons, creeks and reefs and are a vital part of the many food webs (Ogaden and Gladfelter, 1983). They serve as an important habitat for many species of fish, octopia and holothurians and as a sediment trap, thus keeping coastal beaches pristine (KWS, 1999). In addition they serve as feeding grounds for endangered species such as the green turtle, the hawksbill turtle and the dugong. The major threat to the seagrass beds come from excessive sedimentation of shallow coastal waters resulting from erosion of coastal agricultural lands.

2.2.3 Coral Reefs

Coral reefs are the most intensely diversified and biologically productive ecosystem in the coastal zone. The total area of coral reef in Kenya is estimated at 50,000 ha (UNEP, 1998). About 140 different species of hard and soft corals have been identified along the Kenyan coast (Visser and Schoorl, 1991). They run roughly parallel to the coastline at distances ranging from 500m to 2km from the shoreline (McClanahan, 1994). These reefs are mainly of the fringing type (as opposed to barrier reefs), and in addition there are a number of patch reefs (UNEP, 1998). Their structure enables them to withstand and dissipate strong wave action. In this way, they serve as natural protective barriers, deterring beach erosion, retarding storm waves, allowing mangroves to prosper and providing safe landing sites for boats.

In addition to their undisputed value in attracting tourists, coral reefs are also important for fisheries, with the tourism industry as one of the main markets for fish products. The tourism industry has also created demand for other reef resources such as precious corals, seashells and aquarium fishes, which provide a small but important home industry for coastal villages. These pressures coupled with silt deposition, pollution, destructive fishing practices and tourist visits to reefs which result in breakages from boat anchors and trampling, have diminished both the productivity and the species richness of the entire coastal ecosystems. The degradation of coral reef system aggravates the loss of the endangered coastal and marine species and has serious effects on tourism, fishing, and beach stability.

2.2.4 Beach and dune systems

Beach and dune systems occur along the coast and are usually characterized by bare sand dunes (UNCHS, 1996). Dune areas support temperate forests, rainforest, wetlands, and comprise physical attributes of sand dunes and beach areas and their associated fauna and flora make them popular candidates for national park designation (Clark, 1992). Given that sandy coastal areas are some of the world's most highly valued landscapes, conflict of interest inevitably occur where mining is proposed. In areas where fragile vegetation communities clothe unconsolidated sandy slopes, any external disturbances, such as intensified grazing pressure, or stripping of vegetation prior to mining, can trigger erosion.

In addition to their wildlife and recreational functions, frontal dune and beach systems constitute a flexible buffer against coastal erosion. In the interest of coastal protection, their integrity should not be destroyed. Mining of beaches and/or frontal dune ridges should be discouraged, and instead, extraction should take place landward of the frontal dune so that sand continues to be

available for natural beach replenishment. But the main threat to the beach is usually from development on land next to it. Beach protection requires coordinated management to include both beach and the land behind it, including actions to limit construction, prevent excavation, and control structures and intensity of use along the beach.

2.2.5 Lagoons and estuary systems

The Kenya coast has a number of embayment including water bodies such as lagoons, estuaries, and small bays. Many such basins have been converted into harbors, or even large commercial ports, the best example being the port of Mombasa. In addition to shipping, lagoons and estuaries serve a multitude of purposes including waste disposal, mariculture, recreation, and residential development. Improperly planned development on the shores of estuaries and lagoons creates a variety of short and long-term economic losses and opportunity costs resulting from resource collapse (Gabel, 1991). The intensive use of embayments that serve as ports and harbors creates a variety of environmental impacts and severe losses of estuarine and lagunal natural resources. A side from outright fish kills, pollution causes pervasive and continuos degradation, evidenced by the gradual decline of biodiversity and the cleansing ability of the ecosystem, or a decline in the natural carrying capacity of the system (Munga, *et al*, 1993).

An increasing threat to the well being of estuaries is the impoundment and/or diversion of rivers at upstream locations. This not only disturbs the ecosystem, but also increases flood hazards. In this case, confined embayments (particularly, lagoons) need a maximum of protective controls: (i) protection of wetlands, tideflats, and beaches; (ii) additional "buffer strips" above wetlands, (iii) control of sewage and storm drainage effluents; (iv) safeguards against run-off of soils, fertilizers and biocides from the coastal uplands; and (v) restorations on industrial siting (OECD, 1993a).

2.3 Human Activities and Their Impacts in the Coastal Zone

The coastal zone is used extensively and increasingly for a large number of activities that have a variety of impacts on coastal ecosystems. Table 2.2 summarizes the relationship between development activities, their environmental impact and effects of living aquatic organisms. The main human activities in the coastal area include: strategic use for defence, mineral extraction, industrial activities, port and harbor development, fisheries and aquaculture, transportation, tourism and recreation, research and education, waste disposal, and conservation (UNESCO, 1992a). Equally important, the planning and management, or lack of it, of these activities and coastal resources will determine the future, not just of coastal ecosystems, but of coastal population and the economic activities which depend on these ecosystems.

2.3.1 Human settlements

The coast is in increasingly strong demand for human settlements. In Kenya, close to one million people inhabit the coastal area (UNEP, 1998), and populations of coastal area is growing faster than inland population. The presence of large and growing populations in the coast creates major problems (Shaw, 1989). Urban settlements encroach into adjacent lands, destroying estuarine flats, salt marshes, and mangals through land take and land reclamation, the very ecosystem that provide food and protection (UNCHS, 1996). Increased demand for sewage treatment, water supply, and other utilities and services add strain on available resources and on natural systems (Shaw 1992). On the other hand, in urban centres with less infrastructure in place, more people means more pollution of the ocean waters, more pressure on nearby natural resources, and more pressure on fishery resources (UNCHS, 1996). Although human impacts are an unavoidable consequence of human survival, they often can be greatly reduced by appropriate planning and management.

Table 2.2 Economic activities affecting the coastal zone

Sector	Activity	Impact in the coastal zone
Urban	- Sewage disposal. - Solid waste disposal - Uncontrolled sprawl of housing and urban development. - Modification of coastline through construction, filling and dredging. - Demand for food, fuel and raw materials.	- Pollution of ocean waters; seafood contamination; sedimentation; fish kills. - Fouling of beaches, water intake and fishing gears; entanglement of marine life; ghost fishing. - Habitat destruction and depletion of natural resources. - Changed current patterns; coastal erosion.
Industry	- Industrial waste disposal. - Land use. - Modification of coastline.	- Pollution of coastal waters; tainting of seafood. - Habitat destruction, coastal erosion.
Port	- Operational/accidental spills. - Modification of coastline, dredging, filling, etc. - Shipping.	- Water pollution, turbidity and sedimentation, oil spills. - Habitat destruction, beach erosion.
Shipping	- Water pollution from shipping operations. - Dumping of solid waste. - Shipping accidents.	- Accidental oil and chemical spills. - Accumulation of marine debris on beaches.
Tourism	- Uncontrolled sprawl of tourism infrastructure. - Sewage disposal. - Land use. - Overuse of natural resources.	- Habitat destruction, stress to fragile coastal ecosystems, depletion of natural resources. - Water quality degradation.
Agriculture	- Soil erosion. - Agro-chemical runoff. - Habitat destruction through extensive agriculture.	- Sedimentation of lagoons, destruction of corals, reduced flushing of lagoons. - Pollution of marine waters by pesticides. - Filling and channeling of wetlands.
Forestry	- Upland deforestation. - Logging for fuel wood and construction.	- Sedimentation in lagoons. - Clearing of mangroves; habitat destruction; loss of shore protection.
Fisheries	- Over-exploitation of stocks. - Destructive fishing methods. - Discarded/lost fishing gear.	- Depletion of fishing stocks. - Destruction of critical habitat and nursery areas; ghost fishing.
Aquaculture	- Land reclamation. - Use of water, dredging, etc. - Need for natural seed.	- Mangrove/wetland destruction. - Water quality degradation. - Depletion of natural recruitment stocks.

Source: World Bank, 1995.

2.3.2 Industrial development

One of the most visible results of development in the Kenya coast is the enormous growth of industry. Industries have been attracted to the coast because they: (i) benefit from access to low-cost marine and inland transportation systems, (ii) use sea water for processing or cooling purposes, (iii) deal with marine transportation, and (iv) depend directly on the marine environment. As Table 2.3 shows, the main types of industries are food industries, beverage manufacturing and bottling, vegetable oil and soap production, chemical industries, textile industries, and metal processing. Other industries include cement manufacture, steel rolling mills and iron smelting and oil refining.

Table 2.3 Numbers of registered firms by industry category for Coast Province

Category of industry	Number registered
Vegetable and animal oil	13
Grain mill products	10
Bakery products	11
Textiles, knitting and weaving	24
Pulp, paper and board	6
Chemicals, paints, plastics and rubber	22
Sawmills and timber products	6
Petroleum refining	2
Metal products	21
Ship-building and repairs	2
Generation of electricity	3
Soap, perfume and cosmetics	3
Food, malt and soft drinks	12
Cement, lime and quarrying	9
Other	9
Total	**159**

Source: United Nations Environmental Programme, 1998.

Over 60% of these industries are located in Mombasa region. The growing level of industrialization in Mombasa is causing considerable concern as a result of its environmental problems and impacts that extend considerably beyond the plant sites. Location of industries along the shore pre-empts mangroves and other critical habitats. Industrial wastewater discharged into the ocean without adequate treatment results into a multitude of impacts on coastal ecosystems, lowering dissolved oxygen levels, introducing nutrients, changing water salinity, discharging pollutants and toxic substances, and possibly introducing pathogenic organisms (Clark, 1996). This calls for planning decisions relating to industrial siting to include the secondary developments that such industries will induce.

2.3.3 Waste disposal

Historically, the ocean has been used as a disposal ground for waste. Indeed, all urban centres along the Kenya coast discharge their liquid waste into the ocean. Harbors of large coastal centres and industrial ports, particularly the port of Mombasa, give the worst examples of pollutant discharges (Obura and McLanahan, 1994). The lack of adequate sanitation facilities and waste disposal, of sewage treatment and of industrial effluent treatment threatens not only the existence of vulnerable estuarine ecosystems, but other more robust ecosystems as well (FAO/UNEP, 1982). Raw sewage, untreated organic waste from processing plants and municipal waste dumped directly into coastal waters results in lowered dissolved oxygen concentrations, higher levels of plant nutrients, water pollution, and introduction of pathogens and other microbes potentially harmful to fish, wildlife and human beings (UNCHS, 1996). These nutrient overload, the excessive sedimentation, and the discharge of raw sewage, synthetic organic compounds, litter, plastics, heavy metals, oil and hydrocarbons all pose very serious threats to the natural resources of the coastal zone and oceans (UNEP, 1996).

2.3.4 Shoreline protection works

Many property developers find the shore an ideal place for various types of investments ranging from residential houses to tourist hotels and coastal marinas. Unfortunately, coastal hazards such as waves, tsunamis, and land subsidence, subject shoreline property to damage or destruction (Ngoile and Horril, 1993). Shoreline developers are faced with no choice except to build shoreline protective structures such as groins, revetments, seawall, bulkheads, jetties, and breakwaters to permit continued occupation of coastal hazard zones (Abuodha, 1992). These structures disrupt longshore transport of sand, modify currents, cause shoreline erosion or accretion, and adversely affect coastal ecosystems through burial and sedimentation (de Meyer, 1989). This practice has been left unregulated and no efforts have been made to tame these forces. Land reclamation has destroyed many wetland ecosystems along the coast and many reclaimed areas will be under threat with the projected sea level rise.

2.3.5 Port and marine transportation

Major coastal ports and harbours, are the focus of intense activity, experience many user conflicts and are very vulnerable to environmental degradation (Davis *et al*, 1990). Harbour and port development normally involve dredge and fill activities and can affect marshes by altering salinity and water circulation. For example, the location of the port of Mombasa has attracted industries with associated environmental and socio-cultural effects. The expansion of the port has destroyed neighbouring wetlands through land take and run-off which turns nearby wetlands into contaminant sinks. Other impacts of port and harbour development include: (i) dredging impacts, (ii) impacts from construction of piers and breakwaters, and (iii) impacts from ship discharges of oily ballast, bilge water and sewage and possibly impacts from oil spills (UNEP, 1994). The operation of harbours and ports

generates sedimentation, sanitary waste, and toxic chemicals, including bilge oils, as well as resulting in major disruptions of wildlife habitats. This result into the modification to water circulation and oceanography, turbidity and sedimentation damage, loss of adjacent habitat, and blockage of migratory routes used by aquatic species (World Bank, 1996).

2.3.6 Mineral Resource extraction

Coastal and marine environments have been known to contain a great range of minerals and other living resources. Minerals are found from the edge of the coastal lands to the deep ocean waters. In the Kenya coast, salt deposits are found in the coastal environment, the Gongoni deposits, being a good example. Land-based mineral or aggregate extraction changes the physical characteristics of the mining area and disturbs the closely linked flora and fauna, hydrology and soils. Mining of sands extending from shore inland to sand deposits behind beaches, results in the gouging out of huge cavities. Dredging destroys benthic communities and produces excess sedimentation, which smothers coral reefs and causes water turbidity.

Negative effects are not limited to the site itself, but may extend to other parts of the coastal system. For example, coral mining in Bamburi for cement, lime and calcium carbide destroys coral reefs and increases coastal erosion and beach siltation. Also, oil processing and associated infrastructure development if not properly planned can contribute to water quality problems and the degradation of coastal habitats due to thermal and sanitary discharges, production of water effluents, disposal of drilling mud, petroleum leaks and spills, and sedimentation. Chronic oil pollution from ships can significantly degrade reef habitats and kill marine life. Moreover, oily residues and tar balls have since ruined tourist beaches, and thus affecting the income of coastal communities from the economically vital tourist trade.

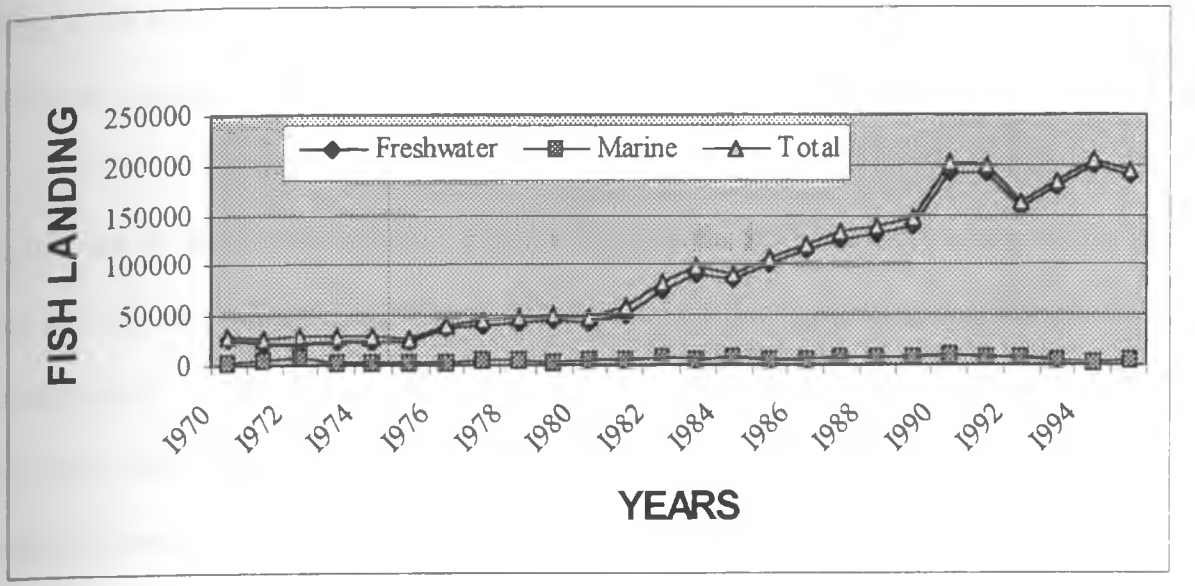
2.3.7 Fishing and aquaculture development

Coastal fishing is an important commercial enterprise, and many coastal communities rely on fisheries for their livelihood (Hinrichsen, 1996). Fishing is done at both commercial and subsistence level. Fisheries provide livelihood for fishermen and their families and for others in the fishing industry, including boat builders, trap and net makers, packers, distributors, and retailers all of which enhances social, cultural, economic and political stability in coastal areas (FAO, 1992).

Marine fisheries in Kenya are based on a small number of species, the most important of which are demersal and caught by artisanal fishermen operating between the shoreline and the reef. Of the total annual fishery production, only 7.4% come from marine waters (Figure 2.2). Freshwater fish landing in Kenya have always been higher than those from coastal waters. Though the disparity was not great until mid 1970s, the difference has broadened significantly due to the marked increase in freshwater fish production since then. According to FAO (1996) estimates, freshwater fish increased from 22,000 tonnes in 1975 to 138,000 by 1989, and 188,344 in 1995, marine fish landing remained consistent between 5,000 and 8,000 tonnes over the period.

There are about 5,000 fishermen in the coast compared to well over 27,000 fishermen engaged in inland fisheries (UNEP, 1998). During the 1988 and 1992 period, the annual mean fish production was about 7,660 tonnes. According to the fish landing records, Mombasa has accounted for 46.6% of the mean fish catch between 1988 and 1992 (FAO, 1992). This may be taken to indicate that the coastal waters around Mombasa are very productive. However, fishermen can land their catch anywhere, regardless of where the fish are caught, and the bigger market and more affluent potential buyers of Mombasa probably attract them.

Figure 2.2 Fish landing in Kenya, 1970 -1995 (metric tones)



Source: FAO Fisheries Tables, 1996.

There are a number of physical, climatic and economic factors, which combine to constrain the coastal and marine fishery in Kenya. First, the area of the continental shelf with a depth of 200m, is only 8,500km^2, less than 10% of the fishable area of Lake Victoria (UNEP, 1998). The 200m depth contour lies within a mere 3-8km offshore except in the Northern Kenya Bank and Ungwana Bay where it extends to about 64km. Secondly, the Southeast Monsoon which is prevalent from March to October are a hazard to small canoes which are the main fishing craft in the Kenyan marine fishery (McCalanahan, 1987).

The fundamental problem of fishery resources, identified by Scott Gordon, (1955) is that, the common property nature of the resource leads inevitably to a "tragedy of commons" outcome (Hardin, 1966). Because there are no clearly defined property rights, the resource appears to have no value and is external to production costs, whilst fish take is below replacement rate. Other threats a part from open access include the loss of fish habitat and water pollution. Over-

exploitation of target and non-target species through excessive fishing effort especially in nursery grounds, and harmful fishing practices such as the use of non-selective fishing gear and dynamite, which also damage coral reefs are unsustainable (McCalanahan, 1987).

Aquaculture development along the coastline represents one of the fastest growing sectors and is seen not only as a valuable supplement of local diets but a means of earning foreign currency through export. Marine aquaculture spreads across the boundary between land and sea where it uses either land (shrimp ponds) or the sea. Uncontrolled aquaculture expansion and resulting habitat conversion reduces reproduction potential of species used in aquaculture and biodiversity (Clark, 1990). In addition, aquaculture and mariculture operations introduce artificially high-nutrient levels and other pollutants into deltas, estuaries and other coastal ecosystems, as well as the disruption of water circulation, physical modification of habitats, and loss of abundance, and possibly introducing pathogenic organisms. Other detrimental environmental effects of aquaculture include increased siltation, turbidity, and the build-up of rich organic sediments, and the degradation of tidal habitats including mangroves.

2.3.8 Coastal hinterland uses: agriculture, forestry and dams

The Kenya coast supports important agricultural activities including the production of food for local consumption and export. Farms average 6-8 ha (UNEP, 1998), with low intensity cropping dominated by maize and rice which is grown in irrigated areas and flood plains of River Tana. Nearly 50% of the arable land is under tree crops - mostly cashews, coconuts, citrus and mangoes. The main arable cash crop is cotton, eventhough yields are very low. Bananas, mangoes, and pineapples are also grown for domestic consumption and export while cashew nuts and sisal are grown mainly for export.

The high population growth has driven cultivated areas to expand into marginal areas and river margins resulting in soil erosion and sedimentation and damage to or burial of coral reefs. Subsistence farmers in the zone tend to practice shifting cultivation with new areas being subject to clearing and planting in a regular cycle (Shaw, 1992). Fires are often used for land clearing and this can lead to destabilization of fragile coastal soil structures such as bluffs and dunes. In addition, the relatively higher potential soils that constitute only about 20% of the total national area have come under more intensive cultivation pressures, and soil conservation measures have not been sufficient to counter the impacts of emerging agricultural patterns.

Livestock raising is destructive near the coast with tracks made by animals tending to lead to severe erosion (Kitheka, 1993). Deforestation and improper management of ranching and rangelands leads to overgrazing by livestock, denudation of ground cover, soil erosion, and sedimentation and water pollution in coastal areas (UNCHS, 1990). An obvious example is the Tana delta where millions of tones of sediment are deposited annually because of soil run-off from deforestation of Kenya highlands and poor farming practices (UNEP, 1998). Clearing and draining of coastal lowlands and wetlands exacerbates flood hazards, in particular, flooding from rainstorms and cyclonic sea storms.

Construction of dams along Rivers Athi and Tana for water or energy supplies, and irrigation schemes reduce river flow downstream and prevent sediments from the catchment area behind them from reaching coastal waters. This results in increased concentration of pollutants from industrial, domestic, and agricultural sources in river systems downstream (UNCHS, 1996). The increased pollution degrades estuarine environments, seagrass beds and coral reefs at the rivers' confluence with the sea (Perez, 1993). The loss in sediment load affects the growth and

productivity of mangroves, salt marshes and estuarine flats and can result in severe coastal erosion, as evidenced by the retreat of the Nile delta since the construction of Aswan Dam (Charlier, 1989). A significant decrease in river flow from water take can allow sea water to intrude further inland where the estuarine area is flat, salinizing groundwater aquifers, potable water supplies and significant land, destroying crops and making land unfit for future use.

2.3.9 Tourism and recreation

A powerful tool for national development, tourism is one of the growing areas of international trade, particularly for coastal nations. Over the past two decades, tourism has become an ever-strong pillar of the Kenyan economy. Since 1987, tourism has been the largest single source of foreign exchange, overtaking both coffee and tea (Table 2.4). Gross receipts from tourism have risen from K£ 152 million in 1984 to K£ 432 in 1989 and to K£ 1,132 in 1998. In 1990 alone, tourism earned Kenya an amount of a bout Kshs 10.7 billion, accounting for 43% of the country's foreign exchange earnings (Visser and Schoorl, 1991).

Table 2.4 Foreign exchange earnings (K£ million) at current prices, 1984 - 1998

Sector	1984	1986	1988	1990	1992	1994	1996	1998
Tourism	152	250	349	533	713	1,045	1,280	1,132
Coffee	203.5	388.5	244.5	203.4	218.3	587.9	717.9	659.9
Tea	189.5	172.7	185.2	346.9	446.7	915.0	1,016.8	1,956.9

Source: Sincliar, 1990; Economic survey, 1994 & 1999.

Tourism is important because, in addition to being a foreign exchange earner, many people have been employed in the tourism industry and its allied concerns. According to the

International Labour Organization, the tourism industry in Kenya generates 9% of the total employment (Ibid, 1991). In the coast, the local economy is overridingly dependent on tourism For example, 90% of the total population of Malindi has been estimated to work directly or indirectly in the tourism industry (Ibid, 1991). Tourism also helps to encourage the protection of natural habitats, wild game, cultures and traditions, and historical monuments. Examples include the marine parks, natural reserves and forests, and monuments such as Gedi Ruins, Vasco Da Gama pillar, Fort Jesus, and Lamu artifacts. Of importance are the improvements made to the services and facilities which are used by tourists, such as hotels, transport and communication routes, water and electricity lines, vehicle for hire companies, restaurants (KWS, 1990).

Though tourist attractions abound in Kenya, the coast and the wild animals in the parks are the major attractions. Tourism in the coastal region is a function of beautiful unpolluted beaches, the sunny climate which coincides with winter in Europe, the major source of tourists, a rich habitat of wildlife, contrasting landscape sceneries, historical sites and artifacts, cultural wealth amongst the coastal people, and the available accommodation of the tourists (Walters and Odero, 1986). Beaches are a focal point of coastal recreation and tourism development. To the developer, the land adjacent to the beach is the preferred site for tourist resorts and once such land has been fully used, the developments tend to sprawl to the hinterland.

The overall effect of these characteristics has increased physical and economic development of the area(s) frequently visited by the tourists. Along the coastline and further inland, the effects are clearly felt. The three major tourist areas at the coast, Diani, Mombasa, and Malindi all have shown major hotel developments, and this trend is likely to continue in the

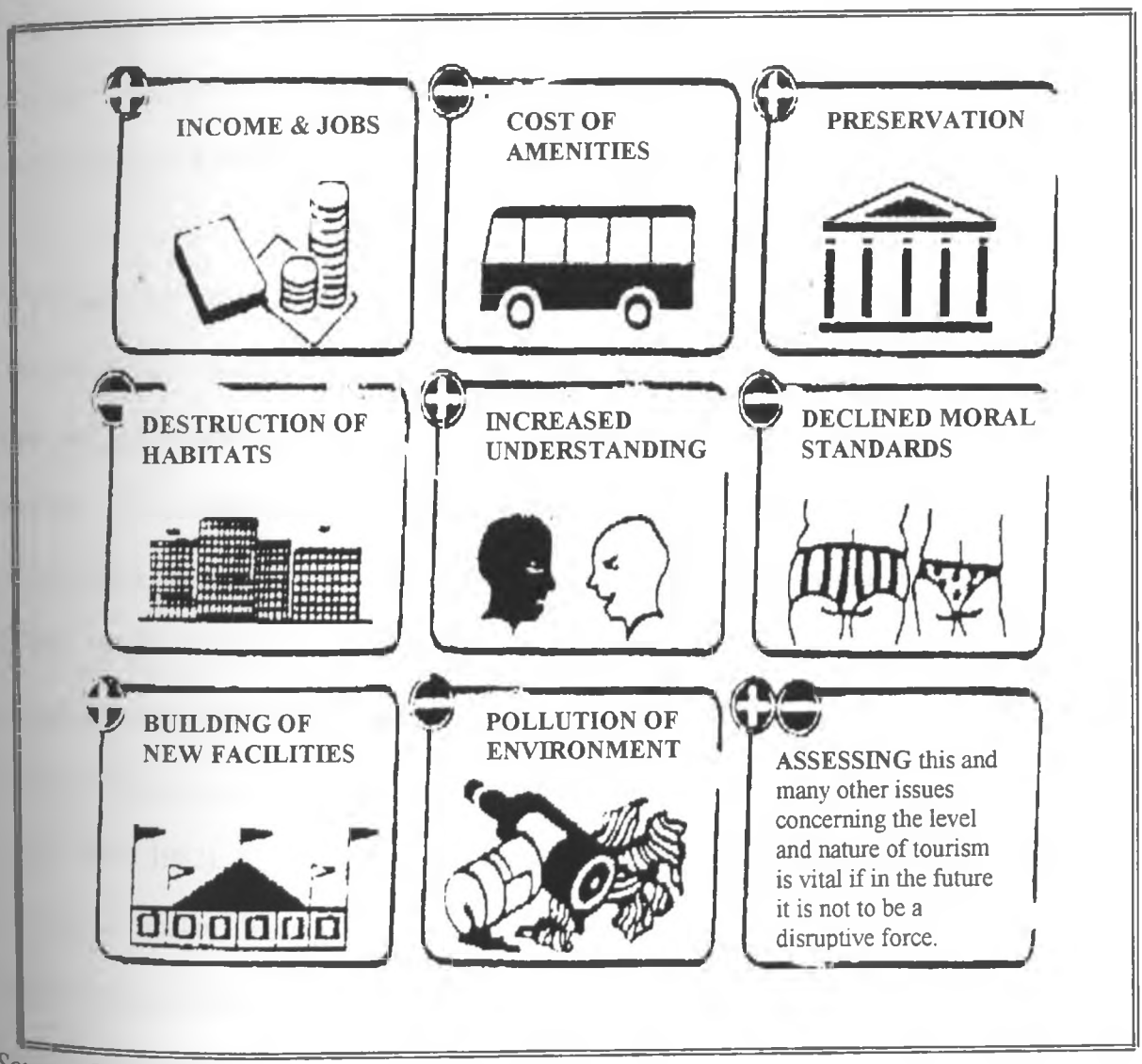
coming years. Between 1985 and 1993, a bout 400 such developments took place (Visser and Schoorl, 1991). This has therefore, increased value of most waterfront and adjacent lands and other physical properties, properties which are becoming more scarce and more dear as the tourism industry expands.

Generally, tourism can have both positive and negative impacts on the human environment (Figure 2.3). On the one hand, it positively benefits the environment by stimulating measures to protect physical features of the environment, historic sites and monuments, and wildlife. In contrast, mass tourism, especially, "sand-and-sun tourism", produces environmental damage to the shore (SAREC, 1994). As tourist demand rises, coastal user conflicts increase and greater stress is placed upon the environment on which it depends. Biodiversity reduction, resource depletion and human health problems may result from the accumulated environmental effects of tourism. When the situation deteriorates sufficiently, there is loss of jobs, income and hard currency earnings: factors that can lead to sociopolitical instability. In addition, tourism disturbances do extend into the social and economic scene. According to Dunkel (1984), resource plundering and environmental deterioration are often root causes of social disruptions. Western lifestyles now dominate the coastal zone, the younger people turning away from their indigenous culture to a more materialistic lifestyle, with all that signifies. Appropriate planning and use of development controls can alleviate such problems.

Policymakers are caught in the typical dilemma over tourism development. They want the income it generates while at the same time they deplore the negative social and environmental impacts. Control of tourism development should be based on knowledge of social and environmental carrying capacity and proved methods of visitor management (Clark, 1992).

It is hoped that through "ecotourism", the more rapacious resource activities, such as clear-cutting of mangroves, mining of coral reefs, and hunting of endangered species, can be discouraged in favour of the lighter footprint of selective tourism - much of it directed to marine parks and nature reserves. It should be noted that ecotourism is no miracle solution for environmental problems - development control based on carrying capacity is still necessary.

Figure 2.3 Possible costs and benefits of tourism



Source United Environmental Programme, 1979.

2.4 Conflicts and Compatibilities: The Need for Integrated Management

The coastal zone is an important resource. Coastal land resources are the scenes of intense competition between public and private interests, between economic and environmental values, and between diverse land and water uses (Pearce, 1995). A part from the animals and minerals in or near them, the zone is useful for commerce, communication and industry. Equally important, the coastal zone has attracted much human settlements. For a long time now, the nearshore waters have been used for outdoor recreation in the form of water sports such as windsurfing, scuba, diving, and yatching. These activities, together with the fact that many people, particularly tourists, get to enjoy outdoor recreation through their eyes have made the ocean-waters an attractive leisure.

As indicated by Table 2.5, the majority of these resources are now being interfered by the activities of man, whose pressures could lead to total destruction if not checked. Dredging of inlets and port entrances, draining of swamps and erection of coastal installation change offshore currents. Those who look for fish, corals and shells for business slowly disintegrate coral reefs. Tidal marshes, swamps and pools are blasted by those who collect marine life for fun or profit (UNEP, 1989). There is the problem of pollution into the ocean waters, pollution from municipal and domestic sewage, farm wastes and industrial wastes, mostly carried to the ocean by rivers and streams, and even by direct discharge of domestic and industrial wastes into the ocean (FAO/UNEP, 1982). Pollution from domestic and/or industrial sources leads to poor near-shore water quality, leading to eutrophication and/or loss of mangrove and coral habitats. Besides, coastal erosion and poor water quality can decrease the beaches' aesthetic value, thus lessening tourist revenue and development prospects.

Table 2.5 Development activities that can affect selected important coastal ecosystems

● Adverse effects possible ○ Significant adverse effects likely Development Activity	Type of Ecosystem							
	Marshes	Deltas	Estuaries	Mangrove swamps	Seagrass beds	Coral reefs and lagoons	Beaches	Islands
Agriculture and farming		●	●	●	○	○		●
Feedlots, ranching and range lands	○	○		●	○	●		●
Forestry		○		●				○
Aquaculture and mariculture	○	○	●	●	●	○		
Nearshore-catch fisheries		○	●	○	●	●		○
Dredging and filling	●	●	●	●	●	●	○	○
Airfields	○	○	○	○	●	●	●	●
Harbours	●	●	●	●	●	●	○	●
Roadways and causeways	○	●	●	●	●	●	○	○
Shipping		●	●	○	○	○	○	○
Electric power generation	○		●	○	●	●	○	○
Heavy industry (onshore)	○	●	●	●	●	●		●
Upland mining	○	●	●	○	●	●		○
Coastal mining	○	●	●	○	●	●	●	●
Offshore oil and gas development		○	○	●	●	●		●
Military training and facility testing	○				●	●		●
Land clearing and site preparation	○	○	○	○	○	●	●	●
Sanitary sewage discharge	○		●	○	○	●		●
Solid waste disposal	●	○	○	●			○	●
Water development and control	●	●	●	●				●
Shoreline management and use		○				●	●	●
Coastal and marine resource use	●	●	○	●	●	○	●	●

Source: Maragos, 1983.

Both natural and artificial predators' worst affect fisheries. They may be marooned in tidal pools and eventually dry up. Increases in population and demand for more fisheries have led to 'better' methods of fishing which threaten fish stocks. The main motives for fishing are food, profit and sport, but these are negated by expanded efforts, which pursue up to the last surviving members of fish species. The overfishing of the near-shore waters by use of destructive methods affects the marine ecological balance, but also threatening the existence of beautiful beaches on which prime part of the national tourism is founded.

The use and abuse of ecosystems is rife throughout the coast but is worse in overdeveloped zones (Hinrichsen, 1990). Ecosystems under particular pressure include beach systems, mangroves and coral reefs. One of the main contributors to this is the reclamation of mangrove areas for ports, industries, marinas, human settlements and associated transportation routes (Olsen, 1993). Other contributors to mangal degradation include overfishing and pollution. Coral reefs are being destroyed the fastest of all coastal ecosystems and damage to them may well be impossible to reverse. Coral mining for cement and building materials, dredge and fill operations, tourism, certain kinds of recreation and destructive fishing practices have destroyed numerous coral reefs and seagrass ecosystems.

The environmental impacts of conservation are positive. In contrast, all other impacts of human activities on the environmental components are potentially negative. In addition, many activities in the coastal area conflict with each other, as demonstrated in Table 2.6. This is by and large a consequence of the increased levels of human population combined with migration such that space itself is becoming a limiting factor to use and for enjoyment. A part from the land use conflicts over space, many economic activities conflict in terms of environmental

requirements, even within them. For example, some industries create substantial water pollution, yet require clean water in their processes to function. If this is not checked by a coordinated national plan, there will inevitable deterioration in the natural environment and possible closure of some economic activities.

Clearly, tourism and recreational development is incompatible with many other economic activities, either because it results in environmental degradation, or because other industries cause environmental degradation to the resource-base upon which it thrives. It requires an aesthetically pleasing environment with good quality environmental attractions. Yet, badly sited tourist facilities, especially hotels with inadequate sanitation, sewage and waste disposal facilities can destroy the resource base on which it relies, through altered long-shore drift patterns leading to beach erosion and water pollution resulting in degraded beaches, coral reefs and bathing water quality.

If the coastal and marine environment has been so important, why has there been a delay in taking advantage of these resources? Some respected authorities, among them, LOICZ have given the following reasons for this reluctance: (i) it is since the last century that properties of the ocean have been systematically recorded, (ii) only in the last few decades has there been invented the tools with which to exploit many of the resources of the ocean, and (iii) it is only in the last century that man's relationship with the sea has begun to go beyond the hunter-gatherer stage (LOICZ, 1996). It can therefore be argued that the policymakers have realized that by ignoring the coastal land and ocean they are losing valuable and essential resources. They now see the possibility of the zone offering new opportunities and of mankind's development.

Table 2.6 Possible use conflicts in the coastal zone

	Sea-based activities						Rural activities						Urban activities							
POSSIBLE USE CONFLICTS IN THE COASTAL ZONE	Aquaculture	Fisheries	Communication: shipping & Navigation	Oil and gas development	Coral mining	Aggregate dredging	Tourism and recreation	Communications: land transport	Mineral extraction: Land	Defence use	Rural land use: forestry/deforestation	Rural land use: agriculture	Coastal engineering and and land reclamation	Port and harbour development	Industry: manufacturing	Industry: food processing	Waste disposal	Land use: infrastructure*	Land use: housing	* Includes water sanitation
Conservation	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			Land use: housing
Research and education	✓	✓		✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	✓			Land use: infrastructure*
	✓	✓								✓										Waste disposal
	✓	✓					✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	Industry: food processing
	✓	✓					✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	Industry: Manufacturing
	✓	✓			✓	✓	✓			✓	✓	✓					✓		✓	Port and harbour development
	✓	✓	✓		✓	✓				✓	✓			✓						Coastal engineering and land reclamation
	✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	Rural land use: agriculture
	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	Rural alnd use: forestry
	✓	✓	✓	✓			✓	•				✓		✓			✓		✓	Defence use
	✓	✓						✓		✓	✓	✓					✓			Mineral extraction: land
	✓	✓								✓	✓	✓					✓		✓	Land transport
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Tourism and recreation
	✓	✓	✓	✓	✓					✓				✓						Aggregate dredging
	✓	✓	✓	✓						✓	✓		✓	✓	✓	✓	✓	✓		Coral mining
	✓	✓	✓		✓	✓				✓	✓	✓		✓				✓	✓	Oil and gas development
	✓	✓			✓	✓				✓							✓			Shipping and navigation
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	Fisheries
	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Aquaculture
			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Research and education
			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Conservation

Source: UNCHS, 1996.

2.5 Integrated Coastal Zone Management

Coastal sectoral management or planning connotes the management of a single resource or use by a unit of government. Sectoral planning is most often undertaken for ports, fisheries, tourism and wildlife. Integrated planning is designed to interrelate and jointly guide activities of two or more sectors in planning and development. In the context of coastal zone, integrated planning implies to balance and optimize environmental protection, public use and economic development. The planning and coordinating is designed to overcome the fragmentation inherent in both the sectoral management approach and the splits in jurisdiction among levels of government at the land-water interface (Chua, 1993).

Integrated coastal zone management (ICZM) is basically cooperation between all responsible actors towards long-term optimal socio-economic outcomes, including resolution of conflicts between sectors and arranging beneficial trade-off. ICZM involves the integration of the responsibilities of: (i) different levels of government sectors ("vertical integration"), (ii) different government sectors ("horizontal integration"), (iii) national government and local groups, (iv) policies across sectors of the economy, and (v) economic, technical/scientific and legal approaches to coastal problems (LOICZ, 1996). This inevitably allows multi-sectoral development to progress with the fewest unintended setbacks and with the least possible imposition of long-run social costs.

The focus of integrated planning and management reflects the growing awareness among managers that renewable resources are the foundation needed to build economic and social development programmes. ICZM analyses implications of development, conflicting uses, and interrelationships among the physical processes and human activities and promotes

linkages and harmonization between sectoral and ocean activities. It aims to achieve sustainable development of coastal and marine areas, reduce vulnerability of coastal areas and their inhabitants to natural hazards, and maintain essential ecological processes, life support systems, and biological diversity in coastal and marine areas (Clark, 1996).

In contrast to sectoral entities and process which tend to be concerned with only one use or resource of the coastal and marine environment, the ICZM process addresses several important functions related to overall patterns of use, the well-being of marine and coastal areas, and the protection of key fisheries habitat, protection of public safety, stewardship of resources and promotion of economic development (Chua *et al*, 1998). Tangible objectives of ICZM therefore include among others, supporting fisheries, protecting the community from storm ravages, attracting tourists, promoting public health, maintaining yields from mangrove forests, and preserving coral reefs habitats (Clark, 1992). This will ensure optimum sustainable use of coastal natural resources, perpetual maintenance of high levels of biodiversity and real conservation of critical habitats.

The two most common expressions of integrated planning are national economic planning and land use planning. As regards land use planning, five main zones can be identified in the coastal-marine spectrum: (i) *inland areas*, which affect the oceans via rivers and non-point sources of pollution, (ii) *coastal lands*, where human activities are concentrated and directly affects adjacent waters, (iii) *coastal waters*, where the effects of land-based activities are dominant, (iv) *offshore waters*, mainly out to the edge of the national jurisdiction, and (v) *high seas*, beyond the limit of national jurisdiction (Chua and Scura, 1992). Since the natural processes in these five zones tend to be highly intertwined, it is difficult to integrate

management regimes across the zones because the nature of property, government interests, and government institutions tend to differ across these zones, as summarized in Figure 2.4.

Figure 2.4. Nature of property, government interests and institutions in the coast

	Inland areas	Coastal lands	Coastal waters	Offshore waters	High seas
Nature of property	Private	Public or private	Predominantly public		
Nature of government interests	Local or provincial	Mix of local, provincial and national		Mainly national	Mainly international
Nature of government institutions	Multi-purpose agencies		Single-purpose agencies		

Source: Cicin-Sain, 1993.

With regard to the nature of property in the coastal area, there tends to be a continuum of ownership: in inland areas, private property tends to predominate, while on the coastal and offshore waters, public property concerns are dominant. Local or provincial interests tend to predominate in inland areas. Moving further out, ultimately to offshore waters and high seas, national and international interests become important. On land, there are often well established, "multi-purpose" government institutions at the local and regional levels to address control of land use and conflicts among uses. On the waterside, there tends to be only "single-purpose" national agencies concerned primarily with a single use of the ocean.

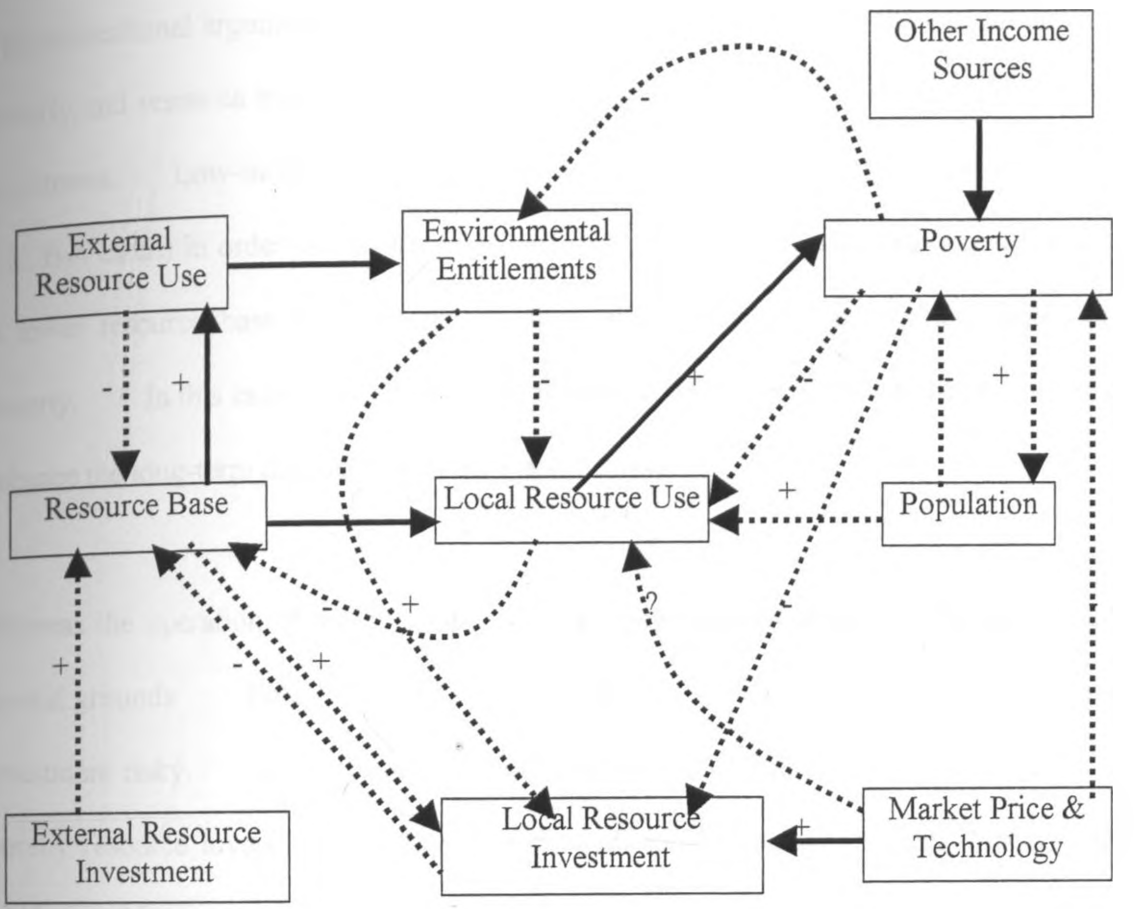
2.6 Theoretical Consideration and Conceptual Framework

2.6.1 Theoretical consideration

There is a rapidly growing literature on the linkage between development and the environment, yet there is relatively little theoretical framework linking the variables together in a consistent manner. Leach and Mearns (1992) and Reardon and Vosti (1995) provide two examples of quite wide conceptual frameworks. These authors focus particularly on how local (traditional) level resource use is influenced by conditioning factors (Leach and Vosti) or structuring factors (Reardon and Mearns). In contrast to such wide frameworks, formal economic models typically focus on the unilateral links from poverty induced high discount rates or short-term horizons to overuse of environmental resources, possibly also with a feedback from a deteriorating resource base to lower income in the future.

The suggested framework, inspired from systems analysis, provides a middle ground: it includes factors normally excluded in economic models, while at the same time suggesting linkages between the various variables than the wide frameworks do. The framework (Figure 2.5) has been made with a poor resource dependent society. Underlying the framework is a set of political and socio-economic factors, which are not made explicit in the figure. Starting with the resource base (coastal and marine ecosystem), the development of the resource stock is determined by four factors: the resource use (extraction) and the resource investment, either by local or external users. The level of poverty (which is taken to be the inverse of income) is a function of the local use of natural resources and external (off-resource) income as well as technology and market prices. Increase in human population affects resource use because of their heavy reliance on the resources provided by natural environment, often causing degradation. The effect of technology and market prices on local resource use is ambiguous.

Figure 2.5. Linkages between the natural resource base, development and poverty



Source: Modified from Leach and Mearns, 1992.

A key variable in this framework is local environmental entitlement, which is also central in the framework of Leach and Mearns (1992). This represents an application of Sen's (1981)-entitlement approach to the development-environment complex. Of particular importance are institutional arrangements in terms of property rights regime governing the resource use: who has access to the natural resource, what are the rules for their use, how effectively are the rules enforced, etc. The local resource use rights are functions of *inter alia*, the use and claims made by external users (migrants, tourists, etc.,) and the level of poverty. Environmental entitlements in turn affect both local resource use and investment.

Vicious Circle I: Resource degradation through lack of investment and overuse

The conventional argument of development-environment connection is the viscous circle between poverty and resource base, working through the effect of local resource use and local resource investment. Low-income forces the resource users (i.e., fishermen) to increase the resource use (i.e., fish catch) in order to survive, which again diminishes the natural resource base and stock. A lower resource base then reduces the flow of services generated which further augments poverty. In this case, poverty will leave fishermen with little surplus for investment that could enhance the long-term productivity of the resource base.

Whereas the operation of this viscous circle has some intuitive appeal, it can be challenged on several grounds. First, insecure property rights (environmental entitlements) will make such investment risky. Second, the collective good nature of many environmental resources (and thereby resource investments) will reduce the individual incentives for investments and create problems of free or easy riding. Third, there is the possibility for higher income contribution to more degradation. It is possible that the higher incomes can be invested in more efficient fishing gear which could increase both the fishing efforts and efficiency, putting the fish stock under increased pressure and thereby increasing the likelihood of unsustainable levels of catch.

Viscous circle II: Entitlement degradation

Poverty influences the environment entitlements negatively, which in turn affect the access and possibility for making use of the resource base, and then the level of poverty. This viscous circle may therefore strengthen the first viscous circle: the loss of environmental entitlements could well exclude the poor from the use of resources, in which case, development of the resource base is determined by other (external) users. This is clearly exemplified in a case where

tourism development has excluded the fishing community from the coastline. Poor group's lack of access and control of natural resources (lack of tenure security) often refers to their disadvantaged position in shoreline development processes. The most serious challenge is when we include resource competition, conflicts, resource rights (entitlements) and power. The loss of entitlements appears to be the key factor in explaining why poverty and environmental degradation coexist. This is well summarized by Lopez (1992:1138-39):

> *"The key source of environmental degradation is the disruption of the traditional institutions of the poor, which until recently had permitted an efficient and sustainable use of resources. The collapse of the traditional system leads to a viscous circle of environmental degradation and further impoverishment. Institutional collapse is caused by displacement and loss of entitlement of resources originating in factors external to communities - large scale tourism, export-oriented fishery operations, etc."*

Empowering local communities and poor groups (more accesses and control over resources) will contribute to higher income and thereby reduce or break the viscous circles. Equally important, it will improve the incentives for resource investments and long-term management of the resource. Issues related to property rights, respect of traditional user rights, tension between customary and statutory law, etc. are central in the debate on local environmental entitlements.

Viscous circle III: Poverty and population growth

The third viscous circle within the framework is the link between environmental degradation and population growth. Development-population-environment nexus is far more complex than such simple hypotheses suggest. Whereas the link between population size and environmental degradation is a widely accepted issue, it is quite correctly to say that there is a general consensus among development experts that rapidly growing population are being increasingly forced by circumstances to degrade the environment. In most cases, the data does not support the thesis

that environmental degradation is largely due to population growth (Shaw, 1992). Population growth is not in itself directly related to degradation, but is a component in a mix of factors that include desiccation, poverty, powerlessness, inappropriate agricultural policies and ineffective land laws (UNSO, 1992). Migration often tends to reinforce the effects of natural population growth and population density. Immigrants often cause land pressure and import inappropriate technologies that lead to resource depletion.

2.6.2. Conceptual interrelationships

Human modifications of ecosystems are reducing environmental quality worldwide. Coastal development in Kenya is rapidly intensifying and thus driving much of the ecosystem changes in the coast. The conceptual model summarized by Figure 2.6 shows connection between population growth and economic activities in the coastal zone, their impacts on the environment and natural resources, and the anticipated effects on people. As illustrated, the initiating factor is population growth. Continuing increase in population growth contributes to overuse of limited natural resources such as land for agriculture and forests and creates urban, economic and social problems that risk becoming wholly unmanageable. Moreover, population growth increases the demand for goods and services and if practices remain unchanged, implies increased environmental damage. This threatens the balance between natural resources and people.

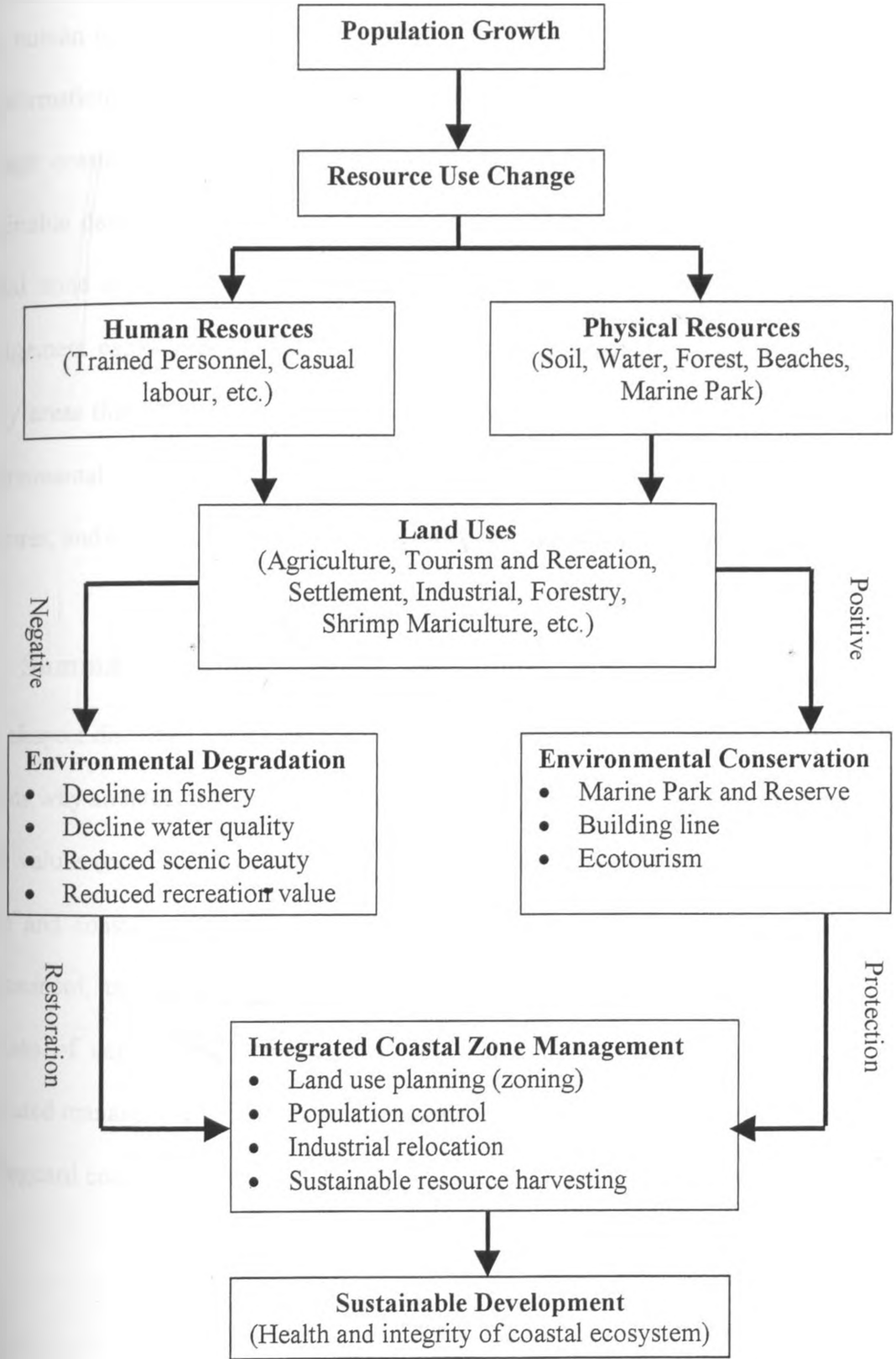
The increase in population, through increased resource use causes changes in land use - agriculture, settlements, industrial, recreation, etc. The removal of vegetation covers due to over-cultivation and use of poor methods result into landscape alteration and the associated habitat loss and increased sediment flows into the open coastal waters. Intense cutting of mangroves for building, fuelwood and charcoal causes the severest form of land degradation near urban areas.

The increased erosion therefrom contributes to increased siltation of coastal waters. This in turn produces three different effects: (i) deposition of sediments on benthic organisms, (ii) increased turbidity of coastal water, and (iii) change in condition of beaches.

Increasing urbanization represents the single-most important source of environmental degradation: landscape alteration and runoff increases as agricultural land is converted into built areas, sewage is directly discharged into the ocean, and industrial development decreases the productivity of the marine environment by introducing pollutants. This increases the pollution load thus affecting the water quality. Landscape alteration and loss of habitats is exacerbated by shoreline development. The increased development along the shoreline does change the shoreline landscape and degrade natural habitats. Most of these activities involve removal of mangrove forests thus interfering significantly with the many functions mangrove performs, such as serving as buffers for coastal storms and nursery habitats for juvenile fishes. The destruction of mangrove forests and the release of dirty water from aquaculture bonds imply that coastal ecosystem is compromised.

The decline in water quality, increased siltation, reduced scenic amenity and decline in fisheries produces four impacts namely: (i) reduced fishery harvests, (ii) increased risk of disease, (iii) reduced shrimp production, and (iv) reduced recreational value and tourism. The decreased growth rate of commercial shellfish means aquaculture operations become unprofitable and are subsequently closed. These aquaculture ponds once filled for urban development initiate new impact chains and networks to further degrade the coastal ecosystems. Unfortunately, it is the poor who bear the blunt of the fierce competition for resource use, consequently becoming increasingly marginalized and degraded.

Figure 2.6 Interactions between different parameters at the coast



Source: Field survey, 1999.

To a certain degree, coastal environmental degradation and resource use conflicts is associated with human population and human activity. Another force behind degradation is the social transformation produced by development. Following the call of Agenda 21, the government, through coastal management agencies should commit herself to integrated management and sustainable development of the coastal area so as to ensure that the health and integrity of the coastal zone ecosystems. Towards this end, the government should develop policies and management capabilities for integrating the development of multisectoral activities in the area. Policy areas that have to be considered include: (i) create public awareness and participation in environmental management, (ii) strengthen administration and regulation machinery and measures, and (iii) action research and monitoring of environmental aspects of development.

2.7 Summary

This chapter discussed the concept of coastal zone management. First it looked at the major reasons why an integrated approach to management of coastal and ocean areas is needed: (i) the many values (economic, ecological, social) present in the coastal areas, (ii) the effects that the ocean and coastal uses, as well as activities farther inland, can have on ocean and coastal environment, and (iii) the effects ocean and coastal uses can have on one another. A range of cases of conflict over use of coastal areas were discussed, exemplifying the need for integrated management to address and mitigate the negative consequences of such conflicts and to safeguard coastal values. Lastly, the evolution of the ICZM concept was briefly depicted.

CHAPTER THREE

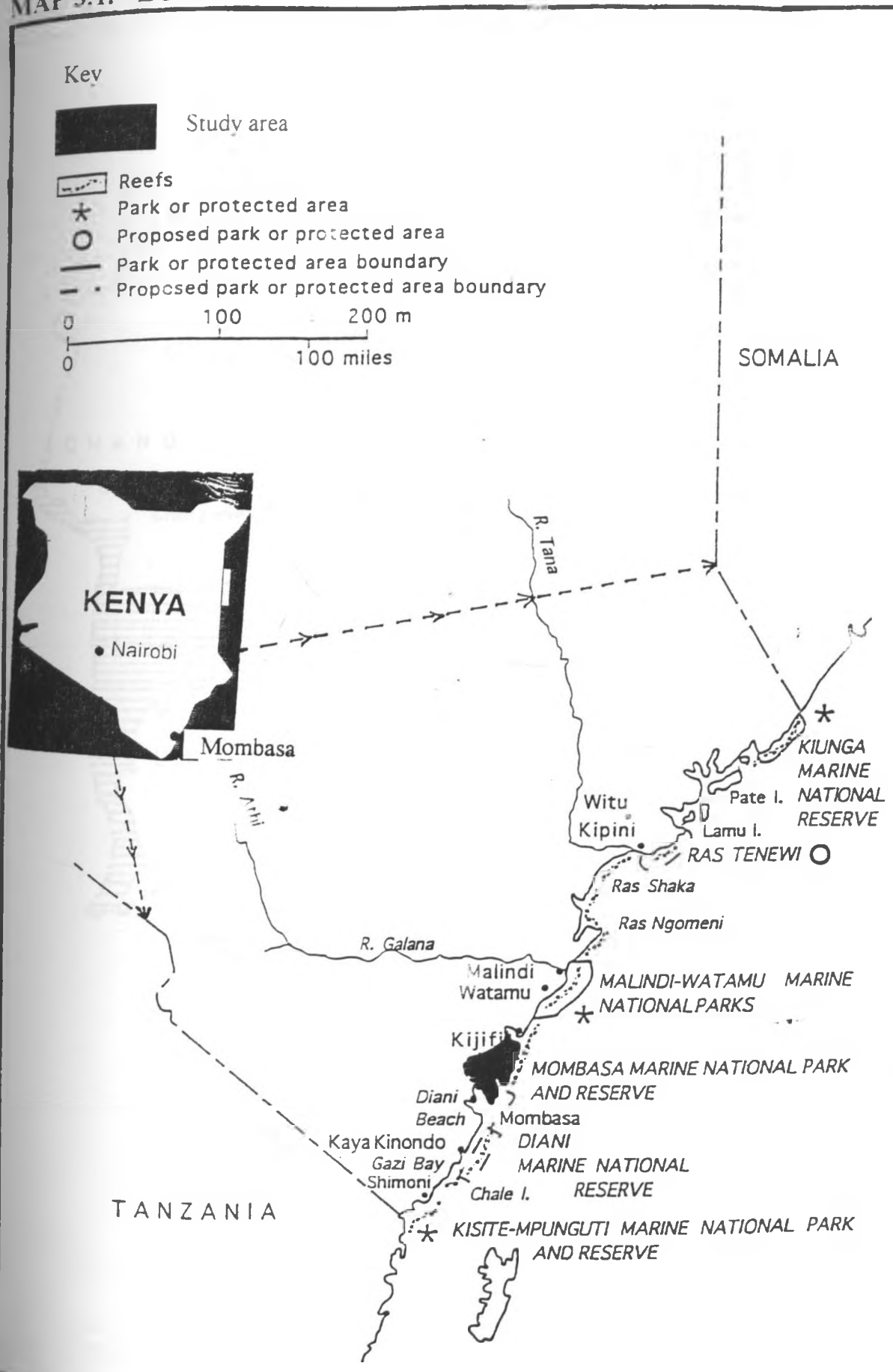
3.0 THE STUDY AREA

This chapter provides background information on the Nyali-Bamburi-Shanzu area. The location, topography and climate of an area plays a critical role in its development. This part details the areas physical characteristics, natural resources and their characteristics, as well as population and economic activities, their distribution and their numbers. It also examines the major trends that are taking place and are threatening the productivity of ecosystems and the long-term economic growth in the zone.

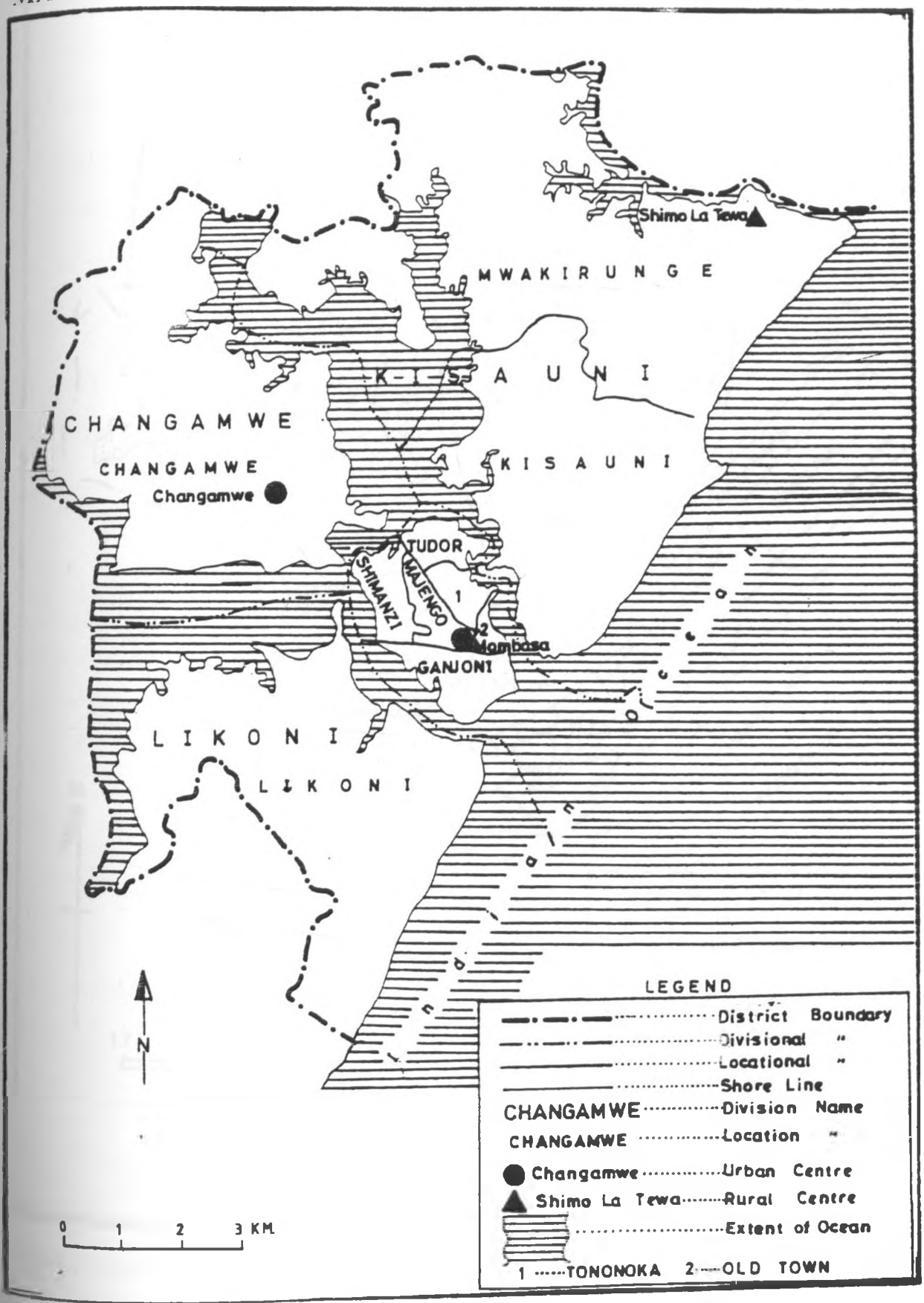
3.1 Position and Size

The Nyali-Bamburi-Shanzu area, popularly known as the North Coast, lies north of Mombasa along the Kenya coast (Map 3.1). This zone, covering an area of 126km^2 corresponds to the boundaries of Kisauni Division, Mombasa District (Map 3.2). It is bounded by the Tudor Creek on the southern end, Mtwapa Creek on the northern limits, the Indian Ocean to the east, and extending over the inland area to the west for about 5-8km (Map 3.3). The coastline from Tudor Creek to Mtwapa Creek stretches for some 15km (UNEP, 1998). The geographical location of the Nyali-Bamburi-Shanzu area determines two very important features, which influence the local character of the area. One is the long strip dominating its physical environment. The other is the close proximity to Mombasa, which creates a peri-urban relationship between the zone and Mombasa with the obvious employment and urbanization links and consequences for the coastal zone.

MAP 3.1. LOCATION OF THE STUDY AREA ALONG THE COAST

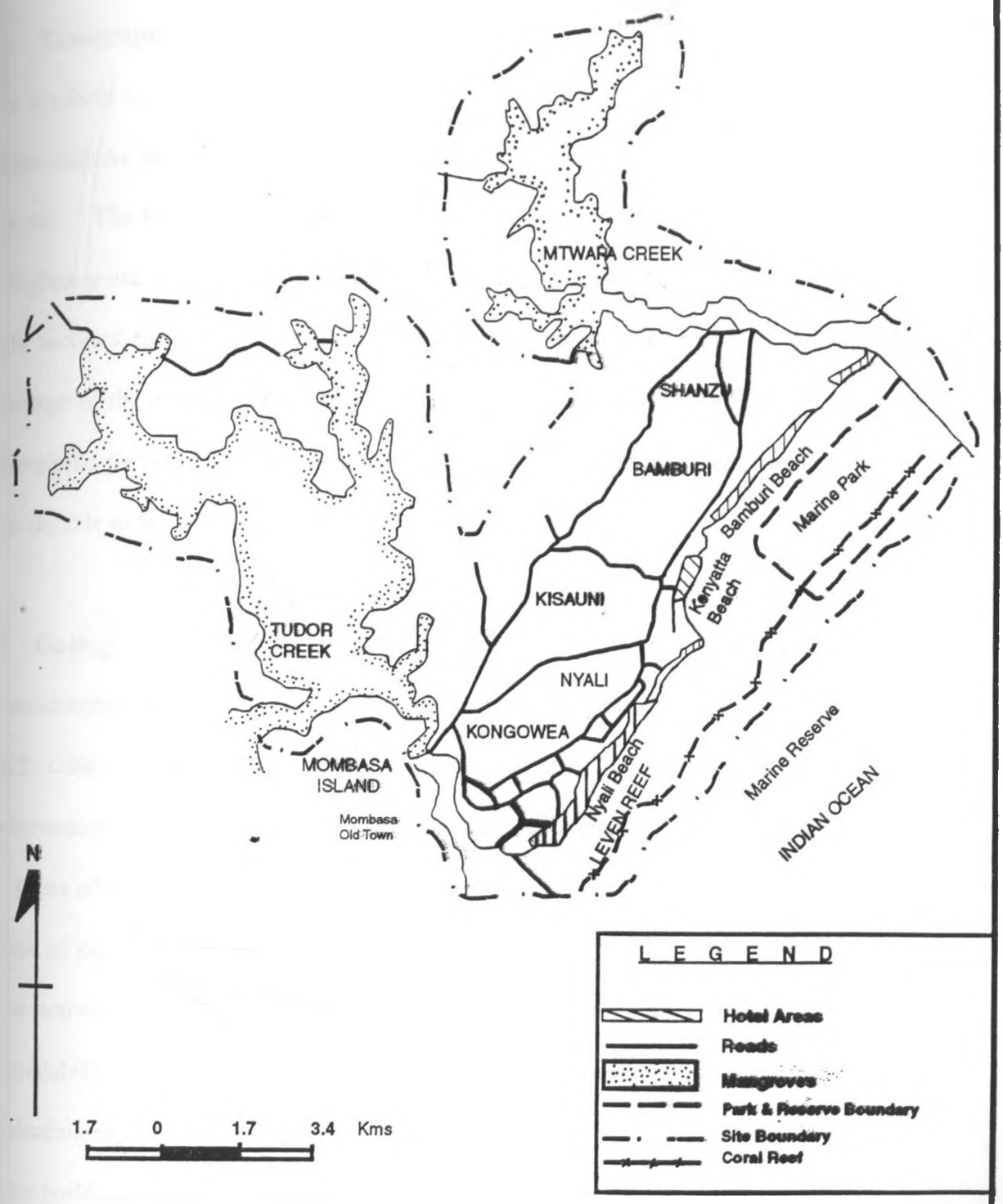


MAP 3.2 MOMBASA DISTRICT, ADMINISTRATIVE BOUNDARIES



Source: Field survey, 1999.

MAP 3.3: NYALI - BAMBURI - SHANZU AREA



Source: Field survey, 1999.

3.2 Physical Characteristics

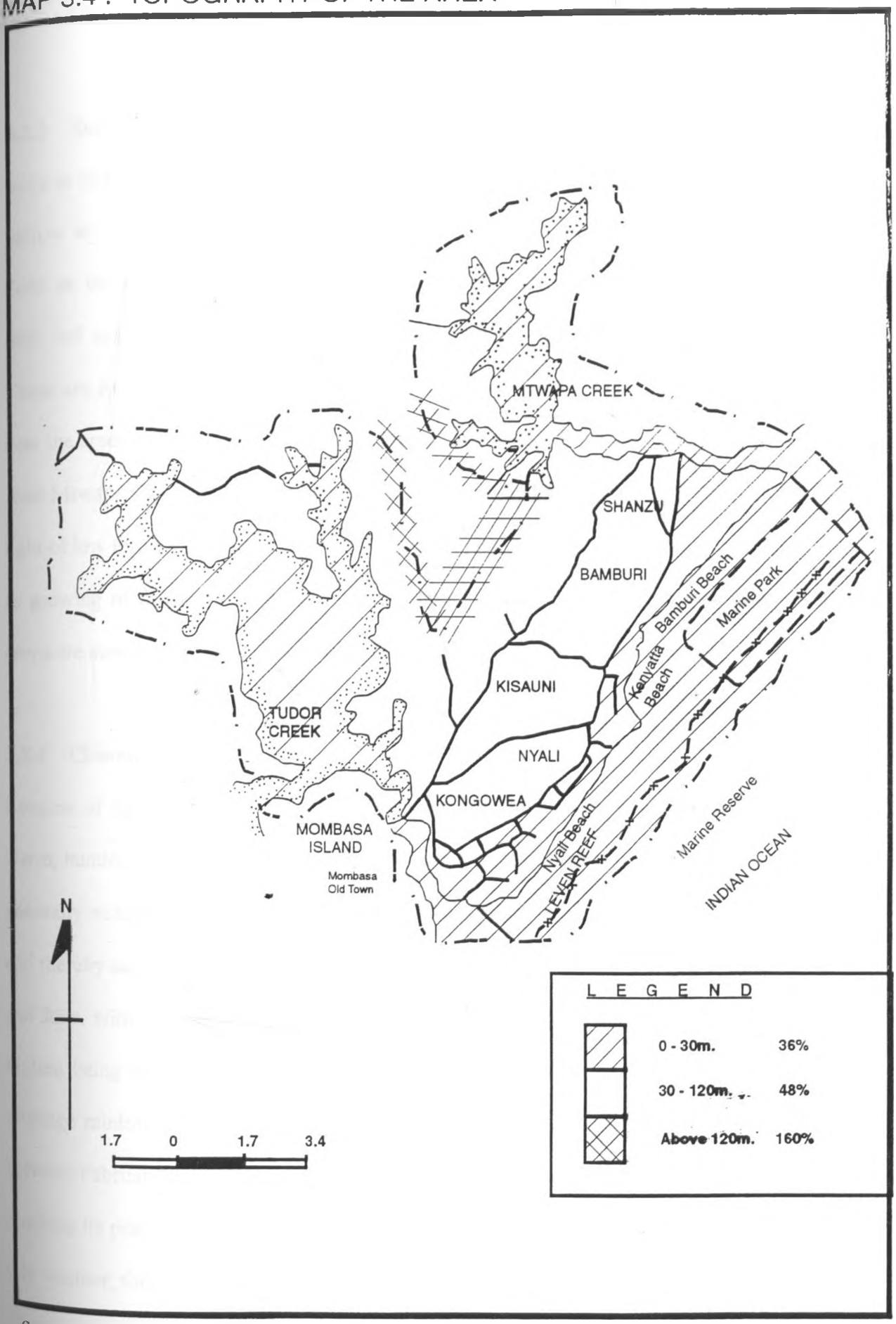
3.2.1 Topography

There are three main physiographic belts in the zone (Map 3.4). These are the Coastal Plain, the Foot plateau, and the Nyika Plateau. The Coastal Plain rises from sea level to 30m above sea level. The Foot Plateau occurs at an elevation between 30m and 120m above sea level. The highest point is Nguu Tatu Hills in the northern part, which rises to 123m above sea level. Gently inclined flat lands suitable for construction dominate the terrain. A considerable percentage of the area (48%) falls within altitudes of 30-120m, 16% falls above 120m, while the remaining parts (36%) of the area lie below 30m. The developments along the shoreline are vulnerable to storm and flooding, and rise in sea level.

3.2.2 Geology

The geomorphology of the Coastal zone is dominated by a series of raised old sea level terraces (UNEP, 1996). Due to its evolutionary history, the principal rocks observed in the zone are of sedimentary origin (UNEP, 1998). The coastal sedimentary rocks and coral reefs produce three types of beaches along the coastline: sandy beaches in Shanzu, the dazzling white sandy beaches of coral rock origin in Nyali and Bamburi, and the rocky beaches in areas where marine activity has failed to break the hard water-fronting rocks and cliffs (Kairu, 1990). The availability of limestones in Bamburi is the basis for the cement manufacturing in the area (Constantinides, 1993). Closer to the sea, coral reefs are found and provide an excellent base for building stones (UNEP, 1996). Many tourist hotels have been built along this zone and are responsible for making Mombasa an important tourist destination for both local and international tourists (Ruwa, 1993).

MAP 3.4 : TOPOGRAPHY OF THE AREA



Source: Field survey, 1999.

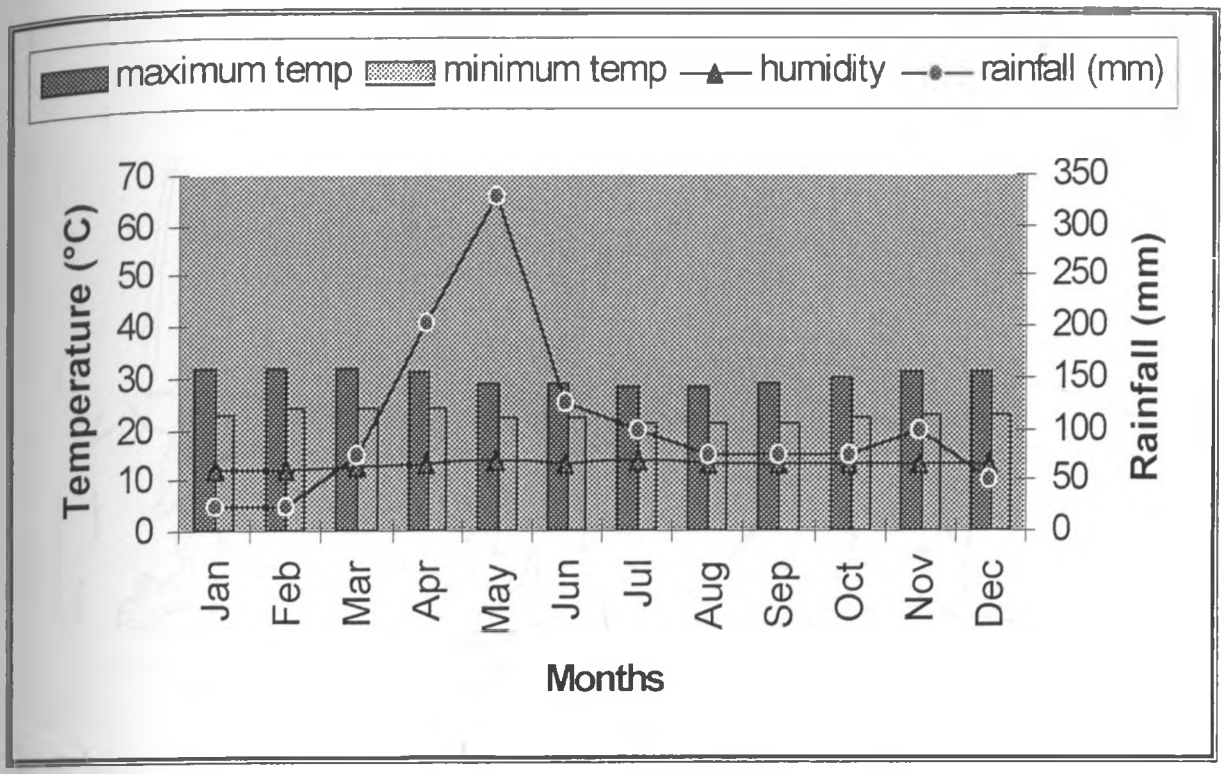
3.2.3 Soils

Soils in this zone show considerable variety. The principle soil types in the area include a narrow strip of coral rag permeated by a narrow band of grumosoils clay soils (UNEP, 1998). Soils on the coastal plain are a mixture of limestone with lagoonal deposits which are deep, dark red and sandy clay loam or sandy clay with top soil of loam sand (MDDP, 1997). These are found in Kisauni, Bamburi, Mwakirunge and Utange areas. The mangrove soils near the creeks are poorly drained and of limited fertility due to salinity (Njuguna, *et al*, 1992). Near Mtwapa Creek they tend to be heavy and moderately fertile, while near Makupa Creek are light of low fertility (Constantinides, 1993). Despite this characterization, the soils are suited to growing of fruits, but because of intense building activity within the zone, most of these crops are now being marginalized by house construction for residential purposes.

3.2.4 Climate

Because of its low altitude and coastal location, the climate of Mombasa can be said to be warm, humid, and moist, characterized by sudden changes of the weather (Figure 3.1). The generally straight shape of the coast ensures that onshore winds flow parallel to the coastline and thereby cannot penetrate further inland. Long rains occur between the months of March and June, with 60% reliability. Mean annual rainfall ranges from 580mm to 1016mm the highest being in May (330mm), the lowest in July (100mm) dropping to 25mm in February. Average minimum temperatures in Mombasa ranges from 21^0C in July and August to 24^0C between February and April. The relative humidity is comparatively high all the year round reaching its peak during the wet months of April and July. While farming is not favored by this weather, the tourism industry has benefited greatly from the sunny and dry weather in the coast.

Figure 3.1. Temperature, humidity and rainfall averages for Mombasa

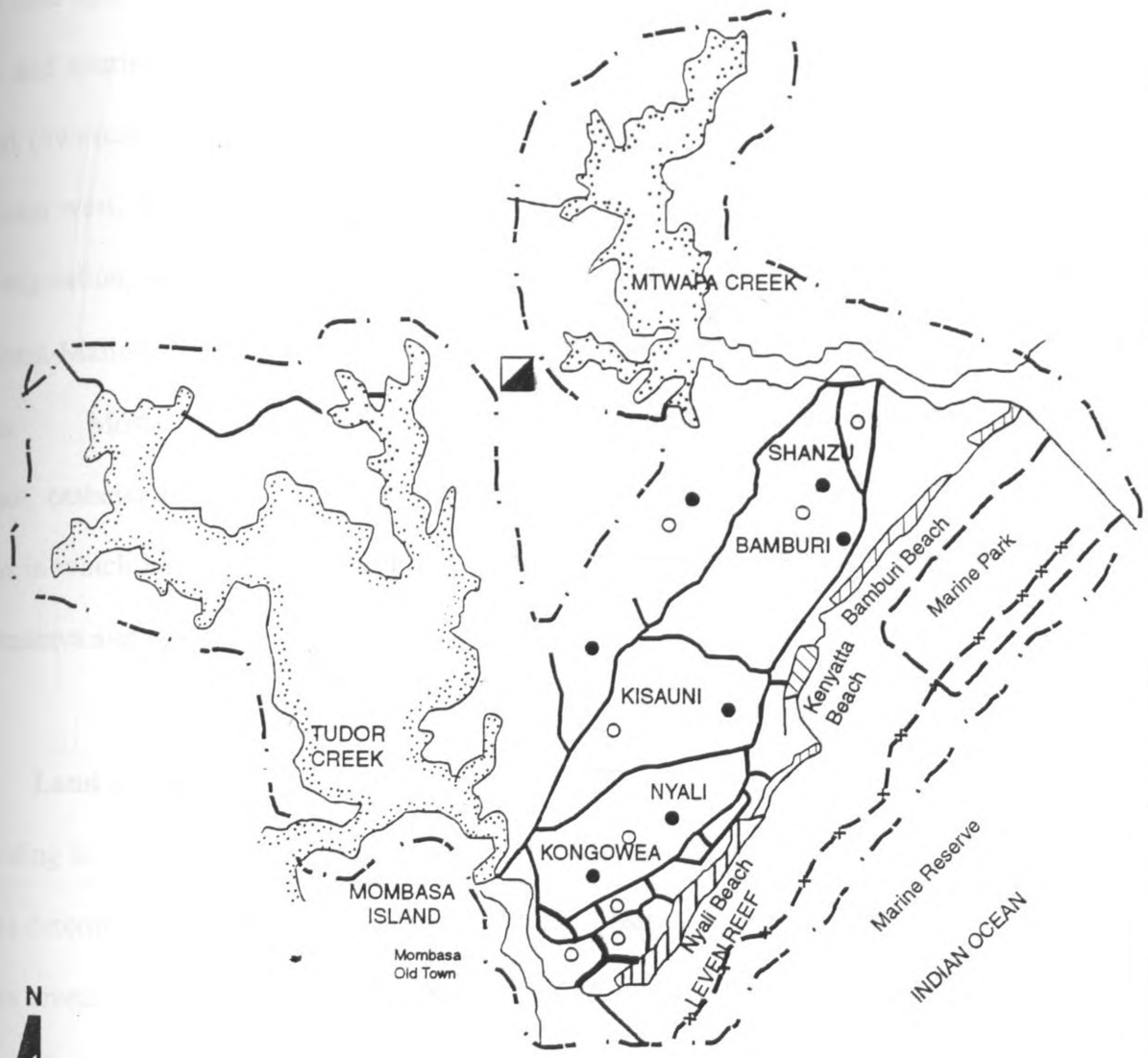


Source: United Nations Environment Programme, 1998.

3.2.5 Hydrology

The entire study area drains into the eastern part of the Indian Ocean. The zone is drained through small creeks running down ravines and small valleys, which extend near perpendicular to the shoreline. The main creeks into which water flows are found at Mtwapa and Mombasa west. These creeks have no permanent yield and usually dry up during the drier months depending on precipitation. Considering the amount needed for current let a lone the future demand, water that can be used for human consumption is relatively scarce. But due to the nature of the rock structure, the water table is high and sinking of wells and boreholes has led to improved water supply in the area. Map 3.5 gives the location of wells in the area. However, as both surface and groundwater sources are threatened by contamination, the protection of water resources is vital to the area.

MAP 3.5: WATER RESOURCES IN NYALI - BAMBURI - SHANZU AREA



Source: Field survey, 1999.

3.2.6 Vegetation

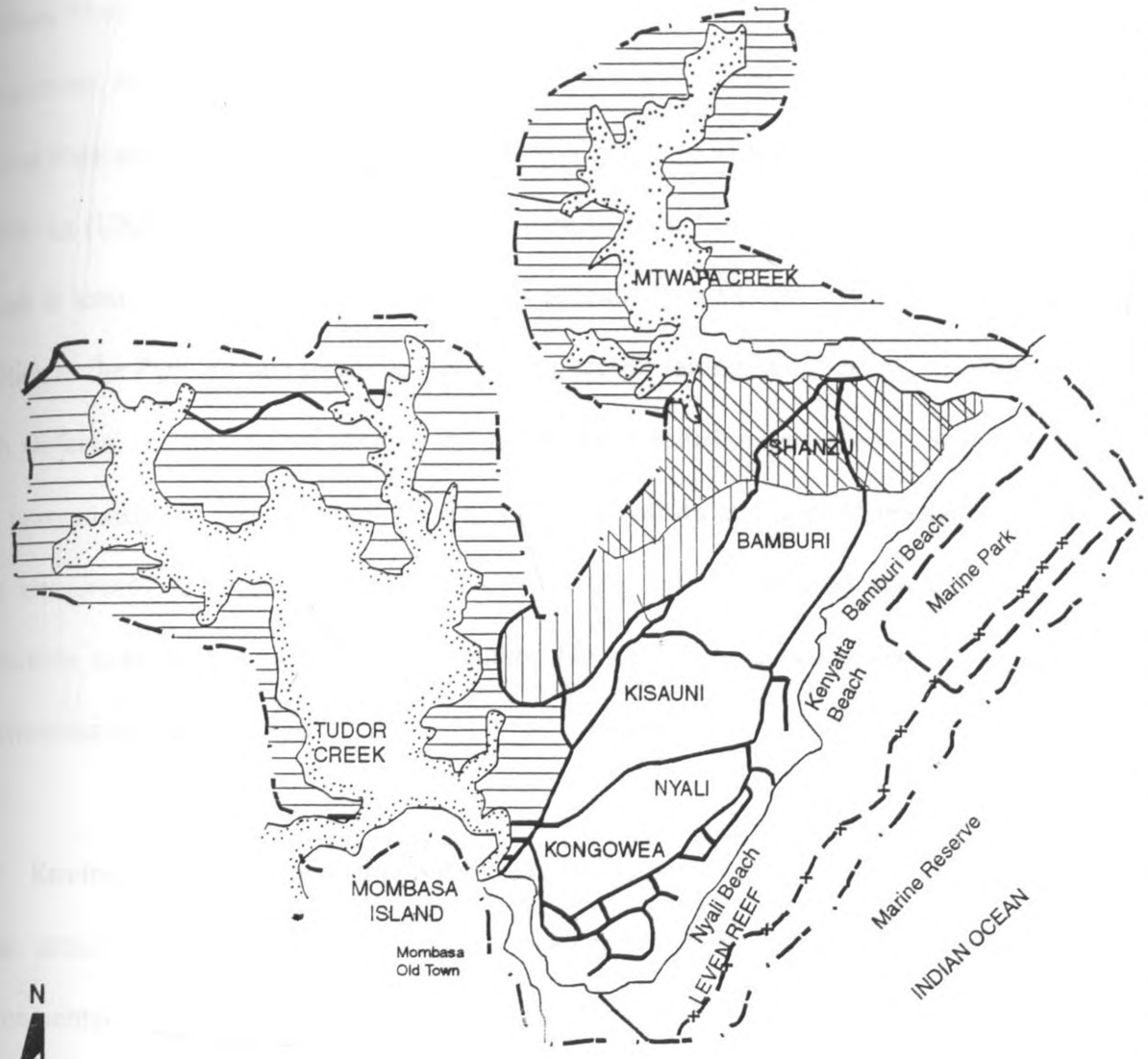
Some time ago, the area was deeply forested but owing to pressure from farming, settlement, urban and tourism development and the quest for building materials, vast areas have been cleared (Swazuri, 1996). However patches of mangroves are found around tidal creeks at Mombasa west, Mtwapa and Mwakirunge. Next to these mangrove zone is woodland and bush vegetation, with some evergreen and deciduous trees. Further westward of the new Mombasa-Malindi Road, one finds thick bush composed of small shrubs and trees, grass and bushes. Most of this land has been cleared to grow crops like maize, fruits and vegetables, coconut, cashewnuts, etc. Further northward, the thick bush gives way to the Nyika dry bushes in which baobab trees dominate. This area supports livestock rearing interspersed with cassava and maize.

3.2.7 Land capability

According to available data, the soil units[3] in the area can be divided into five (5) capability classes determined according to their potential for cultivation. Although the analysis of these classes reveal that most of the area is severely limited to cultivation, still there are considerable areas with minor limitations to cultivation where the choice of crops raised is relatively large. As shown by Map 3.6 the areas with the highest agricultural potential are those which are attractive for tourism development and growth of Mombasa urban agglomeration. Much of this land is found in Mtwapa amd mwakirunge areas. This land, particularly, that at Mtwapa has already been earmarked for various developments. This, coupled with the need to protect these valuable land resources, speaks in itself, of the limitation for the future urban and tourism growth.

[3] These soil units are characterized by a unique combination of properties that distinguish them from one another (soil type, structure, slope classes, deepness, erodability class, limitation factors, etc.

MAP 3.6: LAND CAPABILITY CLASSES



Source: Field survey, 1999.

3.2.8 Areas of outstanding natural value

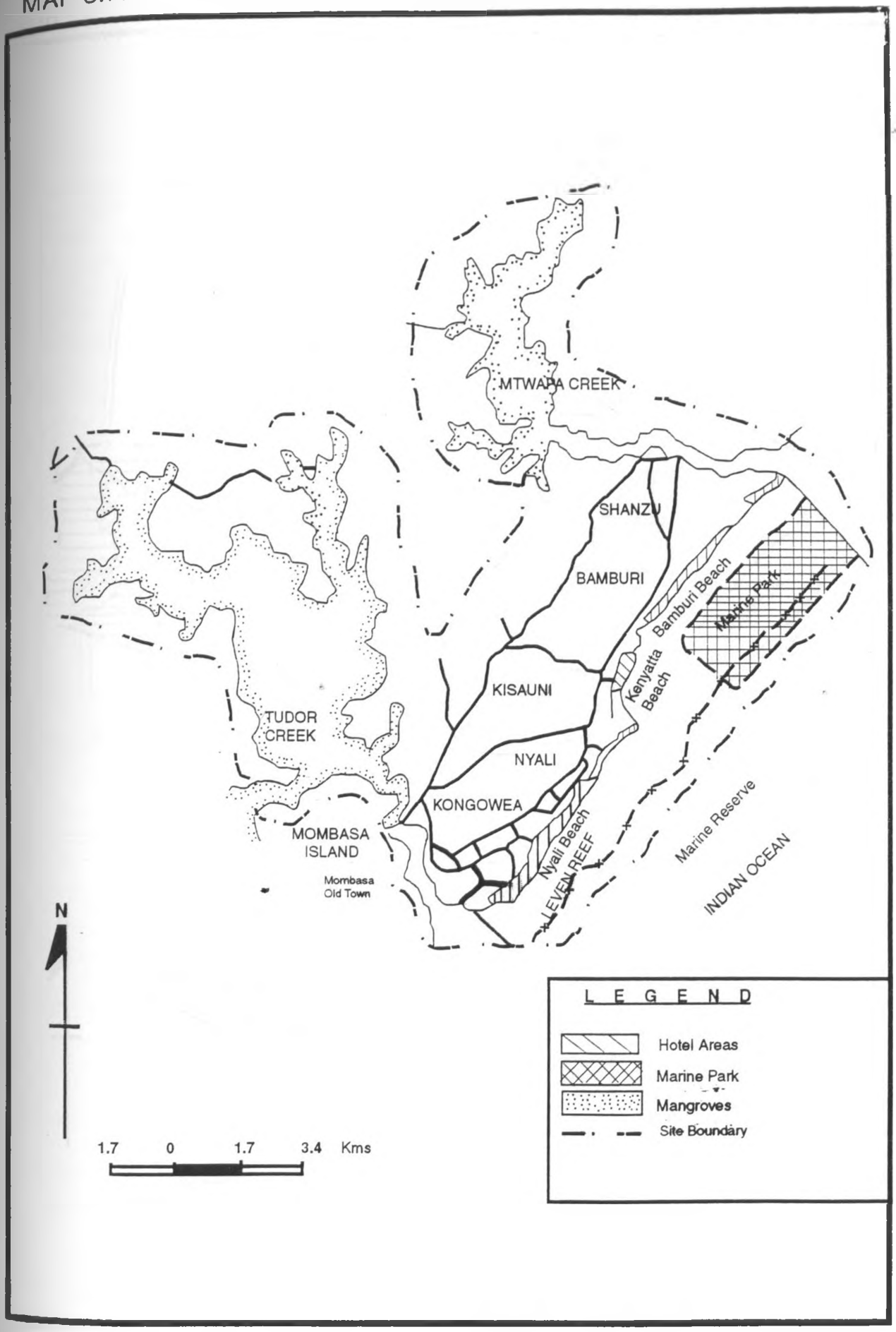
There are two main areas of natural value in the area as shown in Map 3.7. One, the Mombasa Marine National Park and Reserve established under the Wildlife Conservation and Management Act, in 1986. The other is mangrove forest area. The Mombasa Marine National Park and Reserve, located between Nyali Creek and Mtwapa Creek covers an area of 200,000 ha (UNEP, 1986). The Reserve can be reached from the Mombasa-Malindi Road through at least 19 hotels, which have frontages onto the Park beach. Common recreational activities in the Park include goggling, snorkeling, jet-ski sailing, windsurfing, sun bating, and beach walking. These aesthetically and functionally valuable resources must be protected from unregulated use and pollution. These spatial entities and sites of outstanding natural value are already protected, while others should be properly evaluated and protected from undesirable uses with a view to maintaining the ecological balance and enhancing the attractiveness of the landscape.

3.2.9 Environmental zoning of the NBS area: asynthesis

So far, natural resources of the Nyali-Bamburi-Shanzu area have been analysed as separate environmental issues. These natural features can be integrated and categorized on the basis of cumulative effects into zones of different "environmental characteristics" and "development opportunities" for a set of land-use options (urban development, agriculture, tourism, etc.). Using the environmental objectives shown in Table 3.1, the zone can be divided into five broad zones showing different sensitivity to land-use options.[4] These zones are marked in Map 3.8 by letters A, B, C, D, and E.

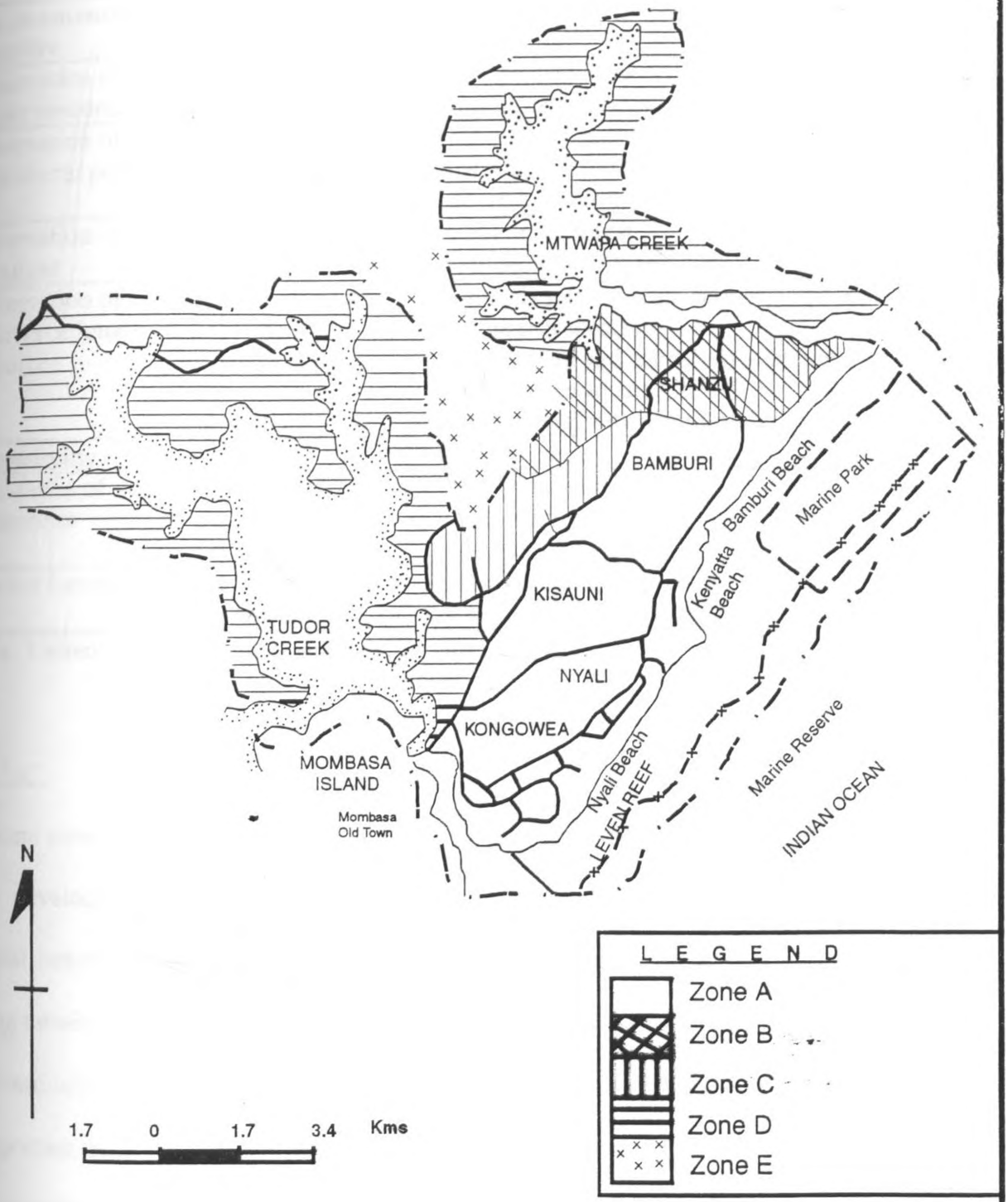
[4] Environmental zones are determined by overlaying all factor maps showing individual constraints and their ranking, and by delineating areas within which the environmental characteristics are more or less homogeneous.

MAP 3.7: AREAS OF NATURAL VALUE



Source: Field survey, 1999

MAP 3.8: ZONES SHOWING DIFFERENT SENSITIVITY TO LAND-USE OPTIONS



Source: Field survey, 1999.

Table 3.1 Environmental objectives and related natural factors used in the categorization of the area into zones

Environmental objective	Related natural factors	Ranking of attributes by degree of constraints
Preservation of water supply resources	Catchment areas	In catchment areas Outside of catchment areas
Preservation of agricultural potential	Land capability	Minor limitations to cultivation Marginal to cultivation Severe limitations to cultivation
Preservation of forest resources	Existing forestry	Areas under forest Potential priority areas for afforestation
Preservation of fishing and recreational resources	Natural identity	Wetlands serving as nursery grounds for marine fish species Natural plant and animal associations significant to aquatic life Areas in relatively natural state
Accessibility	Relief	Altitude zones
Avoidance of slope constraints	Site slope	Steeply dissected terrain Steep or hilly terrain Other terrain
Erosion hazards	Susceptability to erosion	Areas of high susceptability Areas of moderate to low susceptability

Source: United Nations Environmental Programme, 1986.

Zone "A".

The zone covers about 48% of the Nyali-Bamburi -Shanzu area. It can been designated for urban development without serious difficulties in terms of costs required for overcoming physical constraints for development. This zone includes accessible, flat and/or gently sloping terrain up to the altitude 120m. In terms of incidence of the factors that render this zone unsuitable for urbanization, it is observed that major aquifers and the productive soils are an important value and thus a constraint to urban development. In other words, much of the land suitable for urbanization in this zone is also highly productive agricultural land. There, any development that generates toxic wastes, biological discharges or sewage should be discouraged.

Zone "B"

Zone "B" includes the flat and non-consolidated fertile alluvial plain with a water table close to the surface. This zone, particularly in Shanzu is more suitable for agriculture than for urban development.

Zone "C"

Zone "C" covers a steeper sloping area, difficult for construction of residential structures. This zone is categorized as an area of limited opportunities for intensive urban development. It is suitable for afforestation and recreation rather than agriculture. This area, around Mwakirunge and Maunguja, when properly afforested will be able to support low- to middle-density urban development, particularly in its low-lying parts.

Zone "D"

In its larger part, zone "D" covers the wetland areas and saline non-consolidated soil which are suitable neither for agriculture nor construction. This zone is mainly found next to the mangrove swamps, such as Tudor Creek and Mtwapa Creek. This zone is a habitat for a variety of flora and fauna species, important for aquatic life. It should therefore be preserved in its natural state.

Zone "E"

Zone "E" is a high terrain surrounding the Mombasa agglomeration starting from the Nyika plateau. Erosion and run-off are the principal problems in this zone, making it unsuitable for development and cultivation. The conservation efforts must therefore be focused on the preservation of the natural vegetation cover (forests) because of its role in diminishing run-offs, reducing erosion and sedimentation as well as in sustaining wildlife.

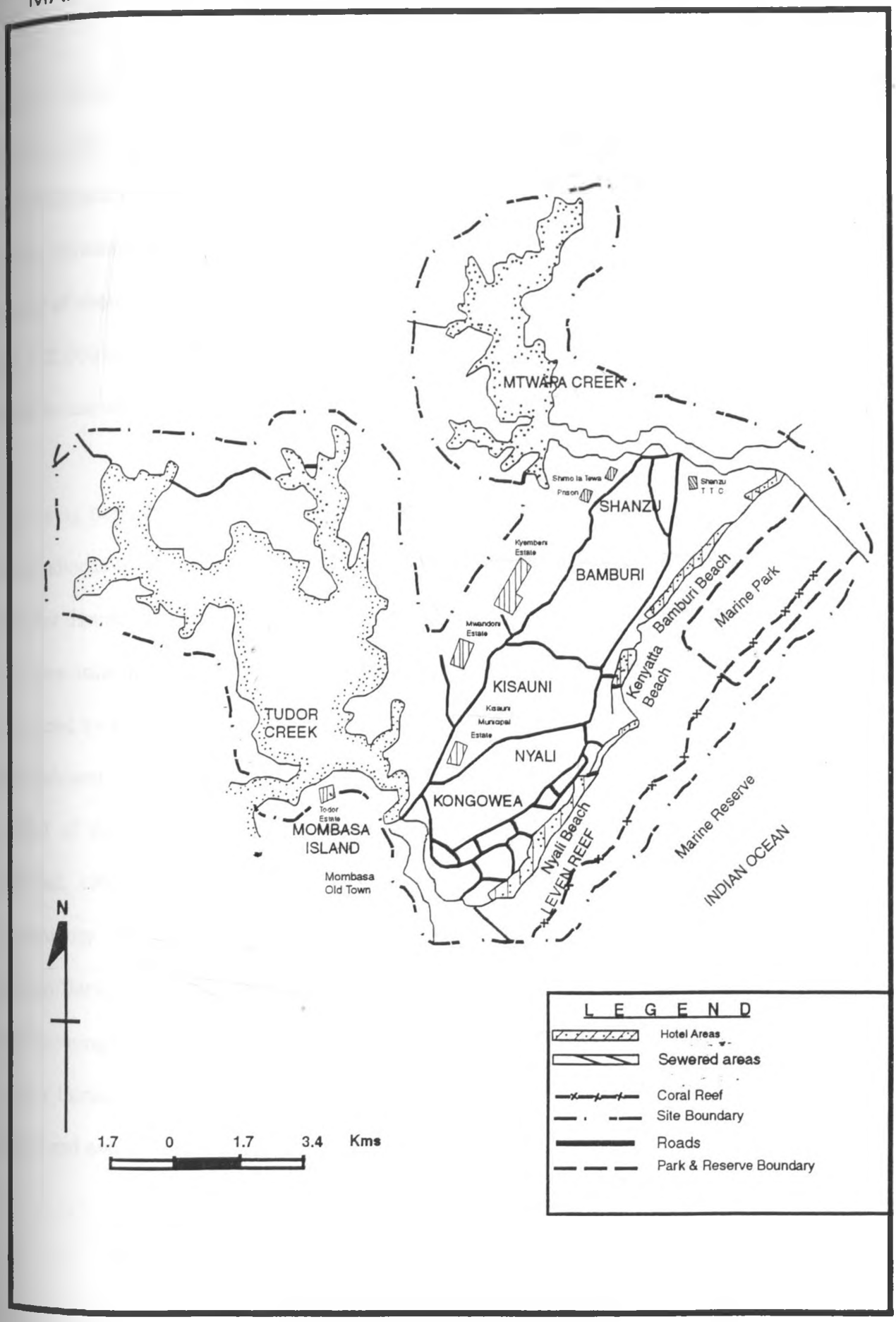
3.3 Physical Infrastructure

During the last 20 years, the Nyali-Bamburi-Shanzu area has seen dramatic growth in the tourism industry and the development of residential buildings. Rapid growth in population spurred by tourism and other commercial and industrial activities has resulted in urbanization. This has created additional demands on already inadequate public services and infrastructure components such as water, roads, electricity, and sewage system. Tourism, commercial and residential development, urbanization pressures and uncontrolled land use changes place a significant strain on existing services and infrastructure in the area. Map 3.9 shows the coverage of the available trunk infrastructure. Uncontrolled development and the inability of public services and infrastructure to keep pace with development threaten the environment and continued economic prosperity, public health and the quality of life of residents.

3.3.1 Roads

Roads which provide the main means of access and linkage are barely enough in the area. The principal major road in the zone is the Mombasa-Malindi Road. Sprawling roadside shops and stands are situated very close to the roadway and presents significant safety hazards. The network from the Mombasa-Malindi Road to the east (i.e., the ocean-side) is well developed unlike in the western side. There are 54kms of tarmac serving the coastal waterfront, and 78 km of murram. Apart from the main trunk road, few other roads serving busy tourist areas (Nyali and Bamburi) have paved roads to the beach, the rest of the areas have no roads. But as rapid development takes place, and the increasing demand for more of these facilities, it will become necessary to expand them.

MAP 3.9 :INFRASTRUCTURE FACILITIES IN THE AREA



Source: Field survey, 1999.

3.3.2 Water facilities

Since the late 1960s when the town of Mombasa entered the period of rapid urbanization and industrialization, the water resources of the coastal area have been used mostly for urban water supply (Mwanguni, 1999). The Nyali-Bamburi-Shanzu zone receives an intermittent water supply of about 35,000m^3 against an estimated demand of 90,000m^3/day during the low season and 120,000 m^3/day during the high tourist season (CDA, 1996). There has recently been a move to use boreholes and water supply tankers to make up the shortfall.

The rising population creates increased demand for freshwater. Concern is growing about water allocation decisions (Table 3.2). Municipal users, particularly tourist hotels and the affluent households in Nyali use more than 75% of the piped water (Mwanguni, 1999).[5] The low-income groups use water sparingly though their efforts do not match the wastage exercised by the affluent groups. There is also concern over groundwater contamination, as groundwater is increasingly relied upon as an alternate source for human use. A majority (68%) of the low-income groups in the zone have very limited access to portable water (Swaleh, 1999). About 80% of the water come from groundwater sources (wells and private or community boreholes) and tanker supplies, while the remaining 18% come from Sabaki/Baricho Water Supply. Moreover, the water supply system still suffer from certain shortcomings with regard to both coverage and quality, which is a consequence of the public sector having difficulty to keep the water supply and infrastructure provision at pace with the rapid and extended urban growth.

[5] They have also constructed underground water tanks, which once they get filled up, cause the pressure in the reticulation system to drop thus necessitating permanent artificial water shortage in the neighbouring areas.

Table 3.2 Use of portable water in the area

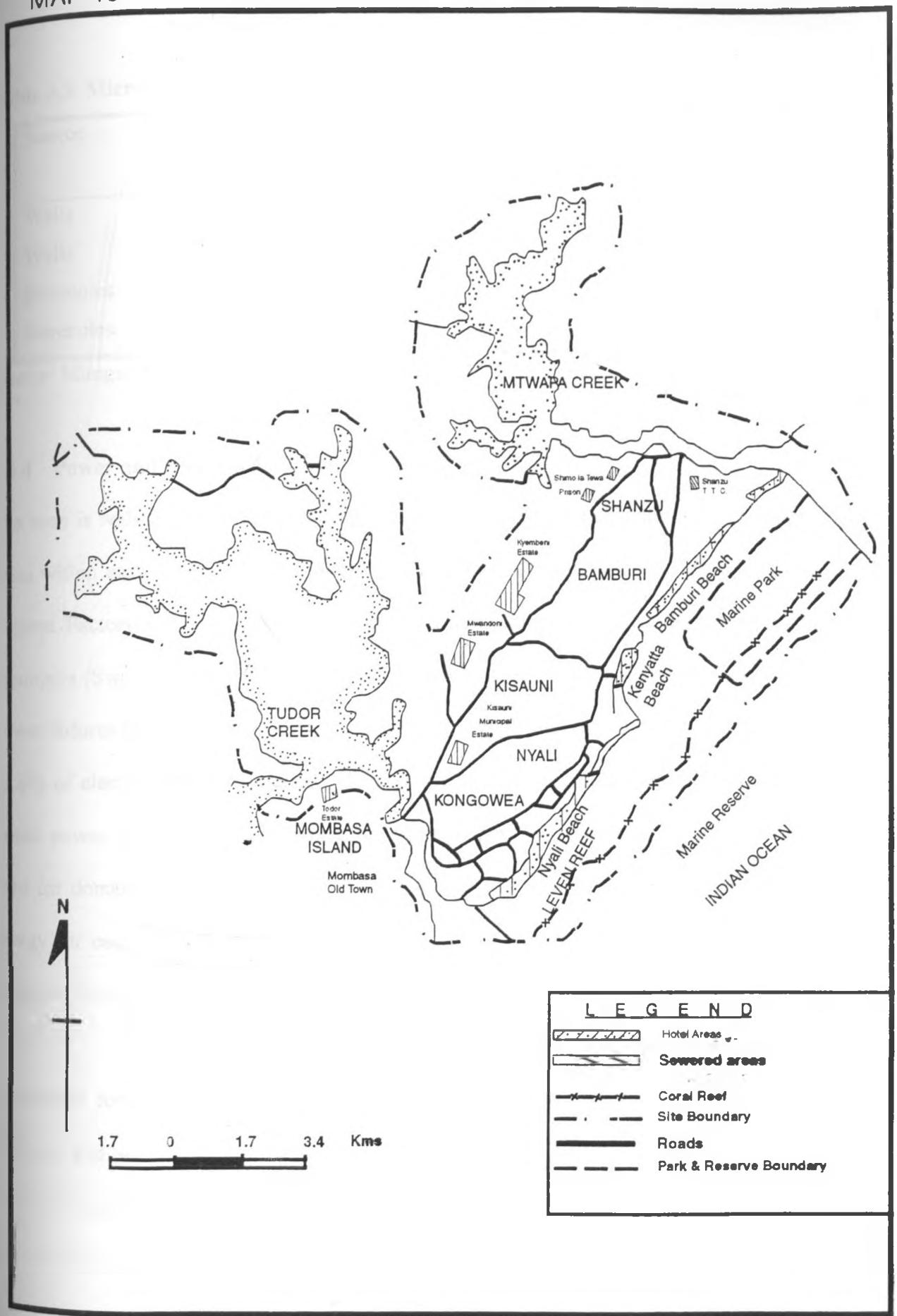
Use Category	Hotels	Households		Industries
		High income	Low income	
Cooking and drinking	100%	100%	100%	-
Laundry/washing rooms	90%	100%	30%	10%
Sprinkle gardens	80%	75%	-	27%
Fill swimming pools	80%	15%	-	-
Flush toilets	80%	100%	-	30%

Source: Mwanguni, 1999.

3.3.3 Sewage services

As shown by Map 3.10, less than 3% of the Nyali-Bamburi-Shanzu area is covered by the sewerage network. This network serves less than 10% of the population (Mwanguni, 1999). The problem of sewerage disposal is by septic tanks/soakage pits (16%) and pit latrines (74%) (UNEP, 1998). When full, these systems are emptied by commercial exhausters and the waste illegally disposed at the Kibarani dumping site or emptied directly into the sea under the cover of darkness (Mwanguni, 1999). Table 3.3 indicates that increasing density of development and reliance on septic tanks/soakage pits and pit latrines for disposal of wastewater has resulted in contamination of groundwater supplies by coliform bacteria and increases the potential for dangerous pathogens such as cholera and typhoid entering the water supply system (Munga *et al*, 1993). However, the greatest problem of the existing sewage system lies in the present wastewater disposal practice: they are being dumped directly into the ocean without any pre-treatment.

MAP 10 : SEWERED AREAS IN NBS AREA



Source: Field survey, 1999.

Table 3.3 Microbial contamination of well and borehole water in Mombasa

Source	Number	Coliform count per 100ml	E.Ecoli count per 100ml	Portability
Wells	20	25-1800+	0-1800+	No
Wells	3	0-4	0	Yes
Boreholes	11	17-1800+	0-5	No
Boreholes	1	0	0	Yes

Source: Munga *et al,* 1993.

3.3.4 Power and telecommunication

The zone is well served with power distribution with virtually all-economic and high potential areas within easy access of the network. The most demanding power units are Bamburi Cement Factory and tourist hotels, whilst the least supplied areas include Mwakirunge and Maunguja (Swaleh, 1999; Swazuri, 1999). Experiences in voltage fluctuations and frequent power failures have been associated with inadequate supply and overloading. The unreliable supply of electricity and the frequent fluctuations have forced hotels and other consumers to install power generators to supplement the power supply. Charcoal, which is commonly used for domestic cooking, is imported from Kwale and Kilifi. Woodfuel as a source of energy for cooking is found in the mangrove forests. Solar energy, which has a great potential, is yet to be exploited.

As regards communication, the networks originate from Mombasa Island. Nyali, Kisauni, Bamburi and Shanzu are well served by a series of a cabinet distribution point carrying a total of 648 channels in optical floor cables in two exchange units (Swaleh, 1998). Because of the increasing demand in the tourism industry, there is need for additional lines.

3.4 Socioeconomic Characteristics

3.4.1 Population growth

A continuing increase of population in Kisauni Division has been a main demographic feature in the recent past. Over a period of 10 years (1989 to 1998) the population grew more than twice, from 163 thousands to close to 255 thousand (Table 3.4). The average annual growth rate recorded over the intercensal periods of 10 years varied from 6.3% to 6.6% over 1970 and 1980 and dropped below 6.0% over 1990 and 1995 period. The notable difference in growth rates between 1970-1980 and 1980-1990 periods suggests that the rate of population increase is gradually declining. However, it has been (and still is) considerably faster than that in the other divisions in Mombasa, which has in the last years been growing at a rate of 5.0% (MDDP, 1997). Assuming that the population will grow at a similar rate to that of Mombasa, this population is projected to increase beyond 400 thousand by the year 2010.[6]

Table 3.4. Size of population, population changes and projection, 1989-2010

	1989	1990	1995	2000*	2005*	2010*
Kenya	21,449,636	23,715,658	25,236,421	28,789,178	31,561200	34,404,784
Mombasa	461,753	586,337	640,762	772,109	1,019,419	1,252,278
NBS Area	163,968	176,326	211,452	254,796	336,416	413,252

Notes. * *Projected figures*

Source: Mombasa District Development Plan, 1997-2001, Economic survey, 1996 & 2000.

[6] The population was projected using the following formula:

$$P_n = P_0(1+r)^n$$

Where:

P_n = Projected population
P_0 = Present population
r = rate of population growth
n = number of years

The overall increase of population in the area has been influenced by the positive values of both migration and natural population growth. Regarding the natural growth, it should be noted that the socioeconomic conditions prevailing in Mombasa have been particularly conducive to the fertility rate decline. According to reliable approximations, the total fertility rate over a 10-year period (1989-1998) declined from more than 6.5 (children per mother) to 3.5 – a trend generally characteristic of the latter stages of the demographic transition.

Although, the natural increase made a sizable contribution to the area's population growth, the role of migration has been quite influential due to its long-term multiplicative effect on coastal population growth. A large portion of these migrants comes from the hinterland parts of the coastal region. While the coast as a whole is caught up in a vortex of rapid population growth, the coastal corridor along Mombasa north mainland will most likely reach saturation or exceed the area's carrying capacity soon if current growth rates continue. Clearly, the tendency for a greater number of people to migrate to Mombasa is exerting serious pressure on the area that could put productivity and usefulness of these resources at risk and the prospects for sustainable development greatly jeopardized: agricultural land will be cleared for new housing construction, overcrowding in low-income housing areas, increased wastewater discharge, overuse of common resources, etc.

A part from the intra-regional migration process, migrants from other regions of the country have also moved to the area (approximately, 22% of the total migration flows), due to the "pull" factors present there (job opportunities, possibilities of investment, better living conditions). In view of that, it is important to note that the hinterland area influencing development processes in the zone actually extend well beyond the boundaries of the coastal

region, wherefrom, due to poor conditions of life, people continue to migrate to larger cities, Mombasa being one of the most popular destinations.

The migration pattern has over the years been characterized by a selective inflow of the predominantly younger population having a strong impact on the general features of the age structure of the population. Nowadays, the age profile of the area's population speaks of a strong prevalence of young adults: 55% are below 25 years, 30% are between 26-60 years, whereas only 15% are over 60 years (Table 3.5). Taking into account the long-run effects often called "population momentum" this young-age population is a guarantee that the number of births will be relatively large, even if fertility rates continue to decline.

Table 3.5 Age profiles of NBS population 1989 and 1995 (% shares of age-group).

Age Groups	Age Groups (%)		
	1989	1995	Index
0-19	42.80	40.00	93.48
20-29	16.73	20.24	120.99
30-59	32.67	33.09	101.29
>60	7.80	6.67	85.46
OAC	0.18	0.166	91.42

Note: OAC –Old-age coefficient (>60 / 0 -19)

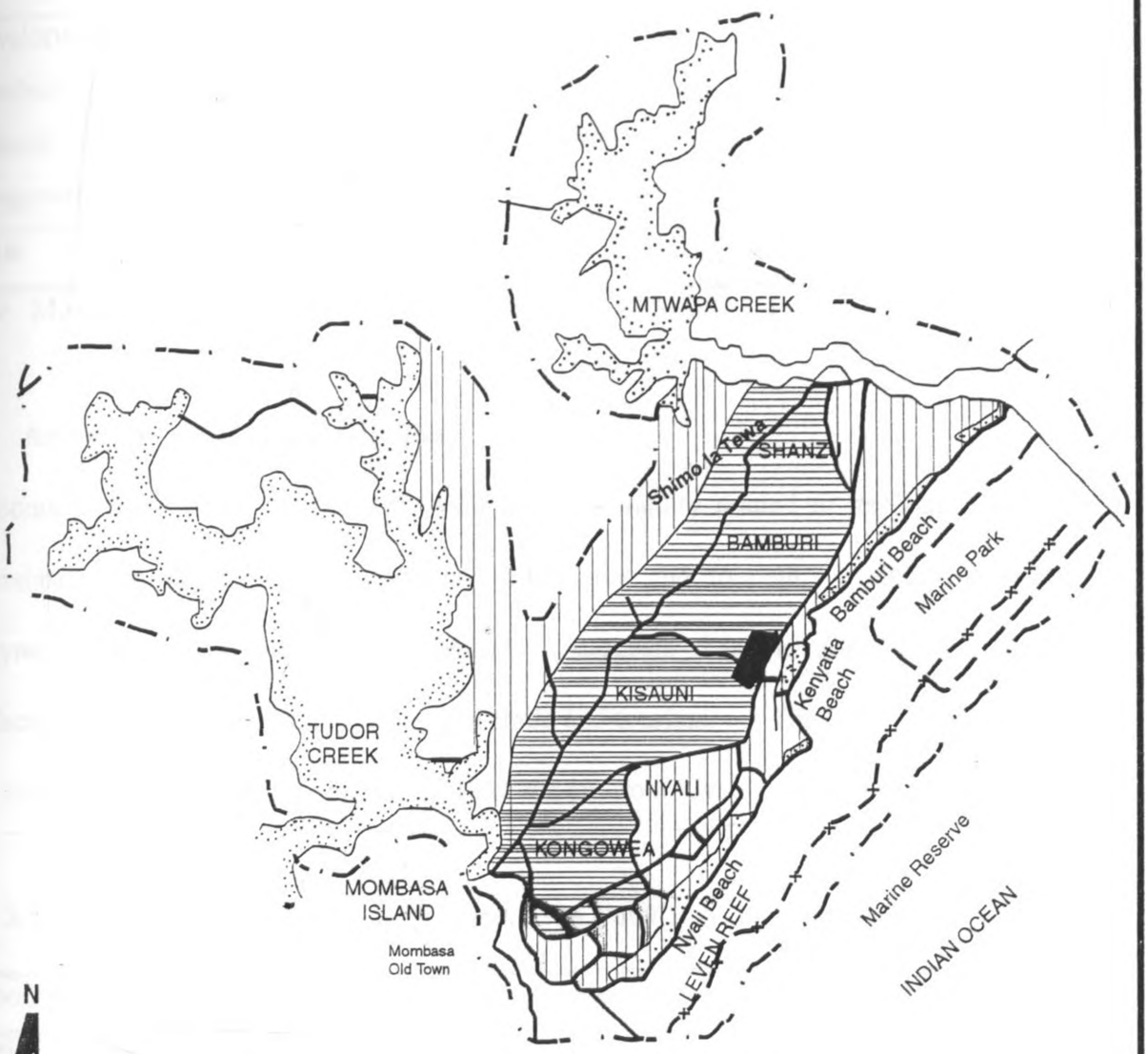
Source: Population Survey, 1989; Mombasa District Development Plan, 1997

3.4.2 Population distribution

Today, the Nyali-Bamburi-Shanzu area has a population estimated at about 255,000 and is not evenly distributed. Three population zones are discernible (Map 3.11). The "hinterland" area covering Mwakirunge, Maunguja, Magongoni, and west of Utange have low population densities owing to the predominance of subsistence farming and some plantation agriculture practices. In the larger part, the middle zone is heavily settled and it runs from Kisauni to Utange, Bamburi, Kiembeni, Freetown, and Kongowea. This narrow belt (i.e., Kongowea-Kisauni-Bamburi axis), accounting for less than 30% of the landmass of the area, houses almost 80% of the zone's population (Swaleh, 1999). This density reflects the very high intrinsic rate of growth in the zone and location of many economic activities. On the other hand, the zone next to the ocean, running from Nyali to Mtwapa, is lightly settled. The low density on the oceanfront lands reflects the existence of high-class low-density residences. In this zone, are also found the tourist resorts.

Table 3.6 indicates that this coastal zone is heavily urbanized, with the average population density of more than 2,500 persons per square kilometer. Such density indicates that the future regional development and population distribution can no longer be based on the persistence of the existing process of polarization. Quite the contrary, the slower pace and the decreasing rate of population growth, particularly after 1992, could be a signal indicating that the area is approaching its saturation in terms of physical occupation of space. On the other hand, the recorded relative growth rates of the surrounding urban centres (Kilifi, Mtwapa) could be a signal that the region's development has reached the turning point at which polarization trends give way to an intra-regional dispersion.

MAP 3.11 : POPULATION DISTRIBUTION IN THE AREA



Source: Field survey, 1999.

Table 3.6 Average densities of population, Kisauni Division, 1998

Location	Estimated Population	Number of Households	Area (km^2)	Density
Mwakirunge	2,726	852	47	58
Bamburi	43,998	7,947	32	1,375
Kisauni	111,823	33,967	31	3,703
Kongowea	82,979	24,783	16	5,186
Total	244,526	67,549	126	2,580

Source: Mombasa District Development Plan, 1997-2001; Swazuri, 1999.

3.4.3 An outline of economic activities

The economic base of Nyali-Bamburi-Shanzu area is mainly related to its coastal location. The mainstay of the economy is maritime commerce and tourism. But, the sectoral employment structure represented in Table 3.7 suggests that the zone has a powerful manufacturing industry and highly developed trade and tourism. The latter depends heavily on the rich ecosystem diversity and the health of the environment.

Table 3.7. Population by industry and sector, 1998 ('000')

Economic activity	Kenya	Mombasa	NBS
Agriculture, forestry and fishing	308.8	-	12.2
Mining and quarrying	5.0	-	4.1
Manufacturing	216.9	31.0	5.0
Building and Construction	78.3	6.3	4.8
Wholesale, retail and hotels	150.7	21.7	13.4
Transport and communication	85.0	30.6	7.1
Finance, Insurance and Real Estate	84.0	13.3	6.1
Community, Social and Personal services	712.2	48.7	10.2

Source: Economic Survey, various issues; Swazuri, 1999; Swaleh, 1999.

Wage income generated from the tourism sector form the main source of local income supplemented by peasant-type subsistence farming and other part-time informal work in repairs, petty trading, fishing and related services (Table 3.8). It is important to stress that tourism income trickles down to the local household stimulating new spending both in and outside the local area. The Nyali-Bamburi-Shanzu area draws its employment from tourism, industrial employment, business, agriculture and fishing, and transport sector services. All activities are secondary and most of them indirectly connected to tourism.

Table 3.8. Total earning by sector, 1996 (K£ million)

Sector	National	Mombasa	NBS
Transport and Communication	55.5	23.8	10.2
Manufacturing	91.2	17.0	2.9
Community services	130.0	13.1	1.3
Wholesale/retail/trade/restaurant	61.8	8.6	1.2
Finance/Insurance	58.5	5.3	0.4
Construction	31.7	5.0	0.8
Agriculture/Forestry	10.5	0.7	0.1
Mining/Quarrying	0.5	0.2	0.1
Total	**439.7**	**73.7**	**17**

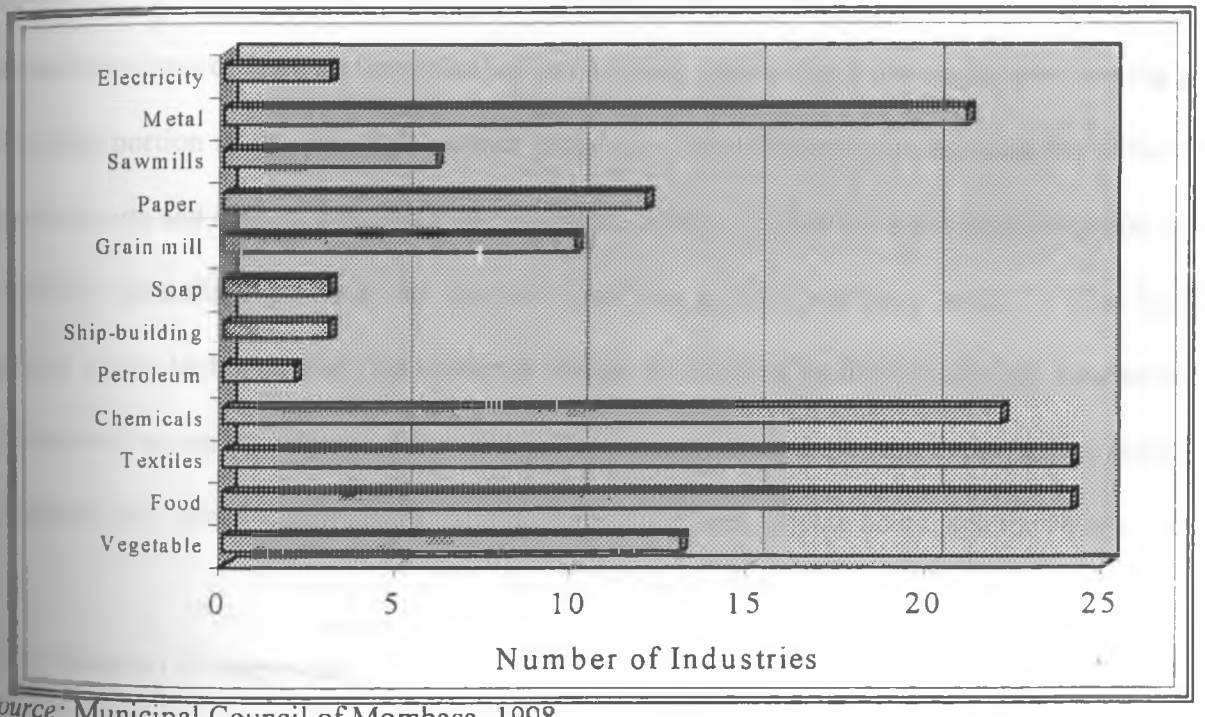
Source: Statistical Abstracts, various issues; Constantinides, 1993; Swazuri, 1999..

3.4.3.1 Industry and the port

A large-scale, extensive industrial development has been the supporting force behind the economic growth of Mombasa over the last 30 years. The Mombasa urban agglomeration embraces a broad array of industries, which have been supporting economic growth. As shown in Figure 3.2, the main types of industry in Mombasa are food industries, beverage manufacturing and bottling, tanneries, vegetable oil and soap production, chemical industries,

paper and pulp factories, textile industries, metal processing, timber products and processing, etc Equally important is the production of salt, manufacture of cement, iron smelting and oil refining. The main industry in the Nyali-Bamburi-Shanzu area is Bamburi Cement Factory and is the single largest employer in the region. The growing level of industrialization in the zone is causing considerable concern of its environmental problems and impacts that they cause.

Figure 3.2 Large and Medium-scale industries in Mombasa



Source: Municipal Council of Mombasa, 1998.

The location of these industries along the shoreline has pre-empted mangroves and other critical habitats, which are obliterated by landfill. This reduces the productivity of the fisheries and use of the beaches for tourist and recreational activities. The conversion of mangrove areas to real estate render large sections of the "hinterland" landscape unattractive and sharply reduce critical habitats for wildlife species.

These industrial activities create negative synergies in terms of impacts on the coastal zone. The direct discharge of effluents to the ocean changes water temperature, lowers dissolved oxygen levels and introduces pollutants and toxic substances. In general, poor siting of the industries and direct discharge of effluents to the ocean results in high pollution loads. The deterioration of water quality, with its impacts on human health and the health and productivity of ecosystems is perhaps the most important form of environmental degradation occurring in the zone. Therefore, planning decisions relating to industrial siting must include the secondary developments that such industries induce.

Besides being one of Kenya's important industrial town, Mombasa is the largest port serving a substantial portion of the country's external trade. The Kilindini port accounts for 45% of annual exports and 65% of imports of Kenya (KPA, 1996). Being a transshipment point for marketing agricultural produce, the Kilindini port has a large servicing area. The land adjacent to the harbor is used for activities related to docking facilities and their supportive services such as warehousing. On average, 1200 commercial ships stop in the harbor yearly. The harbor also provides support for commercial fishing fleet, private boats, and the Navy.

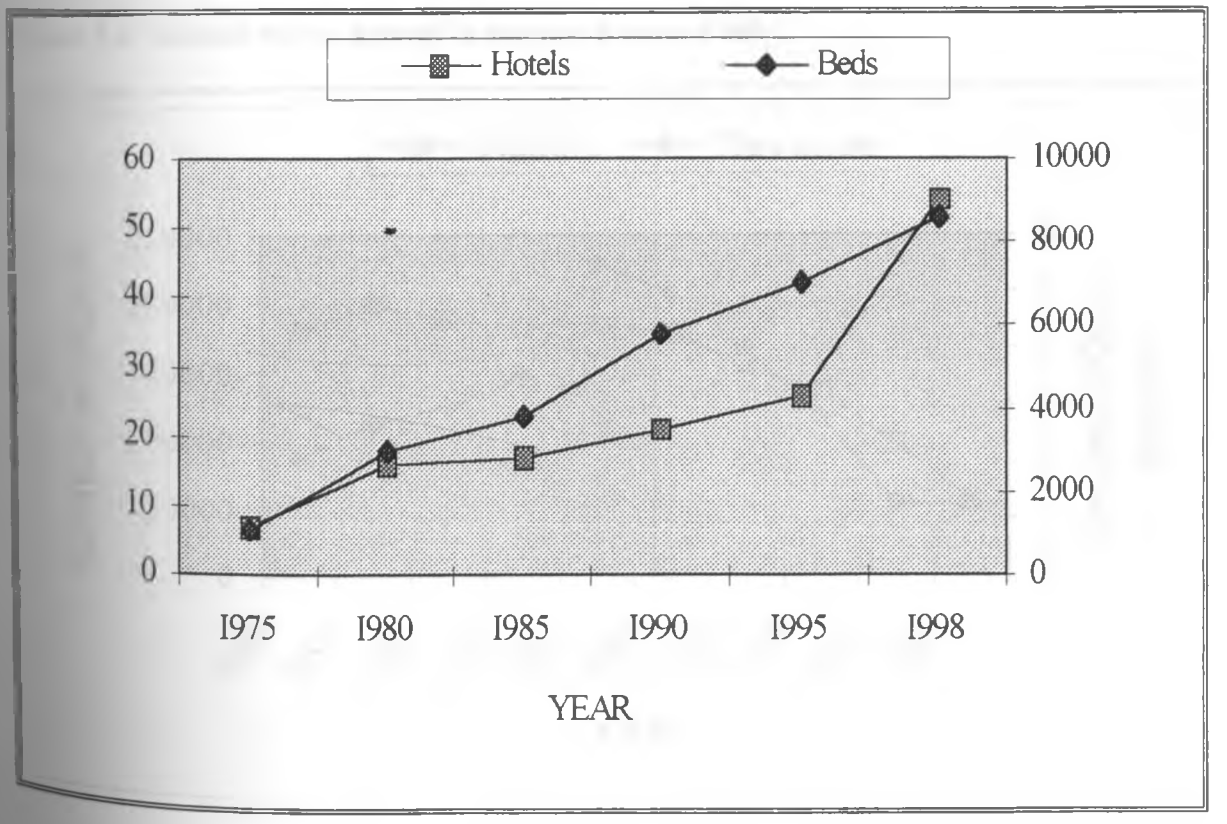
3.4.4. *Tourism Development*

Tourism is yet another resource for the city of Mombasa, which entertains numerous tourists who visit a variety of historical sites and archaeological remains, tourist resorts and nature reserves. Tourism in the Nyali-Bamburi-Shanzu area is well developed. Much of the shoreline is already developed with hotels, restaurants, cottages and resorts. Of the 15km shorefront, from English Point to Mtwapa, hotels already take up 5.3 km (36%), though the remaining is not necessarily natural beaches.

3.4.4.1 Trends in hotel and bed capacity

The first hotel in the zone, Nyali Beach, was constructed in 1946. Tourism however, remained at a low level until the 1970s when it dramatically picked up through the early 1990s (Figure 3.3). The zone has over 40 tourist class hotels with at least 8,600 beds (Mwandoto, 1999). The dramatic increase in hotel bed capacity is largely due to new hotel constructions and partly, expansion of existing ones. The current bed capacity in the area of about 8,600 is on the upper side of the carrying capacity of the area having been generated by the private sector which has been the main player in the industry and which is motivated by short-term profits from their investments. This has decreased the quality of most of the waterfronting land which is getting more degraded and dearer as the tourism industry expand.

Figure 3.3. Trends in beach hotels and bed capacity, NBS area

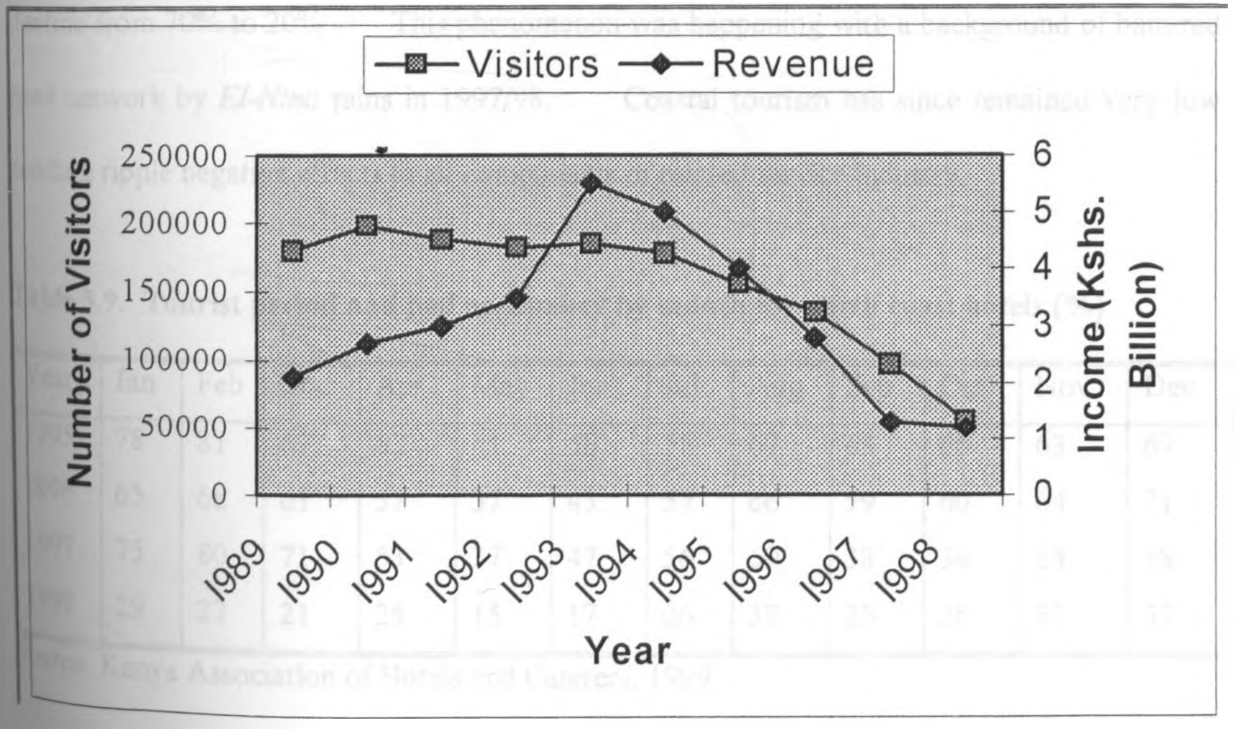


Source: Ministry of Tourism and Wildlife, Catering Levy Trustee, 1999.

3.4.4.2 Trend in tourist arrivals and revenues

Beach tourism is the main tourist development pattern in Mombasa region. The most notable feature is the increase in number of tourist resorts along the beach frontage lands. But also, the number of visitor arrivals in the zone has been on the increase (Figure 3.4). In 1989, 175,000 tourists visited the North Coast and its immediate vicinity. This figure increased to 198,000 in 1993 but declined to less than 50,000 in 1998. This is likely to be higher because low-budget tourists (both local and foreign) who stay with friends, relatives, and families or in rented (private) houses are not included in the statistics. Although the zone has experienced a positive trend in tourism growth up to early 1990s, it has started to decline steadily for a variety of possible reasons: general economic recession, decline in infrastructure, undiversified tourism products and competition from other destinations.

Figure 3.4 Annual visitor arrival in the north coast ('000')



Source: Economic Review, 1994; Tourism Department, Catering Levy Trust, 1998.

On the other hand, revenues from tourism increased from Kshs 2 billion in 1989 to Kshs. 5.5 billion in 1993 and declined to Kshs1.3 billion in 1997. In 1993, tourism earnings from the Nyali-Bamburi-Shanzu area accounted for 24% of the total coastal tourism industry earnings. Based on these statistics, the tourism industry in the North Coast accounts for 8.6% of the total national revenues. Moreover, hotels in the North Coast directly employ atleast, 12,700 people (Swazuri, 1999). A figure slightly larger than this is indirectly employed in other tourist-depended trades including curio sellers, safari guides, masseurs, messengers, and boat operators as well as restaurants and other service businesses.

In the local scene, tourists are reflected by occupancy rates. Generally, coastal tourism as reflected by this parameter is seasonal (Table 3.9). The lowest season in the second quarter shows an occupancy rate of as low as 40%. The social unrest that characterized the Coast prior to the 1997 general elections and the resulting insecurity sent the occupancy rate to decline from 70% to 20%. This phenomenon was happening with a background of battered road network by *El-Nino* rains in 1997/98. Coastal tourism has since remained very low sending ripple negative effects to all components of related service industry.

Table 3.9. Tourist period and bed occupancy by month for north coast hotels (%)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1995	78	81	67	62	41	58	58	67	63	66	63	67
1996	65	68	61	57	37	43	57	66	59	60	64	71
1997	75	80	71	53	37	47	56	69	38	34	24	18
1998	29	27	21	25	15	17	26	32	25	26	32	37

Source: Kenya Association of Hotels and Caterers, 1999.

3.4.4.4 *Diversification of tourism product*

For many years, beaches and historical and/or religious sites have been major attractions of visitors in the coast. As shown in Table 3.10, the development of Mombasa Marine Park in the late 1980s and Bamburi Nature Trail in 1993 as leisure sites have added value to the beach visits.[7] Cultural tourism, however, has not claimed its quality place as part of the diversification of the tourism product. This is shown by the number of visitors attracted to the *Ngomongo* (Big Rock) Theme Park in Shanzu. It is the development of such new ideas that will enhance the tourism potential of the area.

Table 3.10. Number of visitors to specific attractions ('000')

Site/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Fort Jesus	226.6	187.4	187.4	289.9	121.4	245.3	180.2	124.4	88.9
Mombasa Marine Park	29.1	54.6	57.8	43.3	48	23.9	21.7	15.2	16.2
Bamburi Nature Trail	-	-	-	93.2	98.9	109.2	107	86.8	85.0
Ngomongo Theme Park	-	-	-	-	-	-	-	-	5.7*

*Note: * The figures cover the second half of the year.*

Source: Economic Survey, various issues; Ngomongo Theme Park, 1999.

The large-scale tourism, such as that already developed in the Nyali-Bamburi-Shanzu area brings economic gains as well as severe impacts. Construction of hotels, restaurants, recreational facilities, and so forth, located directly on the shore have been responsible for clearing of coastal vegetation, filling of wetlands, and increased loading of sewage and solid waste. Marring of the shoreline and destruction of the aesthetic appeal that attract tourists compound the heavy capital losses resulting from inadequate planning and zoning.

[7] The latter, with its diversified products of casuarina tree planting and fish production in otherwise wasteland after quarrying, now attracts tourists, naturalists, students, researchers and sometimes provides timber for building, thus reducing pressure on over-harvesting mangroves for the same purpose.

Unregulated diving, snorkeling, fishing, speed boating and hunting does also interfere with sensitive coastal ecosystems. The increased demand for water, seafood, souvenirs and other amenities put additional pressure on coastal resources, which are already stressed. Because it is rapidly apparent to visitors, degradation of the coastal zone from pollution, urban sprawl and habitat destruction can rapidly erode the area's tourism base, jeopardizing existing investments and future foreign earnings.

3.4.5 Agriculture

The predominant farming pattern is subsistence agriculture and seems to be more important as a supplementary source of family livelihood rather than a strong element in the local market economy. The most productive agricultural land lies to the north. Farming is favored here because: (i) land parcels are big, (ii) there is favorable climate given that the area is still in the high rainfall zone of the coastal belt, and (iii) there are pockets of very fertile lands. There subsistence farming is concentrated on growing maize, bananas, citrus, cashewnuts, coconuts and dairy farming. On the other hand, commercial farming is confined to two major establishments: the Baobab Farm and the Shimo-la-Tewa Prisons. However, urbanization in recent years has absorbed large areas of agricultural land restricting opportunities for local agricultural expansion.

3.4.6 Fishing

Fishing constitutes the largest product of the ocean waters. The fisheries resources of the coast of Mombasa are estimated at 15,000 metric tones but less than 7,000 metric tonnes are being produced (MDDP, 1993). Approximately, 80% of the marine fish catch is demersal, mainly from shallow coastal waters and reefs. Together with other smaller marine animals

and plants, their harvests have created occupations and employment for very many people along the coastline (Table 3.11). Artisanal fishing is done with the aim of feeding the family, although the excess is sold to obtain money in order to satisfy other basic needs. The fish catch in the zone's nearshore waters is estimated at 30 - 45 tonnes per year, valued at K£. 2.16 million, which is 10% of the total catch of the Mombasa fishing grounds (KWS, 1999). Common methods of fishing include fish traps, and ring nets utilized from dugout canoes, boats and small ships.

Table 3.11. Employment of artisanal fishermen in area

Category	Number of boats	Local crew employed	Total number of people	Total number of households
Unlicensed dugout canoes	240	2	480	141
Licensed dugout canoes	180	2	260	63
Licensed outrigger	55	4	220	29
Licensed dhows	13	6	78	13

Source: Fisheries Office, Mombasa 1999.

Statistics from the fisheries offices show that nearshore waters are being rapidly depleted of demersal stocks as artisanal fishers and a growing number of commercial vessels concentrate their efforts along the narrow continental shelf. Indiscriminate harvesting of reef fish of all sizes and kinds is carried out by a combination of netting, poisoning and dynamiting. Under such extractive pressure, reefs are unable or very slow to recover former levels of productivity, particularly if nearby recruitment sites are destroyed.

Although there are only two fishing clubs in the North Coast, the number of licensed boats involved in sport fishing is estimated at twelve. The fishing competitions that are organized

within the Marine Park and beyond create an influx of visitors to the area, some of whom also visit the Park for goggling, snorkeling or diving. Further, trawling which takes place mainly in the deep sea, has some impacts on the conservation area because turtles, dolphins and sharks, which are an attraction to the Park are often caught in the trawling nets. This has resulted in a clear wipe out of fish and the breakage of corals. The local communities, unable to venture out far, make no substantial catches.

Less directly but potentially damaging, offshore development and poor land use practices are adversely affecting conditions in the coastal zone. Poor land use accelerates soil erosion and increase sediment loads discharged into the sea. Watershed degradation leads to severe erosion, runoff and excessive deposition of sediments along the coast. The result has been siltation of the beaches and the destruction of large stretches of coral reefs "downstream." Other examples of the impacts of unsustainable land use practices along the shoreline are related to mineral extraction, clear cutting of mangroves and livestock grazing.

3.5 Summary

The purpose of this chapter has been to provide a general picture of the changes taking place in the Nyali-Bamburi-Shanzu area. While a detailed inventory was not included, it is possible to draw some general conclusions looking at the overall situation. First, land in the Nyali-Bamburi-Shanzu area is utilized for many purposes. Although there is no rule to use land fronting the ocean for specific purposes, a generalized pattern emerges which suggest a regular system of land use (Swazuri, 1996). The dominant land use along the shoreline is tourism development and recreation purposes. Only in the northmost parts of the zone are there relatively large blocks of shoreland that remain underdeveloped, and even these are presently in

the hands of speculators and developers. It is almost universally the case that competing uses preclude use of shoreline for public recreation and fishing.

Second to note is the concentrationof privately-owned hotel facilities. Regardless of the strong pressure for recreation and fishing, hoteliers have closed the beach access points, and at times institute user fees and other discriminatory devices to preserve for tourists large amounts of their beach frontage. The few public beaches are always congested, while beaches further north become more crowded as recreationers search for new, less crowded accessible recreational areas.

The other land uses range from dock facilities to residences and recreation. The oceanwaters are also used as transport route for local and international vessels, for sport fishing and water sports. The marine waters themselves form the large reservoirs for fish and other marine resources, most of that remain untapped. As most of these activities remain unregulated, the environmental quality of the zone has declined and resource use conflicts increased. Pollution and erosion are often caused by heedless development in ecologically-delicate areas. Pollution, usually most severe where people are concentrated in large numbers, has destroyed coastal and marine habitats, including mangroves and beaches and presents a continous problem in places like Nyali and Bamburi, where available beaches are scarce to begin with. Conservation of these resources within and along the coastline is necessary because of the intensity of use of the available resources and the danger of the resources being degraded. The lack of conservation could cause serious environmental degradation, loss of marine life, marine-related occupations, and the whole marine ecosystem.

CHAPTER FOUR

4.0 DEVELOPMENT - ENVIRONMENT INTERACTIONS

In the previous chapter, economic activities in the Nyali-Bamburi-Shanzu area have been discussed in terms of full extent and impact of the changes. This chapter attempts to examine the major problems and conflicts associated with the use and management of land and resources with special focus on the urban land. It also examines briefly key issues threatening ecosystem productivity and the long-term economic growth in the coastal zone. Institutional constraints that impede rational management and discourage sustainable use of coastal land and marine resources are also examined. These issues require urgent attention if tourism, resources and the economy of the zone area are to be sustained.

4.1 Land Use

Owing to the rapid population growth, industrialization and urbanization, the Nyali-Bamburi-Shanzu area has experienced dramatic changes in land use structure. Table 4.1 shows that during the last 20 years, the urban land expanded more than four times with the rate of land conversion very often faster than the population growth.[8] In addition, detailed planning has not been undertaken to ensure optimal use of limited land to accommodate the needs of the growing population and the associated economic activities. Under these circumstances, various problems concerning utilization of land and land resources have emerged.

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[8] As no comprehensive statistics of land use in Nyali-Bamburi-Shanzu area was available, the researcher prepared some tentative estimates on the basis of the available data. Calculations show that in the last 20 years, more than 150 hectares have been converted for urban land uses every year (residential, tourism, industrial, etc.).

Table 4.1. Breakdown of general land use categories (1970-1998) area (ha)

Category of land use	1978	1998	Index	%
Urban land	790	3,960	429	39.6
Non-urban land	9,210	6,040	73	60.4
Total	**10,000**	**10,000**		**100**

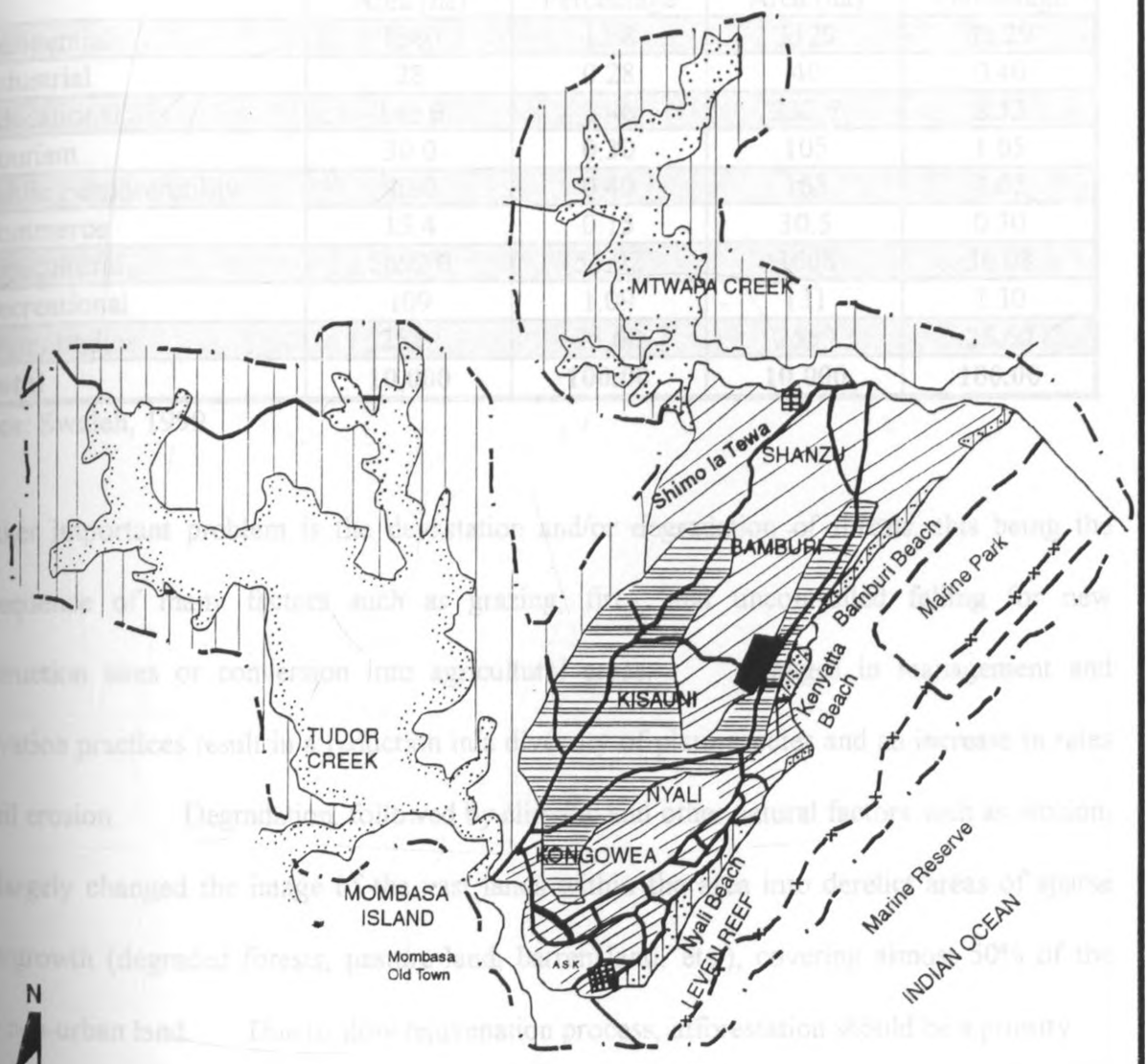
Source Ministry of Lands and Settlement Database, 1999.

4.1.1 Issues concerning the dynamics of the urban land development

During the last 20 years, the Nyali-Bamburi-Shanzu area has seen a dramatic growth in the tourism industry and the development of residential buildings. This has changed the way land is used and managed. Rapid growth in population spurred by tourism and other commercial and industrial activities has resulted in urbanization. Today, more than 40% of the area is used for urban purposes and 60% for those non-urban. The inescapable factor underlying this change in land utilization is the sheer scale and pace of urbanization. The use of land resource has been intensified especially along the major circulation axes. This has resulted in an extensive linear sprawl of urban development focusing on the exact shoreline with access to recreational beaches or outstanding views of the sea. This linear urban development has changed the overall land use structure. Map 4.1 provides information on the present structure of land by type of land use.

One of the most critical problems is the accelerated conversion of high-quality agricultural land to urban uses (Table 4.2). Over 36.6% (2,084 ha) of the total agricultural land (5,692 ha) have been converted to urban uses. The remaining 48% of land is still being used for agriculture. Gains are spread among hotels, restaurants, modern settlements and industrial sites that now characterize the coastal strip. It is realistic to expect the persistence of high pressures on the transformation of these lands into building sites.

MAP 4.1 :EXISTING LAND USES



Source: Field survey, 1999.

Table 4.2. Land uses pattern in the area 1978 - 1998.

Land use	1978		1998	
	Area (ha)	Percentage	Area (ha)	Percentage
Residential	1380	13.8	3129	31.29
Industrial	28	0.28	40	0.40
Educational	146.6	1.46	232.5	2.33
Tourism	30.0	0.30	105	1.05
Public purpose/utility	40.0	0.40	165	1.65
Commerce	15.4	0.15	30.5	0.30
Agricultural	5692.0	56.92	3608	36.08
Recreational	109	1.09	131	1.30
Water bodies	2559	25.60	2559	25.60
Total	**10,000**	**100.00**	**10,000**	**100.00**

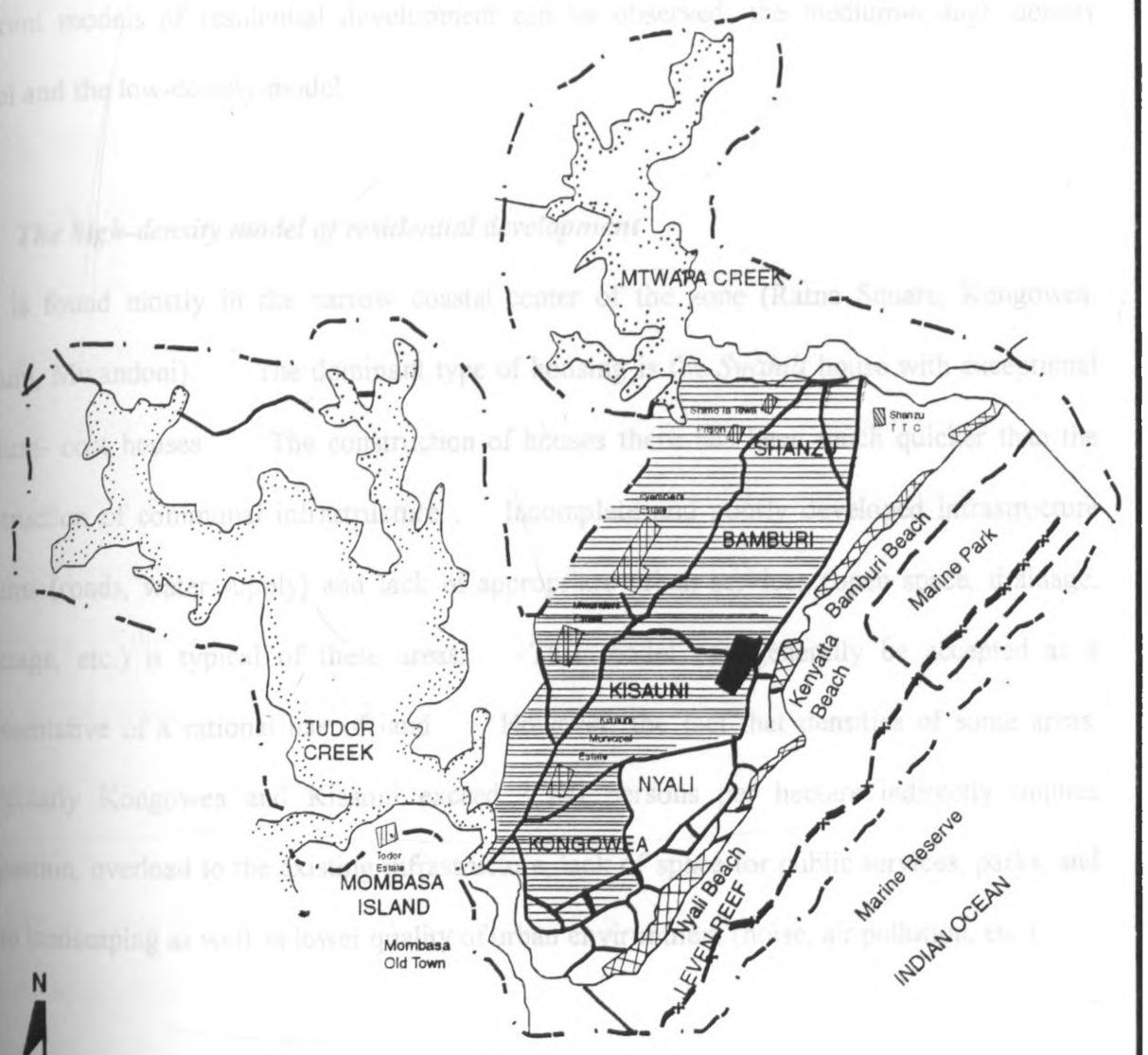
Source: Swaleh, 1999.

Another important problem is the devastation and/or degradation of forests, this being the consequence of many factors such as grazing, fires, and uncontrolled felling for new construction sites or conversion into agricultural areas. Changes in management and cultivation practices result in a reduction in a diversity of plant species and an increase in rates of soil erosion. Degradation, followed by climatic and other natural factors such as erosion, has largely changed the image of the vast lands within the area into derelict areas of sparse undergrowth (degraded forests, pasture land, barren land, etc.), covering almost 50% of the total non-urban land. Due to slow rejuvenation process, afforestation should be a priority.

4.1.2 Built-up areas: a general outlook

The average population density which, in spite of the fact that the population is increasing, stays at the level of 2,580 persons per hectare, indicates that the whole built-up area is densely used. The continuous in-migration is influenced by the availability of casual employment in Bamburi Cement Factory and/or to engage in the tourism-related activities. Map 4.2 provides information on the built-up land by type of land use.

MAP 4.2 : BUILT UP AREA



Source: Field survey, 1999

4.1.2.1 Housing: two models of residential development

More than 84% (3,129 ha) of the built-up area (3,702 ha) are residential areas. Two different models of residential development can be observed: the medium-to-high density model and the low-density model.

(a) The high-density model of residential development

This is found mostly in the narrow coastal center of the zone (Ratna Square, Kongowea, Kisauni, Mwandoni). The dominant type of housing is the *Swahili* house with exceptional medium- cost houses. The construction of houses there has been much quicker than the construction of communal infrastructure. Incomplete and poorly developed infrastructure systems (roads, water supply) and lack of appropriate urban services (open space, drainage, sewerage, etc.) is typical of these areas. This model can generally be accepted as a representative of a rational use of land. However, the fact that densities of some areas, particularly Kongowea and Kisauni exceed 3,500 persons per hectare indirectly implies congestion, overload to the existing infrastructure, lack of space for public services, parks, and urban landscaping as well as lower quality of urban environment (noise, air pollution, etc.).

(b) The low-density model of residential development

This area, with a gross residential density below 100 per/ha is found along the edges of the Nyali-Bamburi-Shanzu area. Frequently, ill-planned and ill-designed family houses on land characterize this model with no infrastructure facilities. Judging by the average gross residential density of 58 persons per hectare, it may be assumed that the interior spare capacity of the existing low-density residential areas is large enough to accommodate a portion of the future population growth without affecting the quality of life. However, filling of the low-

density residential zones is quite a problem since they are poorly organized There is a high degree of probability that, due to the lack of local control over the use of land, future urban growth will continue to encroach on non-urban land.

Another equally important low-density zone is found along the shore front land. This is a high-income residential zone, running parallel to the shoreline from Nyali to Shanzu. Also located here are the beach hotels, which take most of the water-fronting lands. Because of this fast growth in tourism, virtually every available space along the shoreline, including boat repair yards, fish landing sites and public access points to the ocean have been developed. Unfortunately, the rapid growth in population and the unplanned tourism development and the uncontrolled tourist activities have degraded the coastal environment. The developers have ignored the official 30m setback from the high-water mark and built very close to the beach. These developments have destroyed the coastal ecosystem and the services provided by these habitats that have been lost.

A relatively large portion of the low density housing in the Nyali-Bamburi-Shanzu area is mostly the result of an indiscriminate occupation of land by illegal housing which has taken enormous proportions, partly due to insufficient land-use control and policies which failed to slow down migration inflows in Mombasa, or to provide enough equipped land at an acceptable price for low-income households. This has not only given rise to development of marginal (informal) sector of employment, but has also spurred the low-income households to move to the edges of the zone which have not been planned and where land is cheaper. Thus a part of the urban growth "escaped" control, and the phenomenon of informal neighborhoods has been a lingering feature since the 1970s.

4.1.2. Industry: a major source of pollution and conflict

There are an estimated 107 large and medium-scale industries concentrated in the Mombasa agglomeration. These industries, together with small manufacturing units, occupy more than 400 hectares of land. The largest number of industries can be found in the Mombasa Island and Mombasa west mainland. The most important industry in the Nyali-Bamburi-Shanzu is the Bamburi Cement Factory. This industry can be categorized as: (i) a heavy user of land and fresh water, (ii) uses considerable amounts of the low-heating value lignite used to meet the energy demand and heavy polluter of air, (iii) generates largest amounts of industrial residues which add to already high levels of marine pollution, and (iv) generator of an excessive in-out transportation flow and commuters' movement, resulting in congestion bottlenecks along the main arteries, noise, and polluted air. Other small-scale industries in the area include bakeries, posho mills, workshops, metal fabrication, coconut oil press mills, and a milk processing plant among others. These industries, especially those in Mombasa west mainland discharge large amounts of organic matter, suspended solids and floatable effluents into ditch that drains into Tudor Creek.

There are two problems that need to be pointed out. The first pertains to the increasing conflicts arising between industry and other activities in the area (fisheries, tourism, and recreation, protection of water resources, housing, etc.) posing development constraints and requiring high social costs for the elimination of these conflicts. Another problem of equal importance is related to the impact of the existing location of industry on the value of the adjacent areas. The Bamburi Cement Factory does release a lot of dust, which is blown towards heavily populated areas such as Kisauni, Free Town, Kiembeni, and Utange by the Northeast and Southeast Monsoon winds. Further, mining of shales, to provide raw material

to manufacture cement and for building takes place without adequate legal protection of the environment and thus, creates derelict lands and open pits, hence defiling the original landscape (Plate 1) These problems are particularly felt in the central parts of the zone where land appears as an "expensive" development factor due to competition of different u es over land. But the inability to charge the industrial sector a full social cost of operation, including pollution and congestion, only stimulates it to move towards the attractive parts of the agglomeration which are better equipped with infrastructure.

Plate 1. Mining of shales at Bamburi for production of cement

Source: Field survey, 1999.

4.2 Master Plan implementation: major issue of land management

The Master Plan adopted in 1962, is the basis for the long-term management of urban development in the area, as opposed to the long-term draft Structure Plan of 1971 which todate has not been adopted. The Master Plan stipulated a linear macro form characterized by the following land-use pattern: new industrial areas were reserved for polluting industries and manufacturing enterprises which were to be dislocated from the urban core, new residential areas were planned close to major working zones, measures were identified for the protection of historical heritage from deterioration, and land required for public services was determined. However, despite a strong political will and intention to implement the Plan, it appears, judging by the way land has been used, that the process of urbanization in Mombasa moved in the direction which has by-passed the provisions of the Master Plan. This points to the fact that, the Plan failed to anticipate the processes taking place over the last 30 years.

The implementation of the Plan faced considerable problems from the beginning. Decisions departing from the assumption that a significant portion of the public investment will push the planned development of the town in the desired direction seemed to be unrealistic because land ownership structure was not considered carefully. The linear macro form of development necessitated powerful control mechanisms, which have not been properly implemented. However, most severe disturbances in the physical space are attributed to the illegal construction.

Speculations over the reasons attributed to the failure are numerous and require to be explained. The Plan might be said to have been too static, placing much emphasis on detailed layouts and zoning of the expected land use. As such, it focused on desirable urban land use at a future

point in time, rather than on the process through which to achieve it and relied heavily on regulatory-restrictive rather than development-oriented instruments for its implementation. Further, it did not pay enough attention to various important issues such as social ability to conform to spatial regulations, land and property market conditions, and availability of resources for plan implementation influencing urban development.

Considering the above, the local authority seems to have failed to contain the rapid urban growth.[9] A part from the reasons mentioned above, the local authority does not have enough funds ready for land banking and provision of serviced urban land at right locations. This explains why there are no development sites equipped with communal infrastructure ready to accommodated new residents, particularly those belonging to the low-income groups. Under such circumstances, the massive rural migrations toward Mombasa north mainland continue to generate pressures for land to build on, spurring expansion towards the outskirts underdeveloped areas at the edges, pushing the prices of land beyond its agricultural value, and opening grounds for excessive land speculation speeding up the transformation of non-urban land to urban uses. Equally important, the local authority simply does not have accurate and updated information concerning land and property market conditions which renders it incapable of "tightening up" the control screw over the use of land and the Master Plan implementation, nor providing basis for a sound land taxation system which could secure social gains and, thereby, financial consolidation of this very authority.

[9] A part of the problem is directly related to the measures and instruments of national policy which has so far been inefficient in controlling the urban growth and curbing pressure on rural migrants on the Mombasa region.

4.3 Major Management Issues

A number of issues evidently affect sustainable development of the Nyali-Bamburi-Shanzu coastal zone. Table 4.3 gives a summary of specific issues in the NBS zone. These management concerns are generated within the coastal zone itself (as a consequence of human use of coastal space and resources) and from actions outside the coastal zone but which have consequences or impacts on the processes and systems found within it. The major issues listed in order of priority include: (i) deteriorating water quality, (ii) coastal erosion, (iii) over-exploitation of marine resources, (iv) resource use conflicts, and (v) degradation of critical habitats. The main issue identified here is the maintenance of the quality and functional integrity of the coastal zone.

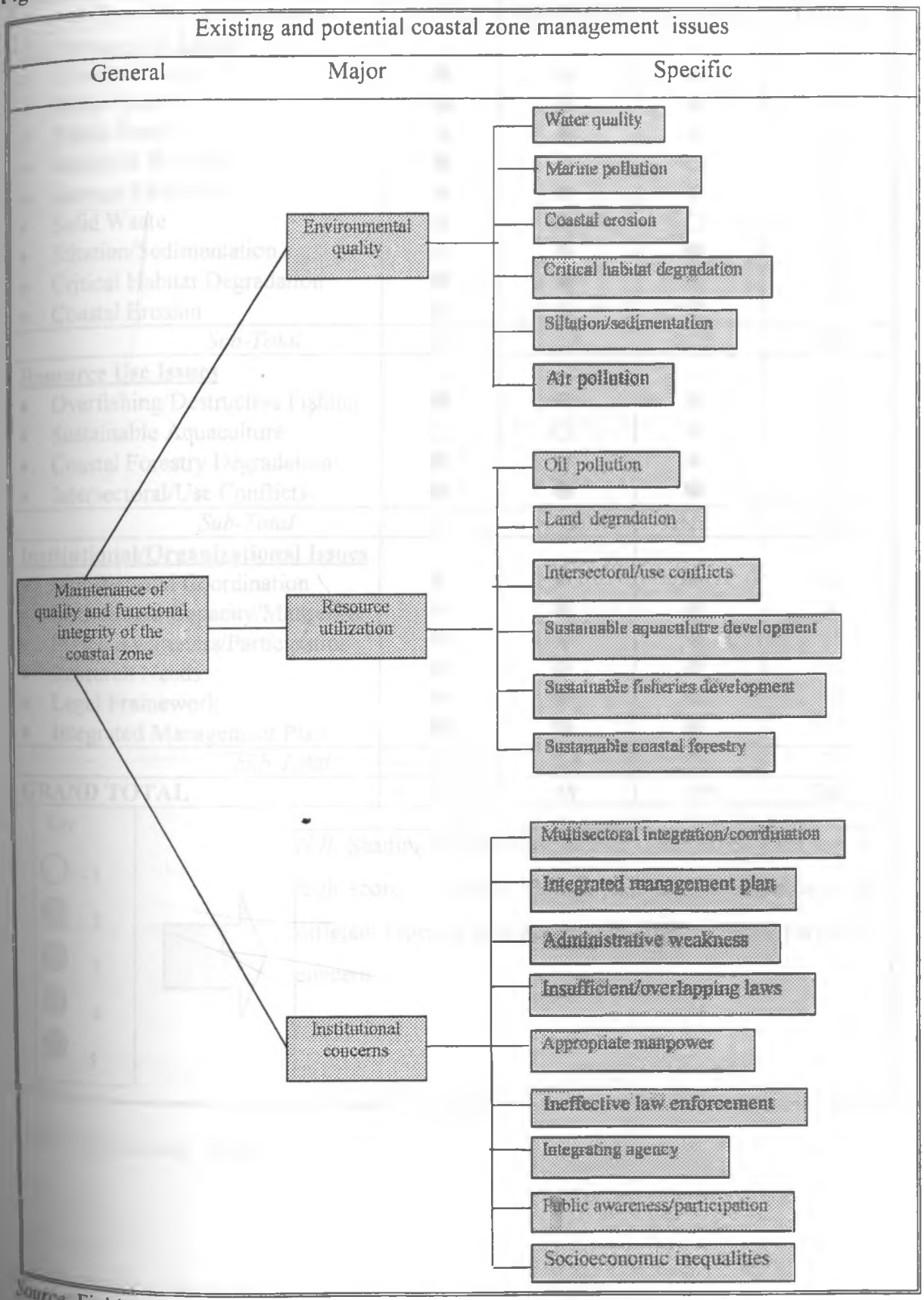
These issues can be categorized into three overlapping categories: (i) environmental quality, (ii) resource exploitation, and (iii) institutional and organizational concerns (Figure 4.1). Environmental issues involve man-induced changes in the natural state of the coastal zone such as pollution, threats to critical habitats and endangered species. These issues are grouped into threats to water quality, siltation and solid wastes. Resource use issues involve the proper rate and manner of exploitation of the natural resources especially fisheries. They also include specific concerns related to sustainable development and management of selected economic activities. The major resource use issues include over-exploitation of living marine resources, resource use conflicts, and aquaculture development. Institutional and organizational issues reflect the capacity of the country to address and correct environmental problems through implementation of sound management policies.

Table 4.3 A summary of the management issues in coastal zone

General Problem	Specific Problem	Causes and/or problem description
Environmental quality	Water pollution	• Untreated domestic/industrial sewage; dumping of waste and petroleum products from boats; and sediment runoff from agriculture, logging, construction and limestone mining
	Solid waste pollution	• Indiscriminate dumping from domestic and/or industrial sources and low handling capacity of waste collection system
	Loss of scenic value	• Construction of building, fences and walls close to the shoreline
	Tourism-related problems	• Destruction of natural assets and tourist overcrowding
Resource exploitation	Mangrove forest conversion	• Conversion into shrimp ponds and agricultural uses; extractive uses of mangroves for construction and fuel wood
	Hinterland forest conversion	• Conversion into agroforestry and coconut plantations
	Poor agricultural practice	• Crops planted on unsuitable soil, e.g., citrus fruits on sandy soil
	Over- and destructive fishing	• Too much fishing effort; use of small-meshed nets; blastfishing; displacement of artisanal fishermen; and lax enforcement of fisheries law
	Shoreline erosion	• Sand and/or gravel mining
	Coral reef damage	• Illegal trawling, blastfishing, and cyanide fishing; siltation; and tourist activities such as anchoring and collecting corals
Institutional and organizational issues	Adoption of integrated management plan	• Plan is not used to accelerate growth or development "overshadows" planning
	Insufficient/ Overlapping regulations	• Sectoral nature of laws on resource use are geared towards short-term economic benefits and non-integration of development and environmental policies
	Lack of interaction among government agencies	• Lack of coordination and the need to transfer some functions, e.g., fish licenses from the Fisheries Department
	Inadequate extension & low public awareness	• Few extension personnel in agriculture and/or aquaculture; and inadequate public awareness programmes
	Laxity in law enforcement	• Lack of enforcement due to scarce manpower, equipment and budget
	Socioeconomic inequalities	• Outside entrepreneurs favored over local residents

Source: Field survey, 1999.

Figure 4.1. System framework of existing and potential issues



Source: Field survey, 1999.

Table 4.4. Matrix [10] showing principal management issues

Coastal Zone Management Issues	NYALI	BAMBURI	SHANZU	TOTAL
Environmental Issues				
• Climate Change	●	◍	◍	12
• Water Quality	●	◍	◍	12
• Public Health	◍	◍	◍	10
• Industrial Pollution	●	◍	○	8
• Sewage Pollution	◍	◍	◍	9
• Solid Waste	◍	◍	○	9
• Siltation/Sedimentation	◍	◍	●	12
• Critical Habitat Degradation	●	◍	◍	12
• Coastal Erosion	◍	◍	○	12
Sub-Total	*40*	*33*	*23*	*96*
Resource Use Issues				
• Overfishing/Destructive Fishing	●	◍	◍	7
• Sustainable Aquaculture	○	○	◍	5
• Coastal Forestry Degradation	●	◍	◍	12
• Intersectoral/Use Conflicts	●	●	●	15
Sub-Total	*15*	*12*	*12*	*39*
Institutional/Organizational Issues				
• Multisectoral Coordination	◍	◍	◍	12
• Institutional Capacity/Manpower	◍	◍	◍	9
• Public Awareness/Participation	◍	◍	◍	11
• Research Needs	◍	◍	◍	12
• Legal Framework	◍	◍	◍	12
• Integrated Management Plan	●	●	●	15
Sub-Total	*23*	*24*	*24*	*71*
GRAND TOTAL	**78**	**69**	**59**	**206**

Key

○ 1

◍ 2

◍ 3

◍ 4

● 5

N/B. Shading indicates increasing significance from low to high score. Figures indicate the relative importance of different types of problem and highlight areas of particular concern.

Source: Field survey, 1999.

[10] In preparing this matrix, a five point scoring matrix was adopted enabling the use of the final matrix as a guide, both to issue and those areas which require the most urgent action.

Table 4.4 indicates that the nature and extent of these issues vary from one point to the other and between the issues themselves. The adoption of an integrated management plan is seen as the most urgent issue. Issues relating to living marine resources and land-based sources of pollution, particularly domestic wastewater and industrial effluents are seen as the most widespread problems. Nonetheless, some issues are of limited scope and localized extent, and thus largely in their initial stages in terms of magnitude. On a regional basis, Nyali and Bamburi are suffering the greatest deterioration in quality of the environment.

4.3.1. Declined Water Quality, Sanitation and Health, and Environmental Impacts

Coastal zone planning has been inadequate or absent in the NBS coastal area. The rapid and chaotic growth of urban populations and economic activities in Mombasa has far exceeded the capacity of the municipal council of Mombasa to provide the public with basic services like adequate water supply and sewerage. The lack of an adequate municipal waste disposal system coupled with overburdened sewerage facilities has led to contamination of shallow aquifers. Water quality in wells and boreholes in the area are declining (Table 4.5).[11] Sources of degradation include seepage of coliform bacteria and human pathogens from septic tanks, soak pits, excess nutrient run-off and seawater intrusion (Table 4.6). The porosity of the limestone geology in the area intensifies the contamination problem because of the natural emptying of pit latrines.

Table 4.5. Microbial contamination of well and borehole water in Mombasa

Source	Number	Coliform count per 100ml	E.Ecoli count per 100ml	Portability
Wells	20	25-1800+	0-1800+	No
Wells	3	0-4	0	Yes
Boreholes	11	17-1800+	0-5	No
Boreholes	1	0	0	Yes

Source: Munga et al, 1993.

[11] Drinking water standards in Kenya are Coliform count <10/100ml or there is no E.Ecoli count.

Table 4.6. Water quality degradation

Type of degradation	Principal sources	Environmental impact	Health and biological effects
Contamination of organic waste and pathogens	Urban wastewater; industrial effluents; river output	Organic deposit in creeks; sedimentation and beach pollution; seafood contamination; turbidity.	Human diseases due to intake or contact with contaminated water; reduced biodiversity in coastal area.
Excess nutrient runoff	Urban wastewater; agricultural runoff; industrial effluents.	Eutrophication of nearshore waters	Reduced biodiversity and unaesthetic effects; fouling of beaches; fish kills.
Contamination by industrial waste	Wastewater from industries and urban sewage into ocean waters.	Concentration of toxins in sediments and marine organisms.	Accumulation in marine organisms with potential effects on marine mammals and humans.
Release of petroleum hydrocarbons	Oil processing; urban and industrial runoff; shipping and port operations; accidental oil spills.	Oil pollution of beaches and coastal ecosystems: tar accumulating in beaches.	Tainting of seafood; reduced biodiversity; sub-lethal effects.
Solid waste litter	Coastal dumping' marine debris from shipping, fishing activities; beach littering.	Accumulation of floating litter; entanglement of marine animals; beach fouling; reduced marine safety.	Death of marine species through ingestion and entanglement; "ghost fishing."
Siltation and turbidity	Land-use in coastal and up-land areas; deforestation; dredging.	Increased sedimentation and siltation; reduced health of coral reefs.	Loss of coral reefs and associated fauna; excessive sedimentation in creeks.

Source: Field survey, 1999.

In terms of downstream impacts, the discharge of municipal waste into nearshore waters has resulted in: (i) health risks from the presence of sewage pathogens, (ii) oxygen depletion due to nutrients and organic carbon, and (iii) contamination of the aquatic food chain leading to toxification of marine organisms and humans. The pollution of marine environment associated with urban agglomeration has compromised public health, fisheries and important biodiversity resources in the subsistence economy of many peri-urban populations. Nevertheless, degradation of coastal and marine habitats has jeopardized the nursery grounds of commercial fisheries.

As shown by Table 4.7, contamination of groundwater resources is high in low-income areas, especially in Mkomani, Kongowea, and Kisauni. Epidemics of waterborne diseases, including outbreaks of cholera, typhoid and malaria are common in these areas, eroding the health and productivity of the labour force and maintaining the high levels of infant mortality. Contamination of groundwater by pathogens is not a pronounced problem in high-income residential areas and tourist hotels because of low-density population. In these areas, the threat of salinization of water is worrying. These areas are very close to the sea, and with coral limestone basement, seawater intrusion is very common as the extraction rate often become greater than the replenishing rate.

Table 4.7 Biological examination of the groundwater sources in Kisauni, Mombasa

Source	Location	Coliform counts	E.Ecoli
Well	Utange refuge camp	80	17
Open well	Ratna square, Nyali	1600	20
Open well	Kitaru farm, Kongowea	110	35
Well	Mkomani	350	30
Well	Mkomani	1800	1350
Well	Shimo-la-Tewa prison	8	2
Well	Shimo-la-Tewa prison	1800	1800

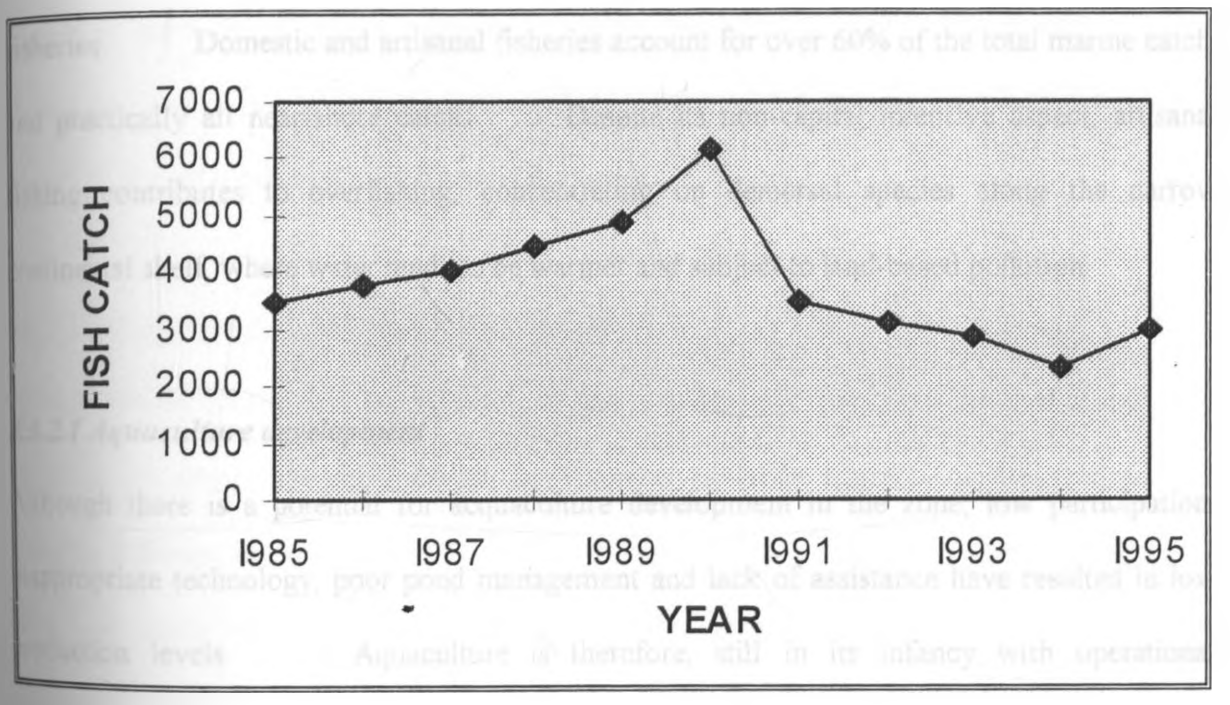
Source: Government Chemists Department, Mombasa, 1998.

4.3.2 Overexploitation of Living Marine Resources

The waters of the northern margins of the zone are productive due to seasonal upwelling of nutrient-rich waters. The fishing area in the North Coast area has been reduced by $10km^2$ with the creation of Mombasa Marine Park and Reserve. This has had an effect on the fisheries catch, effort and landings. An average catch of nearly 4,000 tones of fish has been

reported from the Mombasa region between 1985 to 1995 (Figure 4.2). Although landing data is incomplete and knowledge of the fishery stocks in the zone is limited, it is highly probable that the fishery resources are heavily exploited. Changes in fishing industry have also been shaped by an increase in the shoreline water-dependent tourism activities and development of residential and commercial establishments.

Figure 4.2. Fish landing in Mombasa



Source: Fisheries Department, Mombasa, 1997.

Over-exploitation of fishery stock is related to several factors: (i) inappropriate or unenforceable off-take quotas, (ii) selective harvesting of "preferred species", (iii) hyper-efficient harvesting methods and use of inappropriate gear such as use of small-meshed nets, and (iv) harvesting of small classes and reproductive female which limits juvenile and potential for recovery from heavy fishing pressure. Related to this is the use of encircling driftnets in open waters, forming invisible walls in the ocean, followed by poisoning or breaking of coral

heads to scare fish into the open. Lost or discarded non-degradable fishing gear continues to kill marine life through ghost fishing. Other forms of destructive fishing are discussed in the subsections dealing with habitat degradation. Overall, a lack of public understanding for fisheries management principle is evident.

Artisanal fisheries provide an important source of income and food supply to many people in the zone. This sector involves women to a great extent in the processing and marketing of fisheries. Domestic and artisanal fisheries account for over 60% of the total marine catch, and practically all near-shore catch. Despite its non-capital intensive aspect, artisanal fishing contributes to overfishing, concentrating on demersal species along the narrow continental shelf, where water tends to be warmer and subject to land-based pollution.

4.3.2.1 Aquaculture development

Although there is a potential for acquaculture development in the zone, low participation, inappropriate technology, poor pond management and lack of assistance have resulted in low production levels. Aquaculture is therefore, still in its infancy with operational brackishwater ponds totaling to only six (6) hectares. Among the most important factors limiting the scope for aquaculture development are the quantity and quality of water available for cultivation of aquatic species. In addition to deteriorating water quality, destruction of critical habitats, such as conversion of mangrove areas for brackishwater ponds threatens the development of the entire sector. Moreover, poorly sited and managed mariculture operations pose risks to surrounding production systems through salinization of adjacent agricultural land and competition with offshore fisheries for wild stock recruitment.

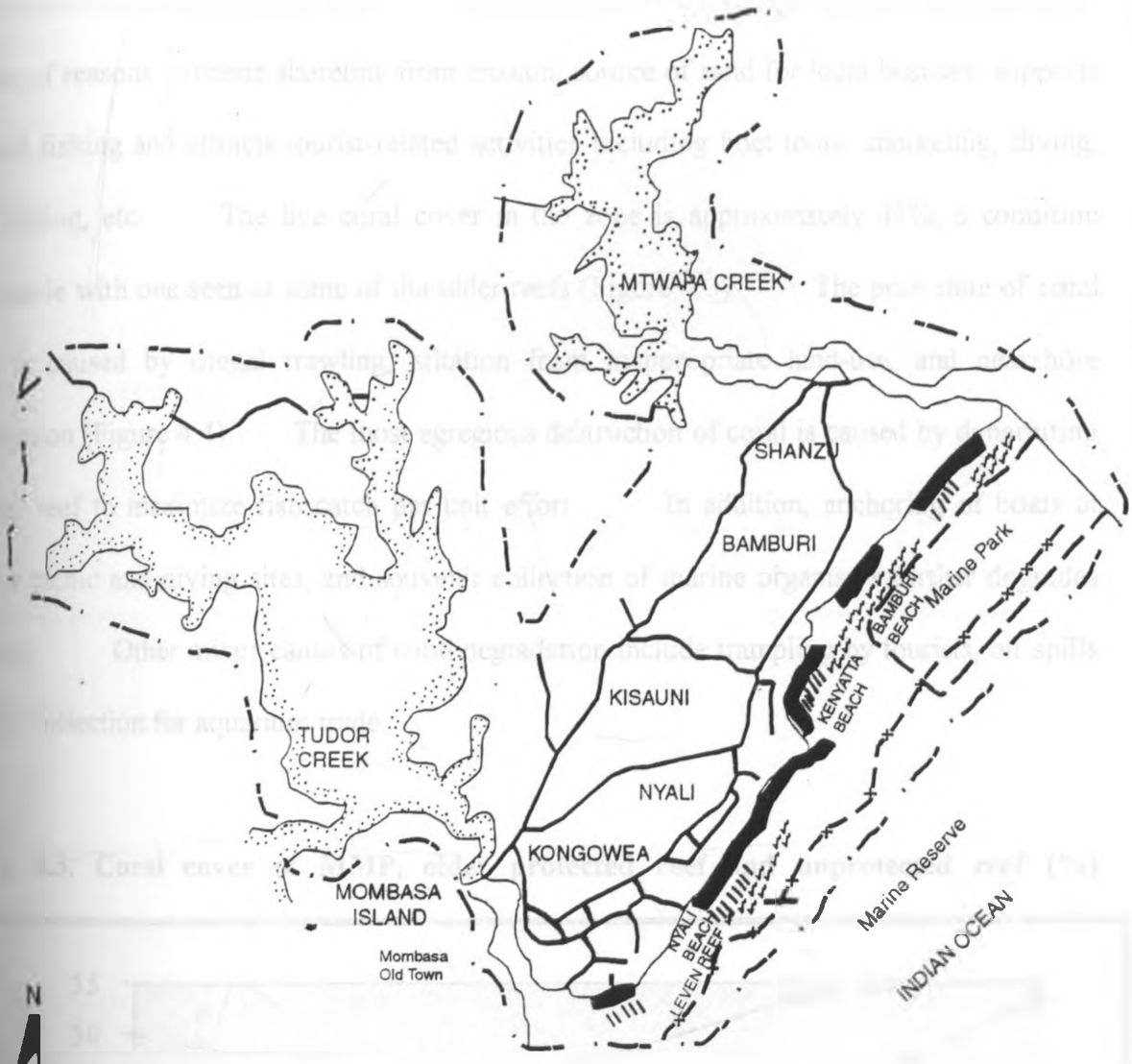
4.3.3 Habitat Degradation

A number of coastal and marine habitats within the zone are important in enhancing its aesthetic quality and functional integrity. Important marine habitats in the area include mangroves, coral reefs, turtle nesting beaches and seagrass beds (Map 4.3). Damage to these habitats beyond their natural capacity to withstand stress rebounds to enormous costs for environmental repair or restoration. Unfortunately, many of these habitats are being degraded through sedimentation, pollution, and other destructive forms of resource extraction related to intensifying human pressures on these systems. Such degradation entails a measurable loss of economic value in the natural goods and services provided by these systems as well as loss of biodiversity and genetic resources.

4.3.3.1 Mangrove deforestation and reclamation

Coastal forests, particularly mangroves provide a number of important functions, including shoreline protection, nutrient and sediment trapping, pollution filtration, feeding and nursery areas for fisheries, and protective habitat for a variety of marine fauna. Mangrove wetlands have been reclaimed for real estate, converted into shrimp ponds and over-exploited for commercial sale, building, amd fuel wood. Rapid population growth and over-exploitation of the mangroves has led to the decline of the mangrove systems and depletion of the resource is a real threat. Dumping of solid waste and non-biodegradable materials, sewage and industrial toxic waste, oil spill from the port of Mombasa, and poor enforcement of forest laws, have been other major causes. The decline in mangrove system has led to the loss of many arboreal organisms, both in terms of number of organisms and species, due to the breakdown in the food chain and loss of fishery breeding grounds. Above all, clearing of mangroves to pave way for physical development encourages erosion and endangers many properties.

MAP 4.3: COASTAL & MARINE HABITATS IN THE AREA

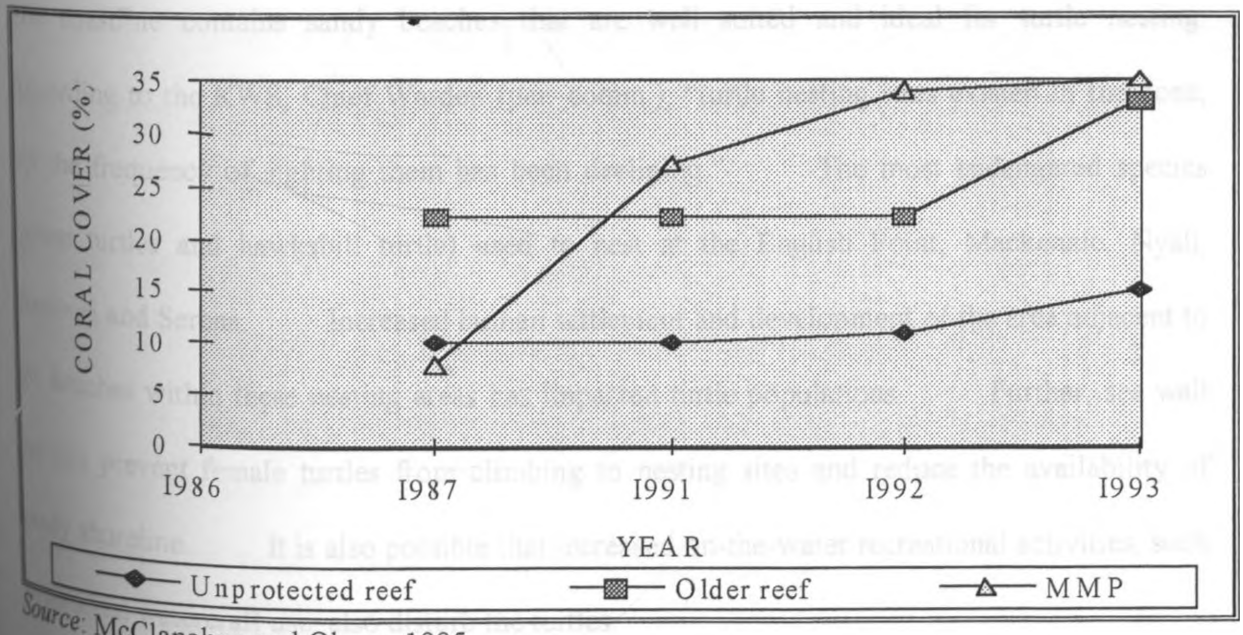


Source: Field survey, 1999.

4.3.3.2 Coral Reefs

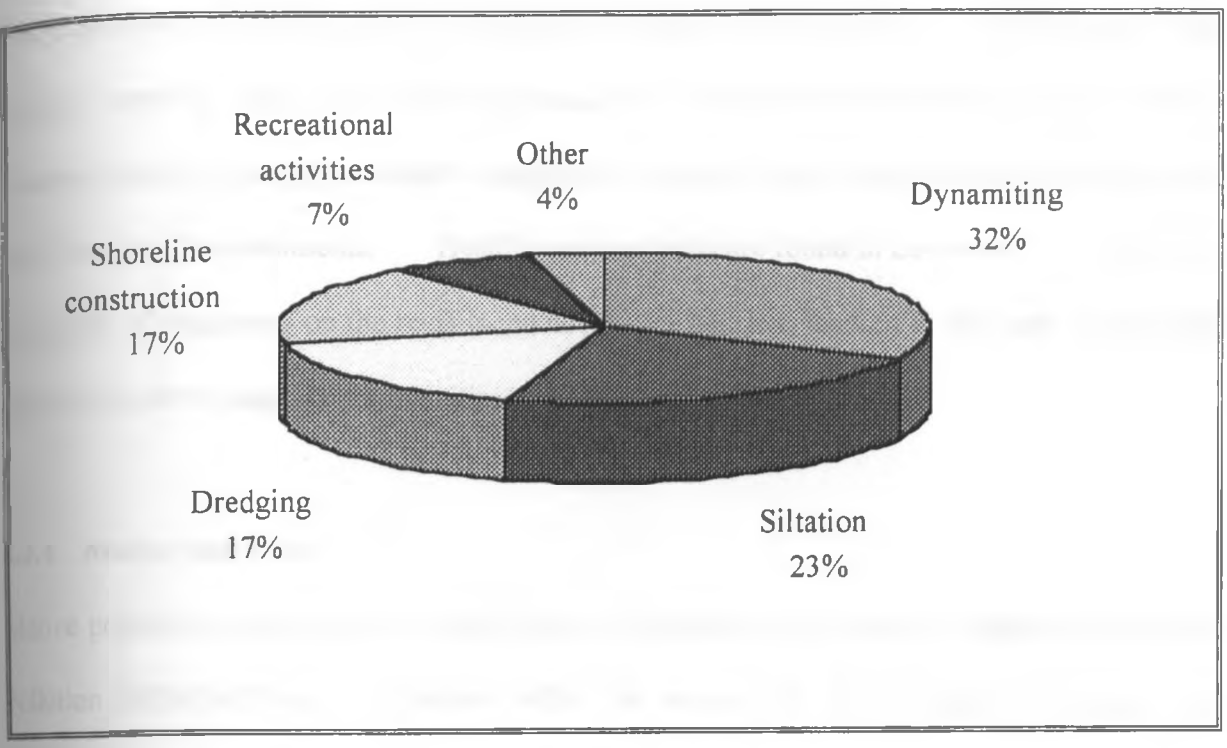
The coastline has an extensive fringing coral reef made of hard corals. The reef extends from Tudor Creek to Mtwapa Creek. Fringing coral reefs are important to the area for a number of reasons: protects shoreline from erosion, source of sand for local beaches, supports artisanal fishing and attracts tourist-related activities including boat tours, snorkeling, diving, sport fishing, etc. The live coral cover in the zone is approximately 45%, a condition comparable with one seen at some of the older reefs (Figure 4.3). The poor state of coral cover is caused by illegal trawling, siltation from inappropriate land-use, and nearshore construction (Figure 4.4). The most egregious destruction of coral is caused by dynamiting of coral reef to maximize fish catch per unit effort. In addition, anchoring of boats at popular picnic and diving sites, and souvenir collection of marine organisms further degrades this area. Other minor causes of coral degradation include trampling by tourists, oil spills and fish collection for aquarium trade.

Figure 4.3. Coral cover of MMP, older protected reef and unprotected reef (%)



Source: McClanahan and Obura, 1995.

Figure 4.4. Causes of coral reef degradation



Source: Field survey, 1999.

4.3.3.3 Beaches and Sea turtles

The coastline contains sandy beaches that are well suited and ideal for turtle nesting. According to the KWS, Chief Warden (per. comm.), "turtle nesting sites existed in the zone, but the frequency of sighting them has been declining." The most endangered species (green turtles and hawksbill turtle) used to nest at the English Point, Mackenzie, Nyali, Bamburi and Serena. Increased human settlement and development of the area adjacent to the beaches within these nesting areas has impacted turtle populations. Further, sea wall barriers prevent female turtles from climbing to nesting sites and reduce the availability of sandy shoreline. It is also possible that increased on-the-water recreational activities, such as personal watercraft use, also disturb the turtles.

4.3.3.4 Seagrasses

Seagrasses are an important part of coral reef and estuarine ecosystems. They provide fish habitat, breeding space and nursery grounds for important commercial and reef fishes. Seagrass beds help to grip sediments together by action of their root systems thus helping to curb erosion of the sediments. Healthy seagrass beds are found in Leven reef. However, the extent of seagrasses on the reefs is unknown. Nutrient loading in the reefs is high and may be a threat to seagrass communities.

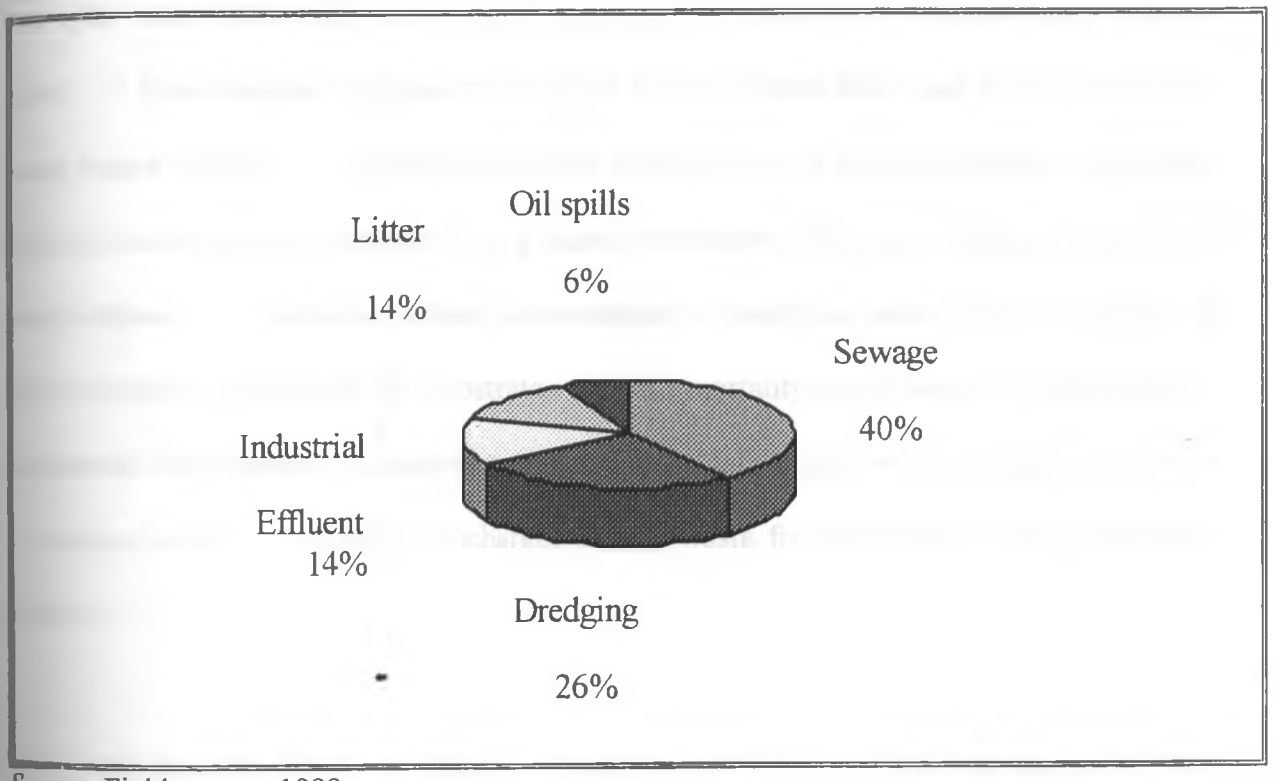
4.3.4 Marine pollution

Marine pollution is defined by the Joint Group of Experts on the Scientific Aspects of Marine Pollution (GEMSAP) as "... a harmful effect on marine life, human health, resources and amenities or other beneficial uses of the sea caused, directly or indirectly, by substances and wastes derived from human activity." Human activities on land and in the sea are disturbing the balance and changing the composition of ocean-water. A part from physical degradation, pollution is the major problem affecting the coastal and nearshore waters. The main causes of oceanwater contamination are industrial effluent, sewage, stormwater, oil spill and various contaminants from ships (Figure 4.5).

Municipal waste is a key component of land based discharges into the ocean. Direct discharges of untreated and semi-treated sewage and sullage water from point sources to the ocean consist mainly of domestic sewage and industrial effluents. In the Mombasa Island, these two waste streams are mixed in the sewage system and are usually dumped untreated into Tudor Creek. These discharges contain organic materials, nutrients, trace elements, organic/petroleum compounds, particulate matter, and micro-organisms affecting the oxygen

balance of the receiving medium. The heaviest pollution loads are associated with overcrowded areas such as Mkomani, Kongowea, and Kisauni, most of which lack even primary sewage facilities. Also, sludge from pit latrines and septic tanks dumped at Kibarani very easily end up in the sea and undetermined mangrove areas.

Figure 4.5. Sources of marine pollution.



Source. Field survey, 1999.

Located in the Mombasa Island and Mombasa west mainland, close to the labour force supply and the port for export markets, are some of the most polluting industries. The industries range from manufacturing to food and beverage processing to mineral exploitation. These industries contribute high biological oxygen demand (BOD), suspended solids, grease and oil, and more complex organic pollutants, which are hazardous and noxious to aquatic life. Manufacturing, chemical (including pesticides, pharmaceuticals and paints), textile and leather

industries are among the most polluting. Along the shoreline, residues from inshore mining operations are released directly into the sea, causing significant loading of suspended solids. Equally important, onshore and offshore oil industry operations releases large quantities of oil, grease, nutrients and other organic compounds into surrounding waters.

The main stormwater drain in the area empties its waters near Tamarind Hotel. There are also other drains that drain into Tudor Creek from Mombasa west mainland and Mombasa Island. The estimated contribution of surface run-off to total BOD load discharged into the ocean waters is high. Principal pollutants in urban run-off include effluents from small-scattered industries and discharges from garages, workshops, Kongowea wholesale market and petrol stations. Excessive nutrient concentration in nearshore water results in changes in physiochemical structure of the substrate, episodic mortality and changes in abundance of commercial fish species, increased production of algal toxins and increased turbidity of recreational water. Chronic discharges of oily waste from ships and boats also require attention.

Solid waste dumped directly on beaches or near the shoreline is washed into the sea by rain, storm surges, waves and tides. A large portion of debris originates from land due to improper disposal and management, and beach littering. Mangroves are often used as garbage dumps, contaminating waters through the introduction of toxic substances and pathogens, which cause physical and hydrological damage to the ecosystem. Municipal solid waste management and final disposal solutions avoiding open dumping in vulnerable coastal ecosystems are urgently needed in the zone. Considerable investments are required, but needs to be of low-cost type for sustainable management.

4.3.4. Coastal Erosion

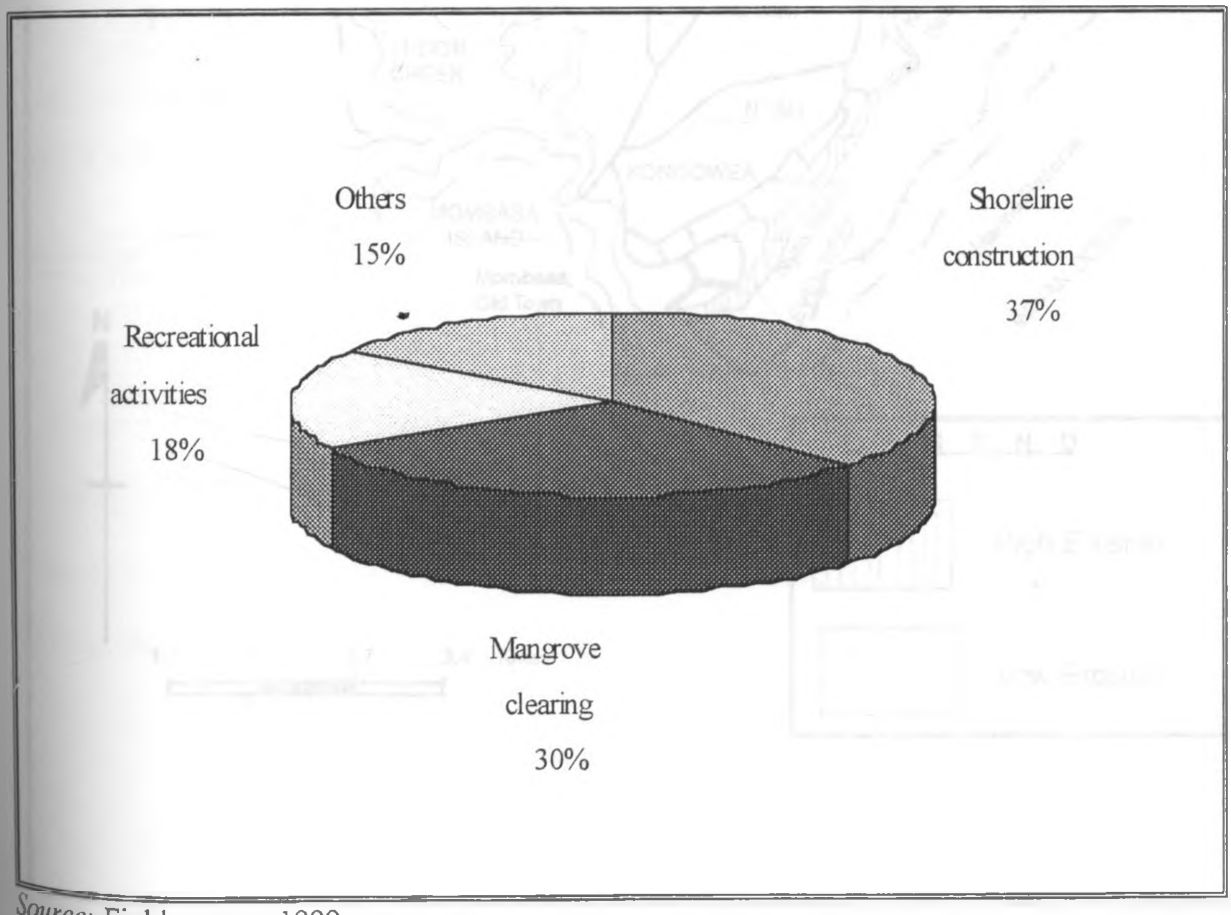
Coastal erosion is a serious problem along the shoreline, where rates of shoreline erosion or beach retreat average some meters per year. Nyali and Bamburi beaches are experiencing erosion which is directly impacting on coastal development. Although data on long-term historic erosion rates in the zone are lacking, erosion is occurring and some areas along Bamburi beach are estimated to be eroding at a rate of two meters per year (Map 4.4). Although the coastline is highly prone to natural erosion and sedimentation process which include the scouring effects of a high wave energy environment, strong littoral transport and a subsidizing coastal plate, erosion has been intensified by human activities.

As shown in Figure 4.6, a number of anthropogenic activities have a synergistic effect on coastal erosion. In most cases, damage has occurred through dredging, for example, port construction and related engineering works, mining of sand, gravel or coral for construction. Other human activities contributing to coastal erosion include construction directly on the beach with insufficient setbacks to account for normal shoreline variations. A good example, are the recently constructed beach hotels with insufficient setbacks from the high-water mark have interfered with normal coastal accretion processes leading to recession of the shoreline and exposure of these investments to storm damage and flooding. In addition, sea walls and rabble lines built to mitigate coastal erosion obstruct passage along the beaches and interfere with the quality of the beach, the main attraction for tourism based recreation.

Deforestation of mangrove forest for firewood, timber and land reclamation has eliminated a critical source of the coastline stabilization. This exposes the shoreline to waves and currents, allowing erosion to occur. To protect coastal development from erosion, significant

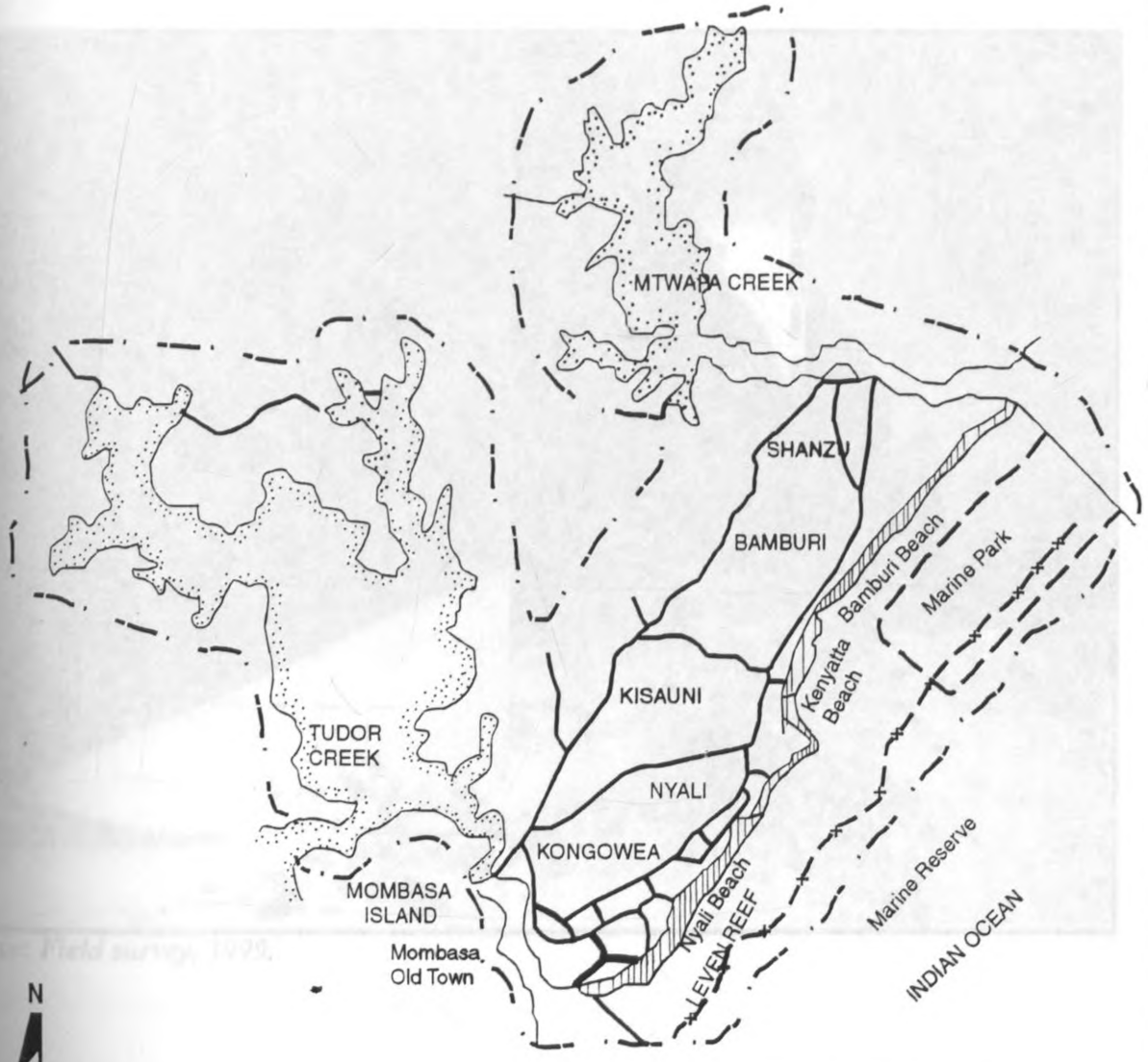
investment in shoreline protection measures such as sea walls, have been made. In areas where these structures are not properly planned, they have exacerbated the erosion problem or transferred the problem to an adjoining location along the shoreline. Sea walls built along the coastline are in danger of collapse while structures built on collapsing cliffs are in imminent danger of falling (Plate 2). The increased number of seawalls has degraded the aesthetic qualities of the beachfront area for tourist activities such as sun-bathing and strolling. Moreover, these structures present a physical barrier to the beach, detracting from the inherent aesthetic value of an unrestricted scenic beach view. Also, they result in the loss of natural beach profile, restricting the ability of sea turtles to access nesting area.

Figure 4.6. Major causes of coastal erosion



Source: Field survey, 1999.

MAP 4.4: COASTAL EROSION ALONG THE NBS SHORELINE



Source: Field survey, 1999.

Plate 2. The effect of coastal erosion on shoreline properties.

*Source: **Field survey, 1999.***

In summary, high erosion potential in the zone combined with the decision-making regarding the siting of coastal infrastructure, *ad hoc* decisions about kinds and location of mitigation measures and the extraction of coastal resources have all contributed to high rates of erosion in the Nyali-Bamburi-Shanzu coastal zone.

4.3.5. Siltation of Coastal Waters

Inland coastal forests are critical to the health and productivity of the coastal environment. Land clearing for industrial and residential development has removed the natural vegetation and exposed soils to erosional forces of wind and rainfall. The extension of agricultural activities to marginal lands, and slush and burn practices associated with short furrow periods, inevitably contributes to soil erosion and increased runoff. Siltation and sedimentation of coastal waters also result from quarrying at Bamburi for landfill and alluvial gravel deposits. A high sediment load increases its turbidity and interferes with normal biological processes and eventually causes damage to marine organisms and entire coral reefs resulting in wide scale declines in both reef productivity and structural integrity. The increased land development activities expected to occur with economic diversification require increased soil erosion control and enforcement measures.

4.3.6. Marine Pollution from Tanker Traffic and Ballast Discharge

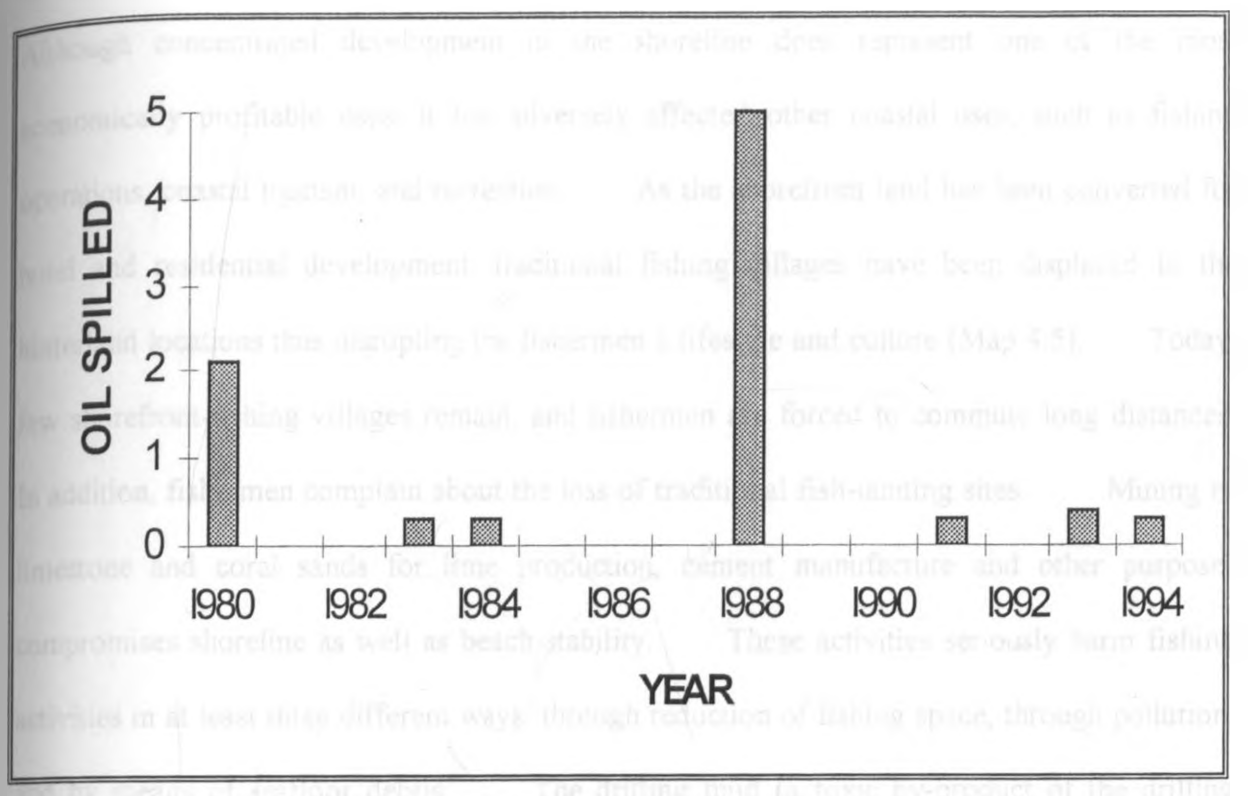
The ocean has long been used as a sink for all kinds of waste from ships, but the problem was not obvious because metal and glass sank, while cloth and other organic waste decayed. Today, plastics are the most common packaging materials. Plastics float, do not decay and tend to accumulate along the beaches. Plastics and other debris such as pieces of nets, ropes, and straps cause mortality in marine species through entanglement and ingestion, reduces marine safety and does have a serious aesthetic impact on the environment with implications for important economic sectors such as tourism.

The potential for oil spill incidents in the coastal waters is quite high considering the number of tanker traffic from the Middle East to various global destinations. It is estimated that 50

ships of various types are in the major shipping lanes off the coast of Kenya at any given time With the traffic pattern and the high volume of oil transported, operational spills and large accidental spills must be expected anytime throughout the area. Two major potential sources of oil spills could occur, namely: (i) maritime accidents due to collision, explosion or grounding of ships, and (ii) accidental leakage of oil from underwater pipes. Minor oil pollution results from normal oil transportation activities including accidental spillage on board ships, or at terminals or when transferring cargo from ship-to-shore or vice versa, tank washing and leakage from upland tank storage. These routine activities do result into spills of a lesser magnitude, but still have significant environmental consequence.

The last major oil spill incident in Mombasa was when a spill of 5,000 tones in Kipevu in 1988 killed approximately two hectares of mangroves at Kibarani (Figure 4.7). A part from this, only minor cases of oil spills have been recorded. This clearly indicates that reception facilities in the port of Mombasa are not adequate for ship-generated waste, such as oil residues, sewage and solid waste to reduce the pollution of marine and coastal waters. Even when collection is arranged from ships, the treatment and final disposal of the waste is often poorly handled. The waste is transported and dumped in Kibarani, with implications for human health, habitat degradation and pollution of coastal waters. The urgency of developing capabilities for a National Oil Spill Contingency System (NOSCS) cannot be overemphasized. This is in view of potential negative impacts of oil pollution on coastal environment (including fisheries, coral reefs and mangroves) as well as the associated high clean-up and social costs.

Figure 4.7. Oil Spillage in Kenya, 1970-1996 ('000' tons)



Source: National Oil Response Spill Committee, 1996

4.3.7. Land and Water Use Conflicts

The rapid growth in population and unplanned development of economic activities continue to pose significant pressure on the coastal environment. Offshore uses (agriculture, forestry, industry, mining, construction) affect coastal and ocean activities (fishing, tourism, recreation, etc.). Figure 4.8, a classification of the relationships among coastal land and ocean water uses, indicate that the zone is beset with problems of conflicts between on-shore and off-shore activities. Dramatic changes in land use have resulted in land use conflicts. On-water conflicts have increased as recreational users and beach hotels provide a wide range of recreational activities for their clients such as glass bottom boating, snorkeling, and wind surfing.

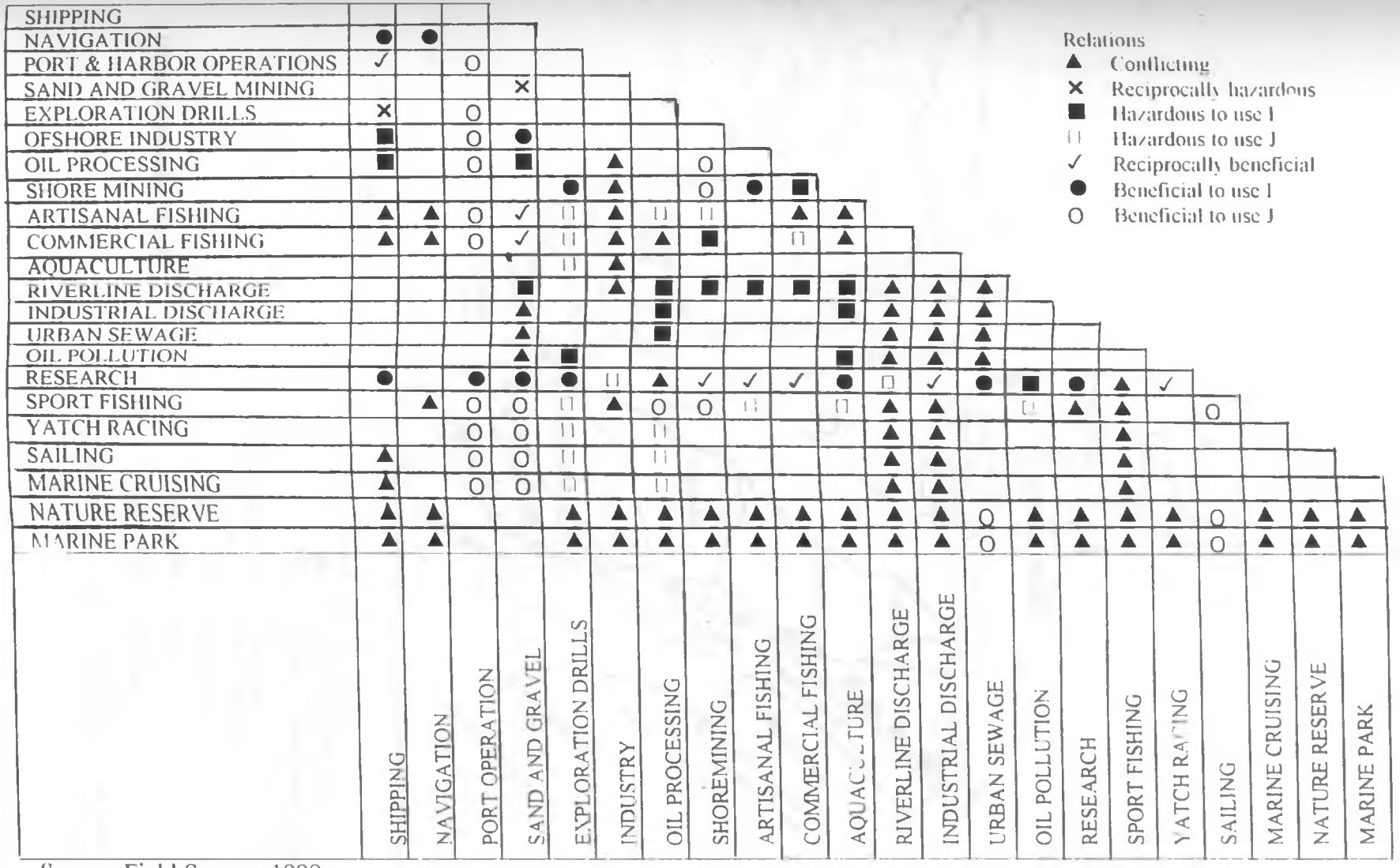
4.3.7.1. Conflicts related to shoreline development

Although concentrated development in the shoreline does represent one of the most economically profitable uses, it has adversely affected other coastal uses, such as fishing operations, coastal tourism, and recreation. As the shorefront land has been converted for hotel and residential development, traditional fishing villages have been displaced to the hinterland locations thus disrupting the fishermen's lifestyle and culture (Map 4.5). Today, few shorefront-fishing villages remain, and fishermen are forced to commute long distances. In addition, fishermen complain about the loss of traditional fish-landing sites. Mining of limestone and coral sands for lime production, cement manufacture and other purposes compromises shoreline as well as beach stability. These activities seriously harm fishing activities in at least three different ways: through reduction of fishing space, through pollution, and by means of seafloor debris. The drilling mud (a toxic by-product of the drilling process) is discharged largely on-site and receives little treatment, thus compromising the health of the coastal ecosystem, particularly at Bamburi. Fishermen complain about the loss of their intertidal fishing areas to mining projects and about fish mortality attributable to oil spills.

4.3.7.2. Conflicts related to marine transportation

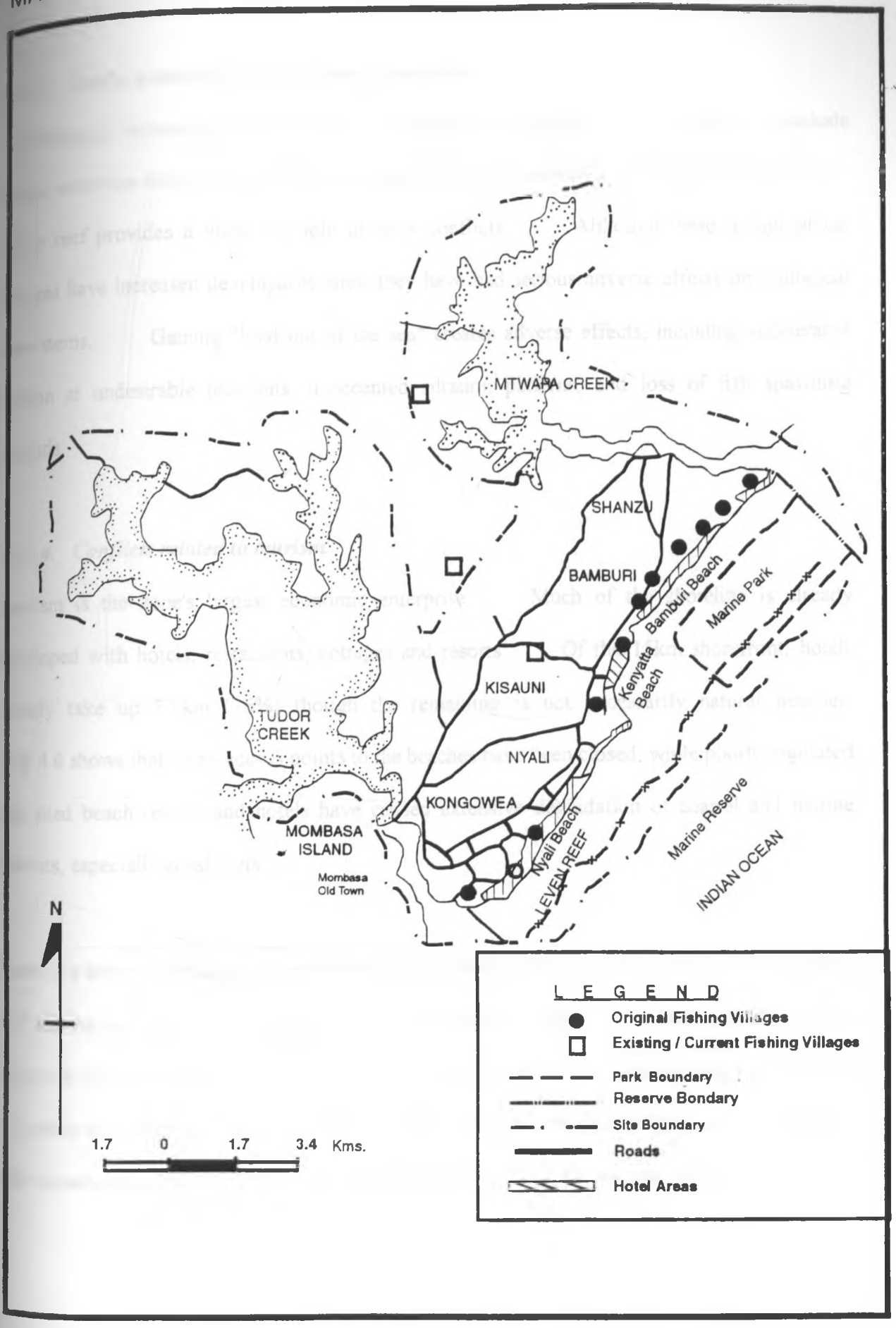
Marine transportation is one of the oldest and most traditional uses of the sea. Most of the country's export and import goods are transported by ship, making marine transportation a huge industry and of great importance to the nation. However, activities related to this use, such as dredging and port expansion, have had significant negative effect on other coastal uses, such as fishing operations, and on environmental quality. Furthermore, fishermen complained of poor water quality caused by anchoring activities in traditional fishing areas.

Figure 4.8 Interaction of uses of the Nyali-Bamburi-Shanzu coastal area



Source Field Survey, 1999

MAP 4.5 :LOCATION OF FISHING VILLAGES



Source: Field survey, 1999.

4.3.7.3. Conflicts related to coastal land reclamation

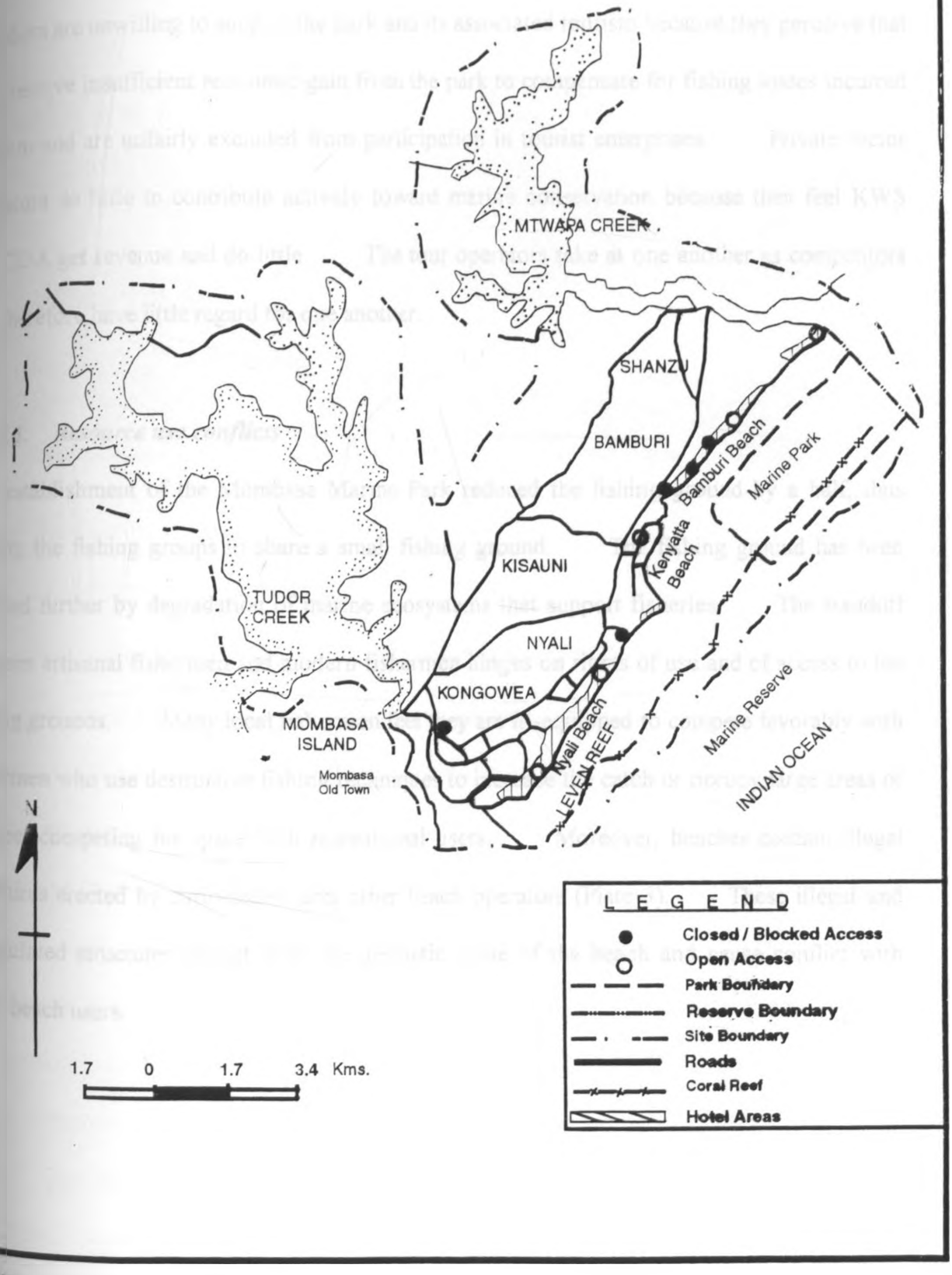
"Reclamation" of coastal wetlands as well as building of seawalls and other barriers to exclude coastal water has been practiced for many years along the shoreline. Coastal reclamation in Leven reef provides a good example of such conflicts. Although these topographical changes have increased developable sites, they have had serious adverse effects on biological ecosystems. Gaining "land out of the sea" creates adverse effects, including accelerated erosion at undesirable locations, unaccented siltation patterns, and loss of fish spawning grounds.

4.3.7.4. Conflicts related to tourism.

Tourism is the zone's largest economic enterprise. Much of the shoreline is already developed with hotels, restaurants, cottages and resorts. Of the 15km shorefront, hotels already take up 5.3km (36%) though the remaining is not necessarily natural beaches. Map 4.6 shows that many access points to the beaches have been closed, while poorly regulated and sited beach resorts and hotels have caused extensive degradation of coastal and marine habitats, especially coral reefs.

There is a serious conflict between the water-dependent activities of tourists (e.g., scuba diving and snorkeling) and those of anglers and recreational activities. While the fishermen believe it is their right to be there and fish, the divers view their fishing baskets as an eyesore and often break them to release the fish. This leads to antagonism between the fishermen and recreation seekers, while the CDA and KWS are criticized for not interfering.

MAP 4.6: PUBLIC ACCESS POINTS



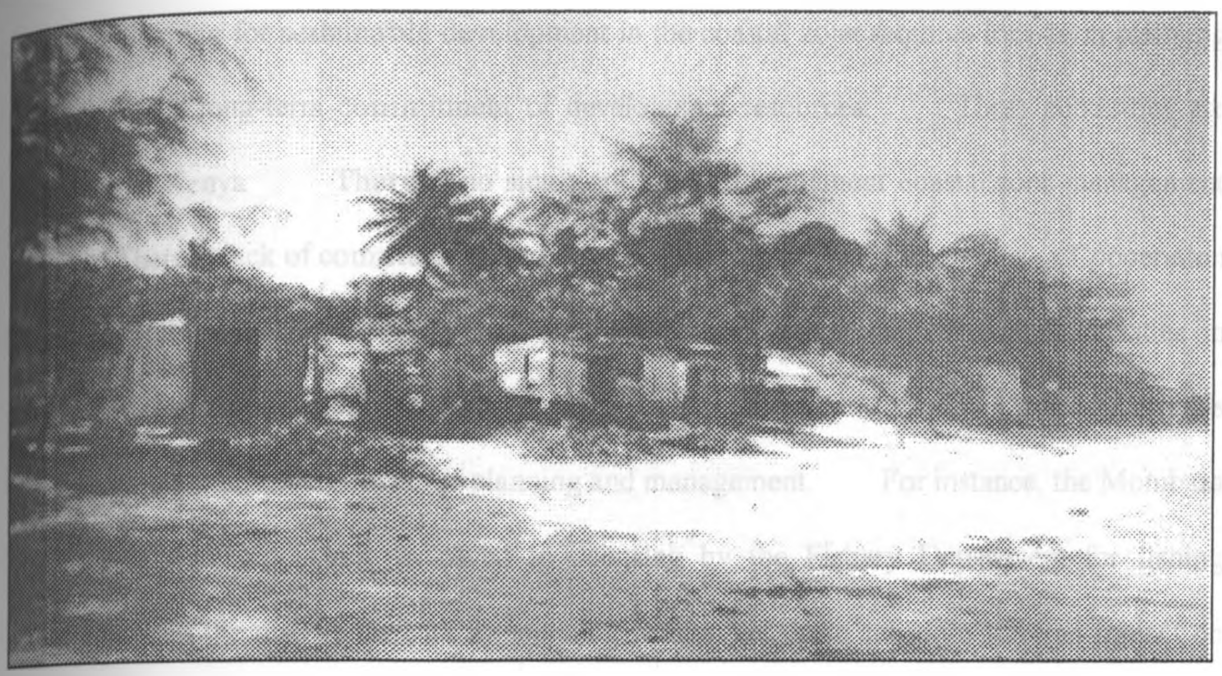
Source: Field survey, 1999.

Strained relationships between tour operators and the community, and among the operators themselves (hotel and non-hotel-based operators), and curio sellers exist. Local community members are unwilling to support the park and its associated tourism because they perceive that they receive insufficient economic gain from the park to compensate for fishing losses incurred to them and are unfairly excluded from participation in tourist enterprises. Private sector operators do little to contribute actively toward marine conservation because they feel KWS and CDA get revenue and do little. The tour operators take at one another as competitors and therefore have little regard for one another.

4.3.7.5. Resource use conflicts

The establishment of the Mombasa Marine Park reduced the fishing ground by a half, thus forcing the fishing groups to share a small fishing ground. The fishing ground has been reduced further by degradation of marine ecosystems that support fisheries. The standoff between artisanal fishermen and modern fishermen hinges on rights of use and of access to the fishing grounds. Many local fishermen feel they are ill-equipped to compete favorably with fishermen who use destructive fishing techniques to increase the catch or occupy large areas of the reef competing for space with recreational users. Moreover, beaches contain illegal structures erected by curio-sellers and other beach operators (Plate 3). These illegal and unregulated structures detract from the aesthetic value of the beach and cause conflict with other beach users.

Plate3. **Illegally erected structures along Nyali beach**



Source: Field survey, 1999.

4.4 Institutional Constraints to Integrated Management at the Coast

While most of the major issues in the zone are recognized, if not entirely understood in terms of full impact of the problem, addressing these issues can be extremely problematic. Apart from the obvious resource constraints, there are significant institutional constraints - both at the national and local levels - which hamper the systematic and coordinated efforts, required in launching viable integrated management programmes. These institutional constraints concern issues related to the management structure, the legal and policy environment, the administrative and organizational aspects of resource management, and the limited human resources available to deal effectively with the issues which currently undermine sustainable development in the zone. The management of the coastal zone is exacerbated by a lack of public awareness concerning coastal problems and inappropriate organization of responsibilities hampering cross-sectoral approaches to problem solving.

4.4.1. Management structure

Strategic planning for sustainable development in the coastal zone requires long-term planning horizons and a long-term commitment of development resources. These conditions are rarely met in Kenya. There is no single authority to implement coastal zone management plans. There is lack of communication between tourism and park authorities. Cooperation is lacking among the KWS, MCM, CDA, Fisheries Department and District authorities in planning for tourism development and environmental concerns. Tourism promotion tends to outweigh other considerations for planning and management. For instance, the Mombasa Marine Park manager is not involved in licensing by the Fishery Department for fishing activities within the reserve and its surrounding waters, yet these activities have an impact on the Marine Park and Reserve. Similarly, the manager is not involved in licensing by the Tourism Department of boat operators, some of which do not have insurance or use un-seaworthy boats. Further, the Forestry Department charged with mangrove management sells concessions to logging companies without checking with KWS or CDA regarding possible downstream effects.

The need for an integrated approach to management of the coastal zone also places a special emphasis on appropriate institutional arrangements and accommodation between stakeholders. Among other things, this requires cooperation between government departments in clarifying their roles and jurisdictional responsibilities over the coastal resources, and harmonizing their policies and management interventions in line with agreed on objectives for the coastal zone Institutional mechanisms are also required to resolve the many user conflicts that are arising over increasingly limited resources, and a commitment to their sustainable use. Compliance with sustainability objectives will depend in part on the degree of ownership and participatory

involvement realized by stakeholders in different stages of coastal zone planning and management. Among the incentives necessary for such voluntary compliance is a partnership between the private sector and government, transparency in decision-making and management accountability, all of which are severely constrained by the current planning system.

4.4.2. Administrative weakness and jurisdictional issues

Since the coast is not a traditional sector *per se* in the economy of Kenya, management of the coastal zone has generally proceeded along *ad hoc* lines. Overlapping jurisdictions of government agencies with authority on the coast (KWS, KEMFRI, CDA, MCM, etc.,), have led to confusion on the one hand as to which resources fall under whose domain, and inertia on the other, as vested interests in conflicting development scenarios compete with one another, eroding enforcement and preventing coordinated action. Government departments and agencies charged with environmental oversight have neither the political clout nor the resources (e.g., expertise in environmental planning and management, finances, etc.), to promulgate the necessary policies and regulatory framework that will balance development with the stakeholder interests in the coast. Lack of private sector and/or community participation, as well as an inadequate database at the local level exacerbates the poor planning and management of the coastal zone.

Related to unclear lines of authority in resource administration is the breakdown of the community user rights. The dislocation caused by environmental degradation, poverty and civil unrest have led to massive social upheavals along with the proliferation of economic refuges concentrated at the coast where resources are viewed as free goods. Without systems in place to allocate rights and regulate access to these resources, conflicts with local

resource users may ignite, leading to further environmental degradation and socioeconomic unrest. National policies and local planning and administration are needed to anticipate these external pressures on coastal resources and mitigate their impacts at the local level.

4.4.3. Limited human resources

Clearly, sustainable management of the coastal zone to meet the development needs of the community and country, well into the future will depend in having a large cadre of well-trained and well-equipped resource managers. There is currently a paucity of personnel with experience and access to the latest technologies (e.g., remote sensing, GIS, EIA, participatory rural appraisal (PRA) and mechanisms to facilitate voluntary compliance with regulations and policies among resource users) and methods to deal with complex issues in coastal zone management. Development of this management tools and their proper use will be critical in terms of meeting the training needs of the staff. Areas of concern include facilities and/or manpower relevant to: (i) combating oil spills and maintaining oil spill readiness, (ii) pursuing appropriate development and support of coastal economic activities, (iii) establishing a viable coastal zone research program, and (iv) multisectoral/coastal environmental planning and management. All these require appropriate financial resources and technical support. Career development incentives, including prospects for promotion and competitive salaries, will also have to be provided to create a competent and highly motivated corps of coastal zone managers. Without investments in human resource development, groundwork for successful integrated coastal zone management programmes cannot be laid in the zone. Development and access to well-planned databases for environmental assessment and monitoring will also be required.

4.4.4. Policy and legal aspects

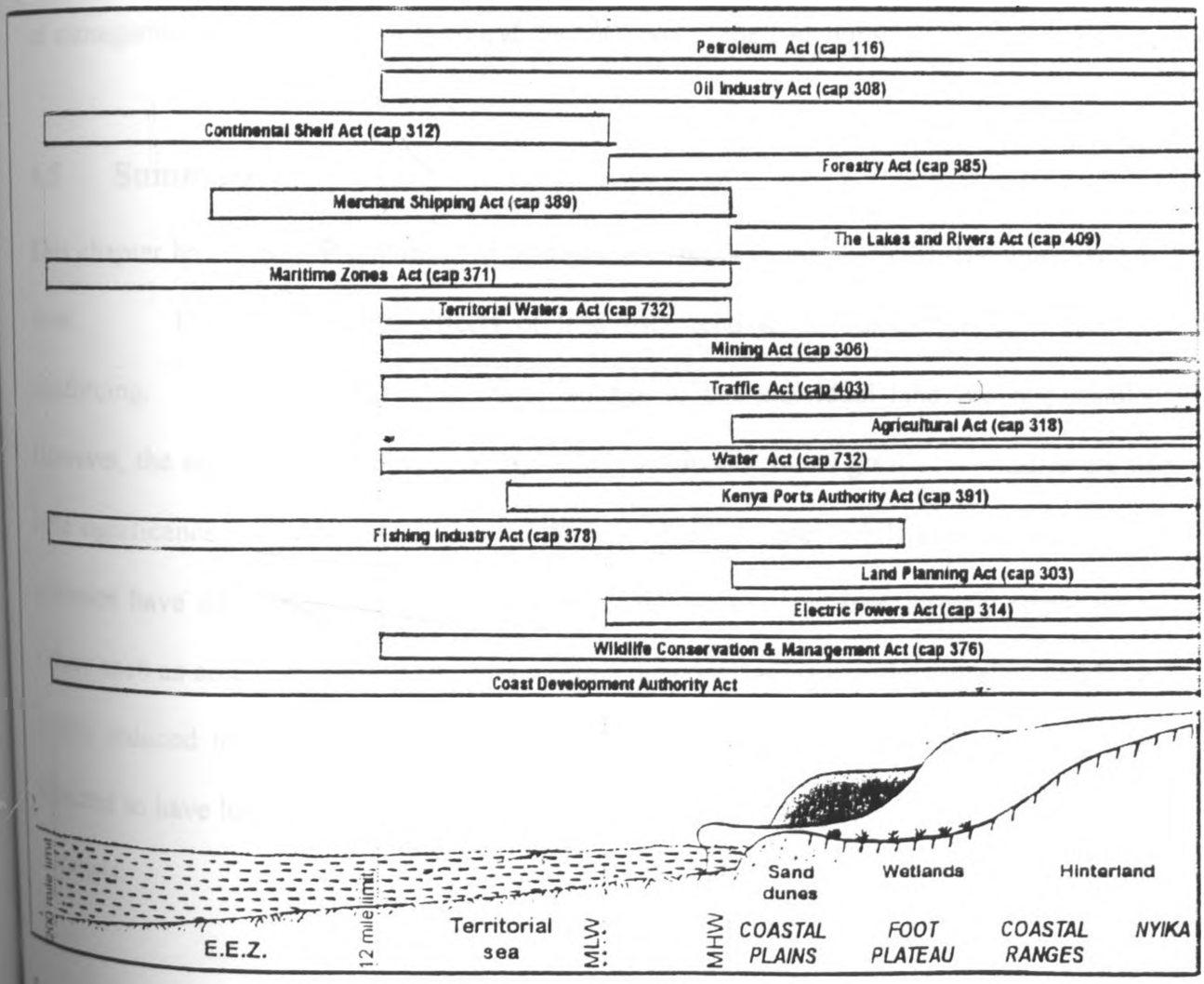
Another important factor which has contributed to the rapid degradation of natural resources and habitats in the coastal zone has been a weak policy environment in which to regulate and otherwise influence the impacts of growth. Figure 4.9 shows the most important legislation governing development along the coast and indicates the extent of their jurisdiction. The legislation gives planning and management responsibility to local agencies (CDA, MCM, DDC) with remit to deal with specific issues involved without necessarily involving other agencies. They are generally purely sectoral by design and largely oriented toward resource exploitation for economic benefit.[12] The zoning regulations of mangrove forests have not been adopted under the Wildlife Conservation and Management Act (cap 376) and the Forestry Act (cap 385). A system for territorial user rights in fisheries (TURF) is not well defined. There is lack of planning at the shoreline for tourism development in terms of land-use practices, setbacks from the beach, waste disposal, simple zoning, and guidelines for tourist activities and conduct. Environmental codes and regulatory legislation to offset the environmental consequences of industrial expansion and other growth sectors (e.g., tourism and agribusiness) are only now emerging. Laws regulating access and use of coastal resources have yet to be developed. There is no single comprehensive law governing the use of various coastal resources.

An additional factor, which undermines the progress being made in the development of appropriate policies and standards for the tourism industry, is lack of enforcement. This is both a resource issue in terms of inadequate surveillance staff and budget, and an accountability

[12] Since sectoral agencies are left to make their own judgment about what steps to take to balance their own objectives with regard to national environmental policies, it is not surprising that short-term resource exploitation is usually given priority.

issue. The existing laws forbidding construction inside the beach setback, illegal fishing by trawlers, and coral and limestone mining are not adequately enforced because either the municipal council of Mombasa does not have the resources, in terms of surveillance staff, equipment and budget, or probably those who are employed are so poorly paid that they are susceptible to compromising situations. Given the tremendous profits made in these growth sectors (tourism, aquaculture, industry etc.) and the lack of legal recourse available to injured parties, there is little incentive for self-regulation.

Figure 4.9. Laws and regulations governing coastal zone management in Kenya



Source: UNEP, 1998.

Weak enforcement of existing laws and traditional use rights has important implications for the management of coastal resources as well. Many coastal and marine resources (e.g., fisheries, mangrove forest, beaches, etc.) are considered common property resources within the legal jurisdiction of local or national authorities. Assurance of a continuous benefit stream to users of these resources was made possible through systems of traditional user rights and licensing schemes, which served -at one time - to limit access to these resources. With high rates of population growth, urbanization and unemployment, the pressure for broader access to these resources has grown along with the agencies' inability to restrict it. A common interest once shared by users in the face of these resources has led to a breakdown of management practices, exploitation and the "Tragedy of the commons."

4.5 Summary

This chapter has discussed a number of management issues facing the Nyali-Bamburi-Shanzu zone. The environmental effects of land uses tend to be cumulative and mutually reinforcing. It is difficult to attribute damage to the individual land use responsible. However, the significance of environmental effects obviously varies greatly. Some are of little significance from the point of view of the individual land user, while some such as water pollution have adverse effects on other users but not on the land user directly responsible. Others such as accelerated coastal erosion threaten the continued use of the shoreline and have greatly reduced its productivity. Others again, such as loss of species diversity, are expected to have long-term adverse effects on the population at large through a loss of genetic materials.

In general, the Nyali-Bamburi-Shanzu zone is not seriously degraded, danger lies in the irreparable character of the damage that is about to be inflicted on the coastal environment, not only by tourism, but by population pressures and industrial development, simultaneously if the present trend is not managed. The future of the various ecosystems that together form the coastal environment, is at stake and with them the enormous biological diversity and productivity they house. Degradation of this environment will eventually lead to collapse of coastal tourism leading to massive unemployment. In addition, the disappearance of fish and crustaceans as food sources will result in widespread poverty for the indigenous coastal people.

CHAPTER FIVE

5.0 TOWARDS SOUND PLANNING AND MANAGEMENT OF THE COASTAL ZONE

In the preceeding chapter, an analysis of the problems and issues of development-environment interactions in the NBS zone has been made, indicating clearly how negative or even unacceptable a future situation can and will be if nothing is done to alter the exixting trends. This part of the study aims at synthesizing these problems and to look into the possible future of the zone. Since this study does not pretend to be a plan, it has not been possible to suggest precise measures for meeting the desirable future of the zone. It offers only an outline of possible development options with a view of identifying their impacts on the state of the environment.

5.1 Evaluation of the Hitherto Development of the Area with Respect to the Environment: Key Problems

5.1.1 Development – environment interactions

5.1.1.1 Urban growth

The greatest problem preventing environmentally sound development in the zone is the sheer scale and pace of urban growth. The uncontrolled power of such expanssion has affected almost all spheres of economic life, bringing about conflicts between uses, at the expense of those activities which are not economically strong enough (agriculture, fishery, recreation) to fight the interests of the more propulsive ones. Under such circumstances, the balance between the need for protection and conservation of natural amenities and the extent of their substitution by by built

environment has been seriously disturbed. All this justifies the warning that continuation of the existing trends would be in total discrepancy with the requirements of environmentally sound development.

5.1.1.2 Unplanned housing

The ecological balance has been disturbed not only because of the inability of the area to accommodate the pressure of human activities, but also because of the way in which the urban population has been settling in the area. The hitherto development of the area has been largely based on extensive development of illegal housing. Environmental implications of such housing are reflected primarily by: (i) the accelerated and irreversible loss to housing of valuable agricultural and other land resources which should be preserved in the natural state, (ii) occupation of hazard prone areas, and (iii) destruction of the green spaces both within and around the zone.

These settlements are not serviced by public infrastructure, Nyali-Bamburi-Shanzu zone particularly the sewerage system. The untreated domestic wastewater is discharged onto the streets. Moreover, these settlements are home to many small-scale, often informal manufacturing units, which discharge their own wastes into the environment. Once population and economic activities grow, urban water and sanitation will deteriorate further and sewage containing bacteria and toxic industrial waste pollutes large stretches of the shoreline. Decline in environmental quality along the shoreline will not only lead to the disapearance of the natural habitats (mangroves, seagrass, coral reefs, beaches, etc.,) but will also halt further tourism development.

So far, the local authority and other agencies have not been able to respond adequately to the massive immigration flows, which have, due to lack of sufficient serviced land, generated pressure for expansion towards peripheral, underdeveloped areas. There, the rising land prices opens up the process of giving priority to all forms of urban development at the expense of valuable land resources. Continuation of these trends mean that the remaining land resources will continue to be consumed, and pose a threat for the environment to experience impacts far beyond its carrying capacity.

5.1.1.3. Concentration of tourism and recreation

Along with rapid population growth, the zone has witnessed mass tourism development. The location of tourist resorts in and/or around the NBS area was guided solely by the principle of economic efficiency, which took into account only the employment effect of the sector and its contribution to the Gross Domestic Product. While development of these hotels and resorts along the coastline has been instrumental in increasing the production efficiency, it has also, due to insufficient controls given rise to disadvantages reflected in various forms of environmental destruction. Decline in environmental quality and resource use conflicts have not been recognized as "negative externalities". Given this scenario, measures haven't been effectively introduced to "internalize" this externality and discourage the growing concentration of tourist hotels in the zone. The pollution of the ocean-waters and the degradation of coastal habitats is particularly serious, as the alterations of water conditions and the natural values of the shoreline have restricted considerably the opportunities for fishing, tourism and recreation.

5.1.1.4 Infrastructure systems

The state of infrastructure systems (water supply, roads, sewerage system, etc.) in the Nyali-Bamburi-Shanzu area is unsatisfactory. None of the systems deserves to be called a "complete system." The public sector has had large difficulties in keeping the provision of infrastructure at pace with rapid urbanization.

(a) Water supply

The water supply system suffers from certain technical shortcomings. Particularly pronounced is the problem of inadequate production and supply. In an attempt to meet the ever-growing need for water, groundwater resources within the area are being excessively pumped. Regardless of the over-exploitation they are still unable to meet the needs so that fresh water must be brought from sources outside the area, which requires expensive engineering and structures, such as tunnels and dams.

(b) Sewerage

Building and reconstruction of the sewage network has been constantly lagging behind the general development of the area. Disposal of wastewater, which are still discharged directly into the ocean without any treatment, stands as one of the major causes of the high level of pollution of the marine environment.

(c) Transport

Concentrations of human activities in the area have generated considerable transportation problems. During peak hours, the major urban arteries, particularly those intersecting the densely populated neighborhoods, become noisy and air-polluted traffic bottlenecks.

5.1.2 State of the environment

The Nyali-Bamburi-Shanzu area is burdened by such a structure of development which has negatively influenced the quality of the environment. Difficulties encountered by the MCM and other agencies to establish a well-coordinated environmental control only augmented the problem opening the path for ever-increasing conflicts between the users of resources and for resulting pollution-related damages. The major losses include: (i) tourism losses, (ii) recreational losses as the inhabitants have to travel long distances for weekend recreation, (iii) groundwater losses attributed to leakage from domestic wastewater intrusion of sea water, (iv) fishing losses caused by pollution, and (v) damage to human health due to lack of sewer services in the area. This calls for a change in setting the basic goals, strategies and policies of the future long-term development. What is actually needed is seeking to establish the balance between the social and economic development and the best use of the zone's limited natural resources. The balance seen from this point of view is not simply a matter of preventing pollution and conserving the natural environment, but an orientation towards sustainable development accepted as a goal both of economic and environmental policies.

5.1.2.1 The Shoreline

Measures of physical, chemical and bacteriological indicators show that the capacity of the ecosystem of the oceanwaters of the area is insufficient to receive the present quantity of wastes from numerous sources. Degradation of organic substances discharged into the sea have caused depletion of dissolved oxygen in the nearshore waters resulting in anoxic condition and bad smell, a typical indicator of the anaerobic process. Suspended solids continually deposited at discharge points are gradually littering the beaches. This limits the use of the nearshore waters for fishing, tourism and recreation.

5.1.2.2 Water quality

Domestic wastewater and industrial effluents seriously pollute the nearshore waters. The nearshore waters contain high levels of nitrogen, suspended solids, and toxic substances including heavy metals, which affect their utilization. Due to concentration of polluting sources (population, hotels, industries, etc.), the groundwater resources are also subject to pollution. Although the impact of urbanization on water in Mombasa ranks as the critical environmental problem, it has not been studied on along-term basis.

5.1.2.3 Soil and vegetation cover degradation

Not only the sea, but also the soil and vegetation cover is exposed to various forms of pollution and destruction. The increasing demand for urban and agricultural land, has resulted in land clearance for building and agricultural purposes, reducing the land which should have been preserved in the natural state, decreasing the level of runoff protection, and spurring erosion processes. The land left without natural protection against negative effects of atmospheric factors has gradually lost its physical, chemical and biological properties. It appears that forest management plans and programs are poorly applied and implemented.

5.1.2.4 Air quality

The quality of the air is affected by concentration of particulate matter, sulphur dioxide and nitrogen oxide. Most of these pollutants are products of industries, especially Bamburi Cement Factory, vehicular exhausts, and low quality fuels burned in other industries. This is exacerbated by the continuous development of hotels and houses along the shoreline which block the wind flow from the ocean and thus creating stable air masses trapping pollutants over the area. As long as the source emissions remain unchecked, air quality will be decreasing.

5.1.2.5 Environmental hazards

The low-lying coastal areas, especially the northern shore (i.e., Shanzu) are endangered by the expected sea-level rise, which is assumed one of the consequences of global warming. In addition to flooding, the expected sea-level rise might provoke ocean-water intrusion into the groundwater and cause the water table to rise. Accordingly, the change of salinity level will affect the quality of the agricultural land around Shanzu where much of the land is under agriculture and with groundwater table near the surface.

5.1.3 Institutional framework and decision making

The growing problems relative to environmental degradation and resource use conflicts clearly indicate that the hitherto environmental management system has not been able to respond adequately to the changing needs of the area. This is mostly due to inability of the local, regional and national authorities to cope with the rapid growth of population and economic activities in and around the zone. Another important reason is the diverging policy objectives pursued by the various agencies. There is no well-coordinated mechanism for decision making or a single authority entrusted with environmental management.

This notwithstanding, lack of sufficient funds for environmental purposes, including the development of a consistent ecological monitoring unit, inhibits the environmental management efforts. The shortage of funds reflects partly the inability of the local authority to raise funds for environmental purposes, and partly, the priorities of the Government in allocating public funds. This scenario is exacerbated by the absence of cost recovery for environmental services which acts as a barrier to generating sufficient revenues for critical infrastructure projects, including maintenance of the existing systems.

5.2 Possible Future Development Scenario

Urban growth is directly or indirectly determined by various factors. However, a possible urban growth in the zone will definitely follow two paths.[13] The first option is the so-called "**trend**" or "**do nothing**" option which is based on the existing development trends. A possible alternative to the "trend" option is the "**moderate growth**" which anticipates a certain change of the existing trends. Unfortunately, no big changes can be anticipated, since it can hardly be speculated that the existing negative aspects of the development process will wholly stop afflicting the area in the short run.

(a) The "Trend" option

This option assumes that no policy measure will be applied to spur the process of regional dispersion. In this case, the dispersion process will be based on a more or less spontaneous course of events. The lack of government intervention to create positive externalities in other areas will discourage re-location of firms out of the zone where profit influences the location decisions. In the meantime, the concentration of activities in the zone will continue to attract population towards the area. As a result, the potential for conflict in the allocation of resources will be very high. Without adequate management structure to dampen these conflicts and buffer the natural resource base against impact of its productivity, a new scenario of urban growth could easily unfold. This will ensure that basic human welfare derived from the coast will decline.

[13] Since it would be hardly possible to provide a multitude of options or work out in detail every single development outlook, only two options are considered.

(b) The "Moderate" option

Bearing in mind the increased congestion of the coastal area, as well as the favourable socioeconomic conditions prevailing in the zone, the "moderate" option of future urban growth is more acceptable than the "trend" option. This expects a gradual change of the existing trend through the implementation of policy measures which will stimulate the slowing down and reversing the hitherto course of polarized regional development. The major policy measures to make the location for activities in small centres less risky for economy, and to re-distribute the population and lessen the pressure on the area include: (i) balanced development of the settlement system, and (ii) completion and extension of municipal infrastructure network and services. Owing to better opportunities provided elsewhere along the coast, there shall be a gradual decrease of immigration rates in Mombasa at the beginning, and their stabilization after some time.

5.2.1 Population growth

Table 5.1 shows the population projection for the Nyali-Bamburi-Zhanzu area. The "trend" option assumes that in the period between 1990 and 2025 the population of zone will increase from 176,326 to 413,252. Because of the declined fertility rates (due to the influence of socio-economic and environmental conditions that will prevail), the overall population growth will be expected to slow. Still, the population will continue to grow relatively fast. The resulting population figures expected in 2010 are more acceptable than those under existing "trend" conditions. In such circumstances it is likely to expect that the balance among demographic, economic and environmental components of development will be difficult to establish and that efforts of the local authority to change radically the existing economic structure and curb the hitherto excessive growth will be less successful.

Table 5.1 Population projection (in '000') for the year 2025.

Population	1990	1995	2000*	2005*	2010*
Trend growth option	176,326	211,452	254,796	336,416	413,252
Moderate growth option	152,481	184,768	215,079	297,914	346,108

Notes: * Projection figures

Source: Mombasa District Physical Plan, 1997; Projection.

5.2.2 Environmental implications

The persistence of the existing trends of urban growth in the Nyali-Bamburi-Shanzu area is bound to have serious adverse effects on the environment. As the population and economic activities grow, urban water and sanitation services will deteriorate further and sewage containing bacterial, organic, suspended solids and toxic industrial wastes pollutes large stretches of the shoreline. Moreover, large quantities of pollutants that are expected to be discharged by run-off will continue to deteriorate the shoreline, particularly its northern shallow coast, in the hinterland of which intensive urban, tourism and industrial development is bound to take place. The utilization of marine resources in this part of the coast will continue to be negatively affected by the urban development-taking place in the immediate hinterland unless adequate protection measures are taken.

As for water, larger efforts will have to be undertaken not only to improve and extend the distribution network, but also to meet the increasing water demand. Limited supply of freshwater for large population increasingly constrained by hotel and higher-income users will lead to recurring epidemics and high mortality rates, particularly among children. As already noted, water demands will be met from sources outside of the Mombasa region requiring expensive engineering works. Therefore, the zone's groundwater resources should

be sustainably utilized. However, the persistence of the existing trends of urban concentration is bound to have adverse effects on the quality of water. Ocean water and groundwater will equally be imperiled. It is expected that some of the sources of water supply will be threatened too, primarily the resources in Shanzu area. Given the increased costs of monitoring the quality of water supply and the high capital outlays for treatment, facilities must be constantly re-assessed inorder to protect public health.

A special problem concerning the persistence of the existing trends of urban growth refers to the tendency of consuming the remaining land. With an average population density of 2,500 persons per hectare of total land used for urban purposes, it is likely that the urbanized land in the zone will expand by 70% i.e., from 55km^2 in 1990 to more than 87km^2 in the year 2010. Taking into account the categorization of the area into zones of different "environmental constraints" with respect to various land-use options (see Chapter 3.2), the analysis of land availability for future urban development within the most prospective zones show the following:

- Zone "A" where land is most habitable, and where urban development can take place without serious difficulties, most of the land has been utilized, so that the reserves of free spaces (undeveloped land) for urbanization are small. In this zone, most of the land to build can be provided by interpolation, reconstruction, or re-zoning.
- The largest potential sites (undeveloped land) for building is within zone "C", but mainly on steep slopes often exposed to erosion risks. The limitations are higher than those on zone "A", both in terms of additional expenses required for overcoming physical infrastructure and other constraints of development, and in terms of efforts towards environmental protection.

It is therefore clear that the remaining undeveloped land to support future urban growth in the NBS area is very scarce. Consequently, the proposed development options are bound to have serious implications on the future land-use. Unplanned development will lead to severe user conflicts. The beaches will be silted and abandoned due to impacts of erosion and sea-level rise. Siltation will decline BOD in nearshore waters and lead to disturbances in the fragile coastal ecosystem. This will intensify to see the subsistence users of coastal and marine resources, particularly artisanal fishermen, pushed a side by commercial interests, resulting in protein deficiency.

Under constant population pressure, the solution to housing is likely to become even more difficult. It may cause further spreading of uncontrolled illegal housing, even towards the areas, which need to be preserved in their natural state. Further, mangrove areas will be reduced to remnants, leading to further coastal destabilization and loss of timber and fuel wood. It again is clear that, due to scarcity of serviced land, the urban growth based on the persistence of the present trends will lead to further concentration of activities and population in the central areas of the zone, which will considerably disturb the structure and use of urban areas at the expense of green and other public areas.

In conclusion, the "trend" growth is hardly acceptable, both from the environmental and economic point of view. Serious environment problems, including massive depletion can be expected in future unless measures are taken to alter the course of on-going processes. The analyses of environmental implications and availability of land for urban development also indicates that the zone will be faced with difficulties in accommodating the inhabitants and associated activities anticipated. Based on this view, it is of crucial importance to recognize

the scarcity of land resources - the problem that must be accorded high priority by the planners and decision-makers. Scarcity of available land, coupled with the growing environmental problems that may be expected due to increased pollution loads, call for immediate actions aiming at the preparation of comprehensive development scenarios which will reduce uncertainties and determine a desirable future of the zone. The scenarios should lay ground for the preparation of an Integrated Coastal Management Plan (ICMP).

5.3 Goals and Policy Recommendations for Sustainable Development

5.3.1 Development strategy concern

Development of the Nyali-Bamburi-Shanzu area has reached a stage where direct benefits of mass tourism and vigorous economic growth are being overwhelmed by costs of environmental degradation. The persistence of the existing trends of urban growth are likely to result into further resource depletion (encroachment of the remaining land resources) and deteriorated quality of the environment due to pollution. The existing trends of economic development and rapid urban growth which are increasingly swallowing natural amenities of the area should be changed or slowed down by adopting a selective model of development and consistent implementation of environmental conservation and recovery methods. The adoption of a sound development model implies a gradual transformation of the existing economic structure, which should be based on:

i. Modernization and technological transformation of the existing industrial capacities with a gradual closing down of those units which are in conflict with the environment. All polluting industries should comply to the anti-pollution measures. It is also vital for the Nyali-Bamburi-Shanzu economy to promote development programmes, which will be able to bear the cost of environmental resuscitation and recovery of the area.

ii. Introduction of new, locationally flexible and ecologically acceptable production structures of small size. Sites available in the coastal belt should only take those production capacities which: (a) do not require much land, (b) do not pollute the environment and do not generate large amounts of wastewater, and (c) can fit into the existing planned spatial and functional structure of the area.

iii. Meeting the spatial, infrastructure and other requirements to enable relocation of the manufacturing sector into less conflicting zones at the outskirts of Mombasa.

In view of the quality and quantity of available resources, the above model aims at curbing the persistent trends of excessive concentration of people in the area. Moreover, population growth in the area must be reduced radically. This calls for actions aimed, first and foremost, to reduce the influx of rural population into the area. Measures to discourage migration flows towards large coastal urban centre, particularly Mombasa, should rely on the policy and strategy of control over the sources of urban growth at the local level. Keeping in mind the fact that squatter settlement have been (and still are) the predominant destination for migrants, migration flows can be diverted by the provision of new jobs as well as urban serviced land, especially for low-income population at locations outside the zone. This may discourage the illegal housing to continue sprawling.

Unfortunately, the slowing down of migration towards Mombasa might cause an excessive growth of the surrounding medium and lower-order centres located close enough to Mombasa to benefit from the spillover. In this case, the relevant authorities need to anticipate the future process and take a more active role in controlling urban growth along the development axes in the bordering areas of Mombasa, mainly Mazeras, Mtwapa, and Kikambala. From

that point of view, Kilifi and/or Mariakani, which are of right size and which have enough economic power to support industrial development, should be considered as possible counterpoles to Mombasa.

5.3.2 Environmental policy concerns

A general picture of the state of the quality of human environment in the zone and indications of serious threats to some particular components of the ecosystem, speak in themselves of the need for an effective management of natural resources as one of the priorities on which the strategy and policy of the future development should be based. Some of the recommendations to achieve this goal are:

i. Harmonization of the future development with the receptive capacities of the ecosystem, potentials for the area, and requirements of their protection and recovery. The authorities should: (a) adopt a preventive and precautionary policy approach so as to minimize (if not avoid) further degradation of the environment, and (b) start taking concrete actions towards its general recovery.

ii. To build an organized and efficient system of pollution control and monitoring of the quality of environment with a view of imposing responsibilities for the enforcement of adopted environmental standards on those who are generating pollution. In this regard, it is vital to take the following steps: (a) the Public Health Department of the MCM, which is responsible for pollution control activities should be strengthened both in terms of human resources and organizational structure, as well as in terms of technical and financial resources, (b) a more efficient coordination and cooperation should be established among the responsible national, regional and local institutions, and with non-governmental organizations (e.g., universities and research bodies)

involved in research and monitoring of the state of the environment in order to: (i) complete the knowledge and facilitate exchange of information, (ii) standardize the quality of human environment at the local level and upgrade legal instruments with the aim to mitigate and reduce pollution, and (c) the MCM and the national authorities wherever applicable, should promote the use of various economic instruments such as pollution charges, marketable permits, penalties and other enforcement incentives.

iii It is also important as a preventive measure to prepare an environmental impact assessment (EIA) for each project/activity assessed as a potential source of pollution.

5.3.3 Protection and recovery of the shore

Pollution of the shore is a major environmental problem in the area. The management of effluents, wastewater and agricultural runoff to minimize impacts on coastal waters is one of the challenges to maintaining marine and coastal water quality, and in turn, coastal habitats, public health, recreation and visual amenity. A decision to build a sewerage system and treatment plant will be the most important response to the pressure to protect the shoreline from further degradation. However, this is but one response to the problems the zone is facing. In this context, several other issues are of importance for securing an effective protection of coastal and marine resources:

i Since a planned sewage and treatment plant cannot be expected to eliminate marine pollution completely (due to the large quantities of pollutants discharged directly into the ocean by runoff) an effort should be made to identify the overland flow paths and develop a strategy of the management of the runoff and other non-point sources of pollution. This calls for inputs from both land-use planning and water engineering services of the municipal council of Mombasa.

ii. The improvement of the existing day-to-day monitoring programme should be validated for chemical parameters being direct indicators of pollution of the ocean waters. A part from the day-to-day monitoring, it is also recommended to start along term cooperative research programme and systematic collection of data on all relevant marine environmental parameters. These data will be used for studying the rate of recovery, and for predicting the effects of global climate change on living marine resources and the marine environment as a whole.

iii Additional measures to reduce degradation of the marine environment from sea-based activities include having adequate receptive facilities at the port of Mombasa to control pollution from shipping and offshore oil processing and handling.

5.3.4 Protection of groundwater resources

As already noted, pollution caused by the tremendous urban growth threatens the groundwater resources. To prevent further contamination and secure stable water supply, it is necessary:

i. To undertake a comprehensive study of the protection of water resources and of the long-term changes of their quality, covering the area and its immediate vicinity. The study will serve as a basis for defining various land-use planning and/or zoning requirements (minimum lot sizes, distribution of septic tanks, etc.).

ii. To control the use of groundwater sources to prevent their excessive pumping.

iii To stop illegal wastewater discharges endangering both the reticulated water system and the aquifers. To assure success of the Industrial Discharge Control Programme the following need to be addressed: (a) monitor the industrial pre-treatment facilities, (b) monitor sludge disposal, and (c) have an efficient analytical laboratory to monitor compliance with regulations.

5.3.5 Air pollution control and abatement

i To reduce air pollution, it is important to promote and encourage a gradual substitution of the existing sources of energy by those (natural gas, better quality fuels) which will be environmentally more acceptable. At the same time, the regulations pertaining to the construction of stacks should be in accordance with the Air Quality Protection Regulations in order to ensure adequate atmospheric dispersion of air pollutants.

ii To control vehicular movement, an overall transportation plan is necessary. In such a plan, mass transportation facilities must be foreseen with less pollutant emissions per vehicle. The use of leaded gasoline must be reduced. Inspection and maintenance of vehicles must be effectively planned and carried out.

iii. Whenever the available space so permits, it is necessary to create green belts and/or sanitary-protection zones, primarily in the areas where Bamburi Cement Factory and housing meet, as well as, along major transportation arteries.

5.3.6 Soil protection

Soil is a very sensitive component of human environment in the coastal hinterland. It has, however, been exposed to various processes of degradation and pollution, primarily erosion and pollution from runoff and wastewater respectively, due to lack of adequate collection and discharge system. To prevent further damage effects of soil erosion, it is necessary to undertake a series of anti-erosion measures with regard to deforested terrain. These measures include aforestation and cover improvement of bushland, contour trenches, contour farming and terraces and the intensive care of young forests. The protection of soil from excessive utilization of fertilizers and pesticides requires the following: (i) to establish a mechanism of systematic control of the quantity, composition and ways of use of fertilizers and pesticides in

agriculture, (ii) to educate farmers and instructing them how to use fertilizers and other compounds, and (iii) to upgrade measures and analyses of soil samples to enable timely interventions for prevention and recovery, as well as determine the zones of saturation with regard to the acceptable limits of soil pollution.

5.3.7 A sound use of limited land resources

Given the quality and quantity of the available land area in the area, which is a critical constraint to further tourism development, the coastal authorities should aim to implement a more efficient land management. Some of the key directions to achieve this goal are as follows:

5.3.7.1 Forest and agricultural land

Preservation of agricultural land should be an integral part of the overall land use and management strategy. In this case, appropriate legislative and planning measures should be reinforced to prevent further unnecessary loss of valuable agricultural land, especially land along and around the expansion axes. This is possible to achieve by imposing restrictions on the conversion of agricultural land to other uses. This should, however, be preceded by a comprehensive study of all relevant factors (accessibility, homogeneity, structure, soil class, etc.) resulting in a classification of agricultural land with respect to the conditions to be met for each particular type of crop.

A deteriorating state of forests (uncontrolled felling for construction sites and conversion into agricultural areas) calls for better forest management. Recognizing the recreational and protective role of forests in maintaining the bio-ecological balance, it is essential for the

respective authorities to improve the management of forests by means of: (i) promoting the planning practice and implementing measures to prevent further unnecessary loss of the forest to construction or agriculture, and (ii) encourage afforestation programmes, particularly in the areas where afforestation would have both protective and rehabilitative character.

5.3.7.2 Urban land

A preliminary analyses and assessments show that the urbanization process in the area has largely by-passed the basic principles of the 1962 Master Plan. Ultimately, the bulk of the disturbances taking place in the physical space are the consequence of a permanent flow of migrants towards the peripheral areas. Under the conditions of a highly speculative land market, the area has experienced a transformation of agricultural land and other environmentally sensitive locations into building land. Therefore, a consistent public control over the source of urban growth in Mombasa and, in particular, control over the use, transaction and prices of land are crucial elements of the policy, which aims at an efficient land organization and protection. To this end, it is necessary:

i. To set up and update databases of land and urban growth and to provide appropriate planning solutions to use of land resource. These data will enable structuring the land taxation system, as fiscal tools cannot function properly without accurate information on land value. In addition, such information is a valuable basis for government planning and decision making, as well as for private investment.

ii. Introduce gradually a system of economically realistic charges (e.g., user fees) for communal services in order to rationalize the consumption and secure means for the implementation of important infrastructure projects (sewage, water supply, etc.) and thereby to discourage new settlers in the area.

iii. To develop an efficient mechanism for taxing value resulting from investments in infrastructure, land registration and titling. The gains can then be used for the implementation of urgent development programmes such as, provision of serviced land for low-income groups at right locations in order to prevent sprawling or building of illegal settlements in environmentally vulnerable areas.

iv. To provide appropriate planning solutions for a rational use of limited land resources. In other words, the MCM should abandon the hitherto practice of static physical planning, adopt a more dynamic approach and move to the preparation of a comprehensive plan incorporating short-term detailed plans, programmes and projects.

5.3.8 Areas of particular value

So far, the Mombasa Marine National Park has been put on the list of Specially Protected Areas (SPA) in the Coast. Regardless of the fact that the law protects this area, there are indications that harmful human activities occur within this area. Generally, the wider area is recognized as a significant scenic and natural resource of particular value for tourism and recreation. Therefore, it is worth to develop a legal framework for its protection. In addition a management programme should encompass the following:

i. Limiting, as necessary, exploitative uses of coastal and marine waters and their resources, or of linked areas that influence life (e.g., preventing mining of coral reef to maintain their value to fisheries and to protect the shoreline from natural hazards).

ii. Tourism and recreation in the park need to be developed and promoted in a manner compatible with natural resource conservation (e.g., ecotourism).

iii. Seek a cooperation of all agencies concerned with activities outside the marine park boundaries, which have negative impacts on the park and its resources.

iv. To rehabilitate this area, the remaining underdeveloped and/or less densely developed areas need to be protected from inappropriate uses by channeling infrastructure for tourism development deeper inland in order to ensure undisturbed access to the beach and improve the visual functions of the ocean.

5.3.9 Improved management of living coastal and marine resources

The analyses found that ecosystem degradation, insufficiently selective gear, overfishing, unreliable data bases and increasing competition between artisanal and commercial fishing and between fishing and other activities are the main problems that face the fishery. The biological production of the system can be enhanced through proper management and enhanced knowledge of the resources. This should include:

i. Fisheries management need to be carried out by local fishers, use of selective gear to minimize by-catch non-target species, protect endangered species and ecologically sensitive areas, and enforcement of seasonal and spatial limitations.

ii. Conflicts between large-scale and artisanal fishers can be resolved by developing a Territorial Use Rights in Fisheries (TURF) system for each fishers in the zone.

iii. The strengthening of legal and regulatory frameworks for fisheries management, use of environmentally sound technology, encouragement of recreational and tourism activities based on marine living resources and protection of marine ecosystem.

iv. Mangrove reforestation programmes and seagrass bed restoration and enforcement of non-destructive fishing methods will result in rehabilitation of many tourist sites and artisanal fisheries.

v. Development of processing industries will provide alternative employment and reduce harvesting pressure on marine organisms by marginal groups.

5.3.10 Natural risks and hazards

One of the major effects of global warming is a rise in sea level due to the melting of glaciers and thermal expansion of ocean waters. Superimposed on these effects will be local subsidence. The rise in temperature and sea level could affect coastal and marine areas, particularly in relation to: (i) groundwater flow and river regimes, (ii) movement of main water masses (waves, currents, tides, erosion of the coastline, etc.), (iii) natural ecosystems due to increased temperature; and (iv) occupation and use of coastal land due to sea level rise. The impacts of such changes may include: (a) an increased seawater intrusion into the coastal aquifers, (b) further difficulties in providing supply of fresh water, (c) increased inundation under storm conditions in unprotected coastline and low-lying areas, (d) increased coastal erosion, and (e) loss of natural vegetation. In view of the above facts, it is of interest to study the possible implications of expected climate changes in the zone.

In many parts of the more densely populated areas, the risks of natural disasters to inhabitants of coastal lowlands and property are rising because of population increases, migration to the coast, and poorly planned development projects. Since the main threat to the beach is usually from development on land next to it, beach protection requires coordinated management of itself and the land behind it, as well as a way to limit buildings, prevent excavation and control beach protection and inlet structures. Safeguarding of resources and features that protect the coast from storms and surges (prohibit sand removal, avoid mangrove clearance, protect coral reefs) and delineating a coastal construction setback line will assist in natural hazard management.

5.3.11 Institutional arrangements for integrated coastal management

There are two essential issues concerning sustainable management of the zone. The first is setting up of boundaries for ICZM, while the other is the establishment of workable and well-coordinated institutional arrangements to support integrated management of the area.

5.3.11.1 Boundaries for ICZM

The boundaries of the coastal area need to be defined to allow the management of all activities that may impact the resources and the environment of the area. Given that the coastal zone boundaries vary depending on biogeographical conditions, the mix of uses and problems present, and the legal system, the boundaries for coastal zone management should extend as far inland and as seaward as necessary to achieve the objectives of an effective management. The area covered by dense population should provide the the landward boundary as opposed to the watershed so as to encompass smaller areas which are easily manageable.

5.3.11.2 A framework for institutional arrangements

The existing institutional arrangements have proved insufficient to support effective integrated coastal management in the zone. The establishment of an adequate institutional arrangement should thus be a priority. One possible and workable solution is to merge separate agencies and departments into one. The merger of separate agencies will be appropriate in order to create a central government body with over-arching responsibility for environmental management and settlement planning. Since this may lead to the emergence of a large, dominant and bureaucratic body, it is necessary for a new agency to be established, if tasks emerge which are not the responsibility of existing agencies. The established committee will the main decision-making body responsible for the areas' development, which should be in

harmony with economic, social and environmental aspirations of the area. The functions and responsibilities of the committee would include coordination of development of the zone, monitoring and control over the use of natural resources, preparation of legal acts and policy measures for sustainable development and preparation and implementation of the integrated master plan for the zone.

However, it is more likely that mechanisms to improve coordination will involve collaboration between existing agencies and departments: integrated management as a supplement to sectoral management. A forum or committee, involving regional representatives of both central government and departments (Ministry of Environment; Ministry of Tourism and Wildlife; Ministry of Lands and Settlements; Ministry of Transport and Communication; Ministry of Planning and National Development; Ministry of Local Government; etc.) and regional agencies (CDA, KWS, KMFRI, etc.,) may be able to integrate environmental and human settlement issues. The inclusion of representatives of the local industry and public interest should also be considered. This is preferable to having a separate coordinating mechanism labeled "environment" which might be sidelined from mainstream development decisions.[14] Effectiveness in coordinating sectoral policies requires that the local authority takes a position at a higher level in the bureaucracy than the sectoral agencies being coordinated. The local authority will be linked to the national development planning agency. Implementation will continue to be the responsibility of line agencies while the coordinating body overseas, monitors and evaluates implementation and organizes cross-agency activities.

[14] A distinction needs to be drawn between coordinating mechanism for decisionmaking purposes, which may only involve politicians, and the technical services needed by such a body. The latter can be provided by a special agency or unit, or by the staff of the agencies represented on the decisionmaking body, perhaps seconded to a task force.

5.3.12 Preparation of the integrated management plan

The experience of Mombasa and other coastal regions with a similar rate of development suggests that for achieving a sustainable pattern of development (i.e., to reduce the existing and to prevent future pollution to conserve the resource base while ensuring a relatively effective economic growth) a largely improved management structure is needed. The reasons for the preparation and adoption of an integrated management plan stem from the hitherto practice in the control of land use, protection and enhancement of the environment in the area. An integrated management plan will provide a detailed presentation of the coastal zone and an inventory of the resources, an identification of critical areas, specifying those in need of special attention and those offering potential for development. This should include: (i) detailed elaboration of the most appropriate and selected cross-sectoral management strategy of the area, (ii) definition of physical requirements that the implementation of that strategy may generate, (iii) preparation of the plan of actions by which that strategy could be implemented, (iv) detailed site-specific land and ocean-use proposal, and (v) policy measures and instruments to be used in the plan implementation. This will help: (i) maintain a high quality of environment, (ii) conserve critical habitats, (ii) resolve conflicts among incompatible activities and use of space, (iv balance environmental and economic pressures, and (vi) provide guidelines on coastal development to reduce inadvert side-effects.

5.3.13 Public awareness and participation

Public awareness is low concerning the value of natural systems and coastal management planning. Basic knowledge about the dynamics of the coastal area (i.e., the beaches, coral reefs, landforms and water quality), is lacking among coastal residents, tourism operators, and tourists at large. Formal and informal education opportunities should be provided with

respect to the following: (i) sewage and solid waste disposal, (ii) discharge of pollutants, (iii) public role in management and enhancement of coastal activities (e.g., fisheries, beach recreation), and (iv) maintenance of important coastal habitats and wildlife. Such a plan should involve community-based organizations (CBOs) and non-governmental organizations (NGOs) which can provide technical support and critical information for improved health and environmental condition of the coastal zone.

5.3.14 Code of conduct for hotel industry

The stakeholders, particularly CDA, KWS and the hotel industry, through KAHC should develop appropriate ***code of conduct*** and regulations to control resource use and minimize damage to resources. Such a code should include guidelines on: (i) water conservation, (ii) wastewater management, (iii) prevention of coastal erosion, (iv) protection and enhancement of flora and fauna around the hotels particularly during the development phase, (v) the non-purchase of threatened fish species for consumption, and (vi) training staff, tourists, and vacationers on environmental and natural resource concerns. Stakeholders and visitors will clearly know the dos and don'ts. Clear understanding that breaking them will mean punishment will create respect and fear.

CHAPTER SIX

6.0 SUMMARY AND CONCLUSIONS

Kenya has over 600 kilometers of coastline. It is characterized by a continous fringing coral reefs usually running prarallel to the coast. Rapid population growth spurred by tourism and industrial activities has resulted in urbanization. Close to one million people live in the coast at an overall density of 100-200 persons/km^2. Of these, about 400,000 live in Mombasa which is Kenya's major seaport and second largest urban area. The coast provides these people with food, shelter, and employment. The coast is also a gateway of Kenya's exports and imports, and a magnet for tourists. Underlying these resources and uses which are of direct human interest, are inherent ecological values of the natural ecosystems (sandy beaches, coral reefs, seagrass beds, rocky shores, mangrove swamps, etc.). These productive ecosystems play a crucial role in the economic and social development of the country.

Until recently, the economy in the Kenya coast depended on fisheries, mangrove harvesting and subsistence agriculture. But in the last three decades, these sectors have been over-shadowed by the tourism and visitor industry. This transformation has in turn led to economic growth, a rapid increase in population and establishment of other industrial enterprises. Unfortunately, population pressures and industrial and tourism developments place heavy demands on coastal habitats and ecological resources, and often result in natural resource depletion, environmental degradation and conflicts over use of these valuable but vulnerable resources. This has direct consequences for those who live in the coastal region as well as the nation.

The study of integrated management in the Kenya coast was based on a case study of the Nyali-Bamburi-Shanzu area, north of Mombasa. It aimed at seeking a wise balance between many conflicting demands being made on the coastal environment. It detailed the land use patterns, trends in economic activities and the problems and issues of development-environment interactions as well as institutional concerns that hinder integrated management in the coastal zone. The aim was to bring into focus the problems of unplanned development and environmental degradation in the hope that tourism and industrial development need not necessarily ruin the natural environment.

6.1 Major Findings

The various aspects of hitherto development in the zone were analysed. The study found that there have been efforts to develop and diversify the zone's economy (tourism, mariculture, industry,etc.,), albeit inappropriately, there being an imbalance between tourism development and the possibilities of natural systems to sustain it. Unisectoral overuse of some resources together with the lack of appropriate and well-coordinated control over the use of natural resources and pollution, has caused grave problems: decline in environmental quality, resource use conflicts, resource depletion and coastal erosion-related damages. Indiscriminate cutting of mangroves forests for aquaculture, building poles, fuel wood and land reclamation for real estate has led to loss in nursery areas of commercially important fish and shrimp, coastal erosion and flood protection, and affected coastal tourism.. Unregulated fishing effort and use of destructive fishing methods such as dynamiting have destroyed fish habitats and reduced the fish stocks. These problems and issues are stemming from the hitherto practice in the control of land use, protection and enhancement of the environment in the area.

Besides this, the study found that in spite of their efforts, government departments, the municipal council of Mombasa and other agencies seem to have failed to channel the urban growth which is increasingly devouring the coastal space and affecting almost all spheres of economic life, bringing about conflicts between different users and making the gap between economic development and environmental conservation even larger. The overlapping jurisdiction and gaps in sectoral responsibility and effort of government agencies with authority on the coast have resulted in vital resources being wasted through duplication as well as confusion and conflict. Equally important, there is a weak system of environmental regulations to offset environmental consequences of urbanization. Less than stringent enforcement of existing laws and traditional user rights has had negative implications for the management and conservation of fisheries and mangroves.

Because of the multifaceted aspects of coastal management issues and the multidisciplinary nature of the potential solutions, disciplinary and sectoral planning and management approach has failed. Many problems relative to environmental degradation and resource use conflicts along the shoreline seem to result from institutional drawbacks, namely: insufficient cross-sectoral (horizontal) and institutional (vertical) coordination and integration of activities at various institutional levels, diverging policy objectives pursued by various government departments, agencies and authorities, lack of sufficient funds for environmental purposes including consistent ecological monitoring, and absence of an adequate system of integrated planning and management. No single institution in Kenya currently has the mandate to adequately address coastal management issues in an integrated manner. The situation is aggravated in case of intelinkage spawned by a common border issue.

6.2 Recommended Measures

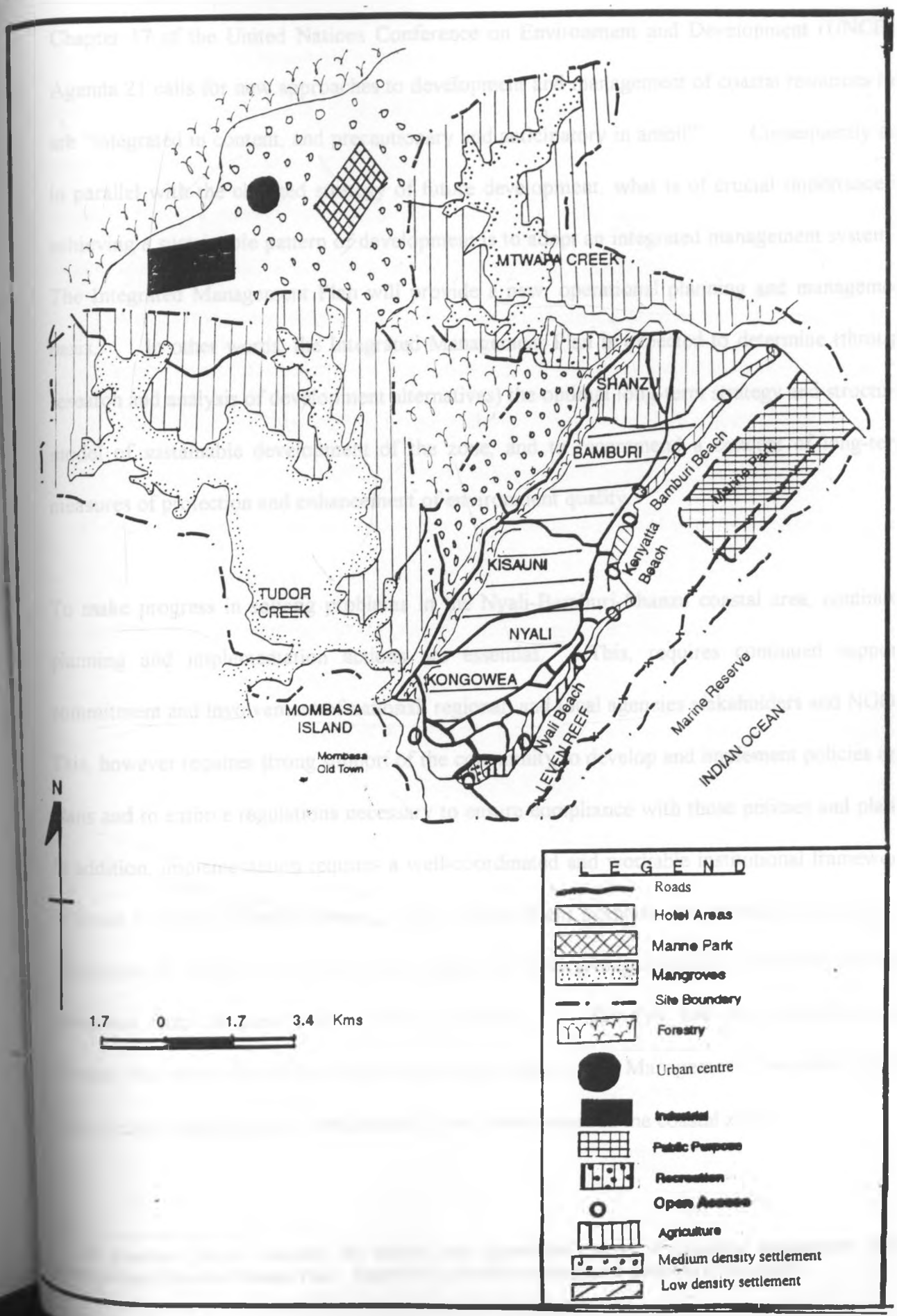
The findings of the study confirm that the existing trends of growth and development in the area must be urgently and radically changed. First there is need for proper planning and coordination not only to manage and minimize the conflicts, but also to take advantage of the positive interactions between activities and maximize the overall benefits acruing from the zone. Map 6.1 provides the possible future land use zoning in the zone. In view of the demands made on the coastal environment and its resources by various, often conflicting land uses, shoreline dependent land-uses should be given priority over uses that do not depend on a coastal location. The undeveloped shoreline should be protected from inappropriate uses by directing buildings deeper inland in order to ensure undisturbed access to the ocean and beach areas and improve the visual and recreational quality of the shoreline. A programme of zoning for multiple use along the shoreline will reduce competition between sectors from competing development options and minimize impacts on humans and the environment. Provision of a buffer strip between the high-water mark and the developed part of the shoreline to keep structures out of the active zone of the beach, provide public access and shoreline recreation thus conserving beach and dune systems and preventing the obliteration of mangrove forests. Also to be included is a management plan to protect designated marine protected areas with joint authority between the local communities and the Government.

Second is the need for reliable monitoring and evaluation of the environment to ensure timely flows of relevant management information. An efficient system of pollution control and monitoring of the quality of environment should be built-up imposing responsibilities for the enforcement of adopted environmental standards on all polluting activities. This should be complemented by a long-term cooperative programme of research and systematic collection of

data concerning all relevant marine parameters should be launched. The data will be used for studying the process of recovery of coastal and marine habitats. Strategic areas of inquiry should include: (i) coastal zone ecosystems and productive modeling, (ii) resource carrying capacities, (iii) appropriate valuation and cost-benefit techniques, and (iv) institutional arrangements and reforms in coastal zone management. To facilitate this, a number of the departments of themunicipal council of Mombasa, especially the Public Health and Town Planning departments, and other institutions responsible for urban planning and development in the zone (e.g., CDA, KMFRI, KWS, etc.) should be strengthened both in terms of structure and expertise, as well as in terms of financial resources.

Nevertheless, with increasing demand of shorefront land, regulations have to be developed and implemented as regards development in the coast. This first requires that the quality of human environment be standardized at the local level and regulations (Ambient Environmental Quality Standards, Effluent and Emmission Standards, Technology Based Standards, etc.) should be upgraded. First, a legal basis should be set up for the preparation of EIA studies for each project and activity which is assessed as having the potential to affect the environment. Regulations should be set up at the national level to rationalize the use or protection of coastal ecosystems such as beaches, coral reefs, mangrove forests, target fish species and sensitive areas or establishing and/or preserving specially protected areas. Furthermore, there is need to consider alternative options such as cost-sharing and decentralization secure funds for the implementation of important infrastructure projects. Such policy reform will offer the best opportunity to maximize the net flow of benefits from coastal resources to the investors, community members and the nation while minimizing environmental costs.

Map 6.1 Schematic representation of urban development in the zone



Chapter 17 of the United Nations Conference on Environment and Development (UNCED) Agenda 21 calls for new approaches to development and management of coastal resources that are "integrated in content, and precautionary and anticipatory in ambit". Consequently and in parallel with the changed strategy of future development, what is of crucial importance to achieving a sustainable pattern of development is to adopt an integrated management system.[15] The Integrated Management Plan will provide a new, operational planning and management basis. In other words, the Integrated Management Plan is expected to determine (through research and analysis of development alternatives) the optimal long-term strategy and structural model of sustainable development of the zone, and to recommend a concept of long-term measures of protection and enhancement of environment quality.

To make progress in solving problems in the Nyali-Bamburi-Shanzu coastal area, continued planning and implementation actions are essential. This, requires continued support, commitment and involvement of national, regional, and local agencies stakeholders and NGOs. This, however requires strong support of the community to develop and implement policies and plans and to enforce regulations necessary to ensure compliance with those policies and plans. In addition, implementation requires a well-coordinated and workable institutional framework to foster coordinated actions among various government agencies, the private sector and the community to achieve the common set objectives, strategies and actions formulated through consensus from the participatory planning process. The first and most important step towards this end is the establishment of an Integrated Coastal Management Committee as the main decision-making body responsible for the development in the coastal zone.

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[15] The Bamburi Cement Company has adopted and applied the concept of integrated management in the development of Bamburi Nature Trail. Appendix iv provides a summarized discusion of the project.

6.3 Implications for Further Research

The preparation of an Integrated Management Plan will ensure sustainable use, development and protection of coastal and marine resources in the zone. To achieve this goal, there is need for improved information and analysis for a better input to priority setting and policy design for proper management of marine resources. The following research areas should receive special attention before the preparation of the area's Integrated Management Plan:

1. A study to understand the ecological function of critical habitats as well as current and future human activities. Natural resources and environmental impacts associated with coastal activities need to be quantified and monetary values placed on the impacts.
2. Identification of the land use pattern, infrastructure needs and the alternative spatial development configurations compatible with the protection of environmentally sensitive areas and ecosystems.
3. Adetailed assessment of the nature, quality and carrying capacity of the zone's environmental resources.
4. A detailed study should be undertaken to predict effects of environmental change (including climate change) on critical habitats and on living resources they support. The study should include the preparation of a risk management plan for beach hotels, residential houses, and the transportation system of the area.
5. A study to provide guidance for establishing policies and programmes and selecting policy instruments aimed at the resolution of specific coastal zone management issues. The study should include a look at the appropriateness and efficacy of the various regulatory and market-based instruments, pre-requisites for successful implementation of various instruments, the mix of instruments most appropriate, and the practicality and cost of implementation of the various instruments.

6. There is urgent need for a study of institutional arrangements and capacities to support integrated management of the zone. Taking into account the legal and institutional conditions prevailing in Kenya, the program should examine the best possible solutions for the establishment of a single authority entrusted with environmental management. The study should include an evaluation of how the existing regional and local institutions, agencies and departments can be utilized and re-organized to provide an adequate professional support in operationalization of the integrated management system.

BIBLIOGRAPHY

Abuodha, P. A. W. (1992) "*Geomorphology and Sedimentology of the Mombasa-Diani Area: Implications to Coastal Zone Management.*" Unpublished Msc. Thesis, University of Nairobi.

Allersma, E. and W. K. Tilmans. (1993) "Coastal Conditions in West Africa - A review." *Ocean and Coastal Management* 19:199-240.

Allusa, A. L. and L. J. Ogallo (1992) "Implications of Expected Climate Change in the East African Coastal Region: an Overview." *UNEP Regional Seas Reports and Studies* 149:28.

Anderson, D. (1990) *Economic Growth and the Environment.* WPS 979. Washington D.C. World Bank.

Angelsen, A. (1995) "Shifting cultivation and Deforestation: A Study from Indonesia" World Development 23 (10): 1713-1729.

ASEAN/US (1991) "Coastal Resource Management Project: Impacts and Lessons Learned." *Tropical Coastal Area Management* 6 (3) December.

Ballinge, R. C. *et al* (1994) "The Management of Coastal Zone of Europe" *Ocean and Coastal Management* vol. 22 no.1 pp45-86.

Bernestein, J. (1991) Alternative Approaches to Pollution Control and Waste Management: Regulatory and Economic Investments, UNDP and UNCHS, Urban Management Program, DP3, Nairobi.

Berry, S. (1989) "Social Institutions and Access to Resources." *Africa* 59 (1): 41-55.

Bess, M. (1990) Kenya's Coral Reefs: Past and Present, Kenya Museums Society.

Bess, M. (1991) Kenya's Reef, Tourism and Development, *Swara* 14(2): 8-12.

Bird, E. C. F. (1985) Coastline Changes: A Global View. John Willey and Sons Ltd., Chichester.

Borgese, E. M. (1991) The Oceans, the Convention and You, UNEP, OCA/PAC pp2-31, Nairobi.

Bryceson, I. *et al* (1990) State of the Marine Environment in Eastern Africa Region, *UNEP Regional Seas Reports and Studies* No. 113. UNEP, Nairobi.

CBS (1998) Economic Survey, 1998. Ministry of Planning and National Development, Government Printer, Nairobi.

CBS (1989) Kenya Population Census. Ministry of Planning and National Development, Government Printer.

Cendrero, A. (1989) "Land Use Problems, Planning, and Management in the Coastal Zone: An Introduction" *Ocean and Shoreline Management* vol. 12 no5-6 pp367-382.

Chua, T. E. (1993) "Essential Elements of Integrated Management." *Ocean and Coastal Management* 21 (1-3): 81-108.

Chua, T. E. and L. F. Scura (eds) (1992) "Integrative Framework and Methods for Coastal Area Management". Philippines: ICLARM Conference Proceedings 12.

Cicin-Sain, B. (1993) "Sustainable Development and Integrated Coastal Management." *Ocean and Coastal Management*, 21 (1-3): 11-14.

Cicin-Sain, B. and R. W. Knecht (1998) Integrated Coastal and Ocean management: Concepts and Practices, Island Press, California.

Clark, R. J. (1996) Coastal Zone Management Handbook, Lewis Publishers, New York.

Clark, R. J. (1992) "Integrated Management of Coastal Zones" FAO Fisheries Technical Paper, No. 327, FAO, United .Nations, Rome.

Clark, R. J. (1991) "Coastal Zone Management" In Managing Natural Disaster and Environment, edited by Alcira Kreimer and Mohan Munasinghe. Washington D.C. The World Bank.

Consntantinides G. (1993) "Bamburi: A Case Study", Consultant Report, June 1993.

Coughanowr, C. and G. Kullenberg (1993) "On the Need for Scientific Input on an International Scale: the Intergovernmental Oceanographic Commissions Perspective on Integrated Coastal Management" *Ocean and Coastal Management*, vol. 21, no.1-3, pp339-352.

Njuguna S G. *et al* (eds) (1992) "Wetlands of Kenya" - Proceedings of a Seminar on Wetlands in Kenya. IUCN Wetlands Programme.

Davis, J. D. *et al* (1990) "Environmental Considerations for Port and Harbor Development", World Bank Technical Paper no. 126, World Bank, Washington, D.C.

de Meyer, C. P. (1989) "Case Studies in Coastal Protection" *Ocean and Shoreline Management*, vol. 12 no. 5-6 pp517-524.

Dogse, P. (1995) "Coastal Tourism Management Guidelines" Paper presented at the SAREC/ World Bank ICZM Workshop in East Africa, February 1995.

FAO (1992) FAO Yearbook, Fisheries Statistics: Catches and Landings (vol. 70 and 73). Rome, Italy

FAO (1991) Mangrove Conservation and Management - Kenya Mangrove Management. FAO Technical Cooperation Programme FAO:TCP/KEN/0051(A).

FAO/UNEP (1982) "Marine Pollution in East Africa Region", *UNEP Regional Seas Reports and Studies* No. 8. UNEP, Nairobi.

Folke, *et al* (1995) Biological Diversity, Ecosystems and Human Scale: *Ecological Applications*, vol.10 No.0, Allen Press.

GoK (1991) Tana River Delta Wetlands Survey, Ministry of Land Reclamation and Development of Arid, Semi- Arid and Wastelands (May) pp 5-47.

Goldberg, E. (1994) Coastal Zone Space: Prelude to Conflict? UNESCO publishing, Paris.

Hardin, G. (1966) "The Tragedy of the Commons" *Science*, vol. 162 pp 1243-1248.

Hardoy, *et al* (1992) Environmental Problems in the Third World Cities, Earthscan, London.

Hansen, N. (1992) "Experts Warn Over Ecological Disaster" *Daily Nation* December, 2.

Harrison, P. and W. Sewerl (1979) "Shoreline Management: The French Approach." *Journal of Coastal Zone Management* 5 (3): 61 - 180.

Hayers, L. P. (1988) "Coastal Tourism: an Overview", *The Executive*, October 26, 1988, pp17-24, Nairobi.

Hinrichsen, D. (1998) Coastal Waters and Fisheries of the World: Trends, Threats and Strategies, Island Press, California.

Hinrichsen, D. (1996) "Coasts in Crisis" *Issues in Science and Technology* 12 No. 44.

Hinrichsen, D. (1994) "Coasts Under Pressure" *People and Planet* 3.No 6-9.

Hinrichsen, D. (1990) Our Common Seas: Coasts in Crisis. Earthscan, London

Horril, J. C and M. A. K. Ngoile (1991) Results of the Physical, Biological and Resource Surveys: Rationale for the Development of a Management Strategy Frontier - Tanzania, The Society for Environment Exploration, London.

IMO/UNEP (1982) Oil Pollution Control in the East African Region". *UNEP Regional Seas Reports and Studies* No. 10. UNEP, Nairobi.

IPCC (1994) "Climate Change: Policy Instruments and their Implications." Proceedings of the Tsukuba Workshop of IPPC Working Group III Tsukuba, Japan, 17-20 January.

IPCC (1994) (1990) Climate Change: The IPCC Responses, Strategies, World Meteological Organization, UNEP, Geneva.

IUCN/UNEP (1985) Management and Conservation of Renewable Marine Resources of Eastern African region. *UNEP Regional Seas Reports and Studies 66.* UNEP, Nairobi.

IUCN/UNEP (1984) "Marine and Coastal Conservation in the East African Region", *UNEP Regional Seas Reports and Studies No. 39.* UNEP, Nairobi.

IUCN/UNEP (1982) "Conservation of Coastal and Marine Ecosystems and Living Resources of the East African Region", *UNEP Regional Seas Reports and Studies* No. 11. UNEP, Nairobi.

Iversen, S.A. and Myklevoll, S. (eds) (1984) "The Fish Stocks and Fisheries in Kenya", Proceedings of the NORAD-KENYA Seminar, Mombasa.

Kairu, K. K. (1990) Preliminary Survey on Coastal Erosion and Coastal Protection Structures: Interdisciplinary Research on Marine Coastal Systems along the Kenya Coast, p. 45-49, UNESCO-ROSTA, Nairobi.

KPA (1996) Annual Bulletin of Port Statistics, KPA, Mombasa.

Kenchington, R. and Crawford, D. (1993) "On the Meaning of Integration of Coastal Zone Management", *Ocean and Coastal Management,* Vol. 21 Nos 1-3: 109-127.

KWS (1999) Management Plan: Kisite/Mpunguti Marine National Park and Reserve, 1999.

KWS (1990) A Policy Framework and Development Programme 1991-1996. Kenya Wildlife Service, November 1990, Nairobi.

KNES (1985) Mombasa District Environmental Assessment Report. Published by the Kenya National Environmental Secretariat (KNES) in Cooperation with USAID and South East Consortium for International Development, Environmental Training and Management in Africa.

Kiflemariam, M. (1989a) "Role of Marine Resources for Development" A Paper Presented in the Regional Symposium of marine and other natural Products, Asmara University and the Chemical Society of Ethiopia, 25, February, 1989, Asmara.

Kiflemariam, M. (1989b) Problems of Marine Fisheries Development: The Ethiopian Case", *Ocean and Shoreline Management*, 12: 347 - 361.

Kigomo, B. N. (1991) Mangrove Ecosystems in Kenya - Resources and Conservation. Report No. 5. For the ECE Group of the Kenya Forestry Master Plan, Ministry of Environment and Natural Resources.

Kitheka, J. U. (1993) "Soil Erosion and River Sedimentantion: A case Study of Nguu Tatu Catchment, Northeast of Mombasa Distric"t, A paper presented at the Fourth Land and Water Management Workshop, Nairobi.

Koth-Barbara, A. (1990) "Integration of Tourism Development and Environmental Issues: A Strategy for Zanzibar." University of Minnesota, Tourism Center, October.

Kokwaro, J. O. (1985) "The Distribution and Economic Importance of the Mangrove Forests of Kenya", *Journal of East African Natural History Society and National Museums*, vol. 75 No. 188, November 1985, p. 1-10.

Koyo, A. (1994) "Marine Parks and Reserves", *Swara*, 17(3):14-16.

Leach, M. and R. Mearns (1992) Poverty and Environment in Developing countries: An Overview Study. Sussex Institute of Development Studies, Univ. of Sussex.

Lele, S. M. (1991) "Sustainable Development: A critical Review" *World Development* 19 (6): 607-621.

Lopez, R. (1992) "Environmental Degradation and Economic Openness in Less Developed Countries: The Poverty Linkage." *American Journal of Agricultural Economics* 74 (5): 1138-43.

Linden, O. (ed) (1995) Proceedings of the Arusha Workshop and Policy Conference on Integrated Coastal Zone Management in Eastern Africa including Island States, SAREC Marine Program, Coastal Management Center, Manila.

Linden, O. (1993) "Resolutions on Integrated Coastal Zone Management in East Africa, Signed in Arusha, Tanzania" In *AMBIO* 22: 408-09.

Lundin, C. G. and O. Linden (1993) "Coastal Ecosystems: Attempts to Manage a Threatened Resource." *AMBIO XXII* (7): 468 - 473.

Mailu, G. M., and H. Muturi (1991) "Effects of Sea Level Fluctuation on Ground Water Quality along the Kenya Coast" IOC-SAREC Workshop on Causes and Consequences of Sea Level Change on the Western Indian Ocean Coasts and Islands, Mombasa, Report no. 77.

Martens, E., *et al* (1990) The Ecology of Mangrove and Related Ecosystems: Declaration on Management Strategies issued by the International Symposium on Mangrove Ecosystems held in Mombasa, September 1990.

Maudsey, B. (1990) "Seaweed." *Swara*, vol. 13 No. 5 October 1990, p. 31-36.

McClanahan, T. R. (1994) "Kenyan Coral Reef Lagoon Fish: Effects of Fishing, Substrate Complexity and Sea Urchins." *Coral Reefs* 13:231-241

McClanahan, T. R. (1987) " Overfishing and Coral Reef Degradation: A Preliminary Report from East Africa. International Conservation News." In *Conservation Biology*, vol. 1. No. 2 p.97-99.

McClanahan, T. R. and D. Obura (1997) "Status of Kenyan Coral Reefs." *Coastal Management* 23:57-76.

McClanahan, T. R. and D. Obura (1993) Status of Kenya's Coast. Nairobi: Oxford University Press.

Mombasa Municipal Council (1991) Environmental Assessment. The Mombasa Municipal Council Observations to the World Cities and Their Environmental Congress, Toronto, Canada, 25-28 August, 1991.

MPND (1998) Mombasa District Development Plan, Government Printer, Nairobi.

Muchena, F. N. and F. M. Ndaraiya (1990) "The Impact of Agriculture in Coastal Areas of East Africa", National Agricultural Laboratories, Unpublished Paper, pp 1-17

Munga, D. *et al* (1993) "Assessment of Land-based Sources of Marine Pollution along the Kenyan Coast". Unpublished Report to the WHO Regional Office for Africa, Brazzaville.

Mwandotto, B. A. J. and S. Truta (1999) "Tourism trend and need for carrying capacity for Nyali-Bamburi-Shanzu area." Contribution to Kenya Coastal Management programme, UNEP/FAO EAF/5, Project June, 1999.

Mwangi, S. *et al* (1999) Status of Marine Pollution in Mombasa Marine Park and Reserve and Mtwapa Creek. Draft Report, KWS, Mombasa.

Mwanguni, M. S. ((1999) "The effects the urban sprawl on the natural environment in Kisauni Division, Mombasa District." Contribution to Kenya Coastal Management programme, UNEP/FAO EAF/5, Project June, 1999.

Mwanje, J. I. (1993) "Coastal Tourism in East Africa: Perspectives, Concepts, Development and Management." A paper presented at the Workshop and Policy Conference on Integrated Coastal Zone Management in Eastern Africa and Island States, Arusha, Tanzania.

Ngoile, M. K. and C. J. Horril (1993) "Coastal Ecosystems, Productivity and Ecosystem Protection: Coastal Ecosystem Management." AMBIO XXII (7):461- 467.

Norconsult, A. S. (1975) Mombasa Water Pollution and Waste Disposal Study: Marine Investigation Report Part VI, Ministry of Local Government, Mombasa Municipal Council.

Nwilo, P. C. and A. Onuoha (1993) Environmental Impacts of Human Activities on the Coastal Area of Nigeria." In Ibe Awosika and P. Schroeder, eds., Coastlines of Western Africa. New York: American Society of Civil Engineers.

Obura, D. and T. R. McLanahan (1994) "Status of Malindi Marine Park" - Study of the 1991 and 1992 Sabaki River Sediment Discharge on the Park's Coral Community.". Unpublished Report prepared for the Kenya Wildlife Services, Kenya Marine and Fisheries Research Institute and Fisheries Department. The Wildlife Conservation Society, Nairobi.

OECD (1993a) Coastal Zone Management: Integrated Policies, OECD, Paris.

OECD (1993b) Coastal Zone Management: Selected Case Studies. OECD, PP 229-243.

Olsen, S. B. (1993) "Will Integrated Coastal Management Programmes be Sustainable: The Constituency Problem." *Ocean and Coastal Management* 21:201-226.

Ostorm, E. (1990) Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge. Cambridge University Press.

Pearce, F. (1995) "Call for Action to Save the Oceans" *New Scientist*, January 28.

Perez, N. H. (1993) "Linking Territorial and Coastal Planning: The Venezuela Experience", *Ocean and Coastal Management* 21(1-3): 227-243.

Rasowo, J. (1993) "Mangroves and Mariculture in Kenya", A paper presented at The National Workshop for the Improved Management and Conservation of Kenyan Mangroves, Diani, Kenya.

Reardon, T. and S. A. Vosti (1995) "Links Between Rural Poverty and the Environment in Developing Countries: Asset Categories and Investment Poverty". *World Development* 23 (9):1495-1506.

Richmond, M. (1997) A Field Guide to the Seashores of East Africa. SAREC Marine Science Programme, Institute of Marine Science, Zanzibar.

Riddle, R. (1981) Ecodevelopment. Gower Publishing Co. Ltd., Hampshire.

Ruwa, R. K. (1993) "Zonation and Distribution of Creek and Fringe Mangroves in the Semi-arid Kenya Coast." In H. Leith and A. Al-Mansoon (eds) Towards the Rational Use of High Salinity Torelant Species Volume 1. Kluwer Academic Publishers, Netherlands.

SAREC (1994) Technical Recommendations of the Workshop on Integrated Coastal Zone Management in Eastern Africa Including the Inland States, 21-22 April 1993, Arusha, Tanzania. Published by SAREC Marine Science programme, Stockholm, Sweden.

Schoorl, J. and N. Visser (1991) "Towards Sustainable Coastal Tourism - Environmental Impacts of Tourism on the Kenya Coast." Discussion Paper Commissioned by the Ministry of Agriculture, Nature Management and Fisheries, Royal Netherlands Embassy, Nairobi.

Shaw, P. R. (1992) "The Impact of Population Growth on Environment: The Debate Heats Up." *Environmental Assessment Review* 12:11-36.

Shaw, P. R. (1989) Rapid Population Growth and Environment Degradation: Ultimate Versus Proximate Factors" *Environmental Conservation*, 16: 199 - 208.

Sincliar, T. (1990) Tourism Development in Kenya, World Bank Report, 86, Nairobi.

Sorenson, J. C. and S. T. McCreary (1990) "Institutional Arrangement for Management of Coastal Resources" *Coastal Management Publication* No.1 US National Park Service/ USAID Series.

Swaleh, A. (1999) "Land use and land use changes in the Nyali-Bamburi-Shanzu region.". Contribution to Kenya Coastal Management programme, UNEP/FAO EAF/5, Project June, 1999.

Swazuri, A. M. (1999) "A study on socioeconomic profiles of the Nyali-Bamburi-Shanzu and Kisauni area." Contribution to Kenya Coastal Management programme, UNEP/FAO EAF/5, Project June, 1999.

Swazuri, A. M. (1994) "An Evaluation of Coastal Land n Kenya." Unpublished PhD Thesis, University of Nairobi.

Turner, R. K. and W. N. Adger (1996) Coastal Zone Resources Assessment Guidelines LOICZ/R&S/96 -4, LOICZ, Texel, The Netherlands.

UNCHS (1996) Issues in the integrated Planning and Management of River/Lake Basins and Coastal areas. A human Settlement Perspective. UNCHS, Nairobi.

UN/UNESCO/UNEP (1982) "Marine and Coastal Area Development in East African Region." *UNEP Regional Seas Reports and Studies*, No. 6. UNEP, Nairobi.

UNEP (1998) East Africa Atlas of Coastal Resources: Kenya, UNEP, Nairobi.

UNEP (1996) The Diversity of the Seas: A Regional Approach, UNEP, World Conservation Monitoring Centre, London.

UNEP (1995) Poverty and the Environment: Reconciling Short-term Needs with Long-term Sustainability Goals. UNEP, Nairobi.

UNEP (1994) "Socio-economic Activities that may have an Impact on the Marine and Coastal Environment on the East African Region." *UNEP Regional Seas Reports and Studies* No. 41. UNEP, Nairobi.

UNEP (1990a) "Sand and Gravel Extraction Projects." *Environmental management Guidelines* No. 20, UNEP, Nairobi.

UNEP (1990b) Africa's Seas- Challenges of the 1990s, UNEP, Nairobi.

UNEP (1989) An Introduction to the East African Action Plan. UNEP, Nairobi.

UNEP (1986) A Coast in Common. UNEP, Nairobi.

UNEP (1985a) "Action Plan for the Protection, Management and Development of the Marine and Coastal Environment in East African Region." *UNEP Regional Seas Reports and Studies* No. 61., UNEP, Nairobi.

UNEP (1985b) "Management and Conservation of Renewable Marine Resources in the East African Region." *UNEP Regional Seas Report and Studies* No. 66, Nairobi, UNEP pp 1-99.

UNEP (1983) "Legal Aspects of Protecting and Managing the Marine and Coastal Environment of the East African Region." *UNEP Regional Seas Reports and Studies*, No. 49. UNEP, Nairobi.

UNEP (1982a) "Conservation of Coastal and Marine Ecosystems and Living Resources of the East African." *UNEP Regional Seas Report and Studies* No. 11, Nairobi, UNEP pp 1-64.

UNEP (1982b) "Environmental Problems of the East African Region." *UNEP Regional Seas Report and Studies* No. 12, Nairobi, UNEP pp 1-65.

UNESCO (1995) Coasts and Small Islands: Targets for Integrated Efforts, UNESCO, Paris.

UNESCO (1993) Environment and Development Brief No.6. *Coasts*, UNESCO, Paris.

UNESCO (1992a) Coastal Systems Studies and Sustainable Development: Proceedings of the COMAR Interregional Scientific Conference, UNESCO, Paris.

UNESCO (1992b) New Technologies - Remote Sensing and Geographic Information Systems, Environmental Development Briefs No.3 UNESCO, Paris.

UNIDO/UNEP (1982) "Industrial Sources of Marine and Coastal Pollution in East Africa Region." *UNEP Regional Seas Reports and Studies*, No.7. UNEP, Nairobi.

United Nations (1992) Earth Summit: Convention on Climate Change. United Nations Conference on Environment and Development, Brazil.

Vallega, A. (1993) "A Conceptual Approach to Integrated Coastal Management" *Ocean and Coastal Management*, 21 Nos 1-3.

Vallejo, S. M. (1993) "The integration of Coastal Zone Management into National Development Planning." *Ocean and Coastal Management* 21(1-3):163-182.

WCED (1987) Our Common Future, Oxford University Press, United Kingdom.

World Bank (1995) Africa: A Framework for Integrated Coastal Zone Management, World Bank, Washington D.C.

World Bank (1993) "Noordwijk Guidelines for Integrated Coastal Zone Management." Paper for distribution at the World Coast Conference, Noordwijk, The Netherlands, November.

World Bank (1992) "Development and Environment" World Development Report, Oxford University Press, New York.

WRI (1995) WRI Indicator Brief: Coastlines at Risk: An Index of Potential Development Related Threats to Coastal Ecosystems. WRI. Washington D.C.

Appendix I

HOUSEHOLD QUESTIONNAIRE.

The information given will be used to assess the problem of environmental degradation and resource use conflicts in the coastal area and will be kept strictly confidential, and used solely for the purpose of developing better management strategies that will reduce conflicts and ensure sustainable development.

A. BACKGROUND INFORMATION.

1. Name of respondent_____
2. Sex _____
3. Educational level _____
4. Marital Status _____
5. Household head income (Kshs)_____
6. Location (area) _____
7. Distance from the shoreline (Kms) _____
8. Household characteristics.

	Household Composition	Household Characteristics			Education		Occupation	
		Sex	Age	Marital Status	At School	Grade	Main	Other
1								
2								
3								
4								
5								

B. LAND USE/ ENVIRONMENTAL CHANGE.

1. Discuss the land and environmental of this area 30 years ago (1960s) today (1999) and as you expect it to be 30 years from now?

1. Land use condition	Land Use Changes					
	1960		1990s		2020	
	Area (Kms)	%	Area (Kms	%	Area (Kms)	%
2. Mangrove forests						
3. Land Ownership . Government . Lease . Group . Private						
4. Pristine Shore						
5. Built Area . Activity . Hotel						
6. Human Settlement						
7. Fenced coastal land						
8. Other						

2. Are there more people living here today (1999) than when you came? Yes ☐ No ☐
3. What are the main land use activities in order of importance? 1, 2, 3, 4
4. Why do you carry out these activities?
5. Do you carry out fishing/engage in tourism activity? Yes ☐ No ☐
6. If Yes, where? _____
7. Is the fish adequate? Yes ☐ No ☐
8. If No, why? _____
9. What do you intend to do? _____
10. What are the major problems facing people in this area?

i)	Land shortage	iv)	Food supply
ii)	Water scarcity	v)	Tourism menace
iii)	Health	vi)	Other

C: NATURE OF LAND AND RESOURCE USE CONFLICT.

1. What activities are carried along the shoreline. Which ones are traditional and new?

Activity	Rank	Traditional/New
Tourism		
Fishing		
Recreation		
Residential		
Other		

2. Are the activities increasing in numbers? Yes ☐ No ☐
3. How destructive are these activities?_____
4. What would you say about tourism? _____
5. Do you encounter any problems with tourism? Yes ☐ No ☐
6. If Yes, what kind of problems do you encounter?

Activity	Habitat Destruction	Fish Depletion	Disease	Competition for Resource	Other (Specify)
Industrial					
Tourism					
Housing					
Waste water Disposal					
Farming					
Other (Specify)					

7. What **three** activities cause severe damage in order of importance?
   i) Crops_____
   ii) Fish_____
   iii) Human_____
   iv) Water resources_____
   v) Other_____

D. LAND/RESOURCE USE CONFLICTS AND DEGRADATION.

1. Which specific areas and under what circumstances/ conditions is resource use conflict and environmental degradation severely manifested?

Problem/Specific Area Conditions	Land Close to the Sea	Beach	Water Resource	Season: Dry or Wet or Both	Month
Habitat destruction					
Fish					
Competition for water					
Coastal erosion					
Disease					
Other (Specify)					

2. Are the problems with tourism getting more serious? Yes ☐ No ☐

3. If yes, do you think the situation will improve or get worse over the next 10 years?_____

E. CAUSES OF CONFLICTS AND ENVIRONMENTAL DEGRADATION.

1. What in your opinion are causing the resource use conflicts and environmental degradation in the area?

Causal Factor	1960		1990		1999	
	Yes/No	Degree	Yes/No	Degree	Yes/No	Degree
Increasd population						
Individualization of land						
Land use change						
Expanding tourism						
No incentive to locals						
Fishing systems						
Sewage discharge						

Key:
Yes = 1
No = 2
Not Know = 3

Degree of causation
1 = Insignificant
2 = Less Insignificant
3 = Significant
4 = Very Significant

F. EFFECTS ON THE ENVIRONMENT.

1 What have you done to control or prevent coastal environmental problems?

Actions/ Problems	Degree of Effectiveness (1,2,3,4).					

2. Have the control measures helped? Yes ☐ No ☐

3. If No, what do you intend to do to environmental problems?
   i.
   ii.
   iii.

4. What do the coastal authorities do? _____

5. What would you like to see the authorities do? _____
_____
_____
_____
_____

G. RESOLVING CONFLICTS AND DEGRADATION.

1. What do you recommend to be done in this area to resolve the conflicts in order of importance?
   i) Restrict land use in the area
   ii) Give local residents benefits to allow tourists on their coastal area
   iii) Fence area to protect it from tourists and other foreigners
   iv) Institute effective fishing control
   v) Fishermen to protect fishing grounds
   vi) Any other

2. Who should do it?
   i) The Government
   ii) Local communities
   iii) Government and People
   iv) County Council

3. What do you think will happen to zone if environmental degradation and resource use conflicts are not solved?
   i) Fish will disappear
   ii) Destruction of natural habitat
   iii) No access to the ocean to fish

4. Does tourism revenue benefit the people? Yes ☐ No ☐ I don't know ☐

5. If Yes, how?
   i) Provides social services
   ii) Provides employment opportunities
   iii) Direct payment to landowners
   iv) Any other_____

H. PERCEPTIONS AND ATTITUDES.

1. Why should coastal tourism be protected?
   i) Foreign exchange earnings
   ii) Material benefits
   iii) Other _____

2. Do you consider coastal conservation a necessary cause to:

i)	Mankind	Yes ☐	No ☐
ii)	Kenya	Yes ☐	No ☐
iii)	People in the area	Yes ☐	No ☐
iv)	Yourself	Yes ☐	No ☐

3. Do you consider a marine park as being of value to:

i)	Mankind	Yes ☐	No ☐
ii)	Kenya	Yes ☐	No ☐
iii)	People in the area	Yes ☐	No ☐
iv)	Yourself	Yes ☐	No ☐

4. Have you benefited from coastal tourism? Yes ☐ No ☐

5. If Yes/No, how and why? _____
_____
_____
_____
_____
_____

I. GENERAL COMMENTS

Any comments

_____
_____
_____
_____
_____
_____
_____
_____

Thank You.

Appendix II:

COASTAL PLANNING AND MANAGEMENT INSTITUTIONS

The following organizations play a major role in the management, development and protection of the Kenya coast and its resources. They are able to provide specialist information on particular aspects of coastal resources and management.

1. Coast Development Authority

The leading coastal planning agency in Kenya is the Coast Development Authority (CDA) which was established by an Act of Parliament in 1990. The CDA, which is a corporate body and which is under the Ministry of Water Resources, is required to plan, initiate, coordinate and monitor development activities within the administrative boundaries in of the coast, and Kenya's exclusive economic zone. The Authority has as its prime goal "the improvement of the standard of living of all coastal people without impairment of the resource potential." It strives for self-sufficiency in food production for the Coast, the creation of wealth from available resources, the provision of meaningful opportunities for public participation, and development on a sustainable basis. These strategies in turn have resulted in the criteria by which development proposals and projects are either deemed to merit promotion, or discouraged by the Authority. As a development agent, the CDA advocates for the effective management of natural resources. It encourages development projects that minimize the negative impacts on natural resources.

2. National Museums of Kenya

The National Museums of Kenya has an extensive programme ranging from the conservation of historic and cultural environments to the identification and protection of archeological and historical remains. They manage a number of archeological and historical resources, such as Fort Jesus, which are open to the public and very popular with visitors.

3. Kenya Marine and Fisheries Research Institute

The Kenya Marine and Fisheries Research Institute (KMFRI) conducts research and survey work on various aspects of aquatic science. These include marine and freshwater fisheries, aquatic biology including environmental and ecological studies and chemical and physical oceanography. The Institute also monitors pollution, investigates and promotes aquaculture and carries socioeconomic research related to fisheries and aquaculture. The Institute is also a repository and manager of the Kenya Geographical Information System for Eastern African Coastal and Marine Environment Resources Database.

4. Kenya Wildlife Service

The Kenya Wildlife Service (KWS) is responsible for the protection of Kenya's indigenous animals and plants and their habitats. It achieves this through the management of Kenya's parks and reserves, which have been set a side as protected areas under the Wildlife Conservation and Management Act. All marine and parks and reserves on the coast are available for public access and enjoyment as long as certain rules are observed. The KWS provides research and educational programmes, management planning and interpretation, camping and visitor centres, park patrols, community wildlife programmes and general assistance to the numerous visitors to marine and terrestrial protected areas.

5. National OIL Spill Response Committee

The National OIL Spill Response Committee (NOSRC) which comprises representatives of the oil industry, the Kenya Ports Authority and scientific and related institutions, is responsible for responding to and coping with oil spills of any size.

6. Other Agencies

In addition to the key contribution made by the CDA, there are a number of other agencies involved in planning for the development and wise use of land and other resources in the coast. The main ones include the Ministry of Planning and National Development, Ministry of Lands and Settlement, and the Local Government Planning functions of the Local Authorities. Between them and in collaboration with other organizations, the above lead agencies cover economic development planning, land use planning and urban planning.

Appendix III

COASTAL LEGISLATION

There are a number of Kenyan statutes, which impinge directly or indirectly on the coastal and marine environment, its resources and their management. There are enough legislation to provide for the protection and management of the coastal zone. However, implementation of the applicable statutes has not always been as efficient. Following is a summary of the objectives and provisions of selected statutes.

1. The Water Act (Cap. 732)

The Water Act provides for the conservation and controlled use of water resources in Kenya. The Government through the Ministry of Water Development implements it. The Act prohibits pollution of water resources and controls discharges of industrial and municipal effluents into rivers and ocean. Through the judicious apportionment of river and groundwater resources, the Act ensures that constant availability of freshwater for coastal communities in Kenya.

2. Agriculture Act (Cap. 318)

The Agriculture Act contains provisions for promoting agricultural development, and it is implemented by the Ministry of Agriculture, Livestock Development and Marketing. The long-term objective of the Act is to ensure the development of arable land in accordance with the sound practice of good land use. It therefore stresses the need for conservation of soil and its fertility and has provisions for soil erosion control. By regulating the utilization of different categories of land for various agricultural purposes, the Act strives towards the sustainable utilization of land resources.

3. Forestry Act (Cap 385)

The Forestry Act is implemented by the Ministry of Environment and Natural Resources and it has provisions for the establishment, control and regulation of central forests and other forests in Kenya. It encourages the conservation of vegetation of all types (both indigenous and exotic). The Act applies to mangrove stands, lowland forests as well as other coastal forest resources and can provide the means through which exploitation of these resources can be managed sustainably.

4. Government Fisheries Protection Act (Cap 379)

The Government Fisheries Protection Act is implemented through the Ministry of Environment and Natural Resources. It has provisions for the control and management of coastal and marine species and other resources, threatened with depletion through commercial exploitation.

5. Merchant Shipping Act (Cap 389)

The Merchant Shipping Act, which is implemented by the Ministry of Transport and Communication in conjunction with other Ministries, provides for the control of pollution of the sea by oil from ships. The Act can be considered to be the mechanism for regulating the pollution of Kenya's territorial waters arising from ship-based pollution.

6. Local Government Act (Cap 265)

The Local Government Act (Cap 265) gives powers to the municipal council of Mombasa to plan and develop the urban area of Mombasa. It also provides for the local authority to establish and maintain sewage and drainage systems. It has also provisions for the construction of water supply systems and measures for the prevention of pollution.

7. Wildlife Conservation and Management Act (Cap 376)

The Ministry of Environment implements this Act in conjunction with other relevant government agencies such as Kenya Wildlife Service. The Act has provision for the preservation and control of wild fauna and flora. Various marine and other national parks apply the Act in protecting flora and fauna in their areas of jurisdiction.

8. Fish Industry Act (Cap 376)

The Fish Industry Act has provisions for control of fishing activities and subsequent processing in both inland and coastal waters of Kenya. The Ministry of Tourism and Wildlife implements the Act in conjunction with other state organizations. The Act has great relevance for the management of Kenya's coastal fisheries resources and guards against over-exploitation through over-fishing and use of harmful fishing methods.

9. Maritime Zones Act

The Maritime Zones Act gives the government greater rights on the control of marine resources situated within Kenya's territorial waters as well as Kenya's exclusive economic zone (EEZ). Kenya's territorial zone and EEZ extend 12 nautical miles and 200 nautical miles respectively. In these zones, the government has rights on the exploitation and development of marine resources and the conduct of research.

10. Land Planning Act (Cap 303)

The Land Planning Act is implemented through the Ministry of Lands and Settlements. The Act has provisions for planning the use and development of land. It determines the extent of use and development of land in the coast in addition to other areas.

11. The Continental Shelf Act (Cap 312)

The Continental Shelf Act of parliament commenced in 1975. It gives the government rights in respect of the management and exploitation of natural resources of the continental shelf situated within Kenya's territorial waters. Such rights include the exploitation of fisheries resources, conducting scientific research, etc.

12. Physical Planning Act, 1996

The Physical Planning Act is implemented through the Ministry of Lands and Settlements. The Act has provisions for planning the use and development of land, both urban and rural. The Act determines the extent of use and development of land in the coastal zone in addition to other areas of the country.

13. Town Planning Act

The Town Planning Act has provisions for proper planning of urban and rural centres in Kenya. It is relevant for the management of coastal resources since the sustainability of such natural resources is affected by the nature of urban and rural centres. Such centres have to be planned taking into consideration their possible environmental impacts.

14. Coastal Development Authority Act

This Act provides for the establishment of the Coastal Planning Authority to plan and coordinate the implementation of development projects in the whole of Coast Province and the EEZ. The Act gives powers to the Authority to plan, coordinate, gather and disseminate information, and to generally manage and develop coastal resources in a sustainable manner.

APPENDI IV

REHABILITATION BY BAMBURI CEMENT COMPANY.

The Bamburi Cement Company has for the last 20 years implemented a rehabilitation policy which has turned barren, disused quarry into a dense foresrt, secretive trails and cool lakes. Plantaions of *Casaurina equisetifulia* hide tracts of dry yellow quarry, some still being exploited by the excavating machines, others bare and abandoned and awaiting rehabilitation. The reclamation comprises an ecological process meticulously planned and based on an understanding of food chains and symbiotic relationships. The achievement is made all more impressive by the fact that no artificial fertilizers, pesticides or other chemical has ever been used at Bamburi.

The South Quarry, popularly known as the Bamburi Nature Trail boasts of animals ranging from a porcupines to a hippopotamuses which are given natural surroundings to thrive and help educate and inform visitors. The Baobab Farm Ltd integrated aquaculture system is another success story. Through judicious water use and reuse, the system produces tilapia, catfish, prawns, crocodiles, rice, vegetables and an income from the ever-increasing stream of visitors.

While generating an income is an important consideration, the company reinvests some of the income into various aspects of research and conservation such as – how to increase fish yield, how to convert the fish farms sludge into biogas to be used as fuel, establishing a Bamburi Kaya that will be a value to scientists, medicine and the surrounding communities, etc.

The Bamburi enterprise is an excellent example of how ecological principles can be applied to obtain sustainable resource use for economic advantage. The Bamburi Cement Company is proud of its achievement which prove that industry need not necessarily ruin the environment.